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# APPLICATION OF ARTIFICIAL INTELLIGENCE IN PREDICTIVE MAINTENANCE OF INDUSTRIAL EQUIPMENT

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**Abstract**

The article analyzes application of artificial intelligence in predictive maintenance of industrial equipment. AI-based predictive maintenance reduces unexpected failures by analyzing sensor data, vibration signals, temperature deviations, and operational history. The approach supports condition-based maintenance and improves the reliability of industrial equipment. The aim of the study was to evaluate the technical, functional, and practical significance of this approach in modern engineering systems. The study used analytical review, comparative assessment, and synthesis of current engineering literature. The results show that the investigated technology improves operational efficiency, reliability, safety, and sustainability. The findings may be useful for engineers, researchers, and managers involved in the modernization of industrial and technological processes.

**Keywords**: artificial intelligence, predictive maintenance, industrial equipment, machine learning, reliability engineering.

## Introduction

Modern engineering is rapidly changing under the influence of digitalization, automation, intelligent systems, and sustainable development requirements. The topic of application of artificial intelligence in predictive maintenance of industrial equipment is relevant because industrial enterprises and technological organizations increasingly require reliable, efficient, and adaptive solutions.

The development of advanced technologies has expanded opportunities for monitoring, control, optimization, and decision-making. In many technical systems, traditional approaches are no longer sufficient to ensure productivity, safety, and cost efficiency. Therefore, the integration of modern analytical tools, sensors, algorithms, and automated platforms has become an important direction of engineering research.

The scientific relevance of this topic is connected with the need to improve performance indicators while reducing energy consumption, maintenance costs, and technical risks. The practical relevance is associated with the implementation of these solutions in real industrial, transport, energy, construction, and manufacturing environments.

The aim of this study was to analyze the main technical principles, advantages, limitations, and practical implications of the selected engineering approach within the framework of modern technological development.

## Materials and Methods

The study was conducted as an analytical review based on scientific publications, engineering reports, technical standards, and applied research related to modern industrial technologies. The methodological basis included comparative analysis, systematization of technical data, and evaluation of practical implementation scenarios.

The analysis focused on key engineering parameters such as reliability, efficiency, safety, energy consumption, implementation complexity, maintainability, and scalability. The reviewed materials were grouped according to technological function, application area, and expected performance outcomes.

A qualitative comparative approach was used to evaluate advantages and limitations. Special attention was given to the relationship between technological innovation and practical engineering effectiveness.

**Results**

The results of the analysis demonstrated that the selected technological direction has strong potential for improving engineering practice. The most important benefits include increased process transparency, improved technical monitoring, optimized resource consumption, and reduced operational risk.

| Evaluation parameter | Observed effect | Practical significance |
|---|---|---|
| Reliability | Higher stability of operation | Reduced downtime and failures |
| Efficiency | Improved resource use | Lower operating costs |
| Safety | Better monitoring and control | Reduced technical risk |
| Scalability | Flexible integration | Wider industrial application |

The comparative assessment showed that technological modernization produces the greatest effect when it is implemented together with systematic data collection, trained personnel, and continuous performance evaluation.

**Discussion**

The obtained results confirm that modern technical solutions should be evaluated not only by their novelty but also by their ability to solve practical engineering problems. Successful implementation depends on compatibility with existing infrastructure, cost effectiveness, user training, and long-term reliability.

A major advantage of intelligent and automated engineering systems is their ability to support evidence-based decision-making. Data-driven control improves accuracy and allows early detection of technical problems. However, several challenges remain, including cybersecurity, initial investment, data quality, and standardization.

The findings also indicate that engineering innovation requires interdisciplinary cooperation. Specialists in mechanics, electronics, information technologies, energy systems, and management should work together to ensure effective application. Such integration increases the practical value of research and supports sustainable technological progress.

**Conclusion**

The study confirms that application of artificial intelligence in predictive maintenance of industrial equipment is an important and promising direction in contemporary engineering. The analyzed approach improves operational efficiency, reliability, safety, and adaptability of technical systems.

The results indicate that the practical implementation of modern engineering technologies requires systematic planning, technical expertise, reliable infrastructure, and continuous monitoring. Further studies should focus on experimental validation, economic assessment, and long-term performance analysis in real industrial conditions.

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