

**THE DIGITAL DEVELOPMENT OF LOGISTICS AND SUPPLY CHAIN  
MANAGEMENT**

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The digital logistics provides for the search, storage and transmission of the information, as well as information technologies that ensure the identification and forecasting of market needs, optimization of vehicle routes, determination of the directions of material, financial and information flows, with a subsequent reduction in the time of their existence in supply chains.

The main trends in the development of logistics and supply chain management are:

- the globalization of the activities of client enterprises;
- the enlargement of logistics enterprises through mergers and acquisitions;
- the growing role of information digital technologies in logistics and supply chain management;
- the moving away from specialized services and focusing on providing complete and complex logical solutions in supply chains;
- the intensive development of inter- and multimodal transportation;
- the increasing the market share of 3PL-providers.

The leading positions in the digitalization of logistics and digital transformation of supply chain management in the world are played by 3PL-providers [1, p. 9].

The digital transformation of the activities of business entities and the automation of their logistics are becoming the norm and necessity not only for the development of business, but also for ensuring the long-term sustainability of corporate business processes. Digital transformation of business entities from the point of view of digitalization of production processes is becoming the norm not only for expanding the activities of an enterprise, but also for ensuring the long-term sustainability of its development, regardless of the degree of size or industry affiliation [2].

For logistics and supply chain management, the digitalization is indeed both an urgent problem and a strategic direction for their development. The dynamically developing environment of the logistics industry constantly generates requirements for quality, flexibility and expansion of the services offered. In order to minimize operating costs, business entities are forced to revise their business models for further development in order to ensure the smoothness and reliability of supply chain management.

The digitalization and the new information technologies are rapidly developing and are becoming indispensable tools for transforming logistics and supply chain management and ensuring their strategic sustainable development. The new

information technologies play an important role in optimizing production capacities, increasing labor productivity and improving the quality of products (work performed, services provided), while ensuring the efficiency of logistics and supply chain management. More and more business entities are turning to innovative solutions that can harness the potential for digitalizing logistics and supply chain management.

The digital transformation of business processes and the introduction of new information technologies are related to the solutions «Industry 4.0», «Internet of Things» and «Smart Industry». The modularity of intelligent logistics solutions based on the principles of cyber-physical systems contributes to the gradual transformation of supply chain management [2].

Transport and logistics organizations that innovate in their logistics business processes can directly respond to the most pressing needs of the logistics services market in a specific supply chain management environment. Business entities are introducing digital information technologies, with the help of which they cope with expected market changes and inevitable problems in response to the challenges of globalization, which generates fierce competition due to increased customer requests for personalization of the logistics services provided.

Consequently, a strategy for digital transformation of logistics business processes can imitate the general process of digitalization of the activities of manufacturing enterprises. Enterprises can start by implementing data collection solutions and then move to horizontal integration of corporate business processes, followed by vertical integration of business processes. The end result is a digital transformation through automated logistics optimization and supply chain management.

The world practice confirms that the digitalization of logistics and supply chain management occurs in three main areas: inventory and warehouse management, internal logistics (intra-production logistics) and delivery and distribution logistics (outbound logistics).

The most common reasons for the digitalization and automation of warehouse management are usually overcrowded warehouses, large volumes of various types of goods and difficult access to relevant information (inventory, handling claims and complaints, returns, expiration dates, etc.).

Thanks to digitalization, the optimization of the management of warehouse business processes takes place in three stages [2].

At the first stage, it is necessary to ensure the correct identification of goods and their movement within and outside the warehouse. All data is generated in real time and can be viewed at any time using the traceability function. In addition to collecting and analyzing data, at this initial stage of optimizing the management of warehouse business processes, the rules for warehousing and picking of goods in the warehouse are also determined with the help of digitalization. This is useful for efficient and optimal filling of warehouse positions by prioritizing warehouse operations in accordance with the implemented digital management or Smart Industry system. This leads to the transformation of an uncontrolled warehouse into a managed warehouse, including compact and mobile buffers located in the workplace.

With this solution, logistics operators interact with the implemented “Smart Industry system”.

In today's conditions of the digitalization of logistics and supply chain management, «Industry 4.0» is never at its peak. Every industry in the global marketplace is turning into a smart industry. By introducing intelligent solutions into their business processes, business entities use the advantages of the Internet of Things and bring their business processes to a new qualitative level that meets the realities of globalization [3].

The next stage in the implementation of an intelligent warehouse solution in the field of Smart Industry is based on the interconnection of all objects in the warehouse through the Industrial Internet of Things and a digital twin. This stage includes dynamic management of warehouse business processes based on a set of predefined rules or stand-alone algorithms. Goods in a warehouse do not move through warehouse business processes in accordance with fixed rules (standards). Instead, algorithms estimate current needs based on a variety of criteria, such as the instantaneous availability of storage bins, the rate of turnover of goods, the seasonality of demand, and many others.

All relevant data is assessed based on the current state and previous evolution of the respective metrics, resulting in dynamic management of warehousing and picking business processes. Thanks to digitalization, the solution for the dynamic management of warehouse business processes provides operating personnel with wide, accurate and comprehensive visualization capabilities when solving the tasks set by the Smart Industry system.

The eliminating human intervention is the third stage of the warehouse digitalization, provided by closed unmanned warehouse systems. The creation of an autonomous warehouse requires custom-made appropriate machinery and equipment, along with automated racks and robots, a fleet of automated handling equipment and drones. All warehouse equipment here is self-organizing, and the activities of warehouses are coordinated on the principles of a multi-agent system, which is an infrastructure through which warehouse machines and equipment can interact in such a distributed environment.

Untimely and insufficient maintenance of production lines or other equipment forces enterprises to optimize the business processes of the internal logistics (production logistics). Another application of innovative intralogistics is the usually inefficient operation of vehicles [2].

The first step towards digitalization and optimization of internal logistics flows is applied in the Milk Run system, which is the standardization of business processes of the internal (intra-production) logistics in accordance with the supply plan. At the same time, operators work in accordance with a set schedule, while an information system or Smart Industry system plays the main role of a tool for visualizing work operations, collecting and analyzing data.

The «Milk Run system» helps to solve the problems of fast delivery of products and increase the efficiency of the enterprise as a whole. The Milk Run system gets its name from the practice of the dairy industry, where one tanker goes to

different milk producers every day to collect milk and then deliver it to the milk processing plant. This ensures a regular supply of fresh milk and prevents overstocking. In fact, the Milk Run system in the intralogistics is a way of delivering goods from a central warehouse to different technological locations of an enterprise [4].

The next step of the smart intralogistics is to collect data from individual production lines and workstations to create real-time requests to move material resources for production purposes. Here, Smart Industry processes and analyzes the raw data, as a result of which it creates and assigns tasks for production personnel taking into account their actual and expected workload and workflow, thereby eliminating downtime and activities that do not have added value.

Then the system monitors the solution of the assigned tasks. An alternative solution relies on the automation of transport business processes using automated vehicles operating on closed routes. The Smart Industry system coordinates the solution of all tasks performed by vehicles, taking into account the requirements and circumstances in real time.

The final step of the smart intralogistics management is complete automation. The fleet of vehicles solves the problem of processing queries in real time based on the results of big data analysis and predictive models, generated by the Smart Industry system. Here, the Smart Industry system provides the infrastructure for a distributed system that enables communication between machines and their mutual data exchange in real time.

In such an architecture based on the principle of a multi-agent system, where the algorithms of machines and equipment independently make decisions in accordance with the current situation, requirements and their own set of data, tasks are solved through decentralized management.

Low efficiency of picking and forwarding business processes, weak (or insufficient) control over the completeness of orders and lack of flexibility in the delivery process based on the order are some of the sources of incentives for the digitalization of logistics and supply chain management [2].

Initially, the pull principle is retained for the order-based delivery business process, while the Smart Industry system monitors and controls the picking business processes by creating pick lists. The system also coordinates parallel picking in the case of multiple storage rooms, and then checks the order and delivery fulfillment.

The next stage of the digitalization is the dynamic management of the distribution of orders and deliveries. The Smart Industry system sets tasks for operating personnel to achieve adequate workload for each operator and generates picking lists. The Smart Industry system evaluates and prepares picking lists according to the current stock status and prioritizes deliveries based on current availability. Typically at this stage, businesses integrate automated and autonomous data collection technologies such as robotic collectors.

Predictive management of the distribution of orders and deliveries is one of the most effective ways to implement Smart Industry solutions in outbound logistics. Based on the analysis of big data, the Smart Industry system creates forecasting

models for customer orders, and then adjusts the inventory in accordance with the available material resources, equipment and human resources. This form of Smart Industry system solution uses artificial intelligence to dynamically and efficiently manage automated delivery business processes.

The modularity and customization of Smart Industry solutions allow their gradual scaling. This means that business entities can organize the digital transformation of their business processes in accordance with their budget, production and business strategy.

Thus, Smart Industry solutions will help to increase production potential and production capacity, ensure sustainable growth of business entities, thereby reducing the payback period for investments in the digitalization of logistics and supply chain management, which is an incentive for further transformation of their business processes, ensuring their competitiveness in conditions of globalization and guarantee their sustainable development.

## References

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