

Digital marketing in logistics: how new technologies change the rules of the game

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Abstract: In the conditions of the rapid development of technologies, digital marketing in logistics undergoes significant changes. The article examines how innovative technologies - such as artificial intelligence (AI), blockchain, the Internet of Things (IoT), and automation - are transforming traditional approaches to logistics, providing improved customer interaction, supply chain optimization, and increased transparency of operations. The main goal of the research is to analyze the influence of new technologies on marketing and logistics processes, as well as to identify relevant strategies for increasing the efficiency and competitiveness of companies. The research methodology includes the use of data analysis, statistical models and examples from the practice of leading global companies. The main tasks of the article are to reveal how digital marketing contributes to the improvement of the customer experience and how technologies allow companies to adapt to modern market conditions. The main results made it possible to substantiate that the implementation of AI allows to improve the personalization of offers and increase the accuracy of demand forecasts, while the blockchain contributes to increasing trust and transparency in supply chains. IoT allows companies to track goods in real time, and automation reduces costs and speeds up order processing. On the basis of the obtained results, it is proved that the digitalization of marketing and logistics processes of modern companies contributes to the strengthening of positions on the market and creates a basis for sustainable growth in the conditions of a rapidly changing economic environment.

1 Introduction

Digital transformation has affected almost all areas of business, and logistics and marketing are no exception. Traditional logistics strategies and marketing approaches are no longer able to effectively meet the new demands of the global market. With the rapid growth of e-commerce, increased customer expectations and increased competition, digital marketing in logistics is becoming critical. The introduction of advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain and automation are changing the rules of the game, turning marketing and logistics into integrated processes aimed at increasing the speed, efficiency and transparency of supply chains. The development of technology and digitalization have led to significant changes in the structure of supply chains, which now actively include marketing elements aimed at improving the customer experience. In the digital era, customers not only expect fast and safe delivery, but also personalized offers, availability of information about each stage of the product's movement, as well as confidence in the security of their data. Therefore, studying how digital marketing in logistics is transforming business processes becomes necessary for creating more flexible and sustainable strategies. In a world where business competitiveness is increasingly determined by the speed and quality of service, this study offers valuable recommendations for companies seeking to adapt to the new reality. The benefits that company receive from implementing digital technologies are varied and extensive. The use of artificial intelligence allows us to process huge amounts of data,

thereby predicting demand, personalizing customer interactions, and optimizing marketing campaigns and flow or management of information. Blockchain technologies provide transparency and reliability of data at every stage of the supply chain, which increases customer trust and reduces operational risks. IoT devices allow us to track goods in real time, which improves inventory management and minimizes losses. Secure and verifiable data also strengthens the reputation of companies that can demonstrate their responsibility to consumers and partners.

This study aims to identify the most effective digital strategies that companies can use to improve customer interactions and increase the productivity of logistics processes. The relevance of the study is due to the need to adapt logistics and marketing to the new challenges of the digital economy. In the context of globalization, increasing speed of change and the development of electronic platforms, companies that do not implement technologies risk losing competitiveness. Thus, the study of digital marketing in logistics has significant practical significance, helping businesses navigate the changing economic environment and use digital opportunities for sustainable growth. To achieve the goals and objectives of the study, specific examples of companies that have successfully integrated digital technologies into their logistics and marketing processes are substantiated. It is expected that the results of the study will be useful not only for companies that already use digital tools, but also for those who are just planning to implement innovations and technologies in their business processes.

1.1 Theory of digital marketing in logistics: argumentation of the features and specifics of the interaction of strategic management

Research on the integration of digital technologies in logistics and marketing demonstrates that technological innovations open up new opportunities to improve customer engagement, increase supply chain efficiency, and create competitive advantages. Current work highlights key aspects of technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, and automation, and their impact on logistics and marketing. Digital marketing plays a key role in modern logistics, helping to improve the interaction between a company and its customers, as well as to increase operational efficiency. Several studies, such as [1] and [2], highlight the importance of digital technologies in empowering logistics companies, improving customer service, and optimizing supply chains. Digital marketing tools, including data analytics, automation, artificial intelligence (AI), and the Internet of Things (IoT), help companies respond more quickly to changing customer needs and manage operations efficiently [3].

It is worth noting that digital technologies have also changed the approach to managing the interaction between marketing and logistics. The integration of technologies such as IoT and blockchain allows companies to offer customers more transparent and personalized services, as well as manage their expectations [4]. The study by [5] shows that IoT in logistics helps track goods and improves supply chain transparency. Thus, the integration of digital tools and data from logistics into marketing allows for better customer service at every stage of the purchasing process, which increases their loyalty. Strategic management of digital marketing in logistics is becoming an important factor for sustainable business growth. Due to the growing importance of digital technologies and data, companies must build strategic management based on data. Works such as [6] emphasize the need for a strategic approach to the implementation of digital solutions, which allows companies to improve demand forecasting and optimize logistics processes. These studies highlight the need for companies to adapt their strategy to new technologies in order to remain competitive in the market. The use of AI and big data in digital marketing improves forecasting accuracy, which significantly reduces storage and transportation costs, and improves customer service [7]. In turn, this allows companies to create personalized offers and respond to changes in demand in a timely manner, which is especially important in unstable conditions. Systematization of data within the supply chain allows companies to provide customers with accurate information about the status of their orders in real time [8]. While the benefits of applying digital marketing in logistics are obvious, such as improving customer experience, cost optimization, and increasing data accuracy, there are also some challenges. For example, studies by [9] and [10] note that digital transformation requires significant financial

investments and can cause difficulties in change management. The shortage of skilled workers and cybersecurity issues are also significant challenges that require a careful approach to strategic management. In today's environment, companies need to develop digital marketing strategies in logistics based on the implementation of advanced technologies to ensure effective customer engagement and adapt to market changes. To successfully implement technologies, companies must consider both the benefits and potential challenges associated with digital transformation. The review shows that further research in the field of digital marketing in logistics should focus on creating accessible and adaptable technologies that can support the sustainable development of companies in the long term.

Conceptually, it should be noted that digital marketing and logistics research shows that new technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain and big data are significant game changers in both logistics and marketing. However, a critical analysis of existing works reveals several important aspects that require further improvement and more in-depth research. Current research in digital marketing and logistics confirms the importance of implementing innovative technologies to improve the efficiency of business processes. However, despite numerous achievements in these areas, there is a significant gap in the scientific literature regarding the full integration of these technologies into logistics and marketing strategies. According to research [8], the use of AI and big data analytics has high potential to create a personalized experience for customers, but so far not all companies have realized these opportunities in practice. In turn, [7] notes that many companies face challenges in implementing digital solutions, such as the high cost of technology and a lack of qualified personnel. Although the implementation of technologies such as IoT and blockchain do contribute to improving transparency and accuracy in logistics, as claimed by [10], in practice these solutions require a high level of integration with existing business processes. This may be associated with additional complexities, such as the need to revise management strategies and organizational structure. Therefore, more in-depth research is needed to analyze different models of technology implementation in a company, as well as to create clear recommendations for their effective use. In addition, insufficient attention is paid to studies aimed at analysing the impact of new technologies on the interaction between logistics and marketing departments. As noted by [1], successful integration of these technologies requires synergy between different departments. It is important to note that the literature review found contradictions in the studies regarding the application of AI in marketing and logistics, and more work is needed to understand how these technologies can work in tandem to improve the overall business process. Many studies confirm the effectiveness of digital technologies in isolation, but there is a lack of

work that would examine their integration at the business level. Particular attention should be paid to the synergy models between marketing and logistics, as well as the need for strategic management of technology implementation. Critical need to rethink strategies. Technologies such as AI and blockchain are indeed changing the landscape in both logistics and marketing, but companies must be prepared for significant internal changes before these technologies can deliver real value. Existing research does not sufficiently take into account the challenges that companies face when implementing digital solutions. Therefore, there is a need to further explore methods for evaluating the effectiveness and profitability of these implementations in a practical context.

1.2 Theoretical aspects of assessing the impact of technology on changing the management of digital marketing and logistics

Digitalization in marketing and logistics is crucial for the growth and efficiency of modern companies. Modern technologies such as artificial intelligence (AI), the Internet of Things (IoT), big data, blockchain and machine learning are actively used to improve all stages of customer interaction and optimize logistics processes. With these technologies, organizations can increase efficiency, decision-making accuracy and improve service quality. However, there are a number of theoretical aspects related to their implementation and impact on overall business strategies. Arguing attention to theoretical aspects and scientific approaches in the field of determining the impact of technologies on the digital marketing and logistics of companies, it is necessary to note the following directions:

- Artificial Intelligence in Marketing and Logistics. The use of AI in marketing allows companies to create personalized offers for customers, predict needs, and optimize advertising campaigns. AI in logistics helps improve demand forecasting processes, automate inventory management, and optimize delivery routes. The impact of AI on digital marketing and logistics is estimated through increased forecast accuracy, improved customer experience, and reduced costs [11].

- Big Data and Analytics. The use of big data in marketing and logistics helps organizations collect and analyze information about customer behaviour and production processes. With the help of analytics, it is possible to accurately predict consumer behaviour and optimize the supply of goods. However, the critical point is the processing and protection of data, which requires significant resources and knowledge [12].

- Internet of Things (IoT). IoT is used to track goods, monitor transport in real time, and automate processes. The benefits of the technology include improved supply chain visibility, minimized human intervention, and increased efficiency. However, the implementation of IoT requires a high degree of integration with existing systems [13].

- Blockchain in logistics and marketing. Blockchain will provide security, transparency and trust in logistics. It allows for lower transaction costs, improved product tracking and fewer errors. However, its implementation is associated with high technological barriers and the need for standardization at a global level [14].

In stating the main results of the presented research, the following advantages and disadvantages should be highlighted:

- Increased efficiency. Current research shows that technology can significantly improve business processes in marketing and logistics, increasing their efficiency and reducing costs.

- Adaptation to change. The introduction of new technologies allows companies to respond more flexibly to market changes and customer needs, making them more competitive.

- High implementation costs. Many studies highlight that the implementation of technologies such as AI or blockchain requires significant investment, which can be a challenge for small and medium-sized enterprises.

- Complexity of integration. The challenges of integrating new technologies into existing business models remain relevant, especially for companies using legacy systems.

Ongoing changes in the technology landscape require businesses to constantly adapt and improve their processes. In a globalized and increasingly competitive environment, companies must be prepared for innovations that can significantly improve their productivity and efficiency. The need for research on the implementation of new technologies is due to their importance for ensuring long-term success and sustainability in a rapidly changing world. Undoubtedly, technologies such as AI, blockchain and big data play a key role in changing the management of digital marketing and logistics of modern companies. Despite the high costs of implementation, they provide significant benefits in the form of increased operational efficiency, improved customer experience and data security.

However, companies must be prepared for the difficulties associated with the integration of technologies and the adaptation of existing business processes. Continued research in this area is necessary to identify optimal strategies for the implementation of technologies and increase their availability to a wide range of companies.

2 Methodology

2.1 Peer review process

The penetration of technology into marketing and logistics is having a profound impact on the way we do business, improving efficiency and speeding up processes. This phenomenon is happening thanks to the introduction of new technologies such as artificial intelligence (AI),

blockchain, the Internet of Things (IoT), big data and cloud technologies. Based on the above, it should be noted that assessing the impact of technology on digital marketing and logistics and changing the rules of the game in the global market is an important tool for companies looking to improve their processes and adapt to a rapidly changing environment. Let's look at some reasons why this is necessary:

- Optimization of business processes: Technologies such as artificial intelligence, blockchain and the Internet of Things (IoT) have the potential to significantly improve processes in marketing and logistics, including supply chain management, personalization of offers and real-time product monitoring. Assessing their impact helps companies determine how to optimize processes, reduce costs and increase productivity.

- Prediction of future changes: Assessing the impact of technology allows you to not only understand current changes but also make predictions for the future. Forecasting allows companies to adapt their marketing and logistics strategies in advance, which is critical for their sustainability in a competitive market.

- Risk Management: Implementing new technologies always comes with risks. These may include technical difficulties, high initial investments, problems with employee training, or even possible legal issues. Assessing the impact of technology helps identify such risks and develop strategies to minimize them.

- Competitive Advantage: Assessing the impact of technology on marketing and logistics helps companies respond faster to changes in the industry. Technologies such as automation and machine learning can provide a competitive advantage to a company by speeding up decision-making and improving customer interactions. Companies that do not conduct such assessments risk falling behind more technologically advanced competitors.

- Innovation and Customer Experience Improvements: Technology affects not only internal processes but also customer interactions. Assessing its impact helps identify which innovations will improve customer experience.

- Reduced Costs and Increased Efficiency: Implementing new technologies, such as automated logistics processes and personalized marketing, can significantly reduce operating costs and increase efficiency. Impact assessments help identify which technologies are best suited for specific business goals, ensuring the highest return on investment.

- Strategic Planning: Assessing the impact of new technologies helps organizations make more informed decisions when planning strategically. Understanding which technologies are best suited to meet company goals allows resources to be focused on areas that will have the greatest impact.

Assessing the impact of technology on digital marketing and logistics enables companies to make more

informed decisions, anticipate potential changes, and adapt their strategies to remain competitive in a rapidly changing marketplace. This not only reduces risks and improves business processes, but also increases customer satisfaction by streamlining operations and improving their interaction with the brand. To assess the impact of technologies on digital marketing and logistics, real data from world-class companies in the field of digital marketing and logistics will be taken as a basis, using the principal component analysis (PCA). Principal Component Analysis (PCA) is a statistical technique used to reduce the dimensionality of data and identify the main factors that explain the most variation in a data set. It is a powerful tool for analyzing the relationship between multiple variables and can be used to assess the impact of technology on digital marketing and logistics [15-16].

PCA reduces a large number of correlated variables to a smaller number of independent variables called principal components. Each principal component is a linear combination of the original variables and explains part of the total variance in the data. The main goal of this method is to reduce the dimensionality of the data while preserving as much information as possible. This is especially useful when you need to analyze complex relationships in the data, such as in digital marketing and logistics, where many factors can interact with each other. The principal component analysis includes the following key steps:

1) Data standardization (1):

$$Z = \frac{X - \mu}{\sigma} \quad (1)$$

where: X - is the original data, μ - is the mean, and σ is the standard deviation.

2) Calculating the covariance matrix C for standardized data (2):

$$C = \frac{1}{n-1} X^t X \quad (2)$$

3) Finding the eigenvalues and eigenvectors of the covariance matrix. The eigenvectors (principal components) determine the directions of maximum data dispersion.

4) Formation of the transformation matrix and projection of the initial data onto the principal components (3):

$$Z = X * W \quad (3)$$

where, W - is the matrix of eigenvectors and Z is the transformed data.

It is important to note that in order to analyze and evaluate the impact of technologies such as artificial

intelligence, blockchain, IoT and big data on digital marketing and logistics, it is important to consider many factors, including economic, technological and operational aspects. Principal component analysis (PCA) is a powerful tool for data analysis in digital marketing and logistics, allowing to identify key factors that influence efficiency and process optimization. Using PCA enables companies to adapt their strategies, increase the efficiency of supply chains and improve marketing results. However, for the accuracy of the analysis, it is important to consider the possible limitations of the method, such as linearity and complexity of interpretation.

3 Results and discussion

Digitalization and the introduction of advanced technologies are radically changing the landscape of logistics and marketing. In the context of globalization and rising customer expectations, companies in the logistics sector are looking to adopt innovative approaches to improve efficiency, meet customer needs and remain competitive. The issues of implementing digital marketing in logistics and flow or management of information are becoming central, as traditional models no longer provide the required level of flexibility and efficiency. Digital marketing in logistics is becoming one of the key aspects of strategic management today, allowing companies to adapt to rapidly changing market conditions and strengthen their competitiveness. The interaction of marketing and logistics occurs through the integration of digital technologies that optimize supply chain management, improve customer experience and increase operational

efficiency. Digital marketing in logistics is a direction that focuses on the use of digital technologies to improve customer interactions, optimize supply chains, and strengthen the brand. It combines marketing methods and tools with technological solutions in logistics, allowing companies to adapt to rapidly changing market demands and ensure high levels of customer satisfaction.

The theory of digital marketing in logistics is based on the integration of modern technologies into logistics processes to improve their efficiency, speed and customer satisfaction. The combination of digital marketing and logistics allows companies to optimize the delivery of goods, improve supply chain management, and provide customers with a personalized experience. Based on the above, it should be argued that intensive digitalization and globalization processes are key triggers that significantly change the current rules of the game in the marketing and logistics market worldwide. Together, they not only transform the processes themselves, but also provide new business opportunities, allowing companies to create more efficient, flexible and adaptive systems of interaction with customers, as well as optimize their operations. Undoubtedly, the emergence of new technologies and their penetration into the marketing and logistics management systems of companies play an important role and require a serious approach to management and operational application. Given the active penetration of technologies into digital marketing and logistics of companies, it is necessary to consider the periodization of the development of technologies and their penetration into the marketing and logistics system of companies, which are presented in Table 1.

Table 1 Periodization of the development and penetration of technologies into the marketing and logistics of companies

STAGE	PECULIARITIES OF PENETRATION INTO THE MARKETING AND LOGISTICS SYSTEM OF COMPANIES
PRE-DIGITAL ERA	Initially, logistics and marketing were completely autonomous and solved their own problems, with minimal automation of processes. Logistics was mainly responsible for storing and transporting products, and marketing was responsible for promotion and sales using traditional methods (printed materials, television, radio). Logistics and marketing rarely interacted directly, which led to data fragmentation and limited opportunities for coordination.
AUTOMATION AND EARLY DIGITALIZATION (1980-1990)	With the advent of information systems, automation began in logistics and marketing. ERP and supply chain management systems (SCM) made it possible to track product flows, optimize stocks, and improve accuracy and efficiency. In parallel, marketing began to use databases for customer segmentation, which contributed to the growth of targeted marketing. The interaction of logistics and marketing remained limited, but some processes began to integrate.
THE INTERNET AND E-COMMERCE (2000)	The introduction of the Internet has changed both marketing and logistics, giving rise to new tools such as CRM systems, online platforms, and marketplaces. Segmentation has become more precise, and personalization has emerged. Logistics has become integrated with marketing to service online orders, which has created unified information flows and the need for data coordination.
THE ERA OF BIG DATA, ANALYTICS, AND ARTIFICIAL INTELLIGENCE (2010)	The emergence of big data, analytics, and artificial intelligence has led to the creation of new strategies for marketing and logistics. Logistics began to forecast demand and optimize routes using analytics, and marketing began to use consumer behavior prediction. The synergy between logistics and marketing has increased thanks to omnichannel approaches and real-time data management.
CURRENT TRENDS (2020)	Modern technologies continue to transform marketing and logistics. Internet of Things (IoT) technologies help track goods, warehouses, and transportation. Blockchain provides transparency in supply chains, promoting customer trust. Artificial intelligence helps to forecast demand and manage personalized marketing. Sustainability has also become a priority, increasing the demands for transparency and environmental friendliness in logistics processes [17-18].

Clearly, modern technologies and their penetration into the digital marketing and logistics management systems of companies significantly transform their business processes at the global level. The penetration of technologies into marketing and logistics opens up new horizons for companies, providing opportunities to increase efficiency, optimize processes and improve customer experience. However, the successful implementation and use of these

technologies requires significant effort, investment and competent risk management. Given that technologies continue to evolve rapidly, companies must be prepared for constant change and adaptation in a dynamic market. Features of technology penetration and their specificity in digital marketing and logistics of modern companies are consolidated and presented by the author in Table 2.

Table 2 Consolidation of features and specificity of technology penetration in digital marketing and logistics of modern companies

TECHNOLOGIES	TECHNOLOGY PENETRATION	
	DIGITAL MARKETING	LOGISTICS
ARTIFICIAL INTELLIGENCE (AI) AND MACHINE LEARNING (ML)	Artificial intelligence helps analyze customer behavior data, automate personalized advertising campaigns, and improve the accuracy of demand forecasting. For example, machine learning algorithms can recommend products based on individual user preferences or automatically optimize marketing campaigns across platforms, which reduces costs and increases conversion.	In logistics, AI and ML are used to optimize delivery routes, predict arrival times, and manage inventory. AI algorithms help improve warehousing, reduce order processing times, and reduce operating costs. This is especially useful for large companies with extensive supply chains, where automation and precise planning provide a competitive advantage.
INTERNET OF THINGS (IOT)	IoT technologies allow the collection and analysis of data from smart devices and sensors that consumers carry. This gives marketers information about how, when, and where products are used, allowing them to better tailor marketing strategies to customer needs.	IoT is actively used to track goods in real time, improve warehouse management and control transportation conditions. With the help of smart sensors and tags, IoT allows you to track the location and condition of goods, which is especially important for perishable or high-value goods. This helps to minimize losses, reduce risks and increase customer satisfaction.
BIG DATA AND ANALYTICS	Big data allows marketing departments to analyze a huge amount of information about customers and the market. Customer segmentation, predictive analytics and real-time behavior analysis are all made possible by big data technologies, which allow companies to make more informed decisions.	In logistics, big data helps analyze historical data, forecast demand and optimize the supply chain. This allows companies to better plan their resources, prevent shortages and manage risks associated with changes in demand and supply in the market [19].
BLOCKCHAIN	Blockchain technologies help build consumer trust as they provide transparency and data protection. For example, blockchain is used to verify the authenticity of goods, especially in areas such as fashion and pharmaceuticals, where customers want to be sure of the quality and origin of products.	In logistics, blockchain is used to track and protect data on the origin and routes of goods. This is important for companies with global supply chains, as the technology helps improve transparency, reduce the number of intermediaries and speed up the document management process.
AUTOMATION AND ROBOTICS	Automation helps marketers speed up processes such as advertising campaigns, collecting and analyzing data, communicating with customers through chatbots. Robotics of marketing operations allows you to quickly respond to customer requests and increase engagement.	Automation of warehouse processes, using robots and automated storage systems, significantly speeds up order processing and reduces personnel costs. Robots can perform routine tasks such as packing, sorting and transporting goods within the warehouse, freeing up employees for more complex tasks.
CLOUD AND SAAS	Cloud platforms allow you to manage marketing campaigns and interact with customers from anywhere in the world, providing access to data in real time. This is especially important for companies with international operations, where a single database and centralized management help maintain brand and marketing message consistency.	Cloud technologies in logistics are used to manage supply chains and interactions between all participants in the process - from suppliers to distributors. This helps reduce IT infrastructure costs, improve process flexibility and quickly respond to changes in supply conditions [20].

In considering the presented strategic goals, it should be noted that the implementation of technologies in marketing and logistics and flow or management of information is not only a way to increase efficiency and

reduce costs, but also a necessity to maintain competitiveness in the global market. Technologies open up new opportunities for personalizing services, improving logistics processes and increasing business flexibility in a

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dynamically changing external environment. However, the implementation of these technologies requires serious investments, a well-thought-out strategy and readiness to quickly respond to new challenges. The penetration of

technologies into the digital marketing and logistics system ensures the implementation of a number of strategic goals, which are presented in Figure 1.

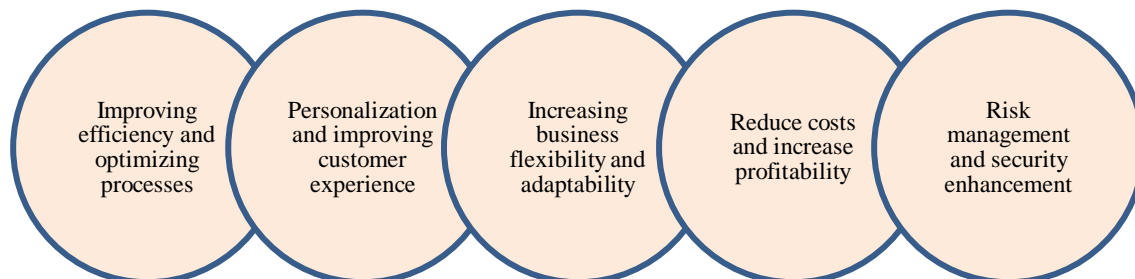


Figure 1 Strategic goals, the implementation of which in digital marketing and logistics depends on technologies

Technology enables marketers and supply chain management to increase efficiency, reduce costs, improve customer interactions, and minimize risks. However, its implementation is associated with a number of challenges, such as the need to scale and adapt to business needs, maintain data security, and train qualified personnel. Clearly, the penetration of technology into marketing and logistics leads to the fact that data becomes the main

strategic resource for a company, and the integration of technologies requires constant updating of strategies and adaptation to new market conditions. Based on this, it is conceptually necessary to formalize the advantages and disadvantages of technology penetration into digital marketing and logistics, thereby changing the rules of the game in global markets, which are presented in Table 3.

Table 3 Formalization of the advantages and disadvantages of technology penetration into digital marketing and logistics, which affect the change in the rules of the game in global markets

TECHNOLOGY PENETRATION	CHARACTERISTICS OF TECHNOLOGY PENETRATION IN MARKETING AND LOGISTICS
ADVANTAGES	
COST REDUCTION	Automation and optimization of processes can significantly reduce operating costs.
INCREASE IN SPEED AND ACCURACY	Technologies speed up processes in logistics, allowing for faster delivery of goods, and in marketing – more accurate targeting of the audience.
IMPROVED CUSTOMER EXPERIENCE	Personalized offers and improved service with the help of technologies increase customer satisfaction.
INCREASED COMPETITIVENESS	The use of modern technologies helps companies stay on the cutting edge of development and offer more efficient and innovative solutions.
TRANSPARENCY AND SECURITY	Technologies such as blockchain increase the level of trust and security in supply chains and data management [21].
DISADVANTAGES	
HIGH INITIAL INVESTMENT	Implementing new technologies requires significant capital investment in hardware, software, and staff training.
CYBER THREATS AND DATA SECURITY	With the increase in digital solutions comes the risk of data leaks and attacks on systems, which can lead to a loss of trust with customers and partners.
DEPENDENCY ON TECHNOLOGY	Complete reliance on automated systems can lead to serious disruptions in the event of technical problems or failures.
NEED FOR SKILLED LABOR	Effective use of technology requires highly skilled personnel, which can be a challenge for some companies, especially in the context of IT talent shortages.
INTEGRATION CHALLENGES	Integrating new technologies with existing systems can be complex and expensive, especially in larger organizations with legacy infrastructures [22].

The use of technology in digital marketing and supply chain management offers enormous opportunities to optimize processes, improve customer experience, and increase competitiveness [23]. However, each technology also carries risks that can affect the safety, reputation, and

efficiency of companies. The structuring of key risks caused by the penetration of new technologies into digital marketing and logistics, which radically changes the rules and conditions of the game in the global market for modern companies, is presented in Figure 2.

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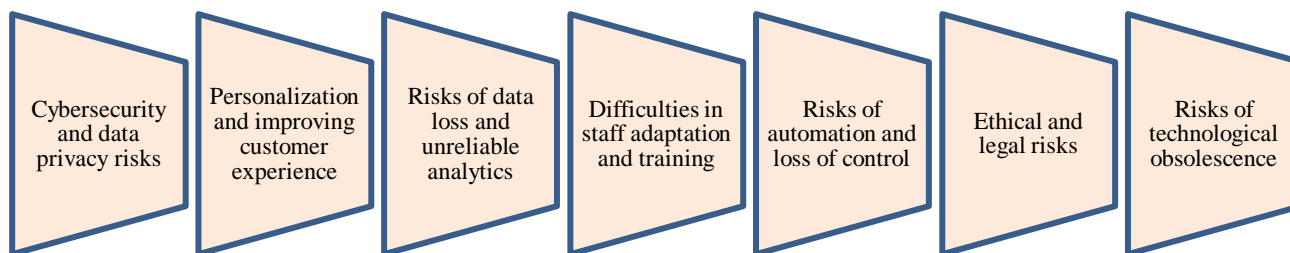


Figure 2 Structuring of key risks caused by the penetration of new technologies into digital marketing and logistics, which radically changes the rules and conditions of the game in the global market for modern companies

The risks associated with the penetration of technology into marketing and logistics are becoming increasingly significant as companies seek to integrate digital solutions to improve efficiency and customer engagement. At the same time, significant challenges arise related to data security, dependence on digital platforms and other factors that can affect the stability and sustainability of the business [24-25]. The risks associated with the implementation of technologies in marketing and logistics must be taken into account in strategic planning. A systematic approach to risk assessment and management will help companies maximize the benefits of digitalization

while minimizing potential threats to their reputation, sustainability, and competitiveness. Conceiving the presented, it should be noted that there is a global and intensive digitalization of the modern economy, which is caused by the penetration of new technologies into all sectors of companies' activities and the transformation of the rules of the game in the markets. Based on this, it is necessary to determine the main indicators of development trends and dynamics of technology penetration into digital marketing and logistics of companies, which are presented in Figure 3.

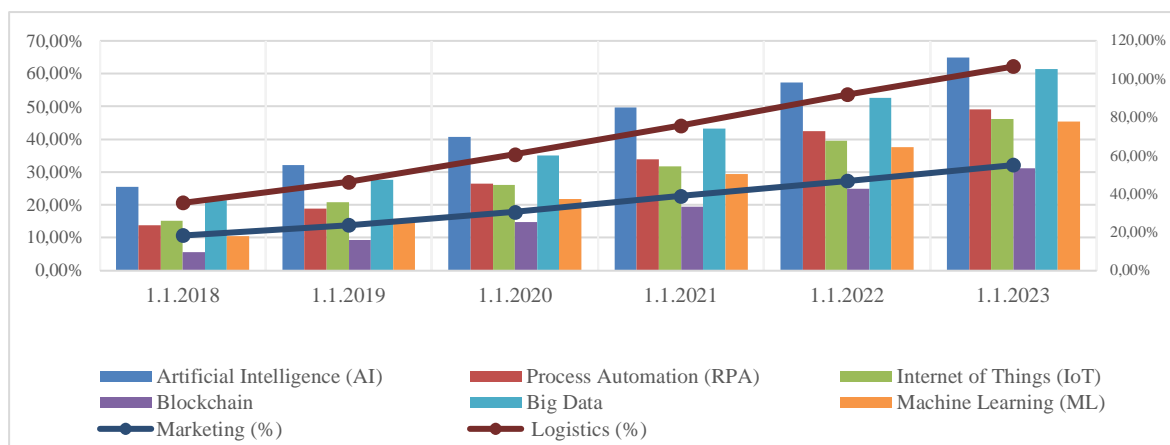


Figure 3 Main development trends and dynamics of technology penetration into digital marketing and logistics of companies, which radically change the rules of the game in the market

It is definitely worth noting that the use of AI in marketing and logistics is growing by 8-9% annually, indicating its significant impact on the processes of analysis and personalization. Automation is growing faster in logistics than in marketing, especially in warehouse and transportation management. The growth in 2023 was about 7% compared to the previous year. In logistics, IoT is actively used for real-time monitoring and supply chain management. In marketing, this technology is used to analyze customer data. Despite the low growth rate, blockchain is finding application in logistics to ensure supply chain transparency. In marketing, its use is associated with data protection and transaction security. Big Data and machine learning (ML) are technologies that provide deep analytics of customer data, helping companies predict demand and improve the accuracy of personalized marketing [25-27]. Growing rates of

advanced technology adoption indicate that companies are looking to integrate digital solutions to improve service quality and increase operational efficiency in marketing and logistics.

In arguing the presented, it should be noted that in order to identify all hidden dependencies and trends in the data, highlighting the main factors and components that have the greatest impact on processes in marketing and logistics and change the key rules of the game in the markets, it is necessary to implement the Principal Component Analysis (PCA) method. To assess the impact of technologies on digital marketing and logistics of modern companies using the principal component analysis (PCA) method, it is necessary to complete several key steps:

- Formulation of the problem and selection of variables. Determination of how technologies (automation, use of AI) affect key business indicators of modern

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companies in the digital marketing and logistics system. The variables used are technology implementation metrics: degree of automation, use of AI. Logistics indicators: delivery time, data processing speed. Business results: revenue growth, customer satisfaction.

- Collection of data on key metrics from real companies through open sources (annual reports, studies). Checking data for gaps, anomalies, as well as their normalization. Technological indicators: automation, use of AI, implementation of IoT. Market: market share, revenue growth. Logistics: order processing speed, delivery time.

- Data Standardization. Before conducting PCA, the data is standardized so that each variable has the same impact on the result. Build a covariance matrix. The covariance matrix shows the relationship between variables.

- Calculate eigenvalues and eigenvectors. Eigenvalues show the proportion of variance explained by each principal component. Eigenvectors determine the direction of the principal components.

- Project data onto principal components. Data is projected onto new axes (principal components) using matrix multiplication.

- Analysis of results. Proportions of explained variance: determine how important each component is. Projection values: allow you to compare companies with the impact of technology.

- Conclusions and recommendations. Which technologies have the greatest impact on company results. Where companies are losing efficiency. How key indicators can be improved using technology [26-27].

Clearly, the use of the PCA methodology allows us to identify which technological factors (automation, AI, blockchain, and others) have the most significant impact on the rules of the game in the digital marketing and logistics market. To substantiate the role and sorption of the influence of technologies on changes in the rules of the game in the digital marketing and logistics management markets [28], the following initial data were determined, using the example of world-class companies, which are presented in Table 4.

Table 4 Structuring of initial data for assessing the impact of technologies on changes in the rules of the game in the digital marketing and logistics market of modern companies

COMPANY	AUTOMATION (%)	PROCESSING SPEED (MIN)	AI USAGE (SCORE)	DELIVERY TIME (HOURS)	REVENUE GROWTH (%)
AMAZON	95.00	45.00	9.00	2.10	22.00
WALMART	85.00	60.00	8.00	3.20	15.00
ALIBABA	90.00	50.00	10.00	2.50	20.00
FEDEX	80.00	70.00	7.00	3.80	12.00
DHL	88.00	55.00	8.00	3.00	18.00

Standardization of data for assessing the impact of digital marketing and logistics market of modern technologies on changing the rules of the game in the companies is presented in Table 5.

Table 5 Standardization of data for assessing the impact of technologies on changing the rules of the game in the digital marketing and logistics market of modern companies

COMPANY	Z (AUTOMATION)	Z (PROCESSING SPEED)	Z (USE OF AI)	Z (DELIVERY TIME)	Z (REVENUE GROWTH)
AMAZON	1.48	-1.28	0.59	-1.40	1.29
WALMART	-0.53	0.46	-0.39	0.48	-0.68
ALIBABA	0.48	-0.70	1.57	-0.72	0.73
FEDEX	-1.52	-1.63	-1.37	1.51	-1.52
DHL	0.08	-0.12	-0.39	0.14	0.17

Based on this, projections were calculated through matrix multiplication of standardized data by eigenvectors, which are presented in Table 6.

Table 6 Projections of matrix multiplication of standardized data by eigenvectors for assessing the impact of technologies on changing the rules of the game in the digital marketing and logistics market of modern companies

COMPANY	PC1	PC2	PC3	PC4	PC5
AMAZON	-2.73	-0.59	-0.11	-0.04	~0.00
WALMART	1.14	0.08	-0.12	0.12	~0.00
ALIBABA	-1.84	0.92	0.04	-0.02	~0.00
FEDEX	3.38	0.00	-0.03	-0.09	~0.00
DHL	0.06	-0.41	0.22	0.03	~0.00

In conceptualizing the presented, it should be noted that the application of the principal component method tools is characterized by its significance, which is determined by the following:

- Multidimensionality of data: Modern digital marketing and logistics cover many metrics (automation, delivery speed, AI). PCA allows you to reduce a large number of variables to a smaller number of key factors.
- Reduction of dimensions: Reducing the number of variables without losing meaningful information simplifies analysis and allows you to identify the main drivers of changes in the market.
- Identification of hidden dependencies: PCA helps to reveal complex relationships between technologies and business results that are not obvious in traditional analysis [29].

The PCA results show that process automation and AI implementation have the greatest impact on company metrics, including processing speed, delivery time, and revenue growth. This is supported by the fact that the first principal component (PC1) explains 94% of the data variation, reflecting the importance of these technologies for business. Clearly, advantages for companies with high technological maturity: companies such as Amazon and Alibaba actively use automation and AI technologies, which allows them to achieve high performance in all key indicators: processing speed, revenue growth, and customer satisfaction. The role of logistics and its relationship with technology: Although logistics also has an impact on business metrics, its effect is limited without the support of technology. Delivery time and order processing speed play an important role, but these factors acquire significance only in the context of integration with high technologies. Therefore, innovation changes competitive strategies: The implementation of advanced technologies such as automation and AI is a game changer in the market. Companies that actively implement these technologies gain competitive advantages in terms of speed, accuracy, service quality and, as a result, revenue growth [30]. Lagging behind the technology race brings risks: Companies that do not take technological changes into account may face difficulties related to insufficient logistics and marketing efficiency. For example, companies with low levels of automation (e.g., FedEx and DHL) risk falling behind competitors unless they implement new technologies to optimize their operations. Diversify approaches depending on the industry: Technologies have different levels of impact in different markets (e.g., e-commerce, logistics and retail). For example, in e-commerce (Amazon), automation and AI play a decisive role, while in logistics (FedEx, DHL), a combination of technology and traditional operational efficiency is important. Companies that want to remain competitive must continue to invest in process automation and AI development. The use of AI for demand forecasting, route optimization and improving customer

experience will play an increasingly important role. The PCA results highlight the need for agility in business strategy. To keep up with technological changes, companies must actively monitor trends and adjust their business processes accordingly. With the development of the Internet of Things (IoT), 5G, autonomous vehicles, and blockchain technologies, changes in logistics will occur much faster. These technologies will allow for even more automation of processes, increase their transparency, and speed up delivery. Based on the results of the study, it should be argued that the main recommendation for companies is to actively invest in technologies that can improve their logistics and marketing processes. This will not only increase efficiency, but also provide better conditions for revenue growth and improved customer service. It is important to create strategies that can be adapted to rapidly changing market conditions. Understanding how technology can change the process will give the company flexibility in decision-making.

4 Conclusions

Digital marketing and logistics have become central elements of modern business strategies, and their integration with new technologies forms the basis for competitive advantages in the global marketplace. Recent years have seen a sharp increase in the implementation of advanced technologies in these areas, which has increased the need to analyze them and understand their impact on business success. It is argued that the introduction of technologies such as artificial intelligence (AI), process automation and the Internet of Things (IoT) radically changes the way companies interact with customers and manage logistics processes. The transition to more automated and intelligent systems allows for a significant reduction in order processing time, increased forecast accuracy and improved service quality. It is substantiated that in conditions where technologies are rapidly changing the market, companies need to promptly respond to these changes and adjust their strategies. Without the introduction of modern technologies, one can expect a loss of competitiveness. It is stated that in order to ensure business sustainability in the long term, it is important not only to effectively integrate technologies into operational processes, but also to take into account their impact on consumer preferences and market trends. This creates new challenges for businesses, including the need to fine-tune marketing and logistics strategies.

The principal component analysis (PCA) method was chosen to analyze the impact of technologies on digital marketing and logistics because it allows for the efficient processing of complex multivariate data and the identification of the most significant factors that determine changes in the market. According to the PCA results, technologies such as automation and artificial intelligence have the greatest impact on business results. The implementation of these technologies can significantly

improve key metrics such as data processing speed, delivery efficiency, and revenue growth.

The results of the analysis show that logistics itself is an important aspect of business, but its efficiency increases many times when integrated with advanced technologies. Companies that have not adopted advanced technologies such as AI or automation face the risk of reduced efficiency. An example of this would be companies with highly efficient logistics but without modern technologies, which could lead to a loss of competitiveness in the future. With the development of new technologies such as 5G, blockchain and autonomous systems, the future of digital marketing and logistics looks even more dynamic. The integration of these technologies will not only speed up processes, but also create new opportunities to improve service quality and personalize offers. In the coming years, we can expect a significant increase in the use of AI to predict customer needs, as well as the use of autonomous vehicles and robotics to optimize logistics operations.

Companies must invest heavily in new technologies, such as automation and AI, to remain competitive and drive revenue growth. Implementing these technologies will improve logistics and marketing efficiency, improve customer service, and reduce costs. To successfully adapt to market changes, companies must be prepared to continually update their strategies in response to technological changes. This requires flexibility and speed of decision-making.

Synergy between technology and operational efficiency will allow not only to implement new technologies, but also to integrate them into the company's existing operational processes. Combining innovation with traditional management methods will allow achieving maximum efficiency. However, the implementation of technologies requires significant investment and adaptation of business strategies. One of the challenges remains the problem of the high cost of switching to new systems, as well as the need for staff training. In addition, with increasing dependence on technology, the risk of cyber-attacks and data leaks increases. Therefore, it is necessary to find a balance between innovation and risk to ensure sustainable growth and business security.

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