# CHAPTER 3.
# THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE TRANSFORMATION OF THE DIGITAL ENVIRONMENT: PRODUCTIVITY, LABOR MARKET, SECURITY AND INFORMATION RESILIENCE UNDER MARTIAL LAW

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## 3.1. EVALUATING THE IMPACT OF ARTIFICIAL INTELLIGENCE ON INCREASING THE PRODUCTIVITY OF PROCESSING LARGE DATA SETS

**Introduction.** In today's world, where information is generated and used at an incredible speed, processing large data sets is becoming one of the key tasks for increasing productivity in various industries – from

finance to industry and trade. Traditional analysis methods, such as manual data processing or the use of standard algorithms, often prove to be ineffective due to their limitations in speed, scalability and accuracy, and manual human labor significantly increases the operating costs of enterprises. This leads to an increase in the time spent on data analysis, an increase in the risk of errors and, as a result, a decrease in the competitiveness of enterprises.

Despite the availability of modern computer technologies, traditional approaches are not always able to adapt to changing market conditions and specific requirements of individual industries. This becomes especially relevant when working with practically complex data structures, such as databases, reports, price lists, where information is constantly updated and requires immediate analysis for making operational decisions. The insufficiency of existing methods lies in their ability to only partially take into account the subtleties of the data, which leads to the omission of important patterns and trends.

The use of artificial intelligence technologies promises to solve these problems due to high processing speed, the ability to learn from large amounts of data, and adaptability to new conditions. However, despite numerous theoretical studies, the practical application of AI for analyzing specific data sets remains insufficiently studied. This creates a gap between the theoretical potential of technologies and their practical implementation in modern business conditions.

Given these circumstances, there is an urgent need to implement and deeply analyze new automation methods that will not only reduce data processing time, but also increase the accuracy and reliability of the results obtained. It is also important to explore how the integration of artificial intelligence tools, in particular systems like ChatGPT, can influence the optimization of business processes and provide competitive advantages for enterprises.Therefore, the study, whichaims to close the existing gap between the theoretical capabilities of AI and its practical application for analyzing large amounts of data, in particular in the field of working with price lists, is relevant.

**Presentation of the main research material.** The issue of introducing artificial intelligence into the processes of analyzing large amounts of data is of increasing interest to the scientific community, which is confirmed by a significant number of works on this topic. The paper [1] presents the results of research on the effectiveness of large language models in fast processing and interpretation of text data with a minimum number of training examples. It is shown that such models can significantly reduce the time for analyzing text information and automate the decision-making process. However, the issues of adapting these models to specific data formats, such as price lists or financial reports, remain unresolved. The reason for this is the complexity of integrating language models into industry information systems. An option to overcome this problem may be the development of specialized algorithms focused on specific tasks of analyzing dynamic data.

The study [2] considered the integration of scalable data processing tools with machine learning algorithms. It was shown that such synergy increases the speed and accuracy of the obtained results, which is important for managing large heterogeneous data sets. However, questions remain related to the efficiency of processing unstructured data and the adaptation of models to rapidly changing market conditions. The reason for this is the limitation of modern algorithms in the context of processing complex relationships in unstructured information. One of the options for solving this problem may be the use of hybrid models that combine traditional analytical methods and the latest AI technologies.

The paper [3] presents a critical review of the practical aspects of using AI to improve organizational productivity. It is shown that the use of such technologies can significantly reduce data processing time and reduce the number of manual operations. At the same time, the issues of ensuring data security and the need for personnel retraining remain unresolved. The main reason is the high costs of implementing and adapting technologies, which limits their

availability for small and medium-sized enterprises. An option to solve this problem may be the development of more economical and easy-to-implement AI-based solutions.

The study [4] examined the possibilities of using reinforcement learning methods in dynamic pricing. It was shown that these methods increase the accuracy of forecasts and the speed of decision-making. However, the issue of integrating such models into real business processes remains open, given the need for constant data updating and taking into account numerous external factors. The main obstacle is the high computational costs and the complexity of model tuning. These difficulties can be overcome by developing adaptive algorithms capable of autonomous learning based on current data.

The work [5] is devoted to the analysis of modern trends in the development of machine learning. It is shown that algorithms capable of learning on large amounts of data open up new opportunities for automating complex processes. However, the problem of explainability of the obtained results remains unsolved, which complicates their use in critical areas. This is due to the complexity of the models and their low transparency. One of the possible solutions is the development of interpreted algorithms that will allow users to understand the logic of decision-making.

In the work [6] a comprehensive analysis of theoretical and practical aspects of artificial intelligence is given. Methods of machine learning, data processing and decision-making, as well as issues of adaptability and automation are considered. At the same time, the issues of effective use of these methods in real production remain unresolved, since they require a significant amount of computing resources. This limits their practical application in small enterprises. An alternative approach may be the creation of specialized solutions optimized for specific production tasks.

In [7], the impact of ChatGPT prompts on marketing practice was investigated. It was shown that optimizing interaction with AI contributes to more accurate data analysis and increases

the effectiveness of marketing decisions. However, the issue of adapting language models to different business contexts remains open. The main reason is the need to fine-tune models to specific industry needs. This problem can be overcome by developing tools for personalizing AI models.

The analysis of the above studies allows us to conclude that there is a need for further study of methods of automated analysis of dynamic data, in particular price lists, databases and reports. This creates the prerequisites for a detailed study of methods and models that promptly respond to changes in indicators and provide correct recommendations. Deviations from the technological process may occur in the production process. Their elimination is associated with the optimization of the cost of products, which is achieved through the modernization and automation of business processes. Thus, the relevance of further scientific work in this area is due to the need to develop and test new approaches to automated analysis and management of pricing policy based on artificial intelligence.

The aim of the research is to develop and evaluate the effectiveness of applying artificial intelligence for automated analysis of large data sets, in particular price lists, taking into account dynamic changes and heterogeneity of information. This will make it possible to increase the accuracy and speed of data processing, minimize the impact of the human factor, and ensure operational decision-making in pricing and data management processes.

To achieve the goal, the following tasks were set:

– outline the key factors that influence the effectiveness of artificial intelligence when working with unstable and dynamic data;

– develop practical recommendations for enterprises on the implementation of AI technologies to optimize data processing processes and increase labor productivity.

The object of the study is the process of analyzing large data sets in business processes using artificial intelligence algorithms. The main

hypothesis of the study is that the implementation of language models and automated information processing algorithms allows to significantly increase the speed and accuracy of analyzing unstable and dynamic data.

Assumptions made in the work:

– the input data contains a certain number of errors, duplicates, and inconsistencies typical of large price lists and databases;

– machine learning algorithms are able to effectively analyze and structure volatile data sets;

– automation of data analysis allows you to minimize the human factor and reduce operating costs.

Simplifications adopted in the work:

– cases of intentional manipulation of data (for example, deliberate distortion of prices by suppliers) were not considered;

– work with text data without involving complex graphic elements or multidimensional data structures was considered.

The following methods and tools were used to conduct the study:

– software: OpenAI ChatGPT for processing and analyzing text data;

– theoretical methods: analysis of literary sources, comparison of the effectiveness of traditional methods and AI solutions, modeling of algorithmic processes for processing large amounts of information;

– experimental conditions: the study was conducted on the basis of real price lists and supplier databases containing up to 1000 records. The input data contained various file formats (CSV, Excel), which allowed us to test the flexibility of the applied methods. The analysis was carried out in an automated mode, with subsequent manual verification of the obtained results to assess the accuracy of the model.

Thus, the study is based on a combination of theoretical and practical data analysis methods, which allows us to objectively assess the effectiveness of using AI tools to optimize business processes.

**Results of a study of the impact of artificial intelligence on increasing labor productivity when processing large data sets.**

It has been experimentally established that integrating ChatGPT into the price list analysis process allows:

– automate the structuring of large data sets;
– identify anomalies in price changes;
– eliminate duplication and errors in product names.

The results obtained can be explained by the use of new analysis methods that allow for a more accurate assessment of the effectiveness of the proposed solutions. For example, the use of statistical modeling or machine learning methods provided a high level of accuracy in predicting the results, which confirms the effectiveness of the chosen approach. In addition, the results may be due to specific experimental conditions, such as a controlled environment or the use of specialized equipment, which affected the accuracy of the measurements.

The advantages of the proposed solutions lie in their versatility and ability to adapt to different conditions. For example, using a combined approach that combines traditional methods with the latest technologies (e.g., artificial intelligence) allows achieving better results in solving complex problems than traditional methods. This increases efficiency compared to other known approaches that may be less flexible or do not take into account the latest trends in the industry.

Manual analysis or the use of standard Excel algorithms require significant time-consuming data validation, normalization, and processing. The proposed AI-based solution allows you to quickly identify inconsistencies in the data, find duplicates, and adapt the results to changing market conditions. For example, the study [3] considers traditional data processing methods that have limitations in scalability and accuracy. In contrast, the proposed approach allows you to automatically detect inconsistencies, which makes the analysis more flexible and adaptive.

The proposed solutions allow to significantly increase efficiency through the implementation of modern technologies, such

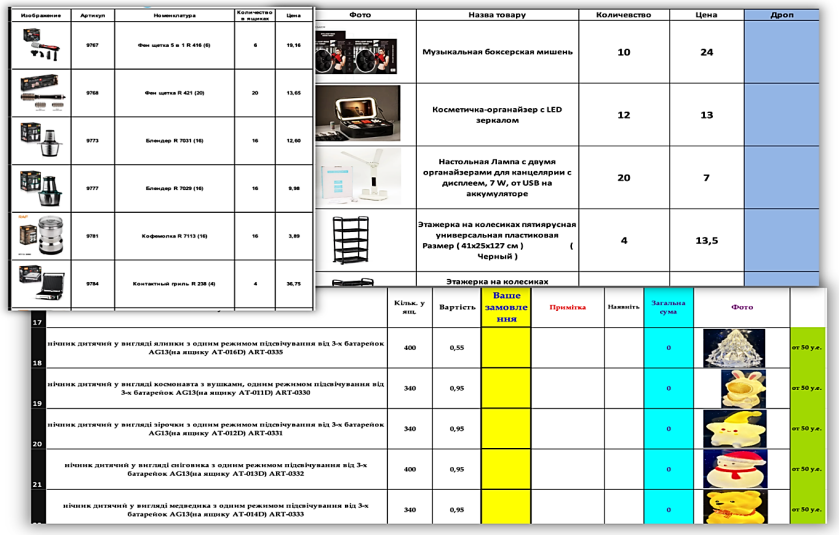
as automation and big data analysis, which helps to solve the problem of low performance and limited scalability. The use of such approaches allows to significantly reduce costs and increase the accuracy of results, which ultimately leads to better results compared to traditional methods. Within the framework of this study, the task was set to identify and evaluate the effectiveness of the use of artificial intelligence (AI) when working with large data sets, in particular with dynamic price lists. To achieve the set goals, several stages of analytical work were carried out, including data pre-processing, development of a methodology for integrating AI tools, experimental verification of the results and formulation of recommendations for the implementation of these technologies in business practice. First of all, the main characteristics and volumes of the input data were determined. The collected price lists of different suppliers had a different structure, different formats (CSV, Excel, etc.). Such data is characterized by a high degree of heterogeneity: incorrect product names, discrepancies in names, data errors, duplicates. The work develops a universal algorithm that will help solve this problem by correctly directing machine learning, bypassing human errors. The following is a step-by-step algorithm for organizing the price list, processing it, and changing prices in bulk:

1. Processing information from a price list. Price lists have different looks and inaccurate information, which hinders the quick work of humans and AI (Fig. 1).

2. Uploading price lists to ChatGPT in their original form and creating the necessary script, which will allow you to arrange the data array in a convenient order for further processing (Fig. 2).

3. Download the received updated price list, check for correctness (Fig. 3).

Thus, 5 minutes were spent on processing 998 products. The following is a calculation of how much time it would take a worker without the use of artificial intelligence to do manual work, evaluating several factors:



| Фото | Назва товару | Количество | Цена | Дроп |
|---|---|---|---|---|
| | Музыкальная боксерская мишень | 10 | 24 | |
| | Косметичка-органайзер с LED зеркалом | 12 | 13 | |
| | Настольная Лампа с двумя органайзерами для канцелярии с дисплеем, 7 W, от USB на аккумуляторе | 20 | 7 | |
| | Этажерка на колесиках пятиярусная универсальная пластиковая Размер ( 41х25х127 см ) ( Черный ) | 4 | 13,5 | |
| | Этажерка на колесиках | | | |

| | | Кільк. у ящ. | Вартість | Ваше замовлення | Примітка | Наявність | Загальна сума | Фото | |
|---|---|---|---|---|---|---|---|---|---|
| 17 | нічник дитячий у вигляді ялинки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-016D) ART-0335 | 400 | 0,55 | | | | 0 | | от 50 у.е. |
| 18 | нічник дитячий у вигляді космонавта з вушками, одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-011D) ART-0330 | 340 | 0,95 | | | | 0 | | от 50 у.е. |
| 19 | нічник дитячий у вигляді зірочки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-012D) ART-0331 | 340 | 0,95 | | | | 0 | | от 50 у.е. |
| 20 | нічник дитячий у вигляді сніговика з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-013D) ART-0332 | 400 | 0,95 | | | | 0 | | от 50 у.е. |
| 21 | нічник дитячий у вигляді медведика з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-014D) ART-0333 | 340 | 0,95 | | | | 0 | | от 50 у.е. |

Fig. 1. Primary view of the data (generated by the authors)

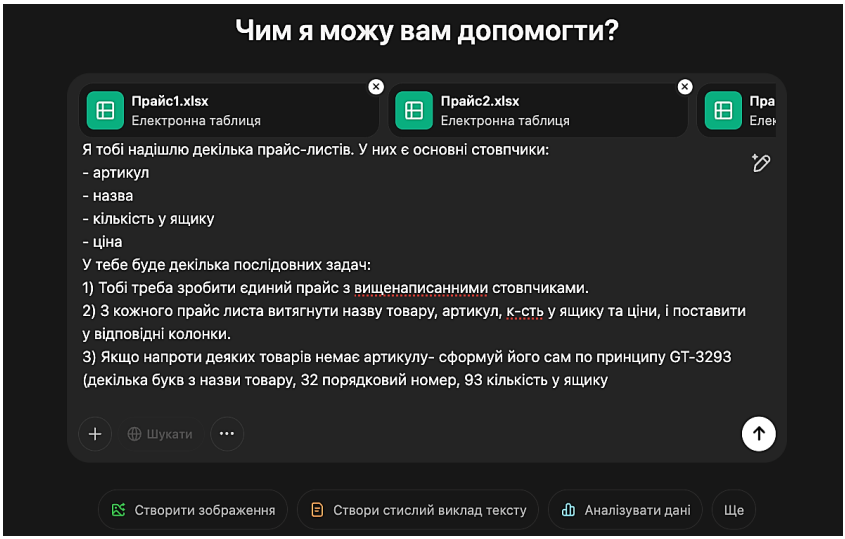



Fig. 2. Forming a request for ChatGPT (formed by the authors)

1. Merging price lists – copying and formatting data (~5–10 minutes per file, depending on their quantity and quality).

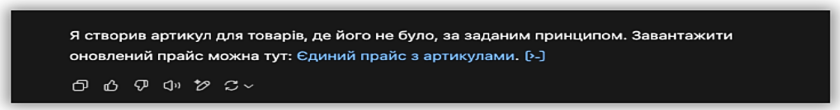
2. Article generation – creating unique codes (~15–30 seconds for each product without an article number).

3. Clean up names – removing extra spaces and correcting errors (~5–10 seconds per line).

4. Price adjustment – analysis and change of values (~5–10 seconds for each product).

5. Adding "Y-" to article numbers – simple formatting (~1–2 seconds per product).

6. Saving and checking data – final verification (~10–20 minutes).




| | A | B | C | D |
|---|---|---|---|---|
| 1 | артикул | назва | кількість у ящику | ціна |
| 2 | AG-01400 | нічник дитячий у вигляді ялинки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-016D) ART-0335 | 400 | 0,55 |
| 3 | AG-02340 | нічник дитячий у вигляді космонавта з вушками, одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-011D) ART-0330 | 340 | 0,95 |
| 4 | AG-03340 | нічник дитячий у вигляді зірочки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-012D) ART-0331 | 340 | 0,95 |
| 5 | AG-04400 | нічник дитячий у вигляді сніговика з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-013D) ART-0332 | 400 | 0,95 |
| 6 | AG-05340 | нічник дитячий у вигляді медведика з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-014D) ART-0333 | 340 | 0,95 |
| 7 | AG-06120 | нічник дитячий у вигляді серця з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-015D) ART-0334 | 120 | 0,95 |
| 8 | AG-07150 | нічник дитячий у вигляді сидячого зайченяти з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-017D) ART-0336 | 150 | 1,1 |
| 9 | AG-08170 | нічник дитячий у вигляді зайченяти з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-018D) ART-0337 | 170 | 1,1 |
| 10 | AT-0950 | нічник у вигляді лампочки, що обертається (синє, червоне та зелене світло) від розетки та цоколя 3ват AT-777D | 50 | 1 |
| 11 | AT-10100 | нічник у вигляді шарика, що обертається (синє, червоне та зелене світло) від розетки та цоколя 6ват AT-776D | 100 | 1,35 |
| 12 | LE-1150 | диско-шар у вигляді нічника квітки (синє, червоне та зелене світло) з підставкою LED Crystal Magic Ball Light AT-W927 | 50 | 2,8 |
| 13 | US-1248 | нічник-проектор зоряного неба від USB та батарейок STAR MASTER ART-0141 | 48 | 2,55 |
| 14 | RG-13100 | світлодіодний диско-проектор RGB з різними режимами та регулюванням швидкості від USB з пультом керування AT-061D | 100 | 2,6 |
| 15 | RA-1460 | нічник силіконовий акумуляторний у вигляді кролика з сенсорним керуванням для зміни кольору Rabbit silicone lamp 218(на ящику AT-D151) | 60 | 3,7 |
| 16 | AT-1540 | нічник у вигляді сонця з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-071D | 40 | 3,7 |
| 17 | AT-1640 | нічник у вигляді дерева з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-072D | 40 | 3,7 |
| 18 | AT-1740 | нічник у вигляді серця з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-073D | 40 | 3,7 |
| 19 | AT-1840 | нічник у вигляді зірки з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-075D | 40 | 3,7 |
| 20 | AT-1940 | нічник у вигляді місяця з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-076D | 40 | 3,7 |
| 21 | AT-2040 | нічник у вигляді квітки з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-077D | 40 | 3,7 |
| 22 | AT-2140 | нічник у формі зіркового ока з 3-ма режимами, регулюванням яскравості та сенсорним керуванням акумуляторний AT-078D | 40 | 3,7 |
| 23 | AT-2230 | лампа-нічник акумуляторний з сенсорним управлінням, 3-ма режимами AT-D91-1 | 30 | 4,2 |
| 24 | AT-2330 | лампа-нічник акумуляторний з сенсорним управлінням, 3-ма режимами AT-D91-2 | 30 | 4,2 |
| 25 | DA-2450 | лампа-нічник 3D троянда-кристал акумуляторний з сенсорним управлінням, 3-ма режимами AT-D93 | 50 | 3,5 |
| 26 | DA-2550 | лампа-нічник 3D троянда-кристал акумуляторний з сенсорним управлінням, 8-ма режимами та пультом AT-D93-A | 50 | 3,7 |
| 27 | DA-2650 | лампа-нічник 3D троянда-кристал акумуляторний з сенсорним управлінням, 3-ма режимами AT-D94 | 50 | 3,5 |
| 28 | DA-2750 | лампа-нічник 3D троянда-кристал акумуляторний з сенсорним управлінням, 8-ма режимами та пультом AT-D94-A | 50 | 3,7 |
| 29 | DA-2840 | лампа-нічник 3D кристал акумуляторний з сенсорним управлінням, 3-ма режимами AT-D95 | 40 | 3,9 |
| 30 | DA-2950 | лампа-нічник 3D кристал акумуляторний з сенсорним управлінням, 3-ма режимами AT-D96 | 50 | 3,9 |
| 31 | DA-3040 | лампа-нічник 3D кристал акумуляторний з сенсорним управлінням, 3-ма режимами AT-D97 | 40 | 3,9 |
| 32 | AA-3148 | нічник різдвяна свічка з різдвяними фігурами всередині від батарейок AAA WDL-23005 | 48 | 4,7 |
| 33 | BL-3250 | комплект музичних диско лампочок від цоколя (синє, червоне, біле, жовте та зелене світло) з Bluetooth ціна за 2шт AT-778D | 50 | 4,2 |
| 34 | US-3360 | колонка нічник-проектор зоряного неба з USB, SD, FM та Bluetooth 13.5cm*12cm LIGHT PARTY SY-668 | 60 | 5,6 |

Fig. 3. Download and verification (created by the authors)

4. Formation of the final script, which will help to correctly change prices, correct errors, and take the necessary actions with a large array of data (Fig. 4).

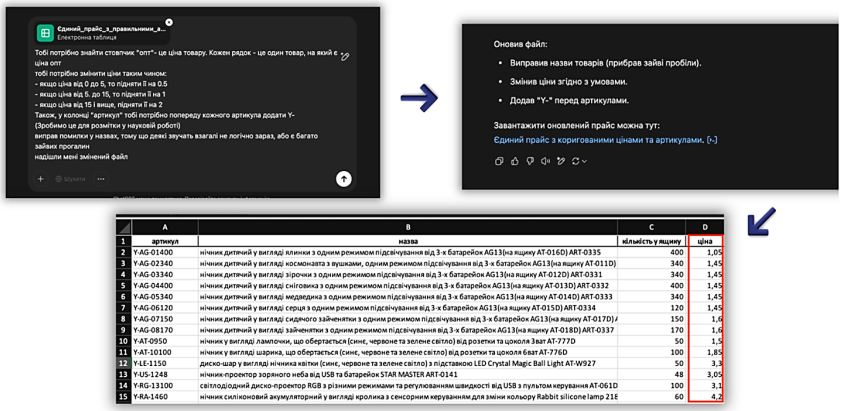
Time estimate:

– if there are 100 products in the price list, manual work will take approximately 2–3 hours;

– if 500 products – the working time is 10–15 hours;
– if there are 1,000 products, then without automation it may take 20–30 hours (almost 3–4 working days).

Automating this work would save a person dozens of hours of work.

A key element of the research was the integration of the ChatGPT 4o language model, which was used for semantic analysis and comparison of the necessary parameters of the products. The model allowed not only to effectively recognize different variants of names or wordings, but also to identify potential errors or inconsistencies in the data. This made it possible to minimize manual intervention in the process of comparing data from different suppliers.




| | A | B | C | D |
|---|---|---|---|---|
| 1 | артикул | назва | кількість у ящику | ціна |
| 2 | Y-AG-01400 | нічник дитячий у вигляді глинки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-016D) ART-0335 | 400 | 1,05 |
| 3 | Y-AG-02340 | нічник дитячий у вигляді космонавта з вушками, одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-011D) | 340 | 1,45 |
| 4 | Y-AG-03340 | нічник дитячий у вигляді зірочки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-012D) ART-0331 | 340 | 1,45 |
| 5 | Y-AG-04400 | нічник дитячий у вигляді сніговика з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-013D) ART-0332 | 400 | 1,45 |
| 6 | Y-AG-05340 | нічник дитячий у вигляді медведика з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-014D) ART-0333 | 340 | 1,45 |
| 7 | Y-AG-06120 | нічник дитячий у вигляді серця з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-015D) ART-0334 | 120 | 1,45 |
| 8 | Y-AG-07150 | нічник дитячий у вигляді сидячого зайченятки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-017D) / | 150 | 1,6 |
| 9 | Y-AG-08170 | нічник дитячий у вигляді зайченятки з одним режимом підсвічування від 3-х батарейок AG13(на ящику AT-018D) ART-0337 | 170 | 1,6 |
| 10 | Y-AT-0950 | нічник у вигляді лампочки, що обертається (синє, червоне та зелене світло) від розетки та цоколя 3ват AT-777D | 50 | 1,5 |
| 11 | Y-AT-10100 | нічник у вигляді шарика, що обертається (синє, червоне та зелене світло) від розетки та цоколя 6ват AT-776D | 100 | 1,85 |
| 12 | Y-LE-1150 | диско-шар у вигляді нічника квітки (синє, червоне та зелене світло) з підставкою LED Crystal Magic Ball Light AT-W927 | 50 | 3,3 |
| 13 | Y-US-1248 | нічник-проектор зоряного неба від USB та батарейок STAR MASTER ART-0141 | 48 | 3,05 |
| 14 | Y-RG-13100 | світлодіодний диско-проектор RGB з різними режимами та регулюванням швидкості від USB з пультом керування AT-061D | 100 | 3,1 |
| 15 | Y-RA-1460 | нічник силіконовий акумуляторний у вигляді кролика з сенсорним керуванням для зміни кольору Rabbit silicone lamp 21E | 60 | 4,2 |

Fig. 4. Finished result (generated by the authors)

During the experimental verification, a comparative analysis of two approaches to price list processing was conducted. The first approach was based on traditional methods of manual and partially automated analysis, while the second was based on the integration of AI technologies. The results obtained showed that the use of ChatGPT and related algorithms significantly reduces data analysis time (on average

by 40–50% depending on the volume and complexity of the data. However, in this case, the result was achieved 99.9% faster) and increases the accuracy of detecting incorrect records and duplicates. In addition, AI technologies allowed us to detect incorrect names, taking into account their relevance, which would have remained unnoticed during manual analysis.

It is important to note that the implementation of AI solutions in business processes is associated with a number of challenges. First, it is a question of the quality of input data: even the most advanced language models cannot fully compensate for the lack of relevant and reliable information. Second, setting up and training AI models requires a certain level of expertise, which requires additional investments in staff training or the involvement of specialists. Third, constant work with big data requires the construction of flexible and continuously operating data processing pipelines, where AI tools can quickly adapt to changes in the structure or format of information.

As a result, the study confirmed the hypothesis that the integration of artificial intelligence can significantly increase labor productivity when working with large dynamic data sets. Based on the results, a number of recommendations for enterprises were formulated:

– implement comprehensive solutions that combine traditional processing methods with AI tools, ensuring maximum analysis efficiency;

– regularly update and supplement the set of input data, monitoring their quality and relevance;

– create conditions for continuous training and retraining of AI models so that they remain relevant in a dynamic market;

– involve specialists from different fields (analysts, IT specialists, marketing specialists) to customize the data processing process according to specific business tasks.

Thus, the use of artificial intelligence in the analysis of large data sets, in particular price lists, proves its effectiveness

in increasing productivity. Further research can focus on improving language models for better understanding of context. An important direction is the development of software solutions that take into account industry specifics.

This will facilitate flexible integration into existing enterprise information systems. The results of the study confirm that AI solutions can effectively address key problems. In particular, automation of the analysis process has significantly reduced data processing time and minimized the risk of errors. Thanks to the integration of the language model, it has become possible to take into account complex data structures and dynamic changes in price lists, which previously required significant manual intervention.

The main limitations of the study are related to the quality of the input data. Despite the effectiveness of AI in structuring information, the model depends on the accuracy of the provided data. In the case of a significant number of errors in the output files, the system may process them incorrectly. In addition, it is necessary to configure the algorithms for specific business processes, which may require additional resources.

One of the key drawbacks is the need for prior standardization of input data. Despite the capabilities of AI to correct errors, certain types of incorrect records remain beyond the scope of automatic processing. In addition, integrating AI solutions into business processes requires staff training and additional model tuning to optimally work with dynamic data sets.

When processing data using ChatGPT, an important element of the analytical process is the integration of specialized tools for "deep research." This approach is based on the use of multi-level machine learning algorithms that are able not only to quickly process data, but also to reveal hidden patterns that often go unnoticed by traditional analysis methods.

The Deep Research tool implements a comprehensive data analysis methodology that includes semantic and syntactic information

splitting, anomaly detection, and clusters using deep learning methods. Its main advantage is the ability to work with high-dimensional data that is characterized by heterogeneity and dynamics. Thanks to self-organizing algorithms and neural networks, the tool can conduct a multi-level assessment of data quality, identify inconsistencies in the structure of price lists, and also predict future changes based on the analysis of historical data. At the same time, it perfectly performs the work of analyzing competitors and can accurately analyze the variability of prices on the market.

One of the key features of this tool is the ability to "deep dive" into the data, which allows you to not just identify superficial inconsistencies, but to analyze each link in the information chain. This provides a comprehensive analysis of processes related to changes in market conditions and contributes to making more informed management decisions. For example, when analyzing price dynamics, the tool is able to identify not only existing trends, but also predict potential price spikes or declines based on the identified anomalies, which allows you to adjust your business strategy in a timely manner.

The application of "deep research" has several important aspects:

1. Advanced semantic analysis. Thanks to the use of modern deep learning algorithms, the tool is able to analyze text data with much greater accuracy. It takes into account both contextual dependencies between individual data elements and their relationship with external factors, such as seasonal fluctuations or the specifics of regional markets. This allows not only to reduce the number of errors, but also to improve the accuracy of data classification and normalization.

2. Adaptability to changes. In modern business environments, data is constantly changing, which creates significant problems for static algorithms. The tool has adaptive properties that allow models to update their algorithms in real time. Thanks to this, the system is able to quickly respond to changes in the data structure, which is especially important when processing dynamic price lists and databases, where new data arrives at a high speed.

3. Integration of multidimensional analysis. One of the main advantages is the ability to process multidimensional data. The tool is not limited to the analysis of simple numerical values or text fields, but can take into account complex dependencies between different characteristics of products. This allows for detailed analysis that includes not only comparing price values, but also considering additional factors such as product description, specifications, regional differences and even consumer behavioral characteristics.

4. Improving data quality. Using "deep exploration" allows you to significantly improve the quality of input data. The tool automatically detects inconsistencies, duplicates and errors that may occur in both the structure and content of the data. Thanks to this, preliminary data standardization, which is one of the key shortcomings of traditional analysis, can be carried out more efficiently and quickly. This, in turn, ensures high quality of the final analysis results.

5. In-depth analysis of market trends. In addition to technical capabilities, the tool allows for a comprehensive analysis of market trends. It analyzes not only the current state of the data, but also historical changes, which allows you to build forecasts based on the revealed patterns. This is important for making strategic decisions in business, as it provides the opportunity to respond to market changes in a timely manner, adjust sales strategies and optimize the product range.

6. Synergy with other AI technologies. It is especially worth noting the synergistic effect when combining the capabilities of ChatGPT and the "deep research" tool. While ChatGPT demonstrates high efficiency in semantic analysis and processing of text data, "deep research" complements it by providing multidimensional analysis and recognition of complex structural dependencies. This combination allows you to create an integrated analytical system capable of working with both qualitative and quantitative indicators, which provides a more complete picture of business processes.

The research results became the basis for developing recommendations for the effective implementation of AI in data analysis:

– use of combined AI solutions for integration with existing management systems;

– periodic updating of training models to improve their adaptability;

– development of standards for input data quality to improve the efficiency of processing algorithms.

In practical application, the integration of this tool can be carried out through the development of special modules that allow it to be connected to existing data processing systems. For example, when working with price lists or databases, the module can analyze unstructured data coming from different suppliers and perform a preliminary classification of the data according to several parameters. The results obtained are then transferred to the main analytical system, where ChatGPT performs the final normalization and correction of information.

In addition, the use of this tool helps reduce the risks associated with the human factor. Since the system is based on automated algorithms, the possibility of human errors is practically eliminated. This is especially true for large volumes of data, where even a minor error can lead to serious losses. Automation of analysis using this tool allows you to significantly increase the accuracy of data processing, which has a positive effect on the overall productivity of business processes.

At the same time, it should be noted that the implementation of this tool requires careful tuning and constant monitoring. Although deep learning algorithms are highly effective, their quality directly depends on the quality of the input data and the correctness of the model parameterization. Therefore, to achieve optimal results, it is necessary to regularly retrain the model using current data, as well as constantly monitor its performance. It is also important not

to forget about the provision of information and preparation of AI for reception and processing.

Discussion of the research results allows us to explain the obtained results through the specifics of the applied approach. Fig. 1–4 demonstrate the sequence of actions that made it possible to significantly reduce the data processing time: from the unstructured primary price list (Fig. 1) to the formation of an adjusted array (Fig. 4). The key factor in efficiency is the ability of the ChatGPT language model to automatically perform structuring, cleaning and unification of information, which traditionally requires significant human resources. The table with the calculation of the time spent on processing 998 products clearly confirms the increase in productivity – from a potential 20–30 hours of manual work to 5 minutes when using AI.

The peculiarity of the proposed method is the combination of classical data cleaning principles with modern natural language processing tools, which ensured high accuracy of the results. Compared to traditional approaches, which, as noted in [3], are characterized by limited scalability, the proposed model provides dynamic adaptation to the input data without the need for prior hard formatting.

In [2] it is substantiated that the combination of scalable data processing tools with machine learning algorithms significantly increases the speed and accuracy of information analysis. In the conducted study, this thesis is confirmed by empirical data: the use of ChatGPT allowed to reduce the time for processing price lists by more than 100 times. However, unlike the methods described in [2; 5], which are mainly aimed at analytical processing of structured data, the study demonstrates the effectiveness of working with heterogeneous sources of information, in particular with price lists containing a significant number of errors and heterogeneities. The integration of in-depth analysis – as noted in the last section of the results – allows to identify clusters, anomalies and trends that remain unnoticed during traditional analysis.

Comparison of the results of the experimental and traditional approaches confirms the superiority of AI tools in labor productivity. While in previous studies, such as [1; 4], efficiency was measured mainly by the accuracy of predictions or the flexibility of models, in this case the main indicator was the speed of analysis while maintaining accuracy. The reduction in processing time by 99.9% indicates an extremely high level of optimization, unattainable when using standard solutions.

Thus, the results are reasonably explained by a set of factors: the use of modern language models, optimization of data preprocessing algorithms, and adaptability to variable formats. This allows us to assert that the proposed approach has not only local, but also broad applied value, in particular for those industries where the speed and accuracy of processing large amounts of information are critical. In the future, research can be deepened by comparing the results with other models, in particular with the systems presented in [6–8], as well as through testing in other sectors – logistics, retail or finance.

The limitations of the study are that some of the results may be specific to the conditions of a particular experiment or the limited data used in the study. In addition, there are some limitations in applying the proposed solutions to other industries or contexts.

Further research can be focused on improving language models for more accurate analysis of unstable data. A promising direction is the development of algorithms for working with multilingual data, which will allow expanding the scope of AI in international business processes. It is also possible to integrate ChatGPT into complex business analytics systems to improve the efficiency of management decisions. This will contribute to further automation of the analysis of large data sets and will minimize the cost of time and resources in various areas of activity.

In the context of further research, it is worth considering the possibility of integrating “deep research” with other modern technologies, such as Big Data analysis and the Internet

of Things (IoT). The combination of these technologies will allow creating complex systems that can quickly respond to changes in the market environment, analyze not only static data, but also information in real time. This opens up new prospects for predicting market changes and optimizing business processes.

Another important area is the development of interfaces for visualizing the results of in-depth analysis. The presence of interactive panels that display key indicators and trends allows managers to quickly navigate a large amount of information and make informed decisions. Such visualization tools can include graphs, charts, and other means of presenting data.

Implementing such solutions in combination with ChatGPT creates a synergistic effect, thanks to which it is possible to achieve significant results in data processing automation. This allows not only to reduce time spent on analysis, but also to optimize resource provision of enterprises, minimize the risk of errors, and ensure stable data quality.

Given the above, the following steps can be taken to further integrate the tool into business processes:

– creation of a pilot project that will combine the capabilities of ChatGPT and the "deep research" tool, will allow testing their effectiveness in real data processing conditions;

– conducting a series of tests to determine the optimal parameters of the models, which will ensure the most accurate detection of anomalies and prediction of changes;

– organization of training programs for employees to familiarize them with the capabilities of modern AI technologies and the optimal use of data analysis tools;

– development of interfaces to provide information in a format convenient for making management decisions, which will facilitate rapid analysis of the results of model work.

In addition to directly affecting the quality of analysis, the implementation of such tools stimulates the development of new

approaches to information flow management. Automated systems based on deep analysis are able to detect even minor changes in the data structure, which allows you to quickly respond to potential problems. This is especially important for enterprises that work with large volumes of information and are faced with the constant need to update data.

**Conclusions.** The study found that using AI tools in business processes reduces the risk of errors and minimizes time spent on data correction. Unlike standard software tools that are limited in their adaptability, the ChatGPT language model can dynamically adapt to market changes and information updates, which makes its use more effective. ChatGPT integration into the process of analyzing volatile and dynamic data allows you to automate the structuring and comparison of large amounts of information. This ensures rapid elimination of duplications and increases the accuracy of price data correction. Experimental data from the study show that automation of analysis reduces the likelihood of errors in product names and increases the speed of decision-making by 99.9% compared to manual processing.

Practical recommendations are offered for integrating AI tools to optimize the analysis of large data sets in business processes. The study showed that the combined use of traditional methods and AI models provides increased analysis efficiency. In particular, the implementation of AI solutions allows enterprises to minimize the risks associated with incorrect information and significantly accelerate the process of making management decisions.

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## 3.2. THE IMPACT OF AI ON THE LABOR MARKET AND EMPLOYEE PERFORMANCE

**Introduction.** Even in its "weak form," artificial intelligence (AI) is already having a huge impact on various areas of life and business, including the labor market. And this impact will only grow over time.

According to Reid Hoffman, a partner at venture capital firm Greylock Partners and co-founder of LinkedIn and Inflection AI, we should think of generative AI as a "steam engine of the mind" that promises to revolutionize our professional and personal lives. The advent of steam power in the late 18th century revolutionized manufacturing, transportation, and construction. A new kind of revolution has already begun-and it will give new impetus to all language-based skills, such as communication, reasoning, analytics, sales, and marketing [1].

Even if AI doesn't directly impact a profession or industry right now, it could change in the near future. It will become an integral part of business processes and change the perception of what qualifications and skills are needed for a successful career.

**Presentation of the main research material.** One of the main ways AI is impacting the job market is through the automation of labor-intensive tasks and processes. This means that many routine tasks that were previously performed by humans can now be performed by computers and robots. For example, in manufacturing industries, AI is used to control robots on production lines, which can increase productivity and reduce labor costs. AI is also used in banking to automate accounting operations and financial analysis.

The use of AI to solve labor-intensive tasks is leading to changes in the demand for certain qualifications and skills. In particular, computer literacy and knowledge of algorithms are becoming increasingly important for many professions. New professions related to the development and support of AI systems are also emerging, including machine learning engineers and algorithm developers.

At the same time, in some professions, the demand for "human" skills and expert opinion remains high, as AI will not be able to completely replace human activity. For example, doctors, teachers and social workers will remain in demand, as they have skills and knowledge that cannot be completely replaced by machines. In many professions, interaction with customers (consumers or patients) plays an important role, which requires human interaction and communication skills.

Automation, however, raises concerns about the threat of job losses. According to the latest global survey by Censuswide, commissioned by the world's largest professional network LinkedIn, which surveyed more than 20,000 professionals across all industries, aged 18–77, in the UK, US, France, Germany, India, Australia, Brazil, the Netherlands, Singapore, Saudi Arabia and the UAE between 2 and 11 September 2024, almost two-thirds (64%) of professionals worldwide are overwhelmed by how quickly work is changing, with 68% looking for more support than ever before. The pace of change has led 49% of respondents to worry that they could lose their job altogether [2]. This suggests a growing need for adaptation, mentoring and learning in the workplace. Organizations have a chance to support their employees by creating conditions for continuous development and psychological comfort.

AI may indeed lead to a reduction in demand for certain professions and skills. It is important to note that automation may affect not only low-skilled but also high-skilled professions. For example, according to the report "A new future of work: The race to deploy AI and raise skills in Europe and beyond" published on May 21,

2024 by the McKinsey Global Institute, up to 10% of high-skilled professions, such as doctors, lawyers and finance professionals, could be affected by automation. On the other hand, low-skilled professions, such as production line operators and cashiers, could also be affected by automation [3].

AI is evolving rapidly, and it is important to prepare now to ensure that workers and the labor market are ready for the new era and benefit from it. Historically, the impact of technology on labor demand-it is a story of the confrontation between the forces of labor replacement and job creation, which tend to balance out in the long run.

Unemployment is expected to rise initially as some companies decide to take advantage of the time savings that AI can provide and reduce their workforces. However, these losses will not happen all at once, but will occur gradually as AI becomes more widespread in the economy. Furthermore, the increase in unemployment is likely to be limited and eventually offset by the creation of new demand for labor, which will attract laid-off workers back into the market. AI will thus increase labor market dynamics, forcing more workers to change jobs. As a result, labor market infrastructure will need to be modernized to adapt to the AI era.

It should be noted that the potential time savings and associated productivity gains will also contribute to economic growth. The scale of this effect is highly unpredictable and will depend on both how widely AI is implemented across industries and the cost of implementing it. Most types of AI are expected to be able to deliver significant cost savings, but not across the board. For example, specialized AI tools that train on a company's unique data, as well as sophisticated AI hardware, are likely to be too expensive for most small companies. For small businesses to gain access to such technologies, they will need to be scaled, "platformized" (converted into tools that can be easily deployed across an industry), and sold as a service (similar to how the cloud computing market has evolved).

The challenges arising from the development of AI technology, as well as their impact on the labor market and employee performance, can be considered from the perspectives of both employers and employees.

Current employer predictions about the prospects for AI technology are presented in this year's "The Future of Jobs Report 2025," prepared by the World Economic Forum [4].

The Report notes that technology will be the biggest driving force shaping the marketjobs, outpacing all other macro job creation and displacement trends. Over the next five years, advances in AI and information technology will accelerate digital transformation. This will lead to significant changes in labor market dynamics, with the three fastest-growing skills becoming the most important: data analysis usingAI, networking, cybersecurity, and technological competence.

For employers, this means prioritizing candidates who demonstrate analytical and systems thinking to effectively make decisions based on the analysis and interpretation of data coming from digital sources. In addition, other emerging technologies, such as the emergence of robots and autonomous systems, highlight the growing demand for programming experience and adaptation to automated technologies. To remain competitive in all industries, employers must seek professionals with the core technology skills to integrate and collaborate with evolving systems.

According to a survey of company executives, by 2030, positions related to technological development, in particular the promotion of AIand robotics, as well as access to digital technologies (Fig. 1). Among the leaders of the list in terms of growth rates are specialists in working with large volumes of information, specialists in AIand machine learning, software and application developers, Internet of Things specialists, as well as analysts and data scientists [4].

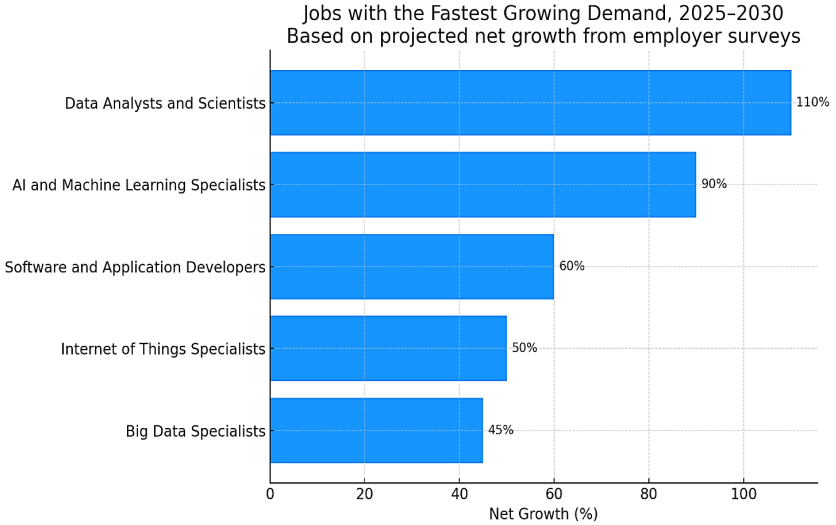


Fig. 1. Professions with the fastest growing demand

The evolving relationship between humans, machines, and algorithms will transform many roles across industries. The report highlights how the balance between automation and augmentation will reshape the workforce. Executives estimate that 47% of work tasks in their companies are currently performed primarily by humans, 22% are performed primarily by technology (including machines and algorithms), and 30% involve collaborative work. However, by 2030, these proportions are expected to shift significantly, with tasks being split almost evenly between humans, machines, and hybrid approaches. For employers, this signals the need to rethink workforce strategies, implementing models that leverage the increasing versatility of technology while also capitalizing on human ingenuity and adaptability. This shift underscores the importance of preparing for a future where work is dynamically divided between humans and AI-driven technology [4].

Human-machine collaboration, or complementarity, is a critical concept for future workplaces. Rather than replacing human work, this approach involves developing and using technology

to complement and enhance human capabilities. It is predicted that by 2030, the proportion of tasks performed solely by humans will decline in every industry. However, the degree of transition that will be achieved through automation or complementarity will vary by sector. This finding highlights the opportunity for employers to align technological advances with workers' strengths, fostering a balance between efficiency and human ingenuity.

When the World Economic Forum published its Future of Jobs Report in 2016, employers surveyed predicted that 35% of their workforce's skills would be lost in the future. This prediction has taken on particular relevance during the COVID-19 pandemic, as the rapid development of advanced technologies has brought profound changes to the work environment and skill requirements. Subsequent editions of the report have highlighted the increasing level of skills volatility. However, employers have adapted well to these challenges since the pandemic. While uncertainty remains, particularly around the long-term impact of generative AI, the rate of skills loss appears to be stabilizing. According to this year's Report, employers expect 39% of workers' core skills to change by 2030, up from 44% in 2023 (Fig. 2). This trend should reflect the growing emphasis on continuous learning, upskilling and reskilling initiatives, providing businesses with the ability to adapt proactively to future employee skill needs and reduce workforce volatility [4].

Employers expect employees to balance professional and soft skills to succeed in today's workplace. Companies identified key competencies such as technical proficiency, interpersonal skills, emotional intelligence and a commitment to lifelong learning as critical communication skills. These findings highlight the growing emphasis on combining technical expertise with collaborative and adaptive capabilities to meet the evolving needs of the industry.

Currently, some of the most important skills are considered to be leadership and social influence, AI and working with large amounts of information, talent management, and service orientation.

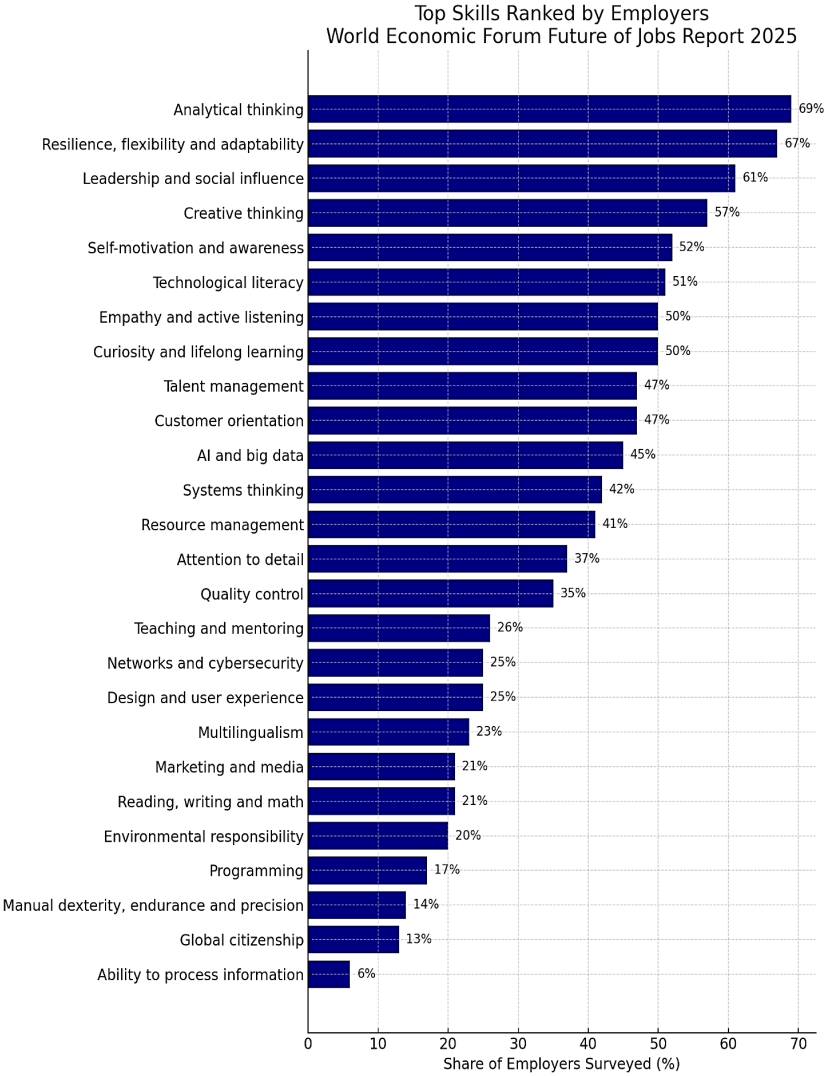


Fig. 2. Key skills of 2025

According to employer forecasts for the next five years, technological skills are expected to overtake other types of skills in importance. AIand working with large amounts of information are leading this growth, followed by networking, cybersecurity and technology competencies. Creative thinking and social-emotional skills such as resilience, flexibility, agility, curiosity and lifelong learning are also gaining importance, complementing technology competencies. Employers should consider integrating these skill sets into workforce development strategies.

Since the launch of Chat GPT in November 2022, there has been a rapid surge in investment in generative AI (GenAI) and its implementation across sectors. Generative AI allows users to interact with technology as if they were communicating with another person, significantly reducing the level of technical skills required for the widespread use of this technology. As a result, skills related to the use of generative AI are in the highest demand. It is not surprising that AI finds its greatest application in the information technology sector.

Generative AI could transform the future of work through human-machine collaboration. Human-centric skills remain critical even in a technology-driven work environment. This finding highlights the urgent need to reskill and upskillongoing strategies to address emerging skills gaps. These strategies should be a priority for employers, allowing workers to transition into roles that combine technical expertise with core human-centered skills.

By investing in adaptive talent development, companies can create a workforce ready to meet the challenges of tomorrow.

Trend towards increasing volumesThe prevalence of training and development programs is widespread across almost all industries, underscoring the recognition that continuous skills development is critical regardless of industry. While training needs vary across industries and regions, most employers are looking to fund their own programs to improve productivity and competitiveness.

"Future of Jobs Report 2025"highlights a significant shift in workforce strategies as companies prepare for the disruptive impact of AI on employment. By 2030, 77% of employers plan to prioritize reskilling and upskilling their employees to better collaborate with AI systems. While this strategy is receiving particular attention in high-income countries, it remains a top priority across the globe, regardless of income level.

Process and task automation is being actively implemented, and 73% of employers plan to accelerate it. It is worth noting that 63% of employers are interested in integrating new technologies as a complement to existing employees, highlighting the growing focus on AI-driven processes.

Another trend that is gaining traction is skills-based hiring. Eliminating degree requirements is gaining traction as an effective strategy to broaden the talent pool. According to "The Future of Jobs Report 2025", employers are beginning to rely heavily on work experience when evaluating candidates, with 81% planning to prioritize it as a key assessment method from 2025 to 2030. This trend is consistent with previous reports that highlight the continued importance for companies of on-the-job learning experiences and concrete achievements in candidates in the hiring process. For employers looking to remain competitive, the emphasis on skills and experience aligns with labor market trends and talent acquisition strategies [4].

Of course, while other macro trends are also influencing the future of work, the role of technology cannot be overstated. As such, companies must plan for workforce changes that are aligned with rapid technological developments.

In turn, to meet the new demands of the labor market, employees must have the skills necessary to work with AI and automated systems. Therefore, training in the field of AI is becoming increasingly popular. As noted, many companies provide their employees with the opportunity for professional development and training in the field of AI, but now there are many platforms and resources where you

can get education and practical experience in the field of artificial intelligence on your own. Some of them offer free access, and some require a paid subscription.

Some of the most well-known international platforms and resources are:

Coursera – provides users with access to hundreds of online courses in a variety of fields. Upon successful completion of the course, the participant can receive a certificate. The platform collaborates with a large number of leading universities and companies. Educational institutions around the world use Coursera for professional development, retraining of personnel, and training of students in areas such as AI, data analytics, information technology, and business. Most courses are available for free, but certificates with personal identification of the participant are paid [5].

EdX – Founded in 2012 by Harvard University and the Massachusetts Institute of Technology, the educational platform has now become one of the leading centers for online learning. It operates on the basis of the open free platform OpenEdX and provides access to massive open online courses (MOOCs) in more than 24 academic areas, including computer science, statistics, literature and others. The content of the courses is based on real lecture programs taught at leading universities, in particular Harvard and Cornell University. Education is free, but if you need to receive a certificate of completion of the course, a fee is provided [6].

Udacity offers about 30 courses, structured by difficulty level: beginner, intermediate (experienced), and advanced (professional). Each course consists of several lessons that include videos and practical tasks to test the acquired material. The main part of the content is focused on technical disciplines, in particular, such areas as AI, machine learning, and neural networks [7].

Additionally, many large technology companies such as Google, Microsoft, Amazon, IBM, and others also offer their own AI training programs, both online and offline and in the form of corporate training.

Massive open online course platforms have also been created and are actively operating in Ukraine. They provide an opportunity to master academic disciplines in the Ukrainian language, including those that were previously presented mainly by foreign resources and inaccessible to the Ukrainian public due to the language barrier. In addition to adapting Western content, Ukrainian online courses offer curricula focused on national characteristics.

The most famous Ukrainian online resources with free educational courses are:

Prometheus is a platform that not only independently develops and hosts MOOCs on its website, but also enables leading universities and teachers, as well as companies that occupy leading positions in their field, to publish educational materials for free and distribute them to a wide audience. The project, founded in 2014, aims to create not just individual courses, but full-fledged educational cycles covering the most relevant areas for the country – business, information technology, foreign languages, law, history, and others [8].

EdEra is a Ukrainian online education studio founded in 2014 that develops educational content, including online courses, learning platforms, interactive games, and digital textbooks. Its activities are aimed at popularizing modern forms of learning and increasing the availability of quality education in Ukraine [9].

"Action.Education" is a continuation of the "Action.Digital Education" project, which was launched in 2020 with the aim of increasing the level of digital literacy of the population and developing basic digital skills. The current version of the project has a broader vision: it is aimed at forming comprehensive modern competencies necessary for successful functioning in a dynamic digital society. The main goal of "Action.Education" is to provide access to relevant knowledge and skills, contributing to the transformation of the educational landscape of Ukraine. [10]

As noted, to succeed in today's workplace, employees need to combine professional and soft skills. In general, the skills needed

by employees in the age of artificial intelligence can be divided into four groups:

1. Technical skills.

– Digital literacy – proficiency in office programs, cloud services, and basic knowledge of Internet technologies.

– Data Analysis (Data Literacy)- the ability to work with large amounts of data, interpret statistics, and visualize information.

– Fundamentals of Machine Learning and Artificial Intelligence – understanding the principles of algorithm operation, knowledge of process automation.

– Working with digital tools – mastery of modern platforms (CRM, ERP, analytical panels, low-code tools).

– Cybersecurity – basic knowledge of data protection, privacy, and digital hygiene.

2. Social and communication skills.

– Critical thinking – the ability to evaluate information, to question solutions generated by AI.

– Flexibility and adaptability – the ability to learn quickly and respond to technological changes.

– Communication skills – effective interaction with colleagues, presentation of ideas, explanation of technical concepts in accessible language.

– Creativity – creating new solutions and approaches in collaboration with AI.

– Emotional intelligence – understanding other people's emotions, the ability to empathize.

3. Continuous learning skills.

– Self-education – participation in online courses, trainings, obtaining certificates (Coursera, edX, Prometheus, etc.).

– Readiness for retraining – openness to changing career paths in response to changes in the labor market.

– Interdisciplinarity – combining technical knowledge with humanitarian knowledge (ethics, law, social sciences).

4. Skills for interacting with AI.

– Prompt engineering – formulating effective queries to AI.

– Control and verification of results – the ability to verify answers generated by AI.

– Ethical use of AI – understanding the social and legal consequences of the application of AI in various fields.

Thus, to be ready to work with AI, an employee must combine technical knowledge, humanity, the ability to learn, and the ability to effectively collaborate with technology.

In conclusion, I would like to draw attention to how AI not only directly but also indirectly affects both employees and employers.

After all, AI can help both teachers and students in their learning and increase the level of educational achievement. A more educated workforce will be more productive, so over time, students trained with AI will increase their productivity. Although this is a slow process, its effect can be significant.

AI can also support a healthier society and, consequently, a healthier workforce, leading to fewer lost workdays, longer and more productive careers, and reduced social costs. Although the use of AI in healthcare is still in its infancy, there is already enormous potential to accelerate medical research, introduce a preventive approach to treatment, more effectively identify, treat, and discharge patients, and develop assistive technologies that can help people with disabilities or temporary health problems return to work.

In addition, AI can contribute to better recruitment and more efficient use of labor resources-just as the Internet did in its time. However, design and control become especially important in this area, as biases arising from algorithms and data patterns can have negative consequences for employment. The principle of employee autonomy remains important: AI should not just passively select people for positions, but should provide them with strategies and information that will allow them to present themselves effectively.

Overall, AI has the potential to improve the quality of work, reduce the number of routine tasks, make jobs more accessible to a wider range of people, and increase occupational safety. Thus, it can contribute to a more engaged, inclusive, and safe work environment.

**Conclusions.** AI is already transforming work at both the individual and corporate levels, increasing employee efficiency.

AI has significant potential to improve labor supply by increasing the quantity, quality, and efficient use of workers in the economy as a whole.

Introducing AI into the economy and using its capabilities to improve education and skills will help realize the potential of AI as a tool for social equalization.

Workers' fears about job losses due to AI are not unfounded, but any attempts to halt progress are likely to be ineffective and harmful in the long run. On the contrary, creating new demand for labor will help attract workers back into new roles.

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## 3.3. WHAT AREAS WILL ARTIFICIAL INTELLIGENCE CHANGE DURING MARTIAL LAW IN UKRAINE?

**Introduction.** When writing the article, the topic of the impact of artificial intelligence technologies on the venture business and the military-industrial complex (MIC) of Ukraine was considered. The ongoing martial law in Ukraine has led to significant changes in the economy and the actual use of artificial intelligence technologies by companies in their business processes, which will have an impact on their further development. It has been studied that during the period of martial law in Ukraine, investments in venture business have increased significantly, the basis of which in our country is the development of AI. The use of artificial intelligence technologies in the process of risk analysis and forecasting is especially relevant, which is actually proposed to be studied in more detail. Artificial intelligence technologies have also influenced the military-industrial complex of Ukraine, which has also begun to actively introduce modern technologies

both in weapons production and in its internal business processes. It is studied that the development of AI in Ukraine during the war has changed in two areas – risk management in the company and its use in the military-industrial complex of Ukraine, which are proposed to be studied in more detail. Thus, the use of artificial intelligence and machine learning can process large amounts of data in real time, identify patterns and make predictions based on this data, thus allowing enterprises to make quick and informed decisions. It is noted that to minimize risks in Ukrainian companies, it is necessary to implement a programGRC, which works on the basis of artificial intelligence and allows you to effectively identify and predict the occurrence of risks. As a result, it was determined thatIn Ukraine, the process of creating an innovative ecosystem of a renewed domestic defense industry based on the use of AI has been initiated and is being actively implemented, the products of which are able to meet the needs of the Ukrainian army, and after the end of the war, foreign buyers as well.

**Presentation of the main research material.** The ongoing martial law in Ukraine has led to significant changes in the economy and the actual use of artificial intelligence technologies by companies in their business processes, which will have an impact on their further development. It has been studied that during the period of martial law in Ukraine, investments in venture business have increased significantly, the basis of which in our country is the development of AI. The use of artificial intelligence technologies in the process of risk analysis and forecasting is especially relevant, which is actually proposed to be studied in more detail. Artificial intelligence technologies have also influenced the military-industrial complex of Ukraine, which has also begun to actively introduce modern technologies both in weapons production and in its internal business processes. That is why researching the main areas that artificial intelligence will change in a martial law environment is a relevant issue for deeper analysis.

Research on the impact of artificial intelligence on changing venture business and the military-industrial complex of Ukraine was carried out by the following scientists and researchers, such as: Nosova E. A., Mohe D. B. [1], Bondarchuk N. V. [2], Philip I. [13], and others.

So, under the conditions of martial law in Ukraine, the development of venture investment in our country intensified, which was based on investments in artificial intelligence and Ukrainian startups that were engaged in the development of AI on a global scale. In Ukraine, venture funds were created as collective investment institutions (CIIs), the purpose of which is to attract investors' funds and invest them in assets in order to receive a profit from investments [1–2]. The dynamics of the number of CIIs in Ukraine is given in Table 1.

Table 1

**Dynamics of the number of CII in Ukraine for the period 2017–2023 [3]**

| Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Number of CII | 1183 | 1190 | 1326 | 1478 | 1711 | 1742 | 1762 |
| Absolute growth (chain) | 13 | 7 | 136 | 152 | 233 | 31 | 20 |
| Growth rate, % chain-linked | 101.11 | 100.59 | 111.43 | 111.46 | 115.76 | 101.81 | 101.15 |
| Growth rate,% chain-wise | 1.11 | 0.59 | 11.43 | 11.46 | 15.76 | 1.81 | 1.15 |

So, analyzing the data in Table 1, it is clear that the number of CII in Ukraine is growing significantly and, despite the war and the general economic crisis in our country, CII grew by 1.81% in 2022 and by 1.15% in 2023.

Next, it is proposed to examine the assets of CII (Table 2).

Table 2

**Dynamics of CII assets in Ukraine for the period 2017–2023, billion UAH [3]**

| Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| CII assets | 275.6 | 296.8 | 339.1 | 414.2 | 520.4 | 534.9 | 598.2 |
| Absolute growth (chain) | 45.3 | 21.2 | 42.3 | 75.1 | 106.2 | 14.5 | 63.3 |
| Growth rate, % chain-linked | 119.7 | 107.7 | 114.3 | 122.1 | 125.6 | 102.8 | 111.8 |
| Growth rate,% chain-wise | 19.7 | 7.7 | 14.3 | 22.1 | 25.6 | 2.8 | 11.8 |

Based on the analysis of the data in Table 2, it should be noted that over the past 7 years, CII assets have grown 3.2 times, which is twice the growth rate of Ukrainian banks' assets, so the ratio of CII assets to banks in 2010–2022 increased from 11.2 to 22.7%.

The level of development of CII in Ukraine can be described as moderate, but with huge growth potential. Even during the war, Ukraine is actively developing its financial system and investment industry and creating a favorable environment for attracting both domestic and foreign investors.

Next, we will analyze the volume of investments in the development of venture business in Ukraine (Table 3).

We see that every year the value of concluded agreements in Ukraine increased, and despite the martial law in our country, in 2022 we managed to attract $17 million in investments, exceeding the indicators of 2021. Therefore, such an increase in investments in Ukraine indicates high prospects for the development of the AI sphere.

The development of AI in Ukraine during the war has changed in two areas – risk management in the company and use in the military-industrial complex of Ukraine, which are proposed to be studied in more detail.

Table 3

**Analysis of the dynamics of venture investments and the number of deals in Ukraine for the period 2015–2023**

| Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| **Investment volume, million USD** | **3.9** | **2.4** | **8** | **32** | **12.8** | **15.7** | **10.8** |
| Absolute growth (chain) | 1.6 | –1.5 | 5.6 | 24 | –19.2 | 2.9 | –4.9 |
| Growth rate, % chain-linked | 169.57 | 61.54 | 333.33 | 400.00 | 40.00 | 122.66 | 68.79 |
| Growth rate,% chain-wise | 69.57 | –38.46 | 233.33 | 300.00 | –60.00 | 22.66 | –31.21 |
| **Number of deals** | **9** | **16** | **15** | **22** | **30** | **17** | **22** |
| Absolute growth (chain) | –3 | 7 | –1 | 7 | 8 | –13 | 5 |
| Growth rate, % chain-linked | 75.00 | 177.78 | 93.75 | 146.67 | 136.36 | 56.67 | 129.41 |
| Growth rate,% chain-wise | –25.00 | 77.78 | –6.25 | 46.67 | 36.36 | –43.33 | 29.41 |

*Source: [3]*

To date, the use of artificial intelligence models to assess the probability of risk occurrence is most common in the following areas (Table 4).

We believe that the use of AI allows us to assess the probability of crisis events occurring at enterprises, which reduces the errors of the occurrence of risky situations. The use of AI allows us

Table 4

**Characteristics of the application of AI in risk management in economic sectors**

| Sector of the economy | Characteristic |
|---|---|
| Finances | Artificial intelligence models are successfully used to solve credit scoring problems. Intelligent models are also successfully used to analyze financial transactions for fraud and to assess insurance risks |
| Healthcare | Artificial intelligence models allow predicting the likelihood of risk of disease occurrence and exacerbation, as well as associated events, such as unplanned re-hospitalization, which leads to a decrease in the level of patient care and overload of the healthcare system |
| Public administration | As an example of the application of artificial intelligence methods for risk management in the field of public administration, we can cite a model of automated risk assessment of public contracts, aimed at increasing the efficiency of public procurement and optimizing budget expenditures |
| Education | In the educational sphere, the application of artificial intelligence methods can also be quite diverse and can be used, for example, to analyze the probability of a student's risk of expulsion or unsatisfactory academic performance |
| Security | Intelligent models can be used to detect administrative and criminal offenses and prevent them in a timely manner |
| Business | Implementing AI into a company's business processes will allow it to predict sales and price increases for raw materials, which will allow it to develop an inventory system and conclude additional contracts with suppliers |

*Source: [5–6]*

to conduct a deep analysis of risks and plan for reducing such risks by processing large amounts of information in real time. The use of AI allows us to identify patterns and affects the speed and efficiency of management decisions. In order to minimize risks, Ukrainian companies are proposed to implement a program GRC, which works on the basis of artificial intelligence and allows you to effectively identify and predict the occurrence of risks. Fig. 1 shows the main advantages of GRC for Ukrainian companies in the context of risk reduction.

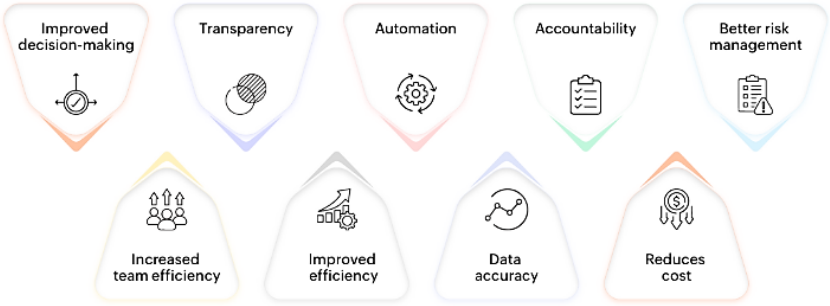


Fig. 1. Key benefits of implementing GRC into a company's risk management system

*Source: [7]*

So, the main advantage of this program for a Ukrainian company is the reduction of commercial risks, because GRC can provide sales volume forecasts for each client and predict possible increases or decreases in sales levels depending on the state of the partner company and the market situation in Ukraine.

The defense industry has identified several priority areas of development in the context of the use of AI technologies (Fig. 2).

GRC will help the company's management develop policies, meet regulatory requirements, optimize audit management, proactively

monitor the commercial risk environment, optimize compliance efforts, obtain risk information, satisfy key stakeholders, improve reporting capabilities, and increase compliance. That is why the implementation of this program will be effective for the Ukrainian company and will help not only to predict the occurrence of risks, but also to improve financial performance through management optimization.

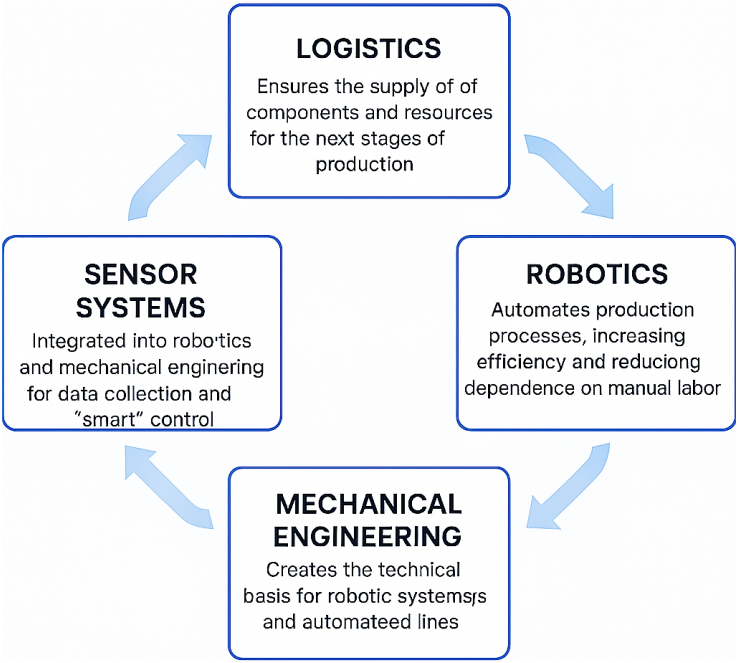


Fig. 2. Main areas of use of AI technologies in the defense industry

*Source: [8]*

So, let's move on to the analysis of technologies in robotics in the defense industry. The most striking example of the use of technologies in the robotics of the military-industrial complex is unmanned aerial vehicles (UAVs), which can operate on the basis of AI and be controlled by a person. It is worth mentioning

the development of sensor technologies in the defense industry separately. Touch screens are used in the armed forces everywhere. They are used in radio engineering troops, chemical troops, space troops, etc. A touch screen allows you to visualize information, control devices using an intuitive approach, and work much faster and more efficiently. But sensor technologies are not limited to screens, they include all kinds of innovative monitoring and data collection systems that are actively used in military equipment and radar equipment. Logistics is an equally important area of activity in the defense industry. Often the success of a military operation depends on the timely supply and support of combat units. Innovations are driven by the use of big data technologies, warehouse management systems (WMS), artificial intelligence technologies in flow management and inventory tracking, as well as the introduction of robotics, including drones. Sensor logistics and RFID tags are being developed, allowing for real-time monitoring of deliveries. This provides constant monitoring of cargo, storage conditions and transportation, which is useful in the defense industry, since military cargo has special requirements for storage and transportation, and tracking movement helps to eliminate force majeure situations [9].

Fig. 3 shows a list of public and private companies that are currently the largest players in the drone industry.

So, analyzing Fig. 3, it is clear that the majority of UAV manufacturing companies are American, whose share in this market is dominant.

Having analyzed innovations in the defense industry, it is necessary to analyze the financial component and determine Ukraine's share among the countries of the world in terms of defense industry spending (Fig. 4).

Therefore, Ukraine's share in defense industry spending is 2.7% of global spending, which is a relatively large amount for our country.

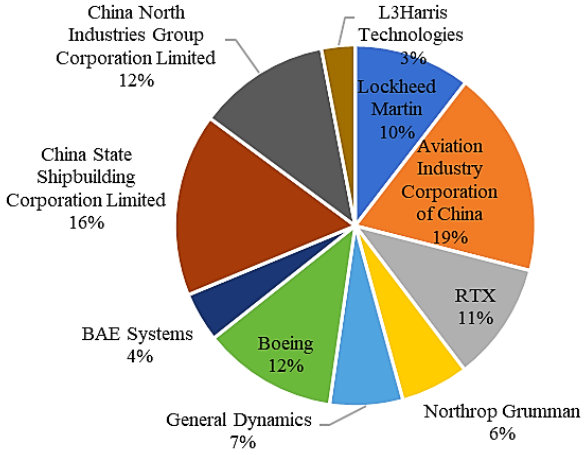


Fig. 3. Structure of global UAV manufacturers by sales revenue as of 2024, %

*Source: [10]*

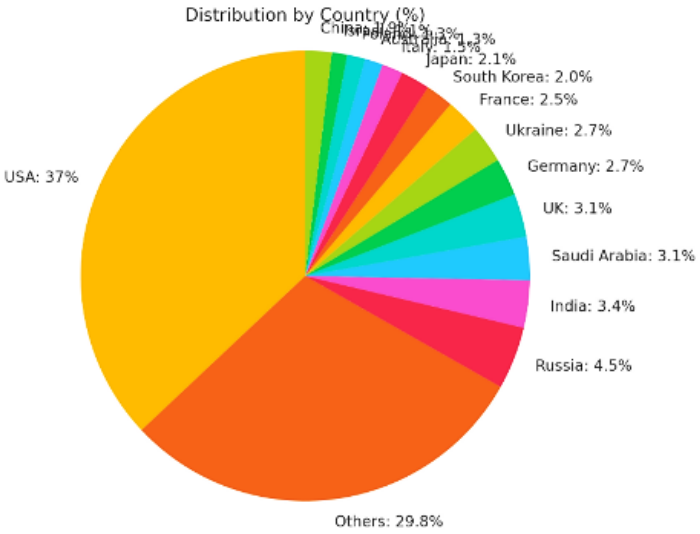


Fig. 4. Global share of Ukraine's spending on defense industry development in 2023, %

*Source: [11]*

At the beginning of the Russian-Ukrainian war, the Brave1 coordination platform in the field of Defense Tech was created [12]. This platform unites Defense Tech companies and all interested organizations and institutions that direct their activities towards Victory based on the use of digital technologies. At the moment, 35 developments using artificial intelligence (AI) are registered in Brave1, of which 29 have already passed military expertise. In conditions of active hostilities, the main task of Ukrainian developers is to create AI solutions for the front. One of such solutions is the Griselda system, which uses AI to collect intelligence and increase the situational awareness of troops. It is able to analyze a huge array of data from satellites, drones, social networks, media and hacked enemy bases. The technology is integrated with the Delta situational awareness system and applications for artillerymen and tankers, such as Bronya, Nettle, Dill and GisArt [13].

To accelerate technological development, the Ministry of Defense of Ukraine launched the Innovation Development Accelerator. Its goal is to accelerate the implementation of innovative projects for the benefit of the Armed Forces. Using modern management methods and IT solutions, the accelerator combines the expertise and powers of specialized departments of the Ministry of Defense and a special Project Office. Applications for cooperation with the Ministry of Defense are submitted through the RIA system on the principle of a "single window" and using process automation [14].

In Ukraine, the process of creating an innovative ecosystem of a renewed domestic defense industry based on the use of AI has been initiated and is being actively implemented, the products of which are able to meet the needs of the Ukrainian army, and after the end of the war, foreign buyers as well.

**Conclusions.** Thus, having determined the change in the military state on the use of AI, it was investigated that the greatest impact and changes were experienced by venture investments and the military sector of Ukraine, which first of all began to actively apply artificial

intelligence technologies in their activities. Under the conditions of martial law in Ukraine, developments began in the defense sector, which have already been tested and are a promising direction in the future of our country, especially after the victory.

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## 3.4. CHALLENGES AND PROMISING DIRECTIONS FOR USING ARTIFICIAL INTELLIGENCE IN COUNTERING DISINFORMATION

**Introduction.** In the current conditions of hybrid warfare, Ukraine is facing an unprecedented wave of disinformation aimed at destabilizing society, lowering morale, and undermining trust in state institutions. At the same time, in the post-war period, the country faces the task of restoring the economy, which requires a stable information environment. In this context, there is a need to involve innovative technologies, in particular artificial intelligence, in ensuring information security.

**Presentation of the main research material.** Recent years have been characterized by an increase in the number of studies devoted to the use of AI in the field of security and information processing. Authors such as Claire Wardle & Hossein Derakhshan have considered the impact of automated systems on the detection of fake news [1]. Developments aimed at creating content verification systems and filtering harmful information are also emerging in Ukraine.

Highlighting previously unresolved parts of the overall problem. Despite the existing achievements, the issue of integrating AI tools into the system of state information policy in the context of war and post-war reconstruction remains insufficiently researched. There

is a lack of applied models adapted to the Ukrainian context, taking into account cultural, linguistic, and regional peculiarities.

Formulation of the article's goals (definition of tasks). The aim of the article is to analyze the potential of artificial intelligence as a tool for countering disinformation in Ukraine during the war and during the post-war economic recovery.

Objectives of the article:

1. To reveal the essence and danger of disinformation in war and post-war conditions.
2. Describe the main AI technologies that can be used to combat fake news.
3. Analyze the practical aspects of using AI for monitoring, analyzing, and verifying information.
4. Consider existing Ukrainian and global practices of using AI against disinformation.
5. Identify the main challenges, limitations, and prospects for the application of AI in this area for Ukraine.

The full-scale invasion of Ukraine by the Russian Federation on February 24, 2022, is accompanied by an information war of unprecedented scale. Disinformation, propaganda, and manipulation have become an integral part of hybrid aggression aimed at undermining the morale of Ukrainians, discrediting the state leadership, splitting society, and distorting the real picture of events for the international community. In times of war, the speed of information dissemination, especially fake information, increases significantly, which creates serious threats to national security.

Disinformation will remain no less dangerous during the post-war reconstruction of Ukraine. At this stage, hostile narratives can be aimed at disrupting reconstruction processes, discrediting aid programs, undermining trust in the authorities and international partners, manipulating the investment climate, and inflaming social tensions. Effective counteraction to these threats requires a comprehensive approach and the involvement of the latest technologies.

One of the most promising tools in the fight against disinformation is artificial intelligence (AI). Its ability to process huge amounts of data, detect hidden patterns, analyze text, images, and video in real time opens up new opportunities for monitoring the information space, quickly detecting fakes, identifying sources of disinformation, and automating verification processes.

Disinformation is the deliberate dissemination of false or distorted information with the aim of misleading, manipulating public opinion, damaging reputations, or achieving political, military, or economic goals [1]. In times of war, disinformation becomes a powerful weapon that the aggressor uses to gain an advantage not only on the battlefield but also in the information space.

The main types of disinformation actively used against Ukraine:

– outright lies (fake news):reports about non-existent events, victories, losses, crimes (for example, fakes about "biolaboratories", "dirty bomb", "Nazi regime" in Ukraine);

– manipulation of facts: using true facts in a distorted context, selective quoting, shifting emphasis to create a false impression;

– propaganda: systematic dissemination of certain ideas, narratives, and stereotypes to shape desired public opinion (e.g., narratives about "historical unity," "liberation mission");

– Deepfakes: AI-generated realistic photo, video, and audio fakes, where one person's face or voice is replaced by another [2]. This can be used to discredit political and military leaders;

– astroturfing: creating the illusion of mass support for a certain idea or position through the use of fake accounts, bots, and comments;

– spreading rumors and panic: launching information aimed at destabilizing society, instilling fear, distrust of the authorities and the army (for example, rumors of surrender, lack of resources).

The dissemination of such information occurs through various channels: social networks, messengers, media outlets controlled by the aggressor, anonymous Telegram channels, as well as through hacked accounts and websites.

The consequences of spreading disinformation in wartime are extremely devastating:

– undermining national unity and trust: attempts to divide society along linguistic, regional, or political lines, to sow distrust in the authorities, the Armed Forces of Ukraine, and volunteers;

– demoralization of the population and the military: spread of panic, disbelief in victory, discrediting the command;

– obstruction of mobilization and defense: spreading fakes about losses, service conditions, and weapon effectiveness;

– complication of the humanitarian situation: spreading false information about evacuation, the operation of humanitarian corridors, and the distribution of aid;

– discrediting Ukraine in the international arena: attempts to present Ukraine as a failed state, to justify aggression, to disrupt the supply of weapons and the provision of financial assistance [3];

– economic losses: Although the direct impact on the economy during active hostilities is difficult to assess, disinformation can indirectly affect financial markets (when it comes to international aid), logistics (fakes about road hazards), and trust in the banking system.

After the end of active hostilities, the information space will remain a battlefield. Disinformation campaigns will be adapted to the new realities and aimed at disrupting the country's recovery process. Main threats:

– discrediting the reconstruction process: spreading narratives about corruption in the distribution of reconstruction funds, inefficiency in the use of international aid, and low quality of work. The goal is to undermine the public's trust in the authorities and international partners, and slow down the reconstruction processes;

– manipulation of the investment climate: dissemination of negative or distorted information about the economic situation, security risks, and the legislative framework to scare away foreign investors;

– social destabilization: inciting conflicts between different groups of the population (for example, between those who left and those who stayed, between military and civilians, residents of different regions) through the dissemination of manipulative messages;

– undermining trust in international partners: spreading fakes about non-fulfillment of obligations, "Ukraine fatigue", ulterior motives for assistance;

– distortion of historical memory: continuing attempts to rewrite history, justify aggression, impose one's own vision of the past and future.

Countering these threats will require no less vigilance and resources than in wartime, and technological solutions, including those based on AI, will play a key role in protecting the information space during the recovery phase.

Table 1 lists the key AI technologies used to monitor the information space.

Table 1

**AI technologies and their application for monitoring**

| AI technology | Monitoring and analysis applications | Examples of tasks |
|---|---|---|
| NLP | Analysis of text content in news, social networks, blogs | Identifying key themes/narratives, tone analysis, identifying propaganda markers, hate speech |
| ML | Classification of large volumes of data, detection of distribution patterns | Identification of coordinated campaigns, detection of bot activity, prediction of content virality |
| Computer Vision | Visual content analysis (photos, videos) | Search for image manipulation, track the spread of memes and visual fakes |
| Network Analysis | Analysis of connections and interactions in social networks | Detection of botnets, identification of influential nodes (influencers) in the spread of disinformation |

*Source: developed by the authors*

Artificial intelligence (AI) is a branch of computer science that deals with creating systems that can perform tasks that normally require human intelligence, such as learning, problem solving, pattern recognition, and language understanding [4]. The potential of AI to counter disinformation lies in its ability to analyze vast amounts of data much faster and more efficiently than humans.

Different AI technologies complement each other, providing a comprehensive approach to monitoring and analyzing the information space. NLP works with text, Computer Vision with images, ML and Network Analysis help detect complex patterns and connections, which allows us to not just capture individual fakes, but to see holistic disinformation campaigns.

In addition to monitoring, AI can become an important tool for fact-checkers and analysts in the process of verifying information:

– automated fact checking: AI systems can automatically match claims in publications with fact-checked databases, encyclopedias (such as Wikipedia), official statements, and reports. This significantly speeds up the process of verifying large amounts of news;

– source reliability assessment: AI can analyze a website or account's publication history, its connections to other sources, and the presence of contact information to assess its level of trustworthiness. Some tools provide "trust ratings" for information sources [7];

– identifying authorship and style: by analyzing the style of a text, AI can help determine whether the text was written by a human or generated automatically, and in some cases, even identify the likely author or group of authors if there are samples of their texts;

– identification of deepfakes: specialized AI algorithms are trained to recognize microscopic artifacts and inconsistencies in deepfake video and audio that are difficult for the human eye or ear to notice [2];

– aggregation of evidence: AI can collect and structure information from various sources (text, photos, videos, data from

social networks) related to a certain event or statement, helping analysts form a complete picture and draw a conclusion about reliability.

It is important to note that at this stage, AI is seen primarily as an auxiliary tool for verification, which significantly speeds up and automates routine processes, but the final decision on the veracity of information often requires human expert assessment.

Combating disinformation using AI is a trend that is actively developing both in Ukraine and around the world.

In Ukraine:

1. Government agencies. The Center for Countering Disinformation at the National Security and Defense Council of Ukraine and other government agencies actively monitor the information space, although there is still little public information about the widespread use of complex AI systems. The main focus is on identifying and refuting hostile narratives [8]. Cyber police use analytical tools to detect bot farms and coordinated attacks.

2. Civil society organizations and fact-checking projects. Initiatives such as StopFake, VoxUkraine, and Detector Media are actively working to refute fake news. They can use available AI tools to monitor social media, find original sources, and verify images, but often the main work is done by analysts [9].

3. Technology sector. Ukrainian IT companies and startups are developing their own solutions for data analysis and manipulation detection. For example, YouControl has created a tool for checking connections between individuals and companies, which can be useful for detecting hidden influences. Respeecher, a company working with voice cloning technologies, is also researching methods for detecting voice deepfakes [10]. Osavul is a Ukrainian startup that uses AI to detect hostile information operations [11].

International experience:

1. Large technology companies. Google, Meta (Facebook, Instagram), Twitter (X), TikTok are investing significant resources

in developing AI algorithms to automatically detect and limit the spread of disinformation, hate speech, spam, and fake accounts on their platforms [12]. They use a combination of AI and human moderation.

2. Academic research. Many universities and research centers around the world are working to create new, more advanced AI models to detect various types of disinformation, including deepfakes.

3. International organizations and projects. The European Union funds research and development of tools to combat disinformation under the Horizon Europe programs. There are projects aimed at creating common databases of fake news and developing verification standards. For example, the European Digital Media Observatory (EDMO) brings together fact-checkers, researchers, and media experts [13].

Table 2 provides examples of AI applications to counter disinformation, demonstrating the use of NLP, ML, Computer Vision, and Network Analysis technologies to detect fake information, monitor information operations, and develop specialized tools in social media, fact-checking, public security, and technology startups.

The use of AI to combat disinformation is multifaceted and spans sectors from global technology platforms to specialized government agencies and community initiatives. While the technologies used are often similar (NLP, ML, Computer Vision), their specific application and scale vary depending on the organization's goals and resources.

Despite its significant potential, the use of AI to counter disinformation faces a number of serious challenges and limitations:

– "Arms race": Disinformation technologies, especially deepfakes, are also constantly being improved with the help of AI. This creates a constant need to update and improve detection algorithms [2];

– complexity of context and sarcasm: AI often has difficulty understanding context, irony, sarcasm, or cultural nuances, which can lead to false positives or false negatives;

Table 2

**Examples of using AI to counter disinformation**

| Scope of application | Organization / platform | AI technologies | Goal |
|---|---|---|---|
| Social networks | Meta, Google (YouTube), X | NLP, ML, Computer Vision, Network Analysis | Automatic detection and labeling/removal of fakes, hate speech, spam, bots, deepfakes |
| Fact-checking | StopFake, EDMO, others | NLP (support), Computer Vision (image search), ML (source evaluation) | Acceleration of the verification process, monitoring the spread of fakes, analysis of sources |
| State security | Central Security and Defense Council of Ukraine, Cyber Police | ML (anomaly detection), Network Analysis (bot networks), NLP (topic monitoring) | Detecting information operations, identifying hostile narratives, investigating cyberattacks |
| Technology startups | Osavul, Respeecher | ML, NLP, voice analysis technologies | Development of specialized tools for detecting IPSOs and deepfakes |

– the problem of "Novyzna": AI models are trained on known examples of disinformation. New, previously unseen types of fake news or narratives may be missed by the system until it is retrained;

– data manipulation and bias: the quality of AI depends on the data it is trained on. If the training data contains biases or is unrepresentative, the AI may reproduce these biases. There is also the risk of malicious actors deliberately poisoning the training data;

– language barriers: Most advanced AI models are designed for English. Their efficiency with Ukrainian may be lower, although this area is actively developing;

– need for human control: Full automation of the process of combating disinformation is currently impossible and undesirable. Human oversight and expert assessment remain critical to avoid errors and abuses [5; 6];

– ethical dilemmas: Where is the line between combating disinformation and censorship? How to ensure the transparency of AI algorithms? These issues require thorough public and expert discussion;

– resource intensity: Developing, training, and supporting complex AI systems requires significant computing resources, large amounts of data, and highly skilled professionals, which can be a challenge for many organizations.

Table 3 lists the main challenges of using AI against disinformation, including the adaptability of disinformation, insufficient understanding of context, data bias, the problem of novelty, the need for human control, ethical issues, and high resource intensity.

Effective use of AI to counter disinformation requires understanding and overcoming a number of technical, ethical, and resource challenges. The "arms race" with fake news creators, the difficulty of understanding context, the potential bias of algorithms, and the need for human oversight are key limitations that need to be considered when designing and implementing AI solutions.

During the post-war economic recovery of Ukraine, the role of AI in countering disinformation may become even more significant. Promising directions:

– monitoring of targeted economic attacks: AI can track and analyze information campaigns aimed at discrediting specific recovery projects, economic sectors (e.g., agriculture, energy), or international financial institutions providing assistance;

– analysis of public sentiment regarding recovery: Using NLP to analyze discussions on social networks and the media will allow authorities and international partners to better understand citizens' concerns, identify points of social tension fueled by disinformation, and respond in a timely manner;

Table 3

**Key challenges in using AI against disinformation**

| Challenge / Limitation | Description | Possible consequences |
|---|---|---|
| The adaptability of disinformation | Constant improvement of methods for creating fakes (especially deepfakes) | Decreased efficiency of detection systems, need for constant updating of algorithms |
| Understanding context and nuance | AI does not recognize irony, sarcasm, or cultural context well | Content misclassification (false positives/negatives) |
| Data Bias (Bias) | Training data may contain hidden biases that are reproduced by AI | Discriminatory decisions, unfair blocking of content for certain groups |
| "The problem of novelty" | AI is bad at detecting new, previously unknown types of disinformation | Skipping new threats before updating the model |
| The need for human control | AI is a tool, not a human replacement; expert supervision is needed | Risk of errors with full automation, need for resources for experts |
| Ethical issues | Balance between security and freedom of speech, transparency of algorithms | Risk of censorship, public distrust of technology |
| Resource intensity | High requirements for computing power, data, and personnel qualifications | Limited access to advanced technologies for smaller organizations or countries |

*Source: developed by the authors*

– investment image protection: AI systems can help quickly detect and refute fakes aimed at scaring off investors, providing

potential investors with access to verified information about the business climate and opportunities in Ukraine;

– information verification for businesses and citizens: creating accessible AI-based tools (e.g., chatbots, browser extensions) that would help citizens and entrepreneurs quickly check the reliability of news related to the economy, support programs, and business conditions;

– forecasting information threats: the development of AI models capable of predicting the likely directions of future disinformation attacks on the economic sphere will allow preventively strengthening relevant communication channels and preparing rebuttals;

– increasing media literacy: AI can be used to create personalized media literacy curricula tailored to the needs of different populations, helping them better recognize manipulation.

Successful implementation of these prospects will require coordinated efforts by the state, the technology sector, civil society, and international partners, as well as continued investment in technology development and training of specialists.

Conclusions. Disinformation is a serious threat to Ukraine both during a full-scale war and during the post-war recovery phase. It is aimed at undermining national security, social unity, economic stability, and international support. The scale and speed of the spread of fake news in the modern information space require the use of the latest technological solutions for effective countermeasures.

Artificial intelligence shows significant potential as a tool in this fight. Technologies of natural language processing, machine learning, computer vision and network analysis allow to automate and significantly accelerate the processes of monitoring the information space, detecting fakes and manipulations, analyzing propaganda narratives, identifying sources of disinformation, including botnets and coordinated campaigns, as well as verifying content, in particular detecting deepfakes.

The practical application of AI to counter disinformation is already taking place at the level of global technology platforms, government agencies, public organizations, and technology companies both in Ukraine and around the world. However, there are significant challenges and limitations: the constant improvement of fake news creation technologies, the complexity of analyzing the context and nuances of human language, the risks of algorithmic bias, ethical dilemmas, and the need for significant resources and human control.

In the future, especially in the context of the post-war recovery of Ukraine's economy, the role of AI may grow. It can help monitor targeted economic attacks, analyze public sentiment, protect the investment climate, verify information important to citizens and businesses, and predict new information threats.

To maximize the potential of AI in countering disinformation, Ukraine needs to:

– invest in developing our own and adapting existing AI solutions focused on the Ukrainian context and language;

– promote cooperation between government agencies, the IT sector, scientists, and civil society;

– to ensure the training of qualified specialists in the field of AI and data analysis;

– develop a clear ethical and legal framework for the use of AI for content moderation, ensuring a balance between security and freedom of speech;

– to increase the overall level of media literacy of the population, as technology is only part of a comprehensive solution.

**Conclusions.** Artificial intelligence is not a panacea for disinformation, but it can become a powerful tool in the hands of those who seek to protect the truth and ensure the sustainable development of Ukraine in the context of information challenges of war and peace. A comprehensive approach that combines technological innovation, human expertise, media literacy, and effective regulation is the key to building a society resilient to disinformation.

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