UDC 004.8:658.5

Optimization of business processes using artificial intelligence-based automated control systems

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The article discusses the optimization of business processes using automated control systems based on artificial intelligence (AI). Modern methods such as machine learning, robotic process automation, natural language processing, and predictive analytics are examined, which enhance operational efficiency, improve forecasting accuracy, and minimize errors. The advantages of implementing AI in various business sectors are analyzed, including the automation of routine tasks, real-time decision-making, and improving customer interactions. Attention is given to the challenges related to the implementation of AI in business processes, such as data protection issues and employee adaptation to new technologies.

Keywords: automation, artificial intelligence (AI), business processes, machine learning (ML), natural language processing (NLP), predictive analytics, robotic process automation (RPA).

Оптимизация бизнес-процессов с помощью автоматизированных систем управления на основе искусственного интеллекта

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В статье рассматривается оптимизация бизнес-процессов с помощью автоматизированных систем управления, основанных на искусственном интеллекте (ИИ). Изучаются современные методы, такие как машинное обучение, роботизированная автоматизация процессов, обработка естественного языка, предиктивная аналитика, которые позволяют повысить эффективность операций, улучшить точность прогнозов и минимизировать ошибки. Анализируются преимущества внедрения ИИ в различные сферы бизнеса, включая автоматизацию рутинных задач, принятие решений в реальном времени и улучшение взаимодействия с клиентами. Уделяется внимание вызовам, связанным с внедрением ИИ в бизнес-процессы, таким как вопросы защиты данных и адаптации сотрудников к новым технологиям.

Ключевые слова: автоматизация, искусственный интеллект (ИИ), бизнес-процессы, машинное обучение (МО), обработка естественного языка (NLP), предиктивная аналитика, роботизированная автоматизация процессов (RPA).

Introduction

Optimizing business processes is a critical task for companies seeking to enhance efficiency and competitiveness in the context of global digital transformation. Artificial intelligence (AI) offers new opportunities for automating operations, improving forecasting accuracy, and minimizing operational risks. The application of AI in business management not only accelerates decision-making but also improves the quality of decisions through deep data analysis, making management processes more flexible and adaptive to changes in the external environment.

Automated control systems (ACS) based on AI provide a high level of integration with existing business processes and allow companies to effectively leverage modern technologies. These systems are capable of analyzing large volumes of data, identifying hidden dependencies, and offering optimal solutions in real-time. This gives companies strategic advantages, enhancing their ability to quickly respond to market changes and improving internal organization. The goal of this work is to analyze AI methods and tools for optimizing business processes and improving operational performance.

Main part. Principles and approaches to business process optimization

Business process optimization is one of the key challenges faced by modern companies striving to enhance their operational efficiency and competitiveness. In the context of a global economy, rapidly changing technologies, and growing customer expectations, companies are forced to reevaluate their internal processes to reduce costs, improve service quality, and speed up operations. To achieve this, both traditional methods of process improvement and innovative approaches related to the implementation of AI technologies are used.

Business processes represent a set of interrelated tasks and operations aimed at achieving a specific outcome within a company's operations [1]. These processes can be divided into several categories:

– **core processes** are related to creating value for customers. Examples include product manufacturing, goods delivery, or service provision;

– **management processes** provide coordination and control over the company's activities, including planning, task execution monitoring, and resource management;

– **support processes** are directed at supporting the company's core activities. These may include HR functions, financial accounting, or IT support.

Both traditional and modern methods of business process optimization play an important role in improving companies' operational performance. However, in the era of digital transformation, increasing attention is being paid to modern methods that use AI for decision automation and improving forecasting accuracy (tabl. 1) [2, 3].

Table 1

Comparison of traditional and modern methods of business process optimization

Criterion	Traditional methods	Modern methods (based on AI)
Approach to process improvement	Improvement based on the analysis of current operations and elimination of losses.	Automation of processes using AI and big data analysis.
Main methods	Lean (reducing waste for customers), Six Sigma (reducing defects and variability in processes), Kaizen (continuous small improvements).	Machine learning (ML), predictive analytics, robotic process automation (RPA).
Goals	Improving efficiency and product quality.	Decision automation, forecasting market trends.
Speed of implementing changes	Step-by-step changes, continuous improvement	Fast reaction to changes through adaptive systems.
Technologies used	Data analysis, statistical methods	AI, ML, neural networks.
Role of the human factor	High dependency on human decisions	Reduced role of humans in routine and repetitive tasks.
Forecasting	Limited, based on historical data	Forecasting with predictive analytics and ML.

From the author's perspective, business process optimization is a fundamental element of the successful functioning of modern companies, and the approaches to its implementation have significantly evolved with the development of technologies. Traditional methods focused on step-by-step improvements aimed at eliminating waste and enhancing quality, which were sufficient for stable conditions and gradual changes. However, today's business environment requires more flexible solutions that can adapt to rapid changes and increasingly complex conditions.

Artificial intelligence and its application in business

One of the key technologies transforming business processes and decision-making methods in companies is AI. With its ability to analyze large volumes of data, identify patterns, and automatically optimize processes, AI has become a crucial tool for enhancing operational efficiency and market competitiveness. Its application spans various business sectors, from production and logistics to marketing and customer service. The global AI market size in 2024 is projected to reach $184,00 billion (fig. 1) [4].
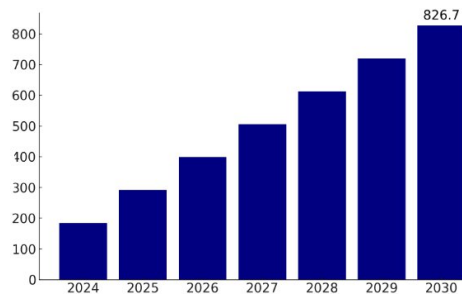

Figure 1. AI market size, billion dollars

An important feature of AI is its ability to **adapt to the specific needs** of businesses, offering solutions that can be integrated into various areas of operation. For example, AI can process large volumes of data in real time, identify hidden patterns, and provide companies with analytical forecasts that would be unattainable using traditional methods.

The integration of AI into business operations enables a **high level of automation**, transforming not only routine tasks but also more complex workflows. AI-driven systems streamline processes by eliminating manual intervention in areas such as data management, customer service interactions, and financial operations. Technologies allow for precise and efficient handling of these activities, freeing up human resources to focus on higher-value tasks. This leads to an overall boost in productivity while also reducing operational errors that are common in manual processes. AI systems are **designed to continuously improve**, learning from data and adapting their performance to further refine operations. According to research, the highest adoption rates of generative AI are found among American companies in the information technology sector (fig. 2) [5].
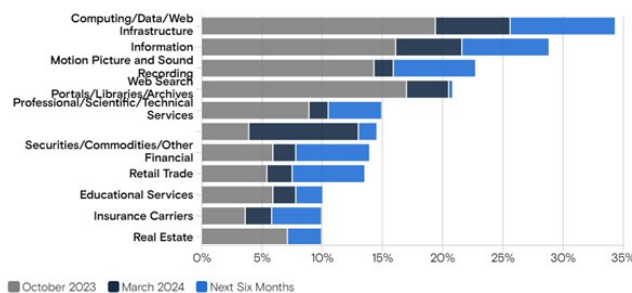

Figure 2. Share of USA firms using AI, top subsectors

There are various factors slowing down the adoption of AI, such as a lack of knowledge about AI technologies and concerns related to data privacy and security. However, as AI technologies continue to improve, their implementation is expected to expand across more industries, leading to significant changes in how companies operate and innovate.

AI tools for business process optimization

One of the most important drivers of business process optimization today is the integration of advanced technologies, which allows companies to streamline operations, enhance decision-making, and improve overall efficiency. y incorporating AI tools into various business processes, organizations can automate repetitive tasks, reduce errors, and quickly adapt to changing market conditions.

One of the most effective AI tools for improving business processes is **ML**, which analyzes large datasets and derives patterns that can be used to optimize operations [6]. ML algorithms enable businesses to enhance accuracy in forecasting, streamline workflows, and automate complex decision-making processes. In supply chain management, for example, ML is employed to optimize inventory levels by predicting fluctuations in demand based on historical data. This results in more efficient resource allocation and cost reduction. For instance, **Walmart** uses its proprietary ML platform, **Element**, to enhance demand forecasting and manage its vast inventory more efficiently [7]. Element allows Walmart to process enormous volumes of data in real time, optimizing the distribution of products across its stores and minimizing waste. This platform not only helps with inventory management but also empowers teams across the organization to build and deploy ML models for various operational needs. Similarly, ML can optimize customer service by analyzing customer behavior and preferences, allowing businesses to tailor their services to meet specific needs, thereby increasing customer satisfaction and loyalty.

A transformative AI tool, **RPA** automates repetitive, time-consuming tasks across various business functions. By using software robots to handle processes such as data entry, invoice processing, and administrative workflows, RPA enhances the efficiency of routine operations, leading to significant cost savings and reduced human error. For example, **American Express** uses RPA to automate a wide range of back-office tasks, including compliance checks, fraud detection, and transaction auditing.

In fraud detection, RPA enables American Express to continuously monitor transactions for irregular patterns and suspicious activity. The automation of this process allows for real-time flagging of potentially fraudulent activities, providing faster response times and enhancing the security of transactions for its customers. The optimization of business processes through AI-based automated management systems has significantly improved the financial performance of American Express (fig. 3) [8].
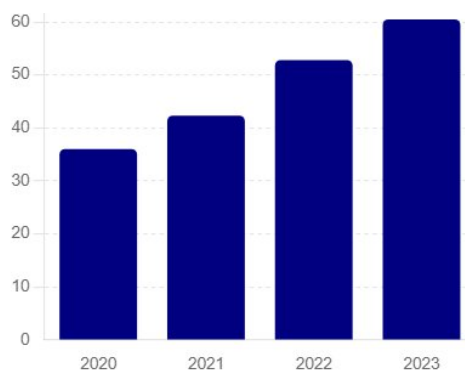

Figure 3. Total revenue of American Express net of interest expenses, billion dollars

By implementing RPA, the company has been able to reduce operational costs, minimize errors, and enhance the speed and accuracy of its internal processes. This automation has led to more efficient use of resources and has streamlined key functions such as compliance checks, fraud detection, and transaction auditing. As a result, American Express has not only improved its operational efficiency but also positively impacted its financial outcomes, showcasing the direct correlation between AI-driven process optimization and financial growth.

Natural language processing (NLP) is another AI tool that improves business processes by automating and optimizing communication flows within organizations. NLP enables the automation of tasks such as customer inquiries, document processing, and sentiment analysis, reducing the time and resources spent on these activities. In customer service, NLP-powered chatbots are widely used to handle customer inquiries, offering immediate support and freeing up human agents for more complex tasks. For example, **Bank of America** uses its virtual assistant, **Erica**, powered by NLP, to assist customers with a wide range of tasks, from checking account balances to providing financial advice. As of 2024, Erica provides over 30 proactive insights to customers each month. Among the most important are: monitoring and managing subscriptions – 2,6 million interactions per month, helping customers understand their spending patterns – 2,2 million interactions per month, and notifying customers of deposits and refunds – 2,1 million interactions per month [9]. Additionally, more than 98% of customers receive the information they need from Erica within an average of 44 seconds. This reduces the need for human intervention in routine interactions while ensuring a high level of service. By analyzing customer feedback through NLP, businesses can also optimize their product offerings and marketing strategies, improving their responsiveness to market needs and trends.

Predictive analytics, driven by AI, allows businesses to forecast future trends based on historical data. This tool is particularly valuable for optimizing supply chains, marketing strategies, and resource allocation. Predictive analytics leverages big data to provide actionable insights, enabling companies to anticipate market shifts, adjust production levels, and optimize logistical operations.

For example, **General Electric (GE)** utilizes AI-based predictive analytics in its supply chain and manufacturing processes. By analyzing vast amounts of data from equipment sensors and historical performance, GE can predict equipment maintenance needs and optimize production schedules. This approach helps GE prevent unexpected equipment failures, reduce downtime, and maintain optimal inventory levels by forecasting demand fluctuations. GE's predictive analytics platform, **Predix**, monitors the health of critical equipment across various industries, including aviation and energy, providing early warnings of potential failures and allowing for proactive maintenance. According to GE, predictive analytics can reduce maintenance costs by up to 30% and minimize unplanned downtime by as 45%, which translates into significant cost savings and improved asset reliability [10].

Characteristics of AI implementation in business processes

The integration of AI into business processes brings a unique set of opportunities and challenges. While AI offers significant advantages, such as increased efficiency, cost reduction, and enhanced decision-making, its implementation requires careful consideration of several factors (tabl. 2) [11, 12].

Table 2

Key factors in AI implementation in business processes

Factor	Description	Impact on business
Data availability and quality	AI systems require large volumes of accurate and high-quality data to function effectively.	Poor data quality can lead to inaccurate predictions, while high-quality data enables better decision-making.

Table 2 (continued)

Factor	Description	Impact on business
Infrastructure	Robust digital infrastructure, including cloud computing and data storage, is essential for AI deployment.	Insufficient infrastructure can limit AI capabilities and slow down implementation.
Workflow adaptation	Existing workflows need to be adjusted to integrate AI tools seamlessly.	Efficient adaptation ensures smooth transitions and maximizes the benefits of AI technology.
Employee training	Employees need training to work effectively with AI tools and systems.	Lack of training can result in underutilization of AI capabilities and resistance to adoption.
Data privacy and Security	Ensuring data privacy and cybersecurity is critical when implementing AI in sensitive processes.	Failure to address these concerns can lead to legal issues and damage to customer trust.
Governance and ethics	Organizations must comply with established ethical standards and regulations when deploying AI.	Compliance ensures responsible AI use and prevents misuse or unintended consequences.

Despite the complexities involved in implementing AI, the advantages it offers far outweigh the challenges. Factors such as data availability, infrastructure, workflow adaptation, and employee training may present initial obstacles. However, once these challenges are addressed, AI significantly enhances operational efficiency, reduces costs, and improves decision-making. Ensuring compliance with data privacy and ethical standards is crucial, but the long-term benefits of AI integration – such as increased productivity, better resource management, and the ability to anticipate market changes – make it a highly valuable investment for businesses.

Conclusion

The optimization of business processes using AI-based automated control systems demonstrates significant potential for enhancing operational efficiency and competitiveness. By integrating AI technologies into business workflows, companies can automate repetitive tasks, improve decision-making accuracy, and respond more swiftly to market changes. AI-driven systems offer real-time data analysis, predictive insights, and seamless process integration, reducing human error and freeing up resources for strategic tasks. Despite challenges such as data quality and privacy concerns, the benefits of AI – such as improved productivity, cost savings, and adaptive business strategies – make it a transformative tool for organizations across industries.

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