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AI IN LOGISTICS. INTERACTION MECHANISMS AND APPLICATION

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The application of artificial intelligence (AI) in logistics is one of the most dynamic directions of the modern digital economy, and it is no coincidence that in recent years AI-based solutions have rapidly proliferated across subdomains such as supply chain management, transport organization, warehousing systems, and customer services. By its nature, logistics is a complex network in which numerous actors, diverse geographies, fluctuating demand, and constrained resources are managed. In such systems, the participation of intelligent algorithms alongside human reasoning accelerates decision making, reduces errors, and anticipates risks. Unlike traditional planning, the AI-enabled logistics model is agile, data-driven, forecast-oriented, and capable of real-time updates.

AI influences logistic flows along two main lines. The first is optimization. This includes automatic route selection, proper allocation of loads to vehicles, minimization of empty backhauls, coordination of multimodal transport, and consideration of external factors such as congestion, weather, border crossings, and customs procedures. For example, a reinforcement learning algorithm recalculates the route each time and selects the option that meets a chosen criterion such as minimal fuel consumption or shortest travel time. In doing so, the system does not only rely on a static map. It also incorporates the outcomes of prior shipments, driver behaviors, seasonal variations, and even customer delivery windows. The second line is forecasting. Demand forecasts are produced in line with sales dynamics, pre-season inventory levels in warehouses are determined, and emerging short-term demand hotspots for specific products in specific regions are identified in advance. As a result, logistics transforms from a purely reactive system into a proactively managed one. It is necessary to highlight the interaction mechanism of AI in logistics. At the core of this mechanism lies the consolidation of data within a unified environment. IoT sensors record cargo temperature, vibration levels, and whether a container has been opened. GPS and telemetry systems transmit precise vehicle coordinates. ERP and WMS platforms display the status of orders. The AI platform integrates, cleans, and standardizes all these streams and then forwards them to analytical modules. In the analytical phase, machine learning models detect anomalies, signal the planning module, and assess risk levels.

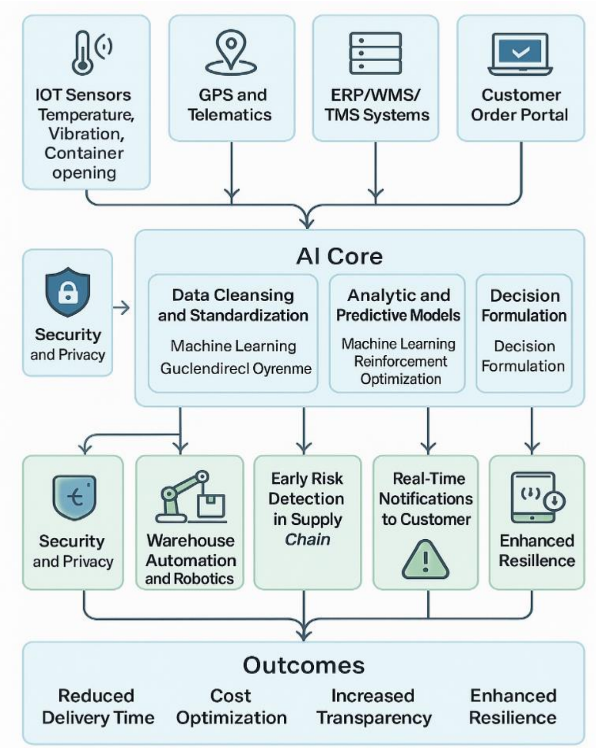

Fig. 1. Integration model of Artificial Intelligence in logistics

In the execution phase, the system is already able to perform certain routine tasks without human instruction. For example, if warehouse capacity exceeds a critical threshold, it automatically generates an additional transport order. If a delay risk emerges, it sends an advance notification to the customer.

The application areas are wide. In warehouse logistics, AI optimizes the routes of robotic picking lines, aligns product placement with ABC classification, and shortens loading and unloading times. In transport logistics, AI-based intelligent dispatching systems distribute orders among carriers in a fair and efficient manner. In strategic supply chain planning, AI builds scenario models and shows the enterprise which alternative routes and contingency schemes should be activated if a given port is closed, if a specific road becomes unusable for military or natural reasons, if prices spike sharply, or if one of the suppliers fails. This is particularly important in unstable regions.

AI brings more than efficiency to logistics. It also creates transparency because a digital trace of all actions is preserved. The customer can see exactly where the order is. The manager can observe in real time which vehicle is delayed more frequently, which route is more costly, and in which warehouse spoilage is more prevalent. This transparency increases mutual trust among participants across the entire chain. At the same time, AI enables the accumulation of large historical datasets on transport operations, which subsequently allows deep learning models to deliver more accurate results.

There are also constraints. Data confidentiality can pose problems, especially in cross-border transport, because AI systems collect information from multiple sources and these data can constitute trade secrets. In addition, since AI models sometimes operate as black boxes, managers may struggle to explain how a given decision was reached. This can be unacceptable for regulators. Therefore, the deployment of explainable AI approaches, auditable algorithms, and cyber-resilient cloud infrastructure is essential in parallel with AI adoption in logistics. Workforce development should be treated as a distinct line of effort, since even the best AI platform will not operate at full potential in the hands of an operator unfamiliar with logistics processes.

The overall conclusion is as follows. AI in logistics should not be viewed merely as a technology applied to isolated modules. It should be implemented as an intelligent management layer spanning the entire supply chain. When this is achieved, in-house systems, partner companies, and international logistics networks communicate in a unified digital language.

This leads to a logistics model that is agile, resilient, transparent, and economically advantageous

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