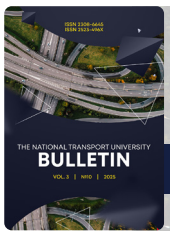

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Anti-crisis strategies and modern technologies in sustainable project management

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Abstract. The increasing frequency and complexity of economic, infrastructural, and geopolitical crises has significantly increased the need for effective crisis management in project-oriented enterprises. This is particularly true in the transport sector, which is sensitive to external changes. In conditions of increased uncertainty, traditional management approaches often prove insufficient, requiring the use of innovative and flexible solutions. The purpose of this study was to justify modern approaches to anti-crisis management based on the use of digital technologies within the framework of sustainable project management. The research methodology was based on systematic and comparative analysis, synthesis, statistical analysis, data visualisation, and scenario modelling, which together provide a comprehensive assessment of anti-crisis management processes. It has been established that the use of data analytics, artificial intelligence, cloud computing, and digital platforms contributes to early crisis detection, risk assessment, and rapid response. These technologies enable enterprises to process large amounts of data in real time, improve forecasting accuracy, accelerate management decision-making, and optimise the allocation of limited resources. An analysis of statistical data for Ukraine's transport sector for 2022-2024 showed the growing adaptive potential of companies undergoing digital transformation, particularly in response to the challenges of wartime and the post-crisis period. The results of the study confirmed that the integration of digital technologies into anti-crisis management systems increases organisational potential, ensures the continuity of project implementation, and contributes to the achievement of sustainable development goals. The practical significance of the study lies in the possibility of applying the results in the activities of transport enterprise managers, government authorities, and other

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stakeholders involved in infrastructure and investment projects, which will contribute to the development of more sustainable and stable transport systems

Keywords: digital technologies; prevention; decision making; business analytics; stakeholders; risks

Introduction

Companies operating in unstable economic conditions face increased uncertainty and risks and need to develop effective anti-crisis strategies. In the transport industry, these challenges are exacerbated by damage to infrastructure, logistics disruptions, and financial constraints. Scholarly research, in particular T. Balanovska *et al.* (2020), O.M. Girzheva *et al.* (2024) and V. Huriev (2024), highlighted the growing role of digital technologies in strengthening organisational resilience. Nevertheless, their application to sustainable project management in Ukrainian transport companies remains underexplored. Anti-crisis management of an enterprise's economic sustainability should be conceptualised as an integrated system encompassing both internal and external dimensions. In order to develop and implement innovative projects while ensuring their stable functioning, Ukrainian enterprises are adopting adaptive strategies, including market diversification, reduced import dependence, innovation and technological advancement, the integration of digital technologies within broader digitalisation processes, and the strengthening of corporate social responsibility practices. Under such conditions, the implementation of effective anti-crisis strategies becomes imperative to anticipate potential risks, prevent crisis situations, mitigate their adverse effects, and ensure the rapid recovery and continuity of enterprise operations. Enterprises operating within a market environment inherently face conditions of uncertainty and risk. In the context of economic instability, the intensity of these factors increases, potentially leading to a decline in organisational efficiency and the emergence of crisis situations. Such crises may arise both in interactions with stakeholders and in the framework of public-private partnerships, particularly in the field of transport infrastructure. Commercial enterprises interact with other organisations, suppliers, consumers, banks, tax authorities and stakeholders, each of which has its own potential and development cycles that may not coincide with the general economic cycles.

The evolution of a company is determined by changes in its activities, technologies, personnel, products, services, etc. These changes are dual in nature, as they can be both positive and negative. Positive changes are reflected in the improvement of the quality of goods and services, which enhances the stability and harmony in the company's operations through increased productivity, the introduction of new technologies, and increased staff motivation. As noted by K. Ivanchenko & O. Bilovodska (2024), adverse changes can cause instability within a company, manifested in a misalignment between its current operational interests and long-term development objectives, ineffective management practices, or the persistence of obsolete technologies. Such negative transformations serve as indicators of an emerging organisational crisis. Accordingly, it is essential to examine the evolution of anti-crisis strategies and the integration of digital technologies into sustainable project management under conditions of ongoing change. T.I. Balanovska *et al.* (2020) focused on the importance of employees' digital competencies in increasing the flexibility of enterprises during crises and spreading the latest technologies among society. Full use of their capabilities is impossible without the constant growth of digital competence, and the formation and development of digital competence among potential and current employees requires their approximation and adaptation to global practices. O.M. Girzheva *et al.* (2024) argued that the main goal of crisis management at the stage of crisis development is to restore the financial stability and solvency of the enterprise, as well as to minimise possible losses. The study by V. Huriev (2024) examined the integration of digital technologies as a component of the anti-crisis management mechanism to ensure regional stability and development. It investigated the impact of digitalisation on enhancing the efficiency of management processes, accelerating decision-making, and implementing measures aimed at mitigating crisis phenomena.

The use of digital technologies to optimise business development management is the subject of a study by O.S. Druhova (2024). The study described the main digital technologies that influence business development management and project management sustainability. This optimises existing business processes and increases employee motivation to implement new technologies and processes. K. Voloschuk *et al.* (2021) explored the theoretical aspects and practical specific tools for resolving crisis situations in the system of anti-crisis management of an enterprise. The integration of digitalisation into the business processes of anti-crisis management of an enterprise contributes to the timely prevention of financial, operational (production), personnel, and marketing crises. I. Plikus (2021) substantiated the role of AI (artificial intelligence), Big Data, and machine learning in the formation of digital tools for crisis management in business processes. This allows companies to significantly reduce operating costs for their business and become customer-oriented by creating personalised services and products. O.Yu. Sokhatskyi & O.D. Zakharov (2025) considered the risks for international business in the context of military conflicts, which necessitates the implementation of effective crisis management strategies. Effective crisis management helps minimise negative consequences, but also helps maintain business reputation and partner trust even in the most difficult conditions. Scientists I.V. Tokmakova *et al.* (2022) considered anti-crisis strategies that use digital technologies, which subsequently change both

management processes and the business model of the enterprise itself, with the aim of ensuring the sustainability of project management.

One of the current areas of research is the study of the peculiarities of the implementation of digital technologies in the activities of Ukrainian enterprises. Given the specific nature of the impact of various types of risks that lead to crises, it is necessary to develop effective anti-crisis management strategies. In addition, it is necessary to take into account the importance of public-private partnerships, as they play an important role in the restoration and reconstruction of Ukraine's infrastructure, help minimise risks, and ensure the sustainable development of enterprises in the context of digital transformation. The results of such research can be useful for developing effective business strategies in the context of digitalisation and project management in the transport industry.

The purpose of this study was to theoretically substantiate and develop a comprehensive mechanism for digital anti-crisis management of transport enterprises of Ukraine. Research objectives included:

1. To conduct a comprehensive theoretical analysis of contemporary approaches to anti-crisis management and to substantiate directions for their improvement under modern economic challenges, including the development of an integrated crisis management mechanism for enterprises.

2. To investigate the potential of public–private partnerships as an effective instrument for ensuring business resilience in crisis conditions and to justify their role within sustainable economic development frameworks.

3. To substantiate the role of digital technologies in strengthening anti-crisis response strategies and to develop a conceptual framework for strategic crisis information and analytical centres aimed at enhancing managerial decision-making, ensuring flexible risk response, and restoring enterprise stability.

Materials and Methods

The object of the study was the process of anti-crisis management at transport enterprises in conditions of economic instability and military risks. The subject of the study was the use of digital technologies to ensure the sustainability of project management at transport enterprises, including tools of business analytics, big data analytics, AI, cloud computing and digital financial diagnostics. The study was based on a systemic and risk-oriented approach, according to which anti-crisis management is considered as a cyclical and adaptive process that integrates risk identification, analysis, strategic decision-making, their implementation, monitoring and feedback correction. The study included theoretical generalisation and empirical analysis of transport sector indicators for 2022-2024. The analysis was based on the following regulatory documents: Law of Ukraine No. 1351-r (2025) and Law of Ukraine No. 4510-IX (2025). A combination of quantitative and qualitative methods was employed to ensure methodological validity, and statistical techniques were applied to assess the dynamics of passenger and freight transport over the specified period. Time series analysis made it possible to identify trends, patterns, and fluctuations in transport performance indicators: phases of decline caused by infrastructure destruction and logistical disruptions; recovery trends associated with the development of alternative routes and digital logistics solutions; structural shifts in transport efficiency indicators. Descriptive statistics and year-on-year comparative assessment were used to determine growth rates and deviations.

Comparative analysis was employed to evaluate traditional and digital approaches to crisis management, compare financial diagnostic models such as the modified Altman and Springate models, and examine the distinctions between reactive and proactive crisis management systems. This approach enabled the identification of the advantages associated with integrating digital technologies into crisis response mechanisms. To assess the risks of financial stability, bankruptcy prediction models were considered, in particular the modified Altman model and the Springate model. These models were analysed as components of digital information and analytical centres for crisis prevention and liquidity forecasting. The study uses the classification of data analysis methods: descriptive analytics (analysis of past transport dynamics); diagnostic analytics (determination of cause-and-effect relationships); predictive analytics (forecasting risk scenarios); prescriptive analytics (selection of optimal response strategies). Methods such as regression modelling, simulation modelling, time series forecasting were considered as tools used in transport enterprises. Scenario modelling was employed to explore alternative development trajectories under conditions including the risks of military escalation, infrastructure disruptions, fluctuations in export logistics, and variability in investment inflows within the framework of public-private partnerships. This approach allowed for the assessment of potential outcomes and the identification of strategies to enhance enterprise resilience in uncertain and dynamic environments. A cyclical risk management model was applied, encompassing risk identification, probability assessment using elements of probability theory, impact evaluation, the development of mitigation strategies, and feedback-based performance assessment. In addition, data visualisation tools were employed to interpret transportation trends and to illustrate structural changes in passenger and freight volumes.

Results and Discussion

Anti-crisis management technologies are a set of measures aimed at implementing a mechanism of influence on the system in order to prevent, mitigate, or overcome various types of crisis situations and ensure effective management of transport enterprises, prevention, and assessment of risk consequences. The main areas of anti-crisis management at the organisational level are constant monitoring of its condition, development of new management, financial, and marketing strategies, as well as strengthening work with personnel. Anti-crisis management uses a set of methods from various fields of management: social

technologies, economic analysis, forecasting, development of investment projects, anti-crisis programmes, etc. Anti-crisis management is based on scientific knowledge, innovative solutions for employee interaction, rights and responsibilities at all levels of the enterprise hierarchy, as well as analysis of practical experience in optimising system regulation mechanisms and identifying hidden opportunities for potential development. It requires making complex management decisions in conditions of limited financial resources, high uncertainty, and risk. In such conditions, there is a growing need to act quickly, timely, competently, and responsibly. (Kompanets *et al.*, 2022; Porfirenko *et al.*, 2025). The process of anti-crisis management in transport companies is complex and systematic, aimed at preventing and eliminating adverse events, ensuring a gradual recovery from the crisis, and maintaining the ability to function effectively in a market economy. This process involves making complex management decisions at every stage, from data collection to the implementation of the final decision (Fig. 1). Therefore, there is a need to introduce modern information technologies to ensure the effectiveness and soundness of decisions, especially in forecasting and overcoming crises at enterprises. This also contributes to the comprehensive use of simulation modelling, intelligence, and the experience of decision-makers.

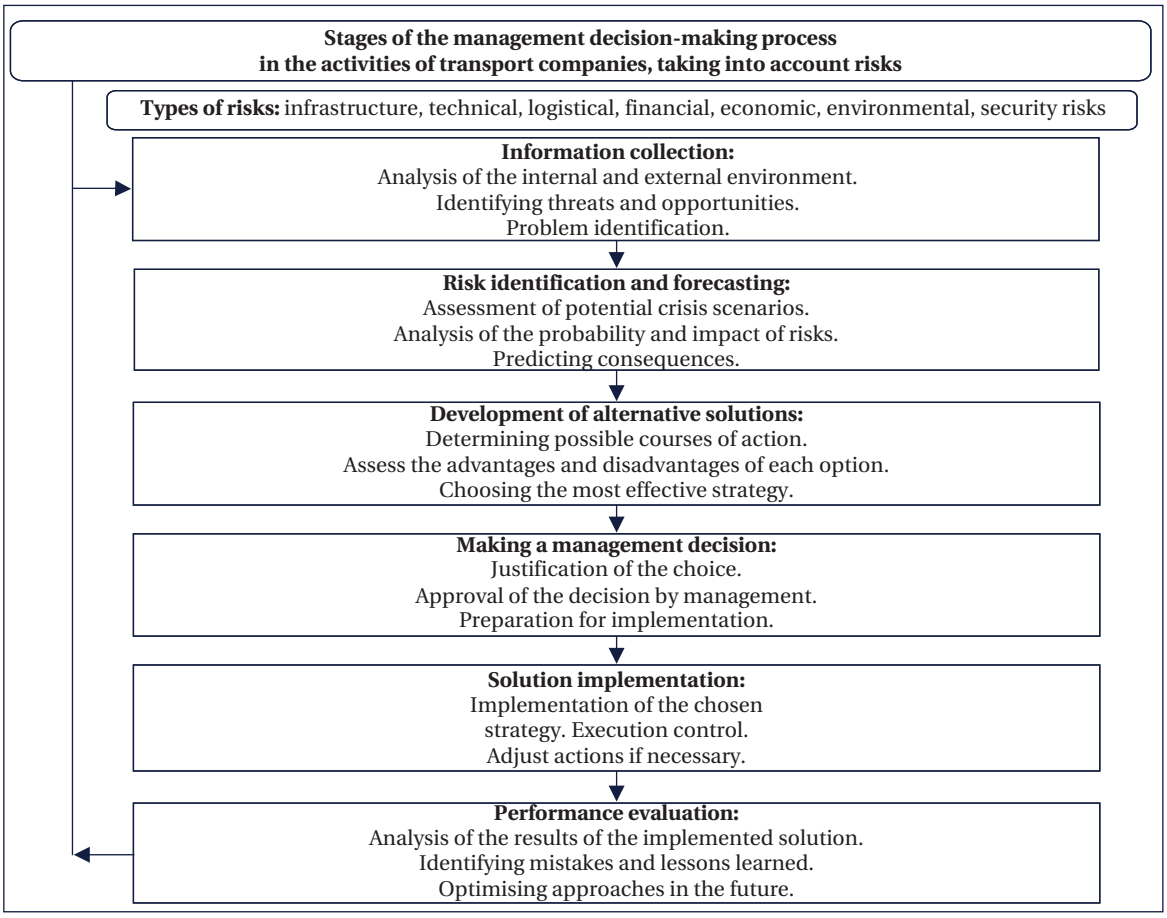

Figure 1. The procedure for making managerial decisions in the context of anti-crisis management
Source: developed by the authors according to K. Kompanets *et al.* (2022), V.I. Porfirenko *et al.* (2025)

Digital technologies are actively being implemented in various sectors of the economy, in public-private partnerships, and in interactions between stakeholders. This evolution necessitates the adaptation of management approaches, the development of new business models, and the implementation of innovative strategies to increase competitiveness. According to McKinsey research, about 89% of companies have initiated digital transformation processes, but only a small proportion of them have fully achieved their planned results (Zaika & Zaika, 2024). Law of Ukraine No. 1351-r (2025) defines priority tasks within the framework of the National Economic Strategy until 2030. In particular, it aims to ensure access for small and medium-sized businesses to modern technologies such as broadband Internet, the Internet of Things, and big data. The strategy outlines the main directions of the country's digital transformation, focusing on supporting innovation, cooperation with business and international partners, developing digital infrastructure, and encouraging the use of information technologies in public and economic life. This document is a strategic policy at the government level, where digitalisation acts as a driving force for development, directly linked to potential public-private partners in the digital sphere. According to the Law

of Ukraine No. 4510-IX (2025), public-private partnerships can be used in various areas, including transportation and transportation infrastructure, electronic communications network infrastructure, education, scientific and scientific-technical activities, tourism, etc. The law provides a regulatory framework for the legal consolidation of digital solutions in the management of public-private partnerships (including electronic tendering, record keeping, data publication, etc.). In the field of public-private partnerships, digital technologies play a key role in streamlining processes, improving project financing and monitoring mechanisms, and strengthening trust between the parties involved. Through cooperation with stakeholders, digital transformation improves access to information, expands opportunities for attracting investors, and strengthens interaction between all participants (stakeholders). Digitalisation processes have become indispensable factors in ensuring the sustainability of project management and business development. They mitigate the negative effects of crises, open up new dimensions of strategic management, and promote innovative growth. In addition, they help optimise operational procedures, improve communication between partners, and increase the transparency and efficiency of decision-making.

The model of risk-based management of transport companies presented in the figure reflects a logically consistent and cyclical process of management decision-making based on systematic risk analysis, development of alternatives, and performance evaluation. The presence of a feedback mechanism ensures the adaptability of the management system to changes in the external environment and increases its stability. The challenges caused by the COVID-19 pandemic in 2019-2020 and the full-scale war in Ukraine since 2022 have significantly changed the established dynamics of business operations and business processes. These crises have led to a transformation of approaches to management, logistics, digitalisation, and strategic planning in such areas of the economy as public-private partnerships, trade, transport and road infrastructure, services, and education, which have also suffered significant economic losses. At the same time, these events have become a catalyst for active digital development in these industries. These transformations have significantly affected the activities of companies of various sizes and geographical locations. In today's environment, the use of digital technologies and modern management tools is seen by businesses as a necessary prerequisite for ensuring effective and uninterrupted operations.

Ukraine's digital transformations in the context of full-scale war are focused on increasing inclusiveness, developing digital literacy, and strengthening cybersecurity at all levels (Table 1). Technology plays a crucial role in enhancing citizens' quality of life, optimising management processes, and stimulating economic growth. Digital tools, including AI, cyber defence, and data analysis, are increasingly being integrated into the country's defence capabilities. Such transformations are a key mechanism for achieving economic stability, strengthening defence capabilities, expanding international cooperation, and establishing Ukraine's digital sovereignty. Thus, 2019-2021 marks a fundamental stage in the launch of state-level digital services. In 2022-2023, the war became a catalyst for the active implementation of digital solutions in government processes and business operations. 2024-2025 saw significant achievements in the implementation of digital infrastructure, international recognition, and the creation of national strategies.

Table 1. Development of digital processes in Ukraine in 2019-2025

Year	Key events/initiatives	Digital transformation trends
2019	Active launch of the "state in a smartphone" idea and announcement of the creation of mobile services	Initial phase of digitalisation, formation of basic strategies
2020	COVID-19 accelerates demand for digital services, remote work, and online business processes	A push for digital solutions in the public and private sectors
2021-2022	Government services, registries, and e-services begin to be more widely used by citizens and businesses	Increased availability of e-services; institutional implementation of digital platforms
2023	Transformation of digital services in wartime: adaptation of actions and online solutions for economic resilience	Active integration of digital tools into critical processes
2024	Development of digital skills, modernisation of registries and data exchange; improvement of cybersecurity	Deepening of digital competencies in the public sector
2025	Approval of the Digital Innovation Development Strategy (WinWin) until 2030	–
	Focus on AI strategy and the development of innovative technologies	Significant strengthening of the digital ecosystem; transition to global standards and international indicators; active partnership

Source: Digital transformation of Ukraine's economy… (2026)

Thus, 2019-2021 marks a fundamental stage in the launch of state-level digital services. In 2022-2023, the war became a catalyst for the active implementation of digital solutions in government processes and business operations. 2024-2025 saw significant achievements in the implementation of digital infrastructure, international recognition, and the creation of national strategies. Among the key state digital initiatives implemented in Ukraine prior to the full-scale war, particular attention is given to their objectives and areas of application. The Diia application was created as a unified digital platform providing citizens with access to public services in electronic form. Its scope includes the use of electronic documents (digital passport and driver's license), access to government services, and direct communication with public authorities. The eSupport Programme was

introduced to provide targeted financial assistance to citizens in digital form, including subsidies and other types of social payments. Its scope covers social assistance, support for low-income households, and the automation of payment processes. Diia.Education was launched to facilitate distance learning and enhance citizens' digital literacy. The platform provides access to educational services, professional development courses, and online training programmes. Diia.Open Data ensures transparent public access to government data for citizens and businesses. Its scope includes open public datasets, analytical tools, and the development of applications based on open data. Diia.Business aims to simplify administrative procedures for entrepreneurs through electronic services. The platform supports business registration, tax services, licensing procedures, and electronic reporting. The eHealth system was developed to digitise healthcare services and introduce electronic medical records. Its scope includes medical information management, electronic prescriptions, patient records, and telemedicine services. The eVeteran platform provides digital services tailored to veterans, taking into account their benefits and social guarantees. It facilitates access to social support measures and state benefits. The eDeclaration system introduced an electronic mechanism for submitting income and asset declarations by public officials. Its scope relates to anti-corruption policy, transparency, and income control. The eRegistration system enables the digital registration of legal entities, real estate, and other types of property. It supports registration services and the automation of state registries. The Ukrainian Railways e-Portal provides electronic services for purchasing tickets, planning trips, and managing train traffic. Its scope includes transport services, logistics, and communication with passengers. The eTicket system was introduced to implement electronic ticketing in public transport. It facilitates fare payment, automated control, and improved convenience for passengers. The ProZorro electronic procurement system ensures transparency and efficiency in public procurement. Its scope includes state tenders, procurement procedures, and monitoring of public expenditures.

The Paperless initiative promotes the transition to electronic document management within public institutions. It aims to optimise administrative processes, improve document circulation, and enhance overall management efficiency. Other electronic documents in the process of digitisation – conversion of a wide range of state services and documents into digital format. Scope of application: all areas of public administration, communication, social security. These initiatives are government projects aimed at creating a modern, transparent, and convenient system of electronic services for citizens, businesses, and government agencies. They cover key areas of public life – from education and health to the economy, social protection, and infrastructure – and contribute to Ukraine's digital transformation. Companies are faced with the task of developing a comprehensive strategy for transforming their activities in order to effectively prevent and manage crises in conditions of instability. The use of digital tools in business contributes to increasing the resilience of enterprises, helping to prevent crises or quickly overcome them in various industries (Voloschuk *et al.*, 2021). The implementation of anti-crisis measures in organisations requires a comprehensive approach that includes an analysis of project implementation experience, particularly in the field of public-private partnerships. This takes into account the impact of risks, sustainable development, digitalisation, and big data analysis to adapt strategies to current business conditions. The interrelationship between the elements of the crisis management process is shown in Figure 2.

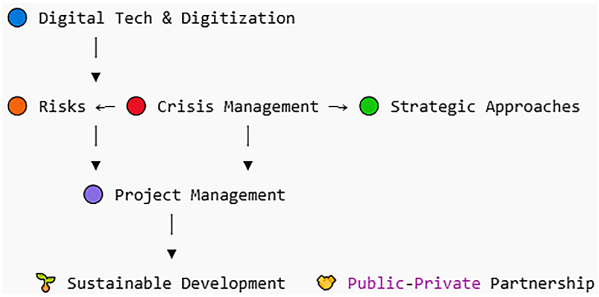

Figure 2. Diagram of the relationship between key concepts of crisis management
Source: developed by the authors

An analysis of Figure 2 indicates that crisis management functions as the central element coordinating the other components of the system. Digital technologies and digitalisation are tools that facilitate effective risk, project, and strategy management. Risks are challenges that need to be identified and minimised with the help of digital solutions. Strategy defines long-term approaches to crisis management and sustainable development. Project management is a system for coordinating crisis management activities using digital technologies. Sustainable development is the ultimate goal, achieved through effective crisis management, digitalisation, and public-private partnerships. Public-private partnerships are a mechanism that facilitates the implementation of digital crisis management strategies. The goal of sustainable development is achieved through effective crisis management, digital integration, and public-private partnerships, which act as catalysts in the implementation of digital crisis management methodologies. In a world where there is an abundance of information, it is extremely important to be able to quickly find, analyse, and apply the most relevant data. The excessive flow of information creates both new opportunities and challenges: the need for effective filtering, accuracy verification, and strategic use of the knowledge gained. Therefore, governments and companies can model different scenarios, identify potential threats, and respond to them in a timely manner using big data analysis. The application of probability theory in the management of business processes of transport companies facilitates the selection of transport routes, time planning, and risk

assessment in finance, insurance, and other areas; assessment of the practical limitations of probability theory, especially in conditions of high uncertainty or unreliable information (Khobta *et al.*, 2025). AI automates complex processes, allowing for faster and more accurate analysis of information, while cloud technologies provide accessibility and flexibility in data storage and processing. The speed and accuracy of decision-making are becoming critical factors for success, and the integration of these technologies not only reduces the negative effects of crises but also builds more resilient and adaptive management systems. In this context, modern technologies such as data analytics, AI, and cloud computing are moving beyond their traditional role as simple tools for optimising business or improving everyday life. Instead, they serve as fundamental mechanisms for addressing and mitigating global crises in the economic, social, political, environmental, medical, and transportation spheres.

Under conditions of instability, organisations increasingly rely on advanced technological solutions to strengthen adaptive capacity, improve responsiveness to dynamic changes, and support evidence-based decision-making. Data analytics, in this context, functions as a key instrument for retrospective assessment and predictive modelling of future trends. As noted by O.M. Veres & R.M. Olyvko (2017), Big Data Analytics is applied to large and complex datasets; Discovery Analytics focuses on identifying patterns and hidden relationships within data; and Exploratory Analytics is aimed at explaining and interpreting data and analytical models. Data analytics is the process of collecting, processing, and interpreting large volumes of data to identify patterns, trends, and correlations that can inform evidence-based decision-making. In the context of crisis management, data analytics enables to:

1) understand the past, as data analytics allows organisations to examine historical data, identify trends and patterns, which helps to understand how past decisions have affected outcomes;

2) identify early warning signs: by analysing data from various sources (social media, financial reports, sensors, etc.), it is possible to detect the first signs of potential crises, such as epidemics, natural disasters, economic downturns;

3) predict the development of the situation: using statistical models and machine learning, it is possible to predict how the crisis will develop, what its consequences will be, and what measures should be taken. It will be much easier to predict future events, allowing them to be more proactive in their strategy;

4) optimise resources: data analysis can help identify inefficient processes and find ways to improve them, allocate resources more efficiently, focusing on the highest priority tasks (Davenport, 2017; Kompanets & Ilchenko, 2025).

The volumes of passenger and freight transportation to Ukraine in 2022, 2023, and 2024 across all modes of transport were analysed (Fig. 3).

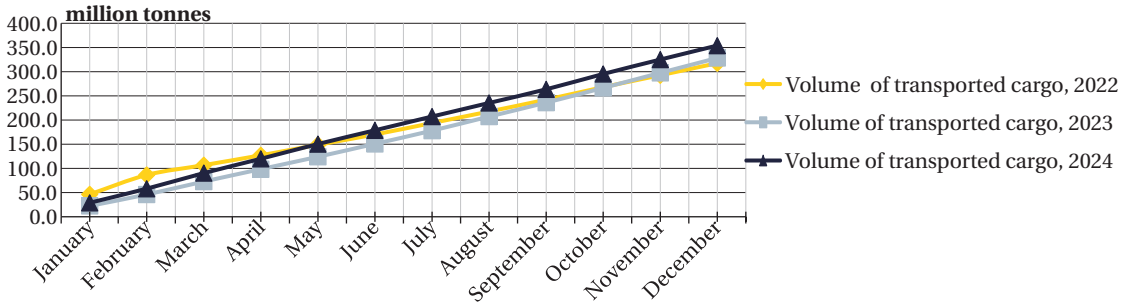

Figure 3. Dynamics of cargo transportation volumes in Ukraine for 2022-2024
Source: developed by the authors according to State Statistics Service of Ukraine (2025a; 2025b; 2025c)

The study findings indicate that in 2022 there was a significant decline in the volume of freight transportation due to the destruction of logistics routes and infrastructure, as well as the blockade of seaports. In 2023, transportation volumes partially recovered due to the creation of alternative delivery routes (rail and road) and the development of the grain corridor. The growth in transportation in 2024 is attributed to the restoration of infrastructure, growth in humanitarian cargo, agricultural exports, and the expansion of partnerships with European countries. Figure 4 shows that the number of passengers transported in 2022-2024 is 209.4 million passengers at the beginning of 2022, and at the beginning of 2023 there is an increase to 1,600.6 million passengers. The annual increase amounted to 1,391.2 million passengers, with the highest growth rates observed during the period from July to December 2022. Analysis of statistical data shows that the transportation system continues to improve. 2023 showed further improvement, but started from a lower level. At the end of the year, the indicators exceeded the level of 2022. Therefore, in the context of military operations, detailed analysis of large amounts of data and the use of business intelligence in transportation services has become a key tool for optimising logistics processes, allowing to assess the efficiency of routes, forecast costs and profitability. Figure 5 shows the methods of big data analysis, which are classified according to the functional relationships and the formal model of this information technology:

1) descriptive analytics provides information about what happened in the past. Statistical methods are used to describe the data;

2) diagnostic analytics – this method helps to understand why something happened by studying cause and effect relationships;

3) predictive analytics uses historical data to predict future events; various models are used, such as regression and machine learning;

4) prescriptive analytics – this method not only predicts, but also offers solutions to optimise the results (Fedorov, 2025; A marketer's guide to descriptive…, 2025; Singh, 2026).

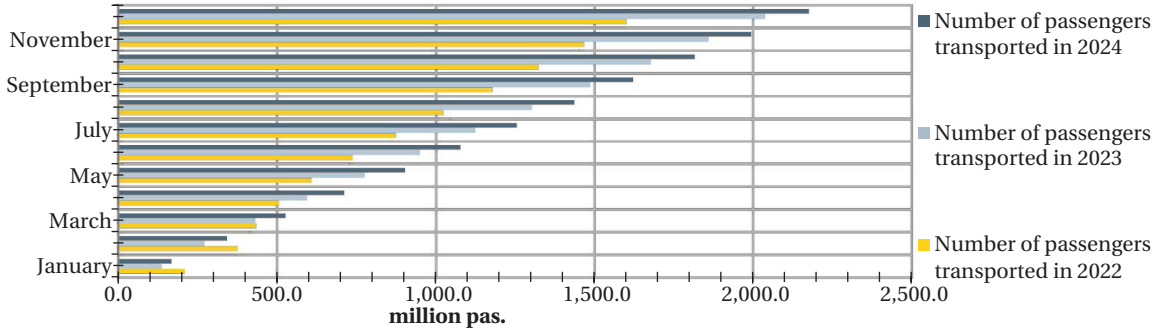

Figure 4. Dynamics of passenger transportation volumes in Ukraine for 2022-2024
Source: developed by the authors according to State Statistics Service of Ukraine (2025b; 2025c)

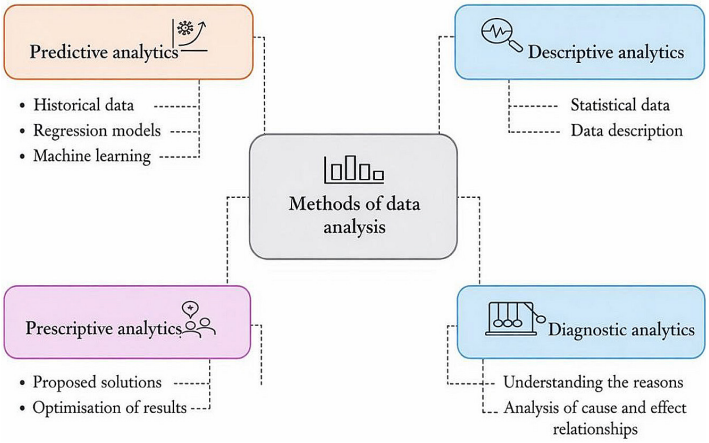

Figure 5. Methods of data analysis
Source: developed by the authors according to T.H. Davenport (2017)

Descriptive analytics provides information about what happened in the past using statistical methods that are used to characterise information. Diagnostic analytics helps to understand why something happened by studying the cause and effect. Different models are used for different purposes, including regression and machine learning, which allows, according to the dogma of descriptive analytics, not only to predict but also to choose the right solutions to improve results. The following analysis methods are used in various fields of activity, including the transportation industry: crowdsourcing, data consolidation and integration, machine learning, neural networks, network analysis, optimisation, including genetic algorithms, pattern recognition, analytics, forecasting, modelling, spatial analysis, statistical analysis, and analytical data visualisation. A variety of tools are available for data analysis. Microsoft Excel is widely used due to its accessibility and user-friendly interface, which enables efficient processing and visualisation of datasets. Tableau serves as a reliable platform for advanced data visualisation and interactive presentation of analytical results. Programming languages such as Python and R are extensively applied in data analysis and machine learning, offering powerful capabilities for statistical modelling and predictive analytics. In addition, SQL is utilised to interact with relational databases, allowing efficient data retrieval, management, and manipulation. Within this framework, business intelligence metrics play a crucial role in supporting informed decision-making during periods of crisis, as well as in assessing economic challenges and identifying potential development opportunities. Business intelligence plays a crucial role in the innovative management of transportation companies. It enables the introduction of advanced digital technologies. Developing strategies for transportation companies allows them to strengthen their ability to focus on the challenges posed by the global market. This ensures effective risk management, optimal resource allocation, and long-term competitiveness of the company in the market (Lozhachevska *et al.*, 2023). Business intelligence is also used to assess the onset of a financial crisis and prevent a company's bankruptcy using the following methods: decision tree, time series analysis, and simulation modelling. Ukrainian companies can apply the modified Altman model (ZAM), which was proposed by Altman in 1983:

$$Z_A м = 0.717A_1 + 0.847A_2 + 3.107A_3 + 0.42A_4 + 0.995A_5, \quad (1)$$

where X4 – is the book value of equity/debt, with a threshold value of 1.23.

The Springate model (ZC) is also used to estimate the probability of bankruptcy:

$$Z_C = 1.03C_1 + 3.07C_2 + 0.66C_3 + 0.4C_4, \quad (2)$$

where *C*1 – working capital/amount of assets; *C*2 – profit before taxes and interest/amount of assets; *C*3 – profit before taxes/short-term debt; *C*4 – revenue from the sale of products, goods, services/amount of assets. It is believed that the accuracy of predicting bankruptcy by this model is quite high and amounts to 92%, but this indicator decreases over time, and if $Zc < 0.862$, the company is a potential bankrupt.

Thus, the problem is to determine how the methods of formation of enterprise finances within the framework of information and analytical centres can effectively prevent or overcome the financial crisis in the enterprise. The solution to these problems necessitates the development of a mechanism for managing enterprises in crisis and determining the set of information and analytical centres for strategic crisis. This will make it possible to effectively manage financial flows with the use of digital technologies, in particular through the introduction of flexible models of control over current assets. The proposed mechanism for managing enterprises in crisis and determining the set of information and analytical centres of strategic crisis is presented in Figure 6.

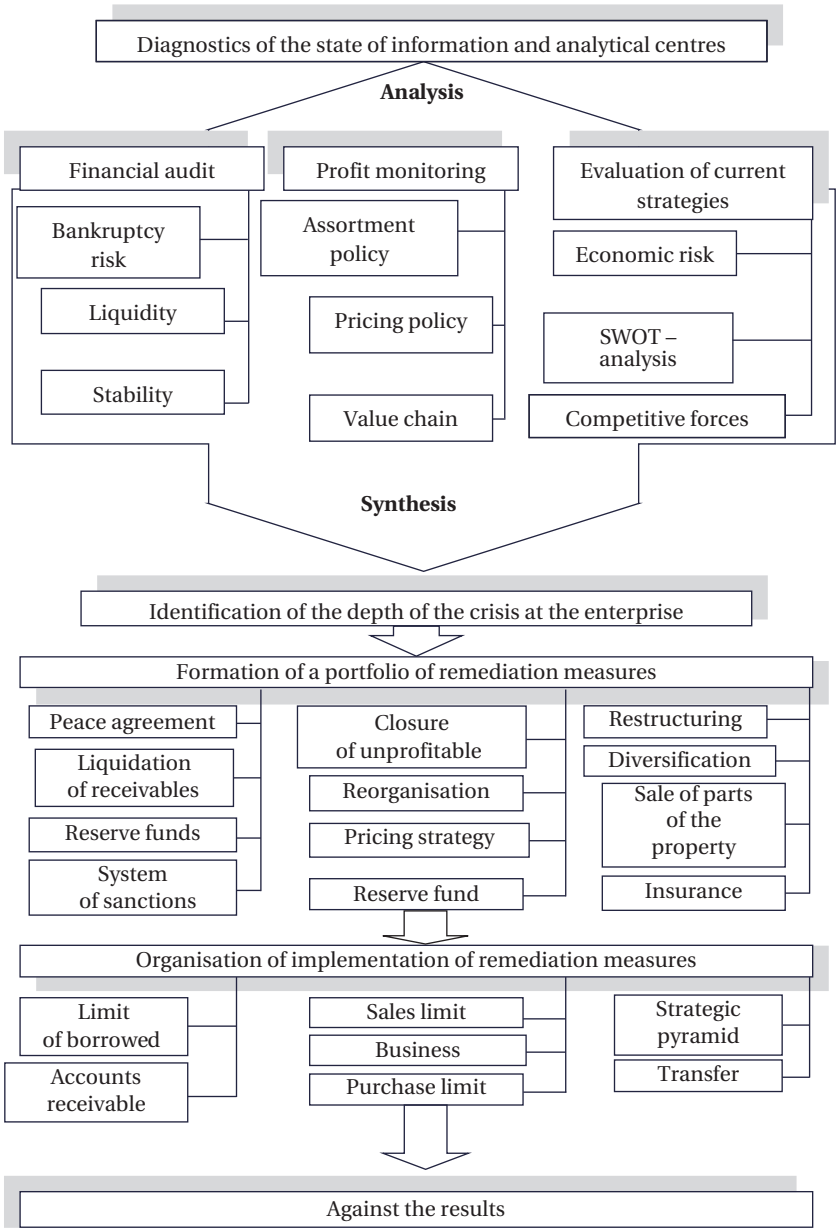

Figure 6. The mechanism of management of enterprises in crisis and the set of information and analytical centres of strategic crisis

Source: developed by the authors according to O.M. Lozhachevska *et al.* (2023), M.O. Khobta *et al.* (2025)

Within the subsystem of information and analytical centres, it is advisable to implement digital liquidity forecasting platforms integrated with risk management, which will allow for the prompt identification of destabilising factors. Such an approach will provide the company with flexibility in financial planning, minimise cash gaps and increase resilience to external risks. Thus, the crisis management mechanism includes the analysis of a large database, the use of digital technologies, and the consistent performance of management functions, which allows achieving a certain economic effect. Based on business analytics, it is possible to determine the effectiveness of attracting investments and innovations to cities and regions of Ukraine based on the public-private partnership mechanism, which allows ensuring the development of regional transport infrastructure in the context of European integration. As for sustainable development in the transport sector, it is based on: innovative digital technologies that improve the efficiency of transport systems; resource optimisation that minimises environmental impact and costs; social responsibility that provides for safe, affordable and comfortable transport. O.M. Lozhachevska *et al.* (2023) emphasised that the continuous analysis and understanding of a situation, along with the dynamics of its change, constitutes an ongoing and dynamic process. One-time analysis and diagnostics cannot serve as a reliable basis for this process, as they provide only limited information. Consequently, the development of strategic decisions cannot be long-term, given the rapidly changing environment in which an innovation-oriented enterprise operates. Modern technologies, including AI, offer powerful tools for predicting, preventing, and overcoming crisis situations in the enterprise. AI plays an important role in modern crisis management, helping organisations to anticipate, analyse risks and respond quickly to crisis situations. The main areas of AI application in crisis management are as follows:

1) predicting and forecasting crises, as AI uses big data analytics to predict possible crises. By analysing historical data, social media, market trends, and other sources of information, algorithms can predict certain threats, such as financial risks, natural disasters, or reputational crises. For example, AI-based systems can detect abnormal patterns in data that may indicate impending crises;

2) rapid data analysis. In crisis situations, it is critical to quickly process a large amount of information to make decisions. AI allows automating data analysis, reducing the time spent on finding the causes of the crisis and the best ways to solve it. This can be useful for tracking competitors' market activity, changes in supply, and social reactions to the crisis;

3) optimising response processes. AI enables the automation of selected crisis response processes, thereby increasing the speed and overall efficiency of decision-making and operational implementation. For example, AI systems can run algorithms to automatically activate contingency plans. This can include supply chain management, resource allocation, or customer and stakeholder interaction. Such solutions help reduce human errors and significantly increase the effectiveness of actions during a crisis;

4) scenario modelling and decision-making. AI allows to adapt models in real time. AI systems can quickly recalculate forecasts depending on changes in the external environment. This allows managers to make informed decisions faster in the face of uncertainty;

5) reputation management. AI plays an important role in monitoring and managing the reputation of companies, especially in times of crisis. Thanks to its ability to analyse large amounts of data in real time, AI allows companies to respond quickly to changes in public opinion and take measures to mitigate negative consequences;

6) post-crisis analysis. AI can also help automate the creation of reports on crisis events, which will save time and allow for a detailed understanding of the causes and consequences of the crisis. These reports can be used to improve crisis response plans and avoid similar problems in the future.

AI can free professionals from routine work, allowing them to focus on more complex tasks that require a creative approach; speed up big data analysis and decision-making several times faster; and create special systems that can learn and adapt to changing conditions. Cloud technologies enable organisations to quickly adapt to changing conditions, reducing costs and increasing productivity. This is especially important in situations where it is necessary to respond quickly to challenges and make informed decisions based on the analysis of large amounts of data. According to V.M. Andriievska & N.V. Olefirenko (2015), cloud service providers enable users to rent computing power and storage via the Internet. This approach offers significant advantages, including cost-effectiveness, as users pay only for the resources they require, and flexible scalability. Furthermore, clients are relieved from the necessity of creating and maintaining their own computing infrastructure. When using cloud technologies, software and hardware are provided to the user as an Internet service. The user has access to their own data, but cannot manage and should not take care of the infrastructure, operating system and software they work with. The "cloud" is the Internet that hides all technical details. Cloud services fundamentally transform the processes of accessing and utilising information and software by enabling remote interaction with data and server infrastructures from any location worldwide, thereby eliminating dependence on stationary hardware and enhancing collaborative engagement among geographically dispersed users. O.O. Hudzovata (2013) emphasised that Amazon was the first company to fully realise the commercial potential of virtualisation technologies, concentrating its efforts on the development and scaling of the Amazon Web Services cloud platform. This approach enabled virtualisation to become an effective business service accessible to a wide range of users. As defined by I. Chernikov (2024), the main models of cloud computing for data processing include the following:

1) IaaS (Infrastructure as a Service): provision of virtual servers, networks, and storage systems. Suitable for companies that want to have full control over their infrastructure;

2) PaaS (Platform as a Service): providing a platform for developing and running applications. Ideal for developers who want to focus on creating software;

3) SaaS (Software as a Service): providing ready-made software solutions over the internet. Popular examples: Google Workspace, Microsoft 365.

Cloud computing allows organisations to quickly analyse large amounts of data, which is critical in crisis situations. Thanks to the powerful computing resources available in the cloud, companies can receive results in real time, allowing them to quickly respond to changes in the market or in internal business processes. Using cloud technologies can reduce IT infrastructure costs. Organisations do not need to invest in expensive hardware because all the necessary resources are provided in the cloud. This is especially important for small and medium-sized enterprises, which may not have the capacity for significant capital expenditures. Cloud computing makes it easy to scale computing resources to meet business needs. When workloads increase or additional data needs to be processed, companies can quickly adapt their resources without significant delays or costs. This allows organisations to remain flexible and ready for any challenge. Therefore, using modern digital technologies, such as Big Data, machine learning, analytical platforms, for a comprehensive and in-depth analysis of the activities of transport enterprises or by studying stakeholder groups, the manager forms an information base for each criterion, which is the basis for developing an anti-crisis strategy, taking into account risks, as noted by I.V. Kravchuk (2024). Thus, the study confirmed that crisis management of transport enterprises in conditions of a wartime economy and global instability has become systemic and multidisciplinary. Its effectiveness is determined not by isolated financial stabilisation measures, but by the integration of a risk-oriented approach, digital technologies, public-private partnership mechanisms, and sustainable development instruments.

Conclusions

Analysis of transportation dynamics showed the industry's deep dependence on external crises, including military risks and logistical constraints. At the same time, the gradual recovery of transportation volumes in 2023-2024 indicated the system's adaptability under conditions of active use of digital solutions, development of alternative routes, and expansion of international cooperation. This confirmed the feasibility of implementing business analytics and Big Data tools to support strategic decisions in the transport sector. It was substantiated that the use of descriptive, diagnostic, predictive, and prescriptive analytics ensured a logical sequence of the management cycle, from identifying problems to selecting optimal solutions. The combination of these methods with financial instability forecasting models, in particular the modified Altman model and the Springate model, improved the quality of risk assessment and contributed to a timely response to crisis phenomena. A key element of digital transformation involved the development of strategic crisis information and analytical centres designed to consolidate data resources, perform scenario modelling, and ensure continuous feedback within governance and management systems. The proposed mechanism involved the integration of digital liquidity forecasting platforms, risk management tools, and cloud infrastructure, which increased the flexibility of financial planning and reduced the likelihood of cash gaps. Public-private partnerships were shown to be a catalyst for implementing digital anti-crisis strategies. Regulatory consolidation of electronic procedures, transparency of tenders, and open data contributed to increased trust between stakeholders and attracted investments in transport infrastructure. However, the study showed that digital transformation was accompanied by several limitations, including uneven digital maturity of enterprises, shortage of data analytics specialists, cyber threats, and limited financial resources. This necessitated further scientific understanding of mechanisms for increasing the effectiveness of digital anti-crisis solutions. Promising directions for further research included empirical testing of the proposed mechanism based on specific transport enterprises with quantitative measurement of the economic effect of implementing digital tools, development of an integral index of digital maturity of transport enterprises and establishing its connection with the sustainability of project management, and modelling of transport infrastructure restoration scenarios using simulation modelling and AI.

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Conflict of Interest

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Антикризові стратегії та сучасні технології в стійкому управлінні проєктами

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Анотація. Зростаюча частота та складність економічних, інфраструктурних та геополітичних криз значно підвищила потребу в ефективному антикризовому управлінні на проєктно-орієнтованих підприємствах. Це особливо актуально для транспортного сектору, який чутливий до зовнішніх змін. В умовах підвищеної невизначеності традиційні підходи до управління часто виявляються недостатніми, що потребує застосування інноваційних та гнучких рішень. Метою цього дослідження було обґрунтування сучасних підходів до антикризового управління на основі використання цифрових технологій у рамках сталого управління проєктами. Методологія дослідження базувалася на системному та порівняльному аналізі, синтезі, статистичному аналізі, візуалізації даних та сценарному моделюванні, які разом забезпечують комплексну оцінку процесів антикризового управління. Встановлено, що використання аналітики даних, штучного інтелекту, хмарних обчислень та цифрових платформ сприяє ранньому виявленню криз, оцінці ризиків та швидкому реагуванню. Ці технології дозволяють підприємствам обробляти великі обсяги даних у режимі реального часу, підвищувати точність прогнозування, прискорювати прийняття управлінських рішень та оптимізувати розподіл обмежених ресурсів. Аналіз статистичних даних транспортного сектору України за 2022-2024 роки показав зростання адаптивного потенціалу компаній, що проходять цифрову трансформацію, особливо у відповідь на виклики воєнного та посткризового періоду. Результати дослідження підтвердили, що інтеграція цифрових технологій у системи антикризового управління підвищує організаційний потенціал, забезпечує безперервність реалізації проєктів та сприяє досягненню цілей сталого розвитку. Практичне значення дослідження полягає у можливості застосування його результатів у діяльності менеджерів транспортних підприємств, органів державної влади та інших зацікавлених сторін, залучених до інфраструктурних та інвестиційних проєктів, що сприятиме розвитку більш сталих і стабільних транспортних систем

Ключові слова: цифрові технології; профілактика; прийняття рішень; бізнес-аналітика; зацікавлені сторони; ризики