

300. OPTIMIZATION OF WAREHOUSE LOGISTICS USING ARTIFICIAL INTELLIGENCE

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This paper analyzes the application of artificial intelligence technology in warehouse logistics optimization. The study focuses on warehouse operations automation, inventory management, and demand forecasting. Key benefits of AI implementation were identified, including improved operational efficiency, reduced costs, and improved accuracy in logistics processes.

Warehouse logistics is a critical element of supply chain management, ensuring the rational storage, movement and release of goods. With global competition and the rapid development of e-commerce, companies are under pressure to manage growing order flows with maximum speed and accuracy. In this context, classical warehouse management methods are losing their effectiveness, which increases the importance of introducing artificial intelligence (AI) technologies [1].

A key area of application of AI in warehouse logistics is demand forecasting and inventory optimization. Machine learning algorithms process past sales data, seasonal trends, and external factors to predict future demand. This allows you to maintain an optimal inventory, reduce inventory costs, and avoid both surpluses and shortages. This speed up inventory turnover and increases the efficiency of the entire supply chain [2].

An important aspect is the introduction of robotics and automation. Autonomous mobile robots (AMRs) and automated guided vehicles (AGVs) are widely used in modern warehouses to transport goods between zones. These systems operate continuously, reducing reliance on manual labor and minimizing the risk of human error. In highly automated complexes, robots can interact with personnel and form hybrid systems that combine flexibility and efficiency [3]. AI also provides real-time monitoring and control of warehouse processes. AI integration with Internet of Things (IoT) devices collects data on inventory levels, device health, and environmental parameters such as temperature and humidity. This is especially important for industries involving perishable or sensitive products. Operational analytics helps managers quickly identify anomalies and make informed decisions, improving the reliability of operations.

Another promising area is the use of computer vision. AI-powered systems are able to recognize assets, verify that withdrawals are correct, and automatically capture errors. This reduces returns and improves the customer experience. In addition, these technologies allow for automatic inventory without manual scanning. The integration of AI technologies with business information systems (ERP, WMS, TMS) creates a single digital environment for logistics management. This ensures seamless communication between the different stages of the supply chain and improves coordination between departments. This gives companies greater transparency in logistics processes and allows them to respond faster to market changes.

However, despite the significant benefits, implementing AI in warehouse logistics comes with its own challenges. The most significant are the high initial investment, the difficulty of integrating new technologies into existing systems and the need for qualified personnel capable of working with modern digital tools. You also need to consider issues related to data protection and system fault tolerance.

Another limitation is the dependence on data quality. AI systems require large amounts of accurate and structured data to operate effectively. Incomplete or incorrect information can lead to incorrect predictions and ineffective decisions. Therefore, companies should pay special attention to data management and ensure that it is collected and processed correctly [4].

However, the introduction of artificial intelligence in warehouse logistics brings significant economic benefits in the long term. Companies that actively use AI technologies achieve greater efficiency, reduce operating costs, and gain a competitive advantage in the market. With the development of digital technologies, the role of AI in logistics will grow even more. Thus, artificial intelligence is becoming a key factor in the transformation of warehouse logistics. It enables companies to streamline operations, improve decision-making, and improve overall supply chain performance. Further development of logistics systems will be inextricably linked to the growing integration of AI and related digital technologies.

References:

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