# The Challenges of the Logistics Industry in the Era of Digital Transformation

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**Abstract.** Digital transformation has a significant impact on the development of such an important sector of the economy as logistics. All major economic trends are traced in logistics, and basic digital technologies are already being used. At the same time, there are certain obstacles to the effective development of digital logistics. For example, there is a lack of informational integration of supply chains. This article systematizes information about the state of digital transformation in logistics, about the main trends, applied technologies, analyzes it, simulates the digital logistics ecosystem, identifies stakeholders, drivers of digital logistics transformation, requirements for the development of the industry. Based on this, the main lines of action to improve the efficiency of logistics activities in the context of digital transformation are formulated. The implementation of the proposed actions requires the integrated use of technology and a specialized mathematical apparatus. The integrated actions of participants in the digital logistics ecosystem will ensure the required role of logistics in integrated economic development.

**Keywords:** Digital transformation · Logistics · Logistics challenges · Digital technologies · Digital supply chains

## 1 Introduction

Doing business now in almost all sectors of the economy requires taking into account the trends of digital transformation. Digital transformation, using digital technology, has an impact on the ways and principles of creating value for various stakeholders in an environment of rapidly changing circumstances. Logistics is also closely related to the processes of digital transformation. Industry development directly affects economic development in general. At present, the industry is more inclined towards the development of tools for optimizing existing processes, rather than towards structural transformation. Time requires that logistics become part of a company's value proposition [1].

The appeared mechanisms for processing large volumes of (including personalized) data and the created technological base became prerequisites for the digital transformation of supply chains. Supply chains traditionally rest on creating value for the end


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consumer and are limited by demand [2]. Moreover, traditional marketing approaches are based on statistical forecasts of demand. But the real, individual consumer in practice is always different from the hypothetical average. Now that marketing has the opportunity to determine the demand of specific consumers based on their preferences, digital marketing has moved to the micro-segmentation paradigm. Important trends in the development of supply chain management are: (i) the transition to unique products manufactured specifically for a particular client (Batch Size One [3]); (ii) integrating the sales channels to converge into a single channel of orchestrated product flow (omnichannelism); (iii) replacement of one product with integrated services based on this product (servitization). Digital logistics should be able to support this new digital marketing ideology, i.e. deliver the right product in the right quantity at the right time. Moreover, since the goods are largely similar, competition is shifting precisely towards the effectiveness of logistics. The cost of missed orders is high enough - the client will go to those who deliver faster and return only when his current supplier does not fulfill the conditions.

Obstacles to the effective development of digital logistics in collaboration with digital marketing are currently associated with the fact that supply chains are still often not integrated. That is, each element of the chain is trying to reach its local optimum (as soon as possible to sell its goods to the next link), not caring about the whole chain, about the cost of moving goods between links. Ideally, it should be that [4] until the final consumer receives the goods, no one in the chain will receive the money. To do this, it is necessary to build integrated supply chains from the first producer in the chain to the final consumer, but at the same time so that the links are relatively independent (so that the collapse of one link does not lead to the collapse of others). Integration is supposed to be primarily informational, based on an integrated single information space (including information on stocks, geolocation of vehicles, etc.). Information integration of supply chains will allow all links to create overall efficiency and at the same time earn money. Classical supply chains will turn into digital “supply chains” of the matrix type, in which each link at any given time affects the entire network as a whole and changes it [5].

## 2 Materials and Methods

The logistics industry is influenced by all the main trends shaping the business. This, for example, is a combination of globalization and glocalization. Leading global companies are increasing the share of revenue received outside the home region. In addition, it allows to get closer to the needs of the end user. It is also important to consider the growth trend of e-commerce. Another influencing trend is urbanization and population aging. The process of growing urbanization leads to the formation of a smart city concept. Smart City, in turn, requires Smart Logistics, which will meet the requirements of efficiency, safety, reduced negative impact on the environment, etc. An aging population reduces labor productivity, which requires the expanded use of modern digital technologies that can level this process. A number of trends are associated with the increasing use of certain digital technologies. For the logistics sector, these are mainly cloud services, artificial intelligence (AI), the Internet of things

(IoT) and the Internet of everything (IoE), Big data, robotics, and 3D printing. The use of these technologies can significantly change the functioning of the entire supply chain. The technologies mentioned are characteristic of the "Industry 4.0" paradigm and allow switching to distributed production, direct access from the producer to the consumer, sharing economy, etc.

Cloud services, such as the cloud computing (CC) concept, can be used as an integrated platform for cloud logistics [6] to realize universal interconnectedness, exchange logistics information and optimize logistics tasks [7].

The transition to cloud services allows reducing operating costs for computing power, providing a single platform for the sender, carrier and customer, unifying document flow and business processes, reducing risks associated with IT infrastructure support issues and the security and reliability of information storage. Cloud service providers also offer automated systems to improve transportation efficiency, which can reduce costs, increase storage capacity and reduce cargo handling time.

AI is indispensable in the processing of large volumes of data and for the development of optimal solutions based on this analysis. AI also allows for the personalization of offers by structuring and analyzing data, customer support, digitalization of workflow, forecasting the volume and characteristics of the supply market. AI is also involved in developing self-learning ability in autonomous (unmanned) vehicles. The magnitude of data flows in these self-learning systems can be mitigated by using decentral control in the form of a Multi-Agent System (MAS). In a joint report, DHL and IBM conclude [8] that AI will be able to transform the scope of logistics services into a predictable, automated, personalized and proactive industry.

The IoT is a provider of data for the work of AI and collects heterogeneous data sets in huge volumes from various devices and objects involved in the supply chain. RFID tags are used on vehicles, containers, unmanned vehicles, and storage vehicles to simplify transportation, control traffic and to determine the location and prevent losses. Also, smart sensors and IoT are used for remote control, telepresence, geolocation services, remote object management, security monitoring and the operation of automated control and accounting systems, and document management. At the same time, labels, sensors, measuring instruments and control devices are integrated into the ecosystem [9].

The key technologies for IoT are sensors, smart chips, wireless transmission network, machine-to-machine communication (M2M), and most importantly, broadband communication channels, computing power and data storage capacity. The main areas of application of IoT in logistics are cargo traceability, warehouse and fleet management, in addition, predictive asset servicing, and route optimization [10]. Other opportunities are manifold: (i) smart containers can maintain their load's prescribed temperature, (ii) heterogeneous smart loads can be combined in one container, thus maximizing capacity usage and (iii) as for road transport, trucks (the 'things' in this case) can be equipped with software that enables truck platooning, thus saving fuel [11].

The IoE is seen as a technology that can provide interoperable, reliable operation of applications such as Smarter Cities, Human Dynamics, Cyber-Physical Systems, Smart Grid, Intelligent Transport Systems, i.e. it is about dynamic ecosystems. For example, cloud-assisted remote sensing (CARS) enables the collection and exchange of data

from sensors, remote and real-time access to data, flexible provision of resources and scaling, and pricing models using the IoE [12].

Big Data technology allows to collect and analyze a significant amount of information on processing applications, schedule management, cost accounting, and planning future expenses. Data is collected on orders, transactions, traffic, incidents, resources, external providers, geolocation, etc. [13]. The received information makes it possible to optimize routing, planning and forecasting, risk management, improve marketing, and use crowdsourcing more actively and, as a result, allows to switch to data monetization [14].

Big data processing technology in collaboration with IoT help to assess and predict the transport risk associated with the deviation of the actual time of arrival of the cargo from the planned one in a situation where both premature arrival and late arrival are equally undesirable. Such an analysis is possible taking into account all demand variables (route, time, weight and volume of cargo, characteristics of the order, participants in the supply chain, etc.) [15].

Big Data Business Intelligence (BDBA) and SCA Big Data Analysis are used for demand planning, procurement in the aspects of supply risk management and supplier performance management (for example, quality, guarantees, on-time delivery, etc.), and in the routing of goods, vehicles, work force [16].

Robotization is used in warehouses to complete shipments. In addition, the use of automated unmanned vehicles is being developed. Many manufacturers are actively testing this technology. The development of technology will ensure productivity growth, improving the quality of operations while reducing costs, including non-personnel [17].

3D printing can now be considered as a technology - the basis for mass customization in modern production [18]. Its application reduces the need for storage facilities, reduces delivery costs, changes the composition of suppliers, and the nature of the transported cargo. The order can come directly from the consumer to the next production. At the same time, a new large sector of the logistics industry will appear, associated with the storage and movement of raw materials for refueling 3D printers [19, 20].

The use of 3D printing can significantly change the principle of functioning of supply chains, as it allows to bring production closer to the end user and significantly reduce the cost of transporting raw materials and finished products. Also, 3D printing allows to increase the customization of goods, allowing to produce an object based on individual consumer needs.

One of the industry trends is logistics outsourcing involving logistics intermediaries (providers). Currently there are 5 levels of logistics service (PL-Party Logistics). At the 5PL level, the latest developments in the field of combining intelligent software of different levels and localization are used, in conjunction with the development of strategic partnerships among all participants in the logistics chains. 5PL-provider provides a full range of services through the use of global information technology space. Its use allows to implement the “division of labor” in order to optimize costs, improve efficiency by reducing operating costs and material resources. Outsourcer automates and optimizes the work of finding logistics solutions. At the same time, the application of various IT technologies is expanding. For example, automation of route

selection, online tracking, RFID tags, client blocks, etc. are used. In the case of outsourcing of the logistics engineering function, it is possible to move to Supergrid Logistics, which accumulates analytics and data management, logistics expertise, interaction with the customer, taking into account his changing needs.

An effective solution is also the creation of transport and logistics clusters, combining freight forwarding and terminal-warehouse complexes, several types of transport. Many wholesale distribution companies (Procter & Gamble, Mars, etc.) are migrating from procurement and sales activities to the category of transport and logistics clusters. In such a cluster, effective interaction, planning, optimal servicing of goods flows, exchange of information between participants based on a single standard is possible. As a result, logistics super networks are formed using multichannel logistics. It is possible to create an ecosystem of digital transport corridors, which, among other things, requires special regulatory regulation. In such an ecosystem, it is necessary to control the quality of functioning of all related subsystems [21, 22].

Another interesting trend is logistics uberization, logistics based on the principles of sharing economy. Moreover, in the field of trucking, this has long been a reality, although until recently there were no digital platforms, and intermediary companies played the role of integrators.

The present study consisted in the analysis of existing scientific literature on selected topics. The goal was to systematize information about the state of digital transformation in logistics, about the main trends, applied technologies, and prospects for increasing the efficiency of digital transformation. Based on the analytical review, conclusions are drawn.

## 3 Results

Thus, it is possible to formulate 3 main lines of action to improve the efficiency of logistics activities in the context of digital transformation:

1. digitalization of data flows on actual consumption and movement;
2. automation of data volumes for planning purchases and stocks (data on current stocks, rhythm of supplies, etc.);
3. the introduction of a mechanism that ensures transparent relationships between participants in supply chains based on digital technologies, such as smart contracts.

To implement these areas, it is necessary to comprehensively use technologies and a specialized mathematical apparatus: electronic platforms, blockchain, smart contracts, paperless workflow; adaptive self-organizing systems based on multi-agent technology, AI, telecommunications, parallel computing.

The main drivers of digital logistics transformation are micro-segmentation, maximum possible customization, increased flexibility of logistics systems without increasing costs, the need to improve efficiency and reduce costs, customer retention opportunities, increasing value proposition, new technologies and industry digital platforms, urbanization, and population aging.

The main requirements for the development of the industry are speed, efficiency, security, transparency.

Drivers directly affect the expansion of requirements. For example, customization, which is a trend in customer satisfaction issues, imposes additional requirements on the manufacturer, namely agility and velocity. Logistic companies acting as intermediaries between the manufacturer and the end user receive a new requirement to improve the quality of economic interactions and fulfill obligations on time and in full. In the new era, Logistic Service Providers (LSPs) are partners with the supply chain parties rather than some distant third party. They manage all or part of the seller's logistic chain, e.g. the management of warehouse inventory, order processing, fulfillment, delivery, and after sales. E-commerce value chains require that huge amounts of cargo should be delivered within tight time windows. In fact, this is a crucial factor in creating customer value in e-commerce. This gives LSPs a key position in the new era. LSPs provide lots of value added services in addition to cargo delivery in the value chain, e.g., they may deliver an item, install it, and take back the previous one.

The main stakeholders of the digital transformation of logistics are manufacturers, logistics companies, and the end consumer, who are part of the value chain as part of the supply chain.

It is also possible to single out a stakeholder of a higher level - a state that is distinguished by increased requirements for economic interactions in terms of security, transparency.

In general, the digital logistics ecosystem can be represented as a model, as shown in Fig. 1.

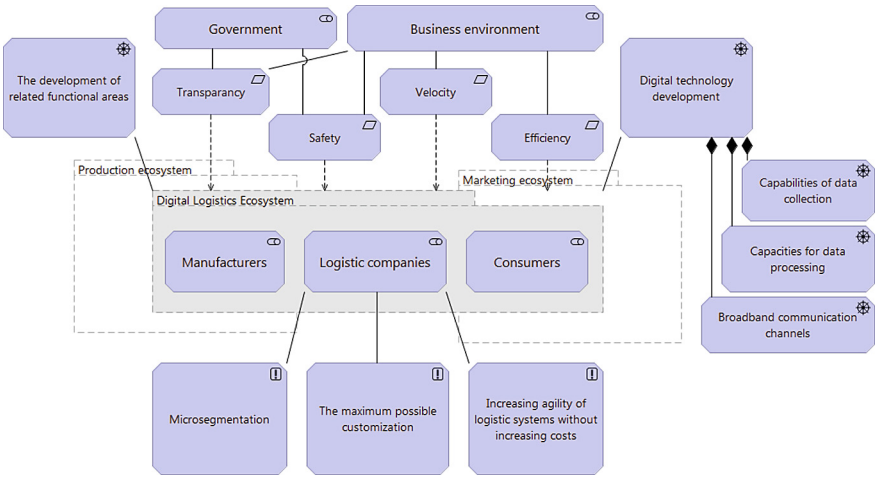


**Fig. 1.** Digital ecosystem of logistics

This figure describes the requirements of stakeholders (government, business environment, manufacturers, logistic companies, consumers), represented by an object marked with a parallelogram. Requirements model the properties of these elements, which are necessary to achieve the "goals" that are modeled by goals. Items marked with a helm mark are drivers. The driver encourages the organization to define its goals

and implement the changes necessary to achieve them. Elements marked with an exclamation mark represent principles. The principles determine the properties of the system, motivated by some purpose or driver.

A large number of participants are involved in the digital ecosystem of logistics (Fig. 2). All of them must act in an integrated manner, in cooperation, using uniform standards, ensuring the growth of consumer value for the consumer.


**Fig. 2.** Participants of the digital ecosystem of logistics

Industry-specific digital platforms that are currently widely used are, for example, the Yard Management System (YMS), which is responsible for managing the warehouse territory and placing vehicles on it, the Transportation Management System (TMS) - a system for controlling the movement of goods from the point of shipment to point of unloading, Warehouse Management System (WMS), which regulates the location and movement of goods and material values directly at the warehouse, a complex of DSS class systems that are engaged in inventory planning and production (including the functionality of BI, MES, APS, etc.). An important and integral element of such an industry platform should be secure payment systems. In addition, platforms for electronic document management, electronic queues for border crossing and others are used. At the same time, for example, in the Russian Federation a key task has been set in the field of digital transformation of transport and logistics, which consists in interfacing industry digital platforms with each other and other state systems. This should increase the productivity, safety and quality of transport systems, the effectiveness of national industrial projects, given the fact that the global transport complex is the largest consumer of digital technologies and solutions [23].

## 4 Conclusion

Currently, the logistics industry, like many others, has technologically approached the opportunity to make a quantum leap in the management of logistics, making it as personalized as possible, at the same time economical, and increasing the level of profitability of associated capital. To realize this, it is necessary to overcome not only technological barriers, but also mental and cultural ones: the willingness of people to move to a new level of transparency, the willingness to share information online, go

from local optimization of individual links to chain optimization is necessary. Today, an extremely small number of global chains are actually implemented in the world, and any shock leads to a break. An obstacle to improving supply chain performance is not technology, but culture and beliefs, habits and skills.

The successful implementation of the main directions of increasing the efficiency of digital transformation in the logistics industry allows increasing security of systems, expanding multimodality, ensuring the combination of the interests of a large number of parties involved in the logistics process and increasing the value proposition, taking into account the changing needs of the end user, without increasing investments in infrastructure. Digitalization is changing the channels of goods movement, delivery formats and management processes. Unified digital platforms and integrated actions of participants in the digital logistics ecosystem can increase overall efficiency and provide a place for logistics as one of the drivers of digitalization.

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