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INTEGRATED LOGISTIC SUPPORT OF THE COMPANY'S ACTIVITIES ON THE MARKET OF QUARRY AND ROAD CONSTRUCTION EQUIPMENT

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This article is devoted to the actual aspects of integrated logistic support of the company's activities on the market of quarry and road construction equipment. The article examines key strategies, innovative technologies and modern approaches that help optimize logistics processes, reduce costs and increase the efficiency of the company.

In today's conditions of globalization and rapid development of technologies, the integration of business processes becomes critically important for the successful functioning of any enterprise. This especially applies to logistics, a field that directly affects the competitiveness of companies on the market. Rapid changes in consumer needs, the development of e-commerce, as well as the growing complexity of logistics chains create challenges for businesses. In these conditions, the integrated logistics system (ILS) becomes an important tool for ensuring effective management of material, information and financial flows, increasing the flexibility and adaptability of the enterprise.

An integrated logistics system unites all stages of the supply process – from the procurement of raw materials to the delivery of finished products to consumers. The main idea is to ensure a continuous exchange of information between all participants in the process, which allows avoiding delays, reducing the number of errors and reducing costs. In practice, this means optimizing transportation routes, reducing order processing time, efficient warehouse inventory management, and maximum order fulfillment accuracy.

Global competition and changing market conditions require companies to be flexible, and this is one of the key advantages of an integrated logistics system. It allows you to quickly respond to changes in demand, optimize processes in real time and adapt supply strategies to new market requirements. For enterprises, this is especially relevant in conditions of rapid technological development and economic instability.

One of the key aspects of ILS is the automation of processes, which becomes possible thanks to the introduction of modern technologies.

Information systems allow you to monitor product flows in real time, ensure data accuracy and speed up the exchange of information between departments and companies.

Research shows that modern technologies open up new prospects for the market of spare parts and service for quarry and road construction equipment, which can significantly change its development. Innovative technological solutions provide significant opportunities for improving and modernizing the processes of equipment and inventory management, which is of key importance for the development of an effective strategy for the company's integrated logistics support.

Automation of logistics processes is a key trend in supply chain management. In conditions of rapid technological development, automation is becoming more and more common. The use of innovative technologies can significantly reduce logistics costs, increase efficiency and safety, and minimize human involvement in the process of planning, purchasing and distribution of cargo.

Let's look at them in more detail in Table 1. All these innovations are aimed at improving supply chain management, reducing costs, increasing transparency and speed of logistics operations. They provide a new level of integration and automation in the management of logistics processes, which allows significantly increasing efficiency and reducing costs. The introduction of modern technologies contributes to the optimization of all stages of the logistics chain – from inventory management to order processing and product delivery. Automation tools and state-of-the-art management systems help minimize manual intervention, speed up data processing, and increase forecast accuracy, which is essential for meeting customer needs in a timely manner.

The Internet of Things (IoT) and Big Data are currently actively used, but technologies such as artificial intelligence, machine learning, cyber-physical systems, digital twins and blockchain are not yet so actively introduced. Often these technologies are used in combination to maximize their impact and effectiveness.

Considering all of the above, it is advisable to develop the conceptual foundations of the integrated material and technical support of the company, combining them on the basis of modern technologies. This makes it possible to ensure maximum efficiency in the management of the supply chain of quarry and road construction machinery and its spare parts.

To increase efficiency and competitiveness, companies operating in the quarry and road construction machinery market are offered the implementation of an integrated logistics system using modern technologies such as the Internet of Things (IoT), Big Data, artificial intelligence (AI) and machine learning (ML).

Table 1 – Modern innovative technologies [based on 1, 2, 3, 4]

Technologies	Essence	Application in Logistics	Advantages	Disadvantages
Internet of Things (IoT)	Network of physical objects equipped with sensors and other technologies	Real-time tracking of cargo, monitoring storage and transportation conditions	Increased data accuracy, reduced costs, improved customer service	High implementation cost, integration complexity with existing systems
Cloud Technologies	Data processing and storage via the internet	Data storage and processing, integration of various logistics systems	Reduced IT infrastructure costs, scalability, accessibility	Data security concerns, reliance on internet connectivity
Blockchain	Decentralized transaction ledger	Tracking goods, ensuring supply chain transparency	Transparency, data security, reduced fraud risks	Implementation complexity, high cost
Augmented Reality (AR)	Virtual elements that enhance the real world	Improving warehouse operations, navigation, staff training	Increased efficiency, reduced errors	High equipment cost, need for specialized software
Virtual Reality (VR)	Creation of a fully virtual environment	Staff training, modeling logistics processes	Safe training, ability to test various scenarios	High equipment cost, limited use
Artificial Intelligence (AI)	Machines capable of performing tasks that require intelligence	Demand forecasting, route optimization, inventory management	Increased accuracy, cost reduction, quick decision-making	High implementation cost, need for high-quality data
Big Data	Analysis of large volumes of data	Demand analysis, forecasting, optimization of logistics processes	Deep analytical insights, ability to respond quickly to changes	Need for powerful computing resources, complexity of large data analysis
Robotics	Use of robots for process automation	Automation of warehouse, sorting, and packaging operations	Increased productivity, reduced labor costs, reduced risk of injury	High implementation cost, need for maintenance and specialists

The synergy of these technologies will make it possible to optimize the management of stocks, equipment and logistics, which will lead to a reduction in costs and an increase in the efficiency of the company's operational activities.

In Table 2 we can see possible consolidated results of combination of different technologies in order to create integrated logistics system.

Table 2 – Use of the innovative technologies at various stages of the supply chain

Stages	Technologies	Description	Expected Results
Demand Monitoring	IoT, Big Data	Use IoT to collect real-time data on demand for specific models of equipment and spare parts. Data is transmitted to the Big Data system for analysis.	Accurate understanding of demand for different models of equipment and spare parts, improved order planning accuracy.
Demand Analysis and Forecasting	Big Data, AI, ML	Analyze sales and demand data using AI and ML to identify trends, forecast future needs, and determine the most popular models.	Improved forecast accuracy, optimized product assortment, reduced inventory holding costs, and minimized overstocking.
Inventory Optimization	Big Data, AI, ML	Use data and AI algorithms to manage inventory based on demand, avoiding shortages or excess of equipment and spare parts in stock.	Reduced risk of shortages or excess, improved inventory turnover, reduced inventory holding costs, and enhanced customer service.
Logistics Process Optimization	Big Data, AI, ML	Analyze logistics data and use AI to plan optimal delivery routes from suppliers, considering costs and delivery times.	Reduced logistics costs, improved delivery times, increased efficiency of logistics operations, and lower transportation costs.
Automated Order Management	Big Data, AI, ML	The system automatically generates orders for supplying equipment and spare parts based on demand analysis and current inventory levels.	Continuous supply assurance, avoidance of delivery delays for equipment and spare parts, reduced risk of stock outs.
Logistics Effectiveness Assessment	Big Data, AI	Use AI to analyze the effectiveness of current logistics processes and identify areas for improvement (e.g., reducing equipment downtime).	Enhanced logistics efficiency, reduced downtime, improved planning and execution of logistics operations.

As we can see technological innovation can create a solid foundation for reducing human errors and the need for manual intervention, ensuring accuracy and speed of operations.

Integrated technologies can enhance supply chain transparency by providing real-time data, improving visibility, and enabling better decision-making and coordination. This increased transparency can help companies manage their supply chains more efficiently, respond to issues more quickly, and ultimately deliver better products and services to their customers.

Conclusion

In conclusion, these technologies provide a new level of integration and automation in the management of logistics processes, which is critically important for the successful functioning of modern companies. In particular, IoT enables the automation of data collection and analysis, which provides precision in planning and inventory management. This not only increases the efficiency of supply and shipment processes, but also ensures transparency at all stages of the supply chain.

Research results confirm that the combination of these modern technologies can significantly improve business operations, reduce costs and increase customer satisfaction. An integrated logistics system that includes IoT, Big Data, AI and ML is a necessary condition for the successful development of companies in a competitive environment. The introduction of such technologies will contribute to increasing the competitiveness of enterprises, ensure their reliability and stability in the market, and also help to cope with the challenges of the modern business environment.

References

1. Ivankova G. V., Mochalina E. P., & Goncharova N. L. Internet of Things (IoT) in logistics. In IOP Conference Series: Materials Science and Engineering. 2020, Vol. 940, No. 1, pp. 12-33).

2. Karpun O.V., Shevchenko Y.A. The impact of industry 4.0 technologies on logistics. Професійні підходи до вирішення економічних проблем в умовах діджиталізації: III Всеукраїнська науково-практична конференція, 26 жовтня 2023 р.: тези доп. Кропивницький (Слов'янськ), 2023. С. 42-25.

3. Lopes Y.M., Moori, R.G. The role of IoT in the relationship between strategic logistics management and operational performance. RAM. Revista de Administração Mackenzie, 2021, 22(3). URL: https://www.researchgate.net/publication/352272228_the_role_of_iot_in_the_relationship_between_strategic_logistics_management_and_operational_performance.

McKinnon A. Integrated logistics strategies. In Handbook of logistics and supply-chain management, 2017. Vol. 2, pp. 157-170.