

# Information technologies in logistics processes of enterprises in the aviation industry

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## Abstract

The paper discusses the features of the use of information technology in the logistics processes of enterprises in the aviation industry. An important aspect of the importance of information technology development in the logistics system of aviation industry enterprises has been identified. The key tasks of using modern information technologies in the logistics processes of aviation industry enterprises have been determined. A description of innovative information technologies and the opportunities for their utilization in the logistics processes of aviation enterprises is presented. Examples of some of the leading international airlines on the use of modern information technologies in their own logistics processes are provided. It has been substantiated that the utilization of information technologies by the world's leading airlines in their logistics processes brings a number of important advantages, which are described in the paper. A regression model for evaluating air transportation using modern information technologies is proposed.

## Keywords

information technology, digitalization, logistics process, logistics system, aviation companies, aviation industry

## 1. Introduction

The efficiency of logistics processes at aviation companies is critical for their successful operation. A high level of coordination and optimization in logistics helps reduce costs, which in turn contributes to the company's competitiveness. Efficient logistics ensures timely delivery of materials, which is key to the smooth production and maintenance of aircraft. In addition, proper management of logistics processes helps minimize the risks associated with delays and unforeseen expenses. This is very urgent in the aviation

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industry, where any delay can lead to significant financial and reputational losses. Accordingly, companies that invest in modern logistics systems and information technologies to support them are better able to respond to changing market conditions and customer requirements. Thus, the development of information technologies to support logistics processes is not only a strategic advantage but also a prerequisite for the stable development of aviation companies.

The information technologies usage in the logistics processes of aviation companies is a pressing necessity due to the growing demands on the quality and speed of air transportation. Information technology enables automation and optimization of numerous operations, ranging from inventory management to real-time cargo tracking. This helps to reduce costs and increase efficiency, which is critical in the highly competitive aviation sector. Thanks to modern technology, businesses can better forecast demand, plan routes, and manage the risks associated with logistical delays. Integration of information technology (IT) solutions also improves the security and accuracy of data, which is essential to ensure high standards of customer service. In today's globalized and rapidly developing markets, the use of advanced information technology is becoming a key factor in successful business. Thus, aviation companies that actively implement modern IT solutions in their logistics processes gain a significant competitive advantage and are able to respond more effectively to market challenges.

## **2. State of the art for the problem of research**

The problem of using modern information technologies in the logistics processes of aviation companies remains insufficiently studied, despite its importance. Although the integration of IT solutions provides significant benefits, many aspects of this process require deeper research. One of the main problems is the lack of adaptation of existing information systems to the specific requirements of the aviation industry, which requires specialized research and development. It is also important to take into account the rapid development of technology, which requires constant updating of knowledge and skills of personnel in the IT field. Ignorance of this issue can lead to mistakes in the implementation of new technologies, which in turn negatively affects the efficiency of logistics processes. In addition, there is a need to develop new methodologies for assessing the effectiveness of implemented IT solutions. Another important aspect is data security, which requires detailed analysis and implementation of reliable security tools. Information technologies can significantly change logistics processes, but this requires thorough research and practical recommendations. Thus, further study of this issue is critical to ensure the stable development of aviation companies and their competitiveness in the market.

Paper [1] analyzes and selects digital solutions and cross-functional technologies according to the stage of the aircraft life cycle, identifies the relevance and need for further strengthening and implementation of information technologies that will determine the efficiency of work, the quality of product life cycle management and help optimize costs.

The scientific publication [2] considers the possibility of using innovative blockchain technology in commercial airline activities. The authors explore the possibility of using

blockchain technology and analyze the advantages of using blockchain technology to optimize the settlement process, optimize air transportation and increase the effectiveness of marketing impact on air passengers through the use of complete and reliable personal information.

Paper [3] reflects the main promising areas of digital technology implementation in the activities of the world's leading airlines. The study analyzes the general transformation processes taking place in aviation through the introduction of digital innovations. The authors also determine how digital technologies affect flight safety and optimize the work of aviation personnel.

In paper [4], it is proposed to define digitalization as one of the main digital technologies during the transformation and optimization of business processes, which helps increase productivity and improve communication interaction with consumers.

The authors of the paper [5] believe that the digitalization of airline logistics business processes is an important factor in increasing their competitiveness in international markets. At the same time, the introduction of advanced technologies in the aviation industry generates the need for changes in the formats of air transportation of goods and passengers and changes the processes of managing logistics business processes.

Paper [6] discusses the modern factors affecting the efficiency of business processes of an enterprise including information technologies, digital transformation, automation of processes, customer experience, innovations in business processes, digitalization strategies, etc. Information technologies make it possible to rationally manage all types of enterprise resources (software, commercial activities).

The authors of the paper [7] determined that for the successful implementation of digital technologies in the enterprise, the management must take into account various problems: technological innovations, customer behavior and requirements, and the level of readiness of the staff for digital technologies.

The use of innovative technologies and processes, the development and implementation of innovative products allow the company to occupy a leading position in the market. This provides products with a high level of scientific content and novelty, thereby making them competitive in the global market [8].

The authors of the study [9] identified a strategic direction for the development of the transport sector and proposed the use of new and innovative technologies for traffic management in both national and international markets. The emphasis is on the development of a value proposition and the use of opportunities to ensure the stability of the enterprise in the long term, based on innovative development.

In the paper [10], it was determined that the transport services market is being formed under the influence of the latest achievements of technological progress due to further computerization and digitalization, automation of all processes due to the modernization of existing basic technologies.

The problem of using modern information technologies in the logistics processes of aviation companies remains insufficiently studied, despite its importance. Although the integration of IT solutions provides significant benefits, many aspects of this process require deeper research. One of the main problems is the lack of adaptation of existing information systems to the specific requirements of the aviation industry, which requires

specialized research and development. It is also important to take into account the rapid development of technology, which requires constant updating of knowledge and skills of personnel in the IT field. Ignorance of this issue can lead to mistakes in the implementation of new technologies, which in turn negatively affects the efficiency of logistics processes. In addition, there is a need to develop new methodologies for assessing the effectiveness of implemented IT solutions. Another important aspect is data security, which requires detailed analysis and implementation of reliable security tools. Information technologies can significantly change logistics processes, but this requires thorough research and practical recommendations. Thus, further study of this issue is critical to ensure the stable development of aviation companies and their competitiveness in the market.

Therefore, this paper considers the generalization of theoretical foundations and the development of methodological approaches to the implementation and development of information technologies in the logistics processes of aviation enterprises.

### **3. Materials and methods**

The information technologies usage in the logistics system of an enterprise is important for achieving high efficiency and competitiveness. Information technologies allow automating numerous processes, reducing costs and minimizing human errors. This allows for faster and more accurate management of inventory, transportation routes, and deliveries. In addition, modern IT solutions allow for real-time tracking of cargo, which improves transparency and control over logistics operations. Integration of information systems promotes better coordination between different departments of the enterprise, which increases overall productivity. The use of modern technologies also helps in demand forecasting and supply chain optimization. Thus, the use of IT in logistics is a key factor in the success of modern enterprises.

Information technology in the logistics processes of aviation companies is the use of modern digital solutions and systems to optimize the management of logistics operations.

They include automation of inventory accounting and management, planning and monitoring of transportation routes, real-time cargo tracking, and supply chain management [5].

The use of IT can improve the accuracy and speed of data processing, ensure timely delivery of materials and components, reduce costs and minimize the risks associated with delays and unforeseen events. In addition, information technology helps to improve communication and coordination between different departments of the enterprise, ensuring transparency and control at all stages of the logistics process. In the aviation industry, where accuracy and reliability are critical, the introduction of modern IT solutions is becoming a key factor in achieving a high level of operational efficiency and market competitiveness [2, 3].

The key tasks of using modern information technologies in the logistics processes of aviation enterprises include those summarized in Table 1. In general, the task of using modern IT in the logistics processes of the aviation industry is to increase the overall efficiency, reliability, and competitiveness of airline companies.

**Table 1**

Key tasks of using modern information technologies in the logistics processes of aviation industry enterprises

<b>Task</b>	<b>Characteristics</b>
1. Automation of inventory accounting and management	Using IT to accurately account for materials, components, and stocks, ensuring their timely replenishment and warehouse optimization.
2. Planning and optimization of transportation routes	The use of GPS and other navigation technologies for efficient route planning, reducing transportation time and costs.
3. Real-time cargo tracking	Using tracking systems to monitor the movement of goods, providing timely information about the delivery status and identifying possible delays.
4. Supply chain management	Integration of different stages of the supply chain through IT systems to increase coordination between suppliers, manufacturers and distributors.
5. Improving the accuracy and speed of data processing	Using software to quickly process large amounts of data, allowing for more informed decision-making.
6. Reduce costs and minimize risks	Use analytical tools to forecast demand, optimize inventory, and manage risks associated with delays or unforeseen circumstances.
7. Improved communication and coordination	Use of corporate information systems to ensure effective interaction between different departments of the airline, which contributes to coordinated work and reduces the likelihood of errors.
8. Data security	Implementation of protective measures and cybersecurity to protect confidential information and prevent unauthorized access.
9. Enhance customer service	Using CRM systems and other IT tools to improve customer experience, provide up-to-date information and respond quickly to customer requests.
10. Analyze and improve business processes	Use analytical platforms to analyze the efficiency of logistics processes and identify opportunities for improvement.

Studies have shown that several innovative information technologies can now be identified that have been widely used in the logistics processes of aviation enterprises. Some of these technologies are summarized in Table 2. Leading international airlines are increasingly using the latest information technology in logistics to improve the efficiency of their operations and ensure a high level of service. Companies such as Emirates, Delta Airlines, and Lufthansa are actively implementing automated inventory management

systems to reduce costs and minimize delays. They also use advanced technologies to plan and optimize routes, which helps reduce fuel costs and improve flight punctuality.

**Table 2**

Description of innovative information technologies and opportunities for their use in the logistics processes of aviation enterprises [11, 12]

<b>Information technology</b>	<b>Opportunities for use in the logistics processes of aviation companies</b>
RFID (Radio Frequency Identification)	Real-time tracking of baggage and cargo, reducing the risk of loss and delays. Automation of inventory and warehouse management, which increases the accuracy and speed of processing. Improved control over the movement of materials and components. Increased security by accurately tracking access to critical areas.
IoT (Internet of Things)	Real-time monitoring of cargo storage and transportation conditions (temperature, humidity, vibrations). Tracking the location of cargo and luggage in real time. Automatic notification of deviations from the set parameters for quick response. Optimize warehouse and transport operations by integrating sensors and analytics.
Big Data	Analysis of large amounts of data to forecast demand for freight and passenger transportation. Route optimization based on historical data and current conditions. Identify trends and anomalies in logistics processes to improve efficiency. Making informed decisions based on data analysis.
AI (Artificial Intelligence)	Automates route and schedule planning to reduce fuel costs and improve punctuality. Demand forecasting based on historical data and current trends. Optimization of inventory and warehouse management to reduce costs. It identifies and manage risks in real time.
Blockchain	Ensuring supply chain transparency and security by recording transactions in an immutable ledger. Improving cargo tracking and ensuring the authenticity of goods. Automation of contracts and payments through smart contracts. Reducing the risk of fraud and increasing trust between participants in logistics processes.

The integration of IoT and tracking systems allows these companies to track cargo in real time, ensuring transparency and reliability of supply. Analytical tools and Big Data platforms help airlines forecast demand and optimize supply chains. In addition, the latest IT solutions help improve data security and the efficiency of communications between different departments [13]. Thus, leading airlines demonstrate how the use of modern information technology can significantly improve logistics processes.

Examples of some of the leading international airlines on the use of modern information technologies in their own logistics processes are given in Table 3.

**Table 3**

Examples of some of the leading international airlines on the information technologies usage in their own logistics processes

<b>Name of the airline</b>	<b>Examples of information technologies in logistics</b>
<b>Emirates</b>	<ol style="list-style-type: none"><li>1. Automated inventory management system to optimize the use of materials and components.</li><li>2. Implementation of IoT for real-time monitoring of temperature and storage conditions of cargo.</li><li>3. Using Big Data analytics to forecast demand for flights and cargo transportation.</li><li>4. Integration of cargo tracking systems to provide transparency and control at all stages of delivery.</li></ol>
<b>Delta Airlines</b>	<ol style="list-style-type: none"><li>1. Use of RFID technologies for real-time tracking of baggage and cargo.</li><li>2. Application of optimized route planning algorithms to reduce fuel costs.</li><li>3. Implementation of a supply chain management platform that increases the efficiency of cooperation with suppliers.</li><li>4. Use of artificial intelligence systems to improve the forecasting of demand for logistics services.</li></ol>
<b>Lufthansa</b>	<ol style="list-style-type: none"><li>1. Use of an automated warehouse management system to increase the accuracy and speed of processing.</li><li>2. Integration of real-time cargo monitoring platforms.</li><li>3. Implementation of analytical tools to assess the efficiency of logistics operations.</li><li>4. Use of mobile applications to improve coordination between logistics departments.</li></ol>
<b>Singapore Airlines</b>	<ol style="list-style-type: none"><li>1. Use of IoT to monitor cargo transportation and storage conditions.</li><li>2. Automation of inventory management processes to reduce costs.</li><li>3. Implementation of analytical tools to optimize routes and schedules.</li><li>4. Use of tracking systems to ensure transparency and security of logistics processes.</li></ol>
<b>Qatar Airways</b>	<ol style="list-style-type: none"><li>1. Use of analytical platforms for supply chain management.</li><li>2. Implementation of IoT to monitor cargo condition during transportation.</li><li>3. Automation of inventory management and route planning processes.</li><li>4. Use of tracking systems to ensure transparency and control over cargo.</li></ol>
<b>British Airways</b>	<ol style="list-style-type: none"><li>1. Use of RFID technology to track baggage and cargo.</li><li>2. Implementation of automated inventory management systems to reduce costs.</li><li>3. Integration of analytical tools to optimize routes and schedules.</li><li>4. Use of mobile applications to improve the coordination of logistics processes.</li></ol>

Competition levels in the aviation industry are elevated [14], even if the aircraft industry is dominated by very few large manufacturers of airframes and engines, that all compete in a global market.

Thus, the examples presented in Table 3 illustrate how airlines use modern information technologies to increase the efficiency, transparency and reliability of their logistics processes.

It can be argued that the use of modern information technologies by the world's leading airlines in their logistics processes provides a number of important advantages [13]:

- increased efficiency and productivity. Automation of logistics processes, such as inventory management, accounting and planning, can significantly reduce the time to complete tasks and reduce the number of errors;
- cost reduction. Optimization of routes and the use of resources such as fuel and storage space help to reduce operating costs. Information systems also help to reduce the cost of spare parts and materials through more accurate accounting and forecasting of needs;
- improved accuracy and transparency. The use of RFID and IoT technologies allows for real-time tracking of cargo and baggage, ensuring high accuracy and transparency of logistics operations. This helps reduce the number of lost or delayed cargoes;
- improved customer service. By managing logistics processes more accurately and quickly, airlines can provide a higher level of customer service by offering more accurate delivery times and responding quickly to customer requests;
- optimization of supply chains. Integration of information systems allows for better coordination with suppliers, ensuring timely delivery of the necessary materials and components. This reduces the risk of supply chain disruptions;
- ensuring data security. Modern IT solutions include high cybersecurity standards that protect confidential information and prevent unauthorized access to data;
- improving decision-making. Big Data analytics tools and platforms allow airlines to analyze large amounts of data to make informed decisions. This contributes to better demand forecasting, inventory management, and route planning;
- environmental responsibility. Optimized routes and more efficient use of resources help reduce CO<sub>2</sub> and other harmful emissions, which improves airlines' environmental responsibility;
- innovation and competitiveness. The advanced IT solutions allows airlines to stay at forefront of innovation and maintain high competitiveness in the global market.

Thus, the introduction of modern information technologies in the logistics processes of airlines significantly improves their operational efficiency, reduces costs, increases the level of customer service and ensures environmental responsibility.

Transport makes a significant contribution to economic growth and improving the quality of life by facilitating the movement of people and goods. Transport, on the other hand, causes external influences that can have harmful effects on the environment and



health [15]. These externalities are a major incentive to support innovations that make transportation greener, safer and more efficient. According to [16], we will analyze air cargo transportation in 2020-2021 in Ukraine (million tkm), as shown in Table 4.

We will build a mathematical model based on regression analysis, using information technology by aviation enterprises. To do this, we use the linear regression formulas:

$$y(x) = A_1 + A_2x,$$

where  $A_1, A_2$  are unknown regression coefficients.

**Table 4**

Air cargo turnover by air transport in 2020-2021

Air cargo turnover by month, (mln. tkm)												
Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020	12,6	29,3	50,9	84,3	139,6	167,8	183,0	199,9	217,7	243,6	275,8	316,2
2021	23,7	44,1	73,7	103,7	135,2	171,4	195,1	212,1	236,7	266,7	301,3	346,3

To determine the discrepancy between the coefficients, we use the least squares method. According to this method, it is necessary to minimize the mean square error:

$$E = \sum_{n=1}^n (y_i - y(x_i))^2 \rightarrow \min,$$

where  $E$  is the root mean square error;  $y_i$  and  $x_i$  are the primary data.

To solve the optimization problem, we find the partial derivatives and equate them to zero:

$$\begin{cases} \frac{dE}{dA_1} = -2 \sum_{i=1}^n (y_i - A_1 - A_2x_i) = 0, \\ \frac{dE}{dA_2} = -2 \sum_{i=1}^n x_i (y_i - A_1 - A_2x_i) = 0. \end{cases}$$

This is where we get it from:

$$\begin{cases} nA_1 + A_2 \sum_{i=1}^n x_i = \sum_{i=1}^n y_i, \\ A_1 \sum_{i=1}^n x_i + A_2 \sum_{i=1}^n x_i^2 = \sum_{i=1}^n x_i y_i. \end{cases}$$

In a matrix form:

$$A = \begin{pmatrix} n & \sum_{i=1}^n x_i \\ \sum_{i=1}^n x_i & \sum_{i=1}^n x_i^2 \end{pmatrix} \begin{pmatrix} \sum_{i=1}^n y_i \\ \sum_{i=1}^n x_i y_i \end{pmatrix}.$$

After the mathematical calculations, we obtained models for the accumulation of air transportation in 2020, formula (1), and in 2021, formula (2):

$$y(x) = -16,5348 + 27,1682x. \quad (1)$$

$$y(x) = -9,026 + 28,44x. \quad (2)$$

The model for current air transportation in 2020 is formula (3) and in 2021 is formula (4):

$$y(x) = 20,2318 + 0,9413x. \quad (3)$$

$$y(x) = 22,452 + 0,936x. \quad (4)$$

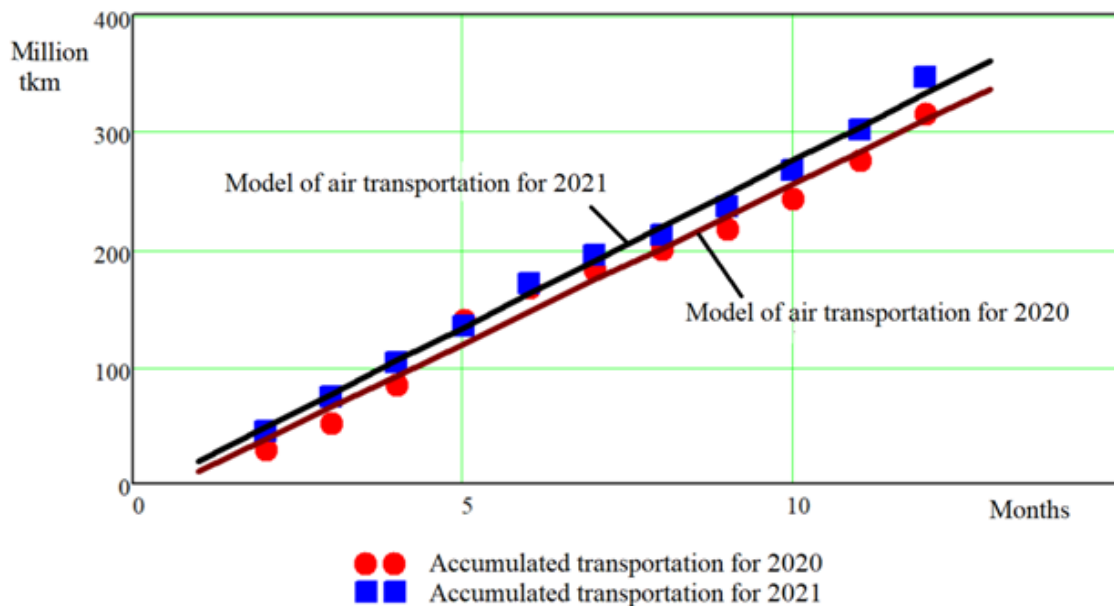
The obtained model's formula (1) - (4) are simplified, since they do not take into account financial indicators from the introduction of information technologies. To make more reasonable conclusions about the feasibility of using a particular information technology, it is necessary to conduct real experiments and calculate data sets for the relevant airline.

In general, the use of indicators of the number of air transportation allows to apply effective and well-studied methods and works to improve the efficiency of information technology use in the activities of airlines and assess their quality.

#### 4. Results and discussions

This section of the paper is devoted to a demonstration example of the proposed models of formula (1) - (4).

At the first stage of modeling, datasets with accumulated transportation for 2020-2021, mil. tkm were formed (Figure 1). The resulting implementation of current transportation according by months to formula (3), (4) is shown in Figure 2. For a more accurate match between the two models, we will use the model of current transportation based on the combined data sample, since the resulting sample has a much larger number of sample points, this model will have greater reliability (Figure 3).



**Figure 1:** Accumulated transportation for 2020-2021, mil. tkm.

The analysis shows that the level of air transportation is growing and tends to increase. However, under the influence of environmental factors that affect air transportation, such as: COVID-19, military operations, and border closures, there is currently no possibility to carry out air transportation in general.

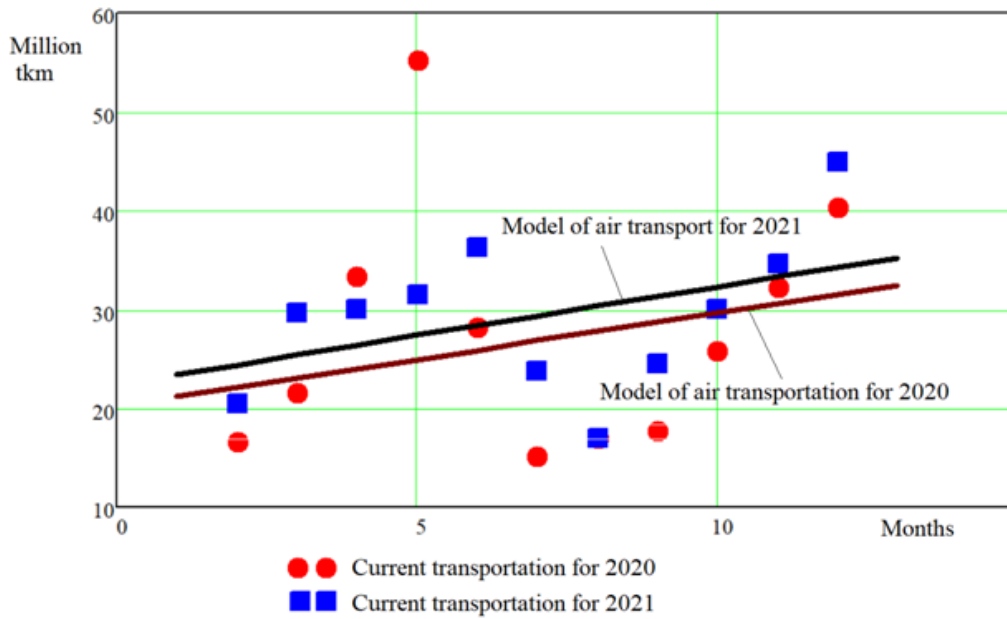


Figure 2: Current transportation for 2020-2021, mil. tkm.

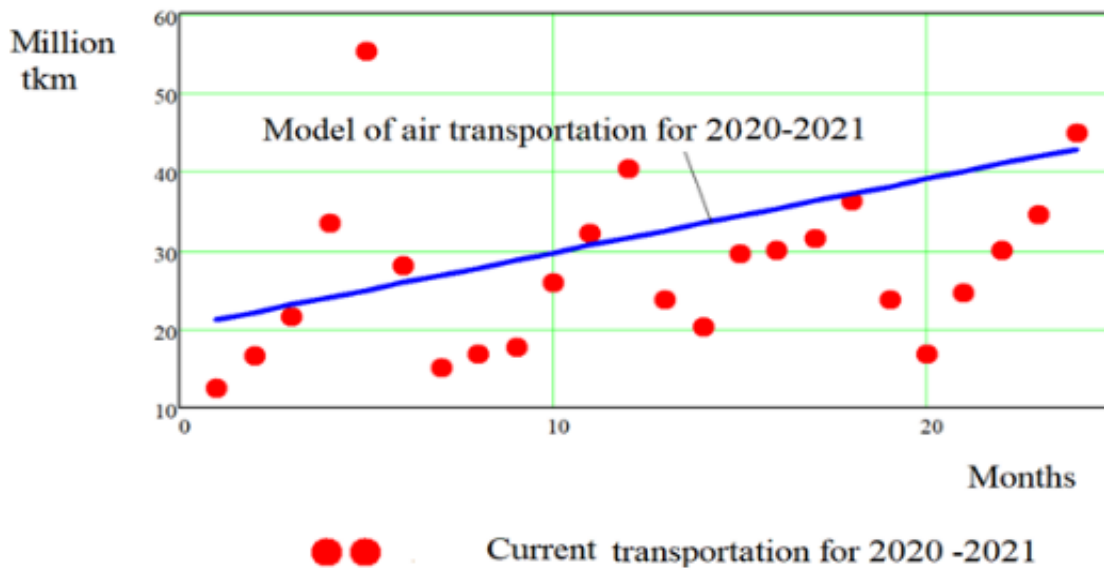


Figure 3: Current transportation for 2020-2021, mil. tkm.

## 5. Conclusions

The introduction of modern information technologies in the logistics processes of aviation companies is an integral part of successful operations in today's global market. The need to further intensify this process is driven by several key factors. Firstly, the rapid pace of technological development and the constant updating of market trends create a need to use advanced information tools. Secondly, competitive pressure in the air transportation

market requires companies to constantly improve their logistics processes. The further implementation of modern IT solutions will allow aviation companies to increase efficiency and reduce costs, which is crucial in the context of constantly rising prices for fuel and other resources. In addition, the use of information technology will help improve passenger and customer service, which in turn has a positive impact on the reputation of companies and increases their competitiveness. The introduction of modern technologies will also ensure a high level of safety and reliability of cargo transportation, which is especially important in the context of the rapid growth of air transport. Another important advantage is the ability to improve the environmental sustainability of aviation companies by optimizing resource use and reducing CO<sub>2</sub> emissions. Taking into account all these factors, intensifying the introduction of modern information technologies in the logistics processes of aviation enterprises is a strategically important step that will ensure stable development and competitiveness in the air transportation market.

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