UDC 338.2:658.8

USE OF SMART TECHNOLOGIES IN LOGISTICS

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Abstract. *The article is devoted to the current application of smart technologies in logistics and considers their future prospects. Exploring real-world examples, it showed how IoT devices, big data analytics, artificial intelligence algorithms and blockchain are already improving efficiency, visibility and customer experience in logistics operations.*

In today's rapidly evolving world, smart technologies have become a driving force behind the transformation of various industries, and logistics is no exception. The integration of technologies such as the Internet of Things (IoT), Big Data analytics, Artificial Intelligence (AI), blockchain, etc. has revolutionized the way logistics operations are conducted [1].

Supply Chain Management uses IoT (Internet of Things) devices, such as sensors and RFID tags, to track and monitor goods throughout the supply chain. This enables real-time visibility of inventory, improves asset management, and helps prevent theft or loss. Also, companies use autonomous vehicles - self-driving trucks and drones equipped with AI and IoT sensors are being tested for last-mile deliveries and transportation of goods. These autonomous vehicles can optimize routes, reduce human errors, and improve delivery efficiency.

Furthermore, artificial intelligence is widely used in logistics. For example, in AI-powered route optimization - AI algorithms analyze various factors like traffic conditions, weather, and delivery constraints to optimize delivery routes. This reduces fuel consumption, minimizes delivery time, and enhances customer satisfaction. In addition, AI algorithms can analyze data from IoT sensors embedded in vehicles or machinery to predict maintenance needs. This proactive approach helps prevent breakdowns, reduces downtime, and improves overall equipment reliability. AI-powered robots and automated systems are used in warehouses to streamline operations. These robots can efficiently pick and pack items, optimize storage space, and improve order accuracy. AI-powered chatbots are used to provide instant and personalized customer support. These chatbots can handle common queries, track shipments, and provide real-time updates, enhancing customer experience.

Blockchain is also popular among businesses - blockchain technology ensures transparency and traceability in the supply chain by securely recording and verifying transactions. This helps prevent fraud, and counterfeiting and improves trust among stakeholders. Blockchain technology enables the use of smart contracts in logistics. These self-executing contracts automatically trigger actions or payments when predefined conditions are met. This streamlines processes such as freight forwarding, customs clearance, and payment settlements [2,3].

Also, blockchain hugely supports Supply Chain Traceability - it provides an immutable and transparent ledger that can be used to track and verify the origin, movement, and authenticity of goods throughout the supply chain. This helps ensure ethical sourcing, prevent counterfeit products, and enhance consumer trust.

Other smart technologies are currently being implemented in logistics - Augmented Reality (AR) for warehouse operations. It is used to enhance warehouse operations by overlaying digital information onto the physical environment. This assists workers in locating items, picking orders, and optimizing storage space, leading to increased productivity and accuracy.

Robotics Process Automation (RPA): RPA technology automates repetitive and rule-based tasks in logistics, such as data entry, invoice processing, and order tracking. This reduces manual errors, improves operational efficiency, and frees up human resources for more strategic tasks.

Digital twin technology creates virtual replicas of physical assets; such as warehouses or transportation vehicles. These digital twins can be used for simulation, optimization, and predictive maintenance, enabling better asset management and cost savings [4].

Metaverse is becoming more popular within logistics – companies tend to store and manage inventory in a digital environment. Moreover, the metaverse could enable the visualization of the entire supply chain in a virtual environment. This would allow logistics professionals to track and monitor the movement of goods, identify bottlenecks, and optimize logistics operations in real time. The metaverse could be used for training logistics professionals in a virtual environment. This would provide a safe and cost-effective way to simulate various scenarios, such as warehouse operations, transportation planning, and supply chain optimization, allowing employees to gain practical experience without real-world risks.

Big Data Analytics is helpful for Chain Risk Management - by analyzing historical and real-time data, predictive analytics can identify potential disruptions in the supply chain. This helps logistics companies proactively mitigate risks, such as natural disasters, supplier delays, or

geopolitical events. Moreover, logistics companies can accurately forecast demand patterns. This helps optimize inventory levels, reduce stockouts, and improve overall supply chain efficiency [5]. As we have observed from these examples, smart technologies are in demand among companies. Well-known corporations that utilize smart technologies in logistics.

IBM offers various smart logistics solutions, including AI-powered supply chain optimization, blockchain-based traceability, and big data analytics for demand forecasting. Amazon, UPS, DHL, FedEx, and Maersk extensively use IoT devices, AI algorithms, and big data analytics to optimize their supply chain operations, track and monitor shipments, optimize delivery routes, improve warehouse efficiency, and enhance last-mile delivery. They also utilize AI-powered chatbots for customer service.

Conclusions

The usage of smart technologies in logistics has already made a significant impact, and its future holds even more promising perspectives. Some key areas where smart technologies are expected to shape the future of logistics are enhanced Supply Chain Visibility, autonomous vehicles and drones, robotics and automation, Artificial Intelligence and Machine Learning, blockchain for Supply Chain Management, Augmented Reality (AR), and Virtual Reality (VR), sustainability and green logistics.

Overall, the future of logistics with smart technologies looks promising. The continuous advancements in IoT, AI, Big Data, and other smart technologies will lead to increased efficiency, cost savings, improved customer experiences, and more sustainable logistics practices. Embracing these technologies will be crucial for logistics companies to stay competitive in the evolving industry landscape.

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