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STRATEGIC-ORIENTED MANAGEMENT OF THE TRANSPORT INDUSTRY: LOGISTICS APPROACHES, INNOVATIVE SOLUTIONS AND MANAGEMENT MODELS

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The monograph outlines aspects of enterprise relocation, improvement of logistics chains and modernization of transport infrastructure are of scientific and practical interest to scientists, entrepreneurs and representatives of public administration.
The scientific value of the monograph's developments is methodological and practical recommendations in the fields of logistics, economics and management both at the level of an individual enterprise and at the national level.
The monograph is of practical interest to managers of state and private transport enterprises from the point of view of implementing logistics strategies for sustainable development and anti-crisis management of transport companies. Theoretically, it will be useful for researchers dealing with issues of transport logistics, risk management, sustainable development, ensuring financial stability and innovative management in the transport sector.
Due to the universal approach to research in the direction of sustainable development of the transport industry and the relevance of the problems raised, the results obtained can be methodologically useful and practically applied both in Ukraine and in other countries.
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ABSTRACT

The study covers a range of problems related to risk management, logistics, enterprise relocation, transport infrastructure and sustainable development of transport enterprises, especially in conditions of military threats. It is determined that modern trends in risk management demonstrate significant progress with the expansion of its boundaries by introducing new concepts such as risk management, risk economics, risk engineering, risk administration and risk production. New professional approaches to risk classification are proposed, and the elements of risk content — certainty and uncertainty, taking into account their limiting values — are specified. It is proven that the erroneous perception of complete certainty or complete uncertainty in management processes is a factor that reduces the effectiveness of organizational decisions. The illusion of complete certainty leads to excessive bureaucratization and loss of adaptability, while the idea of complete uncertainty stimulates impulsive, unfounded decisions without proper analysis and forecasting. The elimination of such illusions allows the formation of adaptive management strategies that are able to respond more effectively to changes in the external environment.

To assess the readiness of enterprises for development, a two-component methodological approach is proposed, based on the analysis of investment adequacy and the balance of activity costs. An integral indicator of investment adequacy is determined, which allows assessing the resource capacity of enterprises. The testing of the approach at Ukrainian motor transport enterprises showed a low level of this indicator — a value in the range of 1.2–1.7 with a standard of 3 indicates limited resources for economic development and the dominance of survival strategies instead of development.

An analysis of the transport industry of Ukraine showed a significant deterioration in its indicators due to military aggression. In particular, the number of operating business entities, the volume of products sold and the level of profitability of enterprises decreased. The main problems of the industry are identified: disruption of transport chains, resource shortages, destruction of infrastructure and a decrease in the solvency of the population. In this regard, the need for the implementation of anti-crisis management is substantiated, which involves four consecutive stages: diagnostics of the state of the enterprise, development of an anti-crisis strategy, implementation of stabilization measures and methods and assessment of the effectiveness of these measures. Particular attention is paid to the adaptation of anti-crisis management to the conditions of the war period.

The problems of relocation of high-tech enterprises under martial law are studied. Logistics planning models are proposed that take into account the risks caused by military actions and disruption of transport corridors. The key stages of relocation are identified: selection of a safe location, adaptation of logistics infrastructure, establishment of new supply channels. Particular attention is paid to optimizing the supply of components at the new location of the enterprise, which is an important factor in maintaining competitiveness and sustainability of production.

The study considers the role of transport infrastructure in ensuring regional economic development. It is emphasized that transport facilities can have both positive and negative impacts on the regional economy.

On the one hand, they contribute to the development of material flows and business activity, and on the other hand, they can stimulate population outflow and cause uneven development. The introduction of innovative transport infrastructure management mechanisms is proposed to ensure sustainable economic growth of regions.

Particular attention is paid to the sustainable development of passenger transport enterprises. A set of measures is proposed to financially support transport enterprises taking into account the principles of sustainable development. It is shown that investing in the modernization of vehicles, process automation and environmentally friendly technologies will contribute not only to reducing costs, but also to improving the quality of services and minimizing the negative impact on the environment.

An important aspect is the improvement of the route network and optimization of bus schedules. The need for integration of various types of public transport, the use of monitoring and dispatching information systems for prompt adjustment of routes in accordance with changes in demand is identified.

The obtained research results can be used both at the level of individual transport enterprises and for the formation of state transport policy. The proposed approaches will contribute to increasing the stability of the transport system, ensuring the effective functioning of logistics processes and sustainable development of the country's economy in the face of modern challenges.

KEYWORDS

Risk management, logistics, relocation of enterprises, transport infrastructure, sustainable development, anti-crisis management, military threats, investment adequacy, supply optimization, regional development, organization, logistics provider.

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The monograph is of practical interest to managers of state and private transport enterprises from the point of view of implementing logistics strategies for sustainable development and anti-crisis management of transport companies. Theoretically, it will be useful for researchers dealing with issues of transport logistics, risk management, sustainable development, ensuring financial stability and innovative management in the transport sector.

The outlined aspects of enterprise relocation, improvement of logistics chains and modernization of transport infrastructure are of scientific and practical interest to scientists, entrepreneurs and representatives of public administration.

The scientific value of the monograph's developments is methodological and practical recommendations in the fields of logistics, economics and management both at the level of an individual enterprise and at the national level. In particular:

— an algorithm for anti-crisis management of transport enterprises during wartime has been developed;

— strategies for relocation of high-tech enterprises and ensuring logistics processes have been formed;

— a system of financial support for sustainable development of transport companies has been proposed;

— the methodology for integrating transport infrastructure for regional economic growth has been substantiated;

— approaches to managing passenger transport routes and optimizing traffic schedules have been improved;

— recommendations have been developed for information support for dispatching transport processes in crisis conditions.

Due to the universal approach to research in the direction of sustainable development of the transport industry and the relevance of the problems raised, the results obtained can be methodologically useful and practically applied both in Ukraine and in other countries.

INTRODUCTION

The transport industry plays a key role in ensuring the economic development of the state, contributing to the mobility of the population, the effective movement of goods and the strengthening of interregional ties. At the same time, the destabilization of the geopolitical, socio-economic and security situation in the world, in particular the consequences of military aggression against Ukraine, pose new challenges for enterprises in the transport sector. In particular, disruption of transport chains, resource shortages, destruction of infrastructure and a decrease in the solvency of the population complicate the sustainable development of this industry.

In such conditions, the issues of optimizing logistics processes, relocation of enterprises, ensuring the stability of supply and implementing innovative approaches to managing transport systems become particularly relevant. Along with this, an important task remains the formation of effective anti-crisis strategies to overcome crisis phenomena and ensure the sustainability of the transport industry.

The monograph is devoted to the analysis and solution of current problems of logistics, sustainable development and management of transport enterprises, especially in conditions of martial law and crisis situations. Key factors influencing the efficiency of transport enterprises have been identified, conceptual approaches to their adaptation in conditions of instability have been developed, and scientifically based management strategies have been proposed.

Particular attention has been paid to the modeling of logistics processes of enterprise relocation, which is an important component of maintaining their competitiveness and ensuring the stable functioning of production and supply chains. Methods for diagnosing crisis phenomena, forming anti-crisis strategies, applying sustainable development tools and assessing the efficiency of transport operations have been investigated.

The scientific value of the study lies in the comprehensive approach to the issues of logistics management and sustainable development of transport enterprises in wartime conditions. The results obtained can be used both at the level of individual transport industry organizations and for the formation of state policy in the field of transport and logistics.

The recommendations proposed in the monograph are aimed at supporting the sustainable development of the transport industry, ensuring effective logistics and increasing the competitiveness of enterprises in difficult market conditions.

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1 INCREASING THE EFFICIENCY OF MANAGEMENT OF THE INDUSTRY THROUGH ELIMINATING ITS NON-EXISTING PART — THE ILLUSORY PRACTICE OF MANAGEMENT IN CONDITIONS OF COMPLETE DETERMINATION AND COMPLETE UNDETERMINATION

Vasil Babailov, Iaroslava Levchenko, Iryna Kyrchata, Igor Britchenko

ABSTRACT

In recent years, significant progress has been made in risk management. Moreover, along with risk management, new concepts have been introduced: risk management, risk economics, risk engineering, risk administration and risk production; a new, basic, general and professional criterion for dividing risks (into economic, engineering, administrative and production) has been established; the interpretation of the elements of risk content has been clarified: certainty and uncertainty, in particular, their minimum and maximum values.

However, most scientists consider the idea of the existence of such two forms of them — complete certainty and complete uncertainty — to be erroneous. Eliminating illusory management practices is necessary to increase the effectiveness of organizational decisions. In conditions of complete certainty, managers may mistakenly believe that all processes are predictable, which leads to excessive bureaucratization. In conditions of complete uncertainty, the illusion of control contributes to making impulsive decisions without relying on analytics and scenarios of events. The elimination of such illusions allows to form adaptive strategies and respond more effectively to changes in the external environment. Therefore, this section has proven the absence of complete certainty and complete uncertainty both outside and inside the risk. For the first time, the widespread idea of the existence of complete certainty and complete uncertainty has been refuted.

The results obtained will deepen our understanding of the essence and content of risk, risk management and risk governance in general, and will increase the efficiency of managing enterprises and organizations in the face of risks by eliminating unnecessary activity in the face of non-existent so-called "complete certainty" and "complete uncertainty". Such results will allow to concentrate attention and resources on the real subject of risk management — only on risk.

KEYWORDS

Risk, complete certainty, complete uncertainty, management, illusory management practice.

1.1 THEORETICAL PRINCIPLES OF UNDERSTANDING AND PRACTICE OF APPLYING RISK MANAGEMENT

It is known that the activity of mankind in the conditions of risks has always been in the past, is now, and in the future, post-industrial, entrepreneurial era will only grow. It is necessary to state with pleasure

that to date, knowledge about risks and management in their conditions have achieved significant success, including with the participation of the authors of this article. Thus, the following have been newly defined: the stages of their development, methods of management in the conditions of risks, the essence, the content of risk — as the unity of two basic elements (uncertainty and certainty); the concept of "risk management" has been clarified — as a composition of new concepts "risk economics", "risk engineering", "risk administration"; a new concept of "risk management" was introduced — as a composition of risk management and risk production and as "management under risk conditions" instead of the erroneous one — "risk management" [1, 2]. The need to increase the effectiveness of risk management was also proven, primarily by establishing a new, basic, general and professional criterion for dividing types of risks into economic, engineering, administrative and production. The interpretation of risk as a unity of two main elements: certainty and uncertainty was also clarified. However, the authors believe that among the types of certainty and uncertainty, the idea of the existence of complete certainty and complete uncertainty (inside the risk) is erroneous? Therefore, the very formulation and solution of this problem becomes an exceptionally relevant problem of risk management.

The authors of this section conducted a scrupulous and capacious analysis of a significant number of literary sources on the basic concepts of risk management [3–6]. It shows that there are various interpretations of the concepts of risk, certainty, uncertainty, complete and incomplete certainty, complete and incomplete uncertainty.

But the main result of the analysis is the conclusion that the literature assumes the existence of three different separate phenomena: risks, complete certainty and complete uncertainty. The authors of the article consider the idea of the existence of complete certainty and complete uncertainty (inside the risk) to be a mistake. Let's give a few quotes that clearly illustrate this mistake.

Thus, in [4] it is stated: "Complete uncertainty is a type of uncertainty characterized by close to zero predictability of events. In conditions of complete uncertainty, economic entities are completely unable to predict in any way both the prospects of their own development and the market as a whole... Complete certainty is characterized by a predictability of an event close to 1 and allows economic entities to predict not only their strategy in the market, but also its development trends with a 100 percent probability". But an enterprise is a phenomenon created by man, and therefore there can be neither complete certainty, nor the absence of fluctuations in the magnitude of results, nor can there be complete uncertainty (this follows from the risk principle).

A similar point of view is present in [7–9]. Here the author is sure that "... one can talk about the conditions of certainty, risk, and uncertainty in decision-making". That is, it is also asserted that certainty and uncertainty exist separately, outside of risk. At the same time, it follows from the whole context that here we are also talking about complete certainty and uncertainty.

Analysis of recent research and publications as a whole shows that the most important unresolved component of the problem. In contrast, the authors of this study, based on their personal many years of experience in researching risks as a subject of risk management, or more precisely, as a subject of all risk management as a whole, put forward a hypothesis about the lack of complete certainty and complete uncertainty in general in the phenomena created by mankind.

1.2 RESEARCH METHODOLOGY

To achieve the aim, the following methodological approach will be followed in the study:

— the meaning of the risk principle is revealed;

— the absence of complete certainty and complete uncertainty outside the risk is proven;

— the absence of complete certainty and complete uncertainty within the risk is proven.

When solving the first problem, which was to establish the risk principle, the authors drew attention to the fact that risks are an integral part of any human activity. This is due to the fact that every phenomenon that arises as a result of human activity always carries a certain risk. Risks have accompanied humanity at all times, since the beginning of the development of civilization, and will remain an important component of our existence in the future. Any phenomenon created by humanity cannot exist without risk, and at the same time there is no risk without a phenomenon. In other words, these two concepts are inseparable.

The principle of inseparability of risk and phenomenon emphasizes: if there is a phenomenon, then it is necessarily accompanied by risk. This applies not only to complex technical or innovative processes, but also to everyday actions. For example, the invention of the car brought with it the risks of road accidents, and the development of digital technologies gave rise to the risks of cyber threats. At the same time, if there is no risk, this means that the phenomenon to which this risk is associated also does not exist. This dependence is explained by the fact that risk is not just a random component, but a natural property of any phenomenon that arises as a result of human activity.

Given this inseparability, a logical question arises: how exactly is risk related to the concepts of certainty and uncertainty? It is especially important to explore these relationships in cases of absolute certainty and absolute uncertainty. After all, it is these extremes that are most often used as theoretical concepts for analyzing complex situations. The answer to this question became the basis for solving the second problem.

The second task was to prove that beyond the risk there is neither complete certainty nor complete uncertainty. To do this, the authors relied on the risk principle established during the solution of the first task. According to this principle, if there are risks, then there must be corresponding phenomena. Among these phenomena there may be such extremes as complete certainty and complete uncertainty.

However, let's imagine a situation where there is no risk at all. In this case, there are no corresponding phenomena, since they are always associated with risk. This means that beyond the risk, it is impossible to exist either absolute certainty or absolute uncertainty. This statement is explained by the fact that the phenomena of complete certainty and complete uncertainty are theoretical constructs that exist only in connection with risk. Without risk, these constructs lose their meaning and cannot actually be realized.

This conclusion is important for understanding the nature of risk and its role in shaping human activity. Outside the risk, the world becomes "empty" in terms of certainty or uncertainty, because their presence is possible only in interaction with risk. Therefore, the statement about absolute certainty or absolute uncertainty in a world where there are no risks makes no sense.

Additionally, the authors considered the question of whether phenomena of complete certainty or complete uncertainty can exist in the risk itself. To do this, they turned to the analysis of the content of risk,

which consists of two main elements — certainty and uncertainty. This means that risk by its nature is a simultaneous combination of these two components.

From the content of risk, it follows that if risk exists, then both of its components must necessarily exist: certainty and uncertainty. This conclusion is based on the concept of "content", which means the set of basic elements of the phenomenon. If even one of these elements disappears, the entire structure of risk collapses. Thus, risk is impossible without the interaction of certainty and uncertainty.

The key point is that none of these elements can completely disappear or become absolute. In other words, certainty cannot be reduced to zero, but it cannot completely replace uncertainty either. Similarly, uncertainty cannot fill the entire risk space, but it cannot be completely absent either. This means that it is impossible to achieve a state of absolute certainty or absolute uncertainty in risk itself.

Risk is a complex phenomenon that is inextricably linked to phenomena created by mankind [10]. Its content is determined by the simultaneous presence of certainty and uncertainty, which cannot exist separately. Outside the risk, neither absolute certainty nor absolute uncertainty is possible, and inside the risk they always coexist in a certain balance. These conclusions emphasize the importance of the risk principle as a key tool for understanding complex processes and phenomena.

1.3 DISCUSSION OF THE RESULTS OF ELIMINATING THE ILLUSORY PRACTICE OF MANAGEMENT UNDER CONDITIONS OF COMPLETE CERTAINTY AND COMPLETE UNCERTAINTY

The principle of inseparability of risk and phenomenon is a fundamental concept that emphasizes that any phenomenon created by man is always accompanied by a certain degree of risk. This dependence is due to the fact that human activity is always associated with uncertainty, and therefore with the potential for adverse or unpredictable consequences. That is why risk cannot be separated from any human project, discovery or process.

For example, the development of transport technologies, such as cars or airplanes, opened up new opportunities for humanity to move quickly, but at the same time brought with it the risks of accidents, technical malfunctions and security problems. A similar situation is observed in the field of information technology: the creation of computer networks has greatly facilitated the exchange of information, but at the same time the threats of cybercrime have arisen [11]. Even such everyday phenomena as housing construction or agricultural activities involve risks — from possible natural disasters to man-made accidents.

Thus, the established principle of the inseparability of risk and phenomenon is of profound importance for understanding the nature of human activity. It emphasizes that no progress or change can be absolutely safe or completely predictable. Humanity is always left to seek a balance between positive development opportunities and managing potential risks that inevitably arise in the process of creating new phenomena.

The proof of the absence of complete certainty and complete uncertainty outside the risk boundary is based on the principle of the inextricable link between phenomena and risks. Outside the risk boundary, where potential threats or opportunities are not considered, it is impossible to speak of absolute

predictability or complete chaos. This is explained by the fact that any phenomenon that is not accompanied by risk actually ceases to exist as a real process or event.

Complete certainty implies the existence of an ideal state in which all factors affecting an event or phenomenon are fully known and controlled. However, in the real world, this is not possible, since there are always unknown variables, even in the simplest situation. For example, even in a stable production process, unforeseen circumstances may arise, such as equipment breakdowns or external economic changes. The absence of risk here becomes a theoretical abstraction that has no practical meaning. Similarly, complete uncertainty means a state of absolute chaos, where there is no predictability or structure. However, in nature and society, there are always certain patterns and regular relationships that exclude complete chaos. Thus, both complete certainty and complete uncertainty outside the limits of risk become absurd concepts.

Within risk, it is also impossible to achieve a state of absolute certainty or absolute uncertainty. This is explained by the nature of risk itself, which includes the simultaneous interaction of two main components — certainty and uncertainty. It follows from the content of risk that these components are its inseparable components.

Certainty within risk means the presence of partial information about the possible outcomes of an event or process, while uncertainty reflects the inability to predict all possible consequences. None of these components can completely disappear or become absolute. If certainty disappears completely, risk as a phenomenon ceases to exist, since any logical basis for forecasts is lost. On the contrary, if uncertainty disappears, risk also disappears, since all outcomes of the event become predictable.

Thus, neither absolute predictability nor complete chaos are possible even within risk. Risk always functions as a balance between a certain share of certainty and a share of uncertainty, which complement each other.

Effective risk management allows to identify, assess and minimize existing risks by developing response strategies and preventing potential losses. An important tool is the construction of risk forecasting models based on data analysis and the implementation of contingency plans to ensure resilience, in particular supply chains.

The financial sustainability of an organization is characterized by the ability to maintain solvency, ensure continuous operations and meet financial obligations even in crisis conditions. In the logistics sector, this includes cost control, inventory optimization, and management of receivables and payables.

Risk management in this context helps to form financial reserves to cover unforeseen costs, maintain flexibility in financial flows and avoid significant losses from logistics failures. For example, the use of insurance mechanisms or hedging currency risks are practices that support the financial sustainability of logistics operations.

The readiness of a logistics system to develop lies in the ability to quickly adapt to market changes, introduce new technologies and management methods. The assessment of such readiness includes an analysis of financial indicators, organizational flexibility and risk management strategy.

Risk management in this context contributes to effective planning of the expansion of logistics capacities, development of scenarios for adaptation to changes and reduction of the probability of failures during

the implementation of innovations. In addition, it allows to avoid overspending of resources and to increase the overall efficiency of management, in particular logistics.

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2 METHODOLOGICAL APPROACH TO TWO-COMPONENT ASSESSMENT OF SUSTAINABILITY IN ORGANIZATIONS AND ORGANIZATIONAL NETWORKS AND STRATEGIC-ORIENTED MANAGEMENT OF THEIR DEVELOPMENT

Tatiana Vorkut, Lyudmila Volynets, Iryna Gorobinska, Yurii Lushchai

ABSTRACT

The object of the study is to assess the financial stability and readiness of logistics activities in organizations for development. The proposed two-component methodological approach makes it possible to optimize the assessment of the readiness of organizations for development based on determining a sufficient level of investment, on the one hand, and a balanced level of activity costs, on the other. Thus, for the first component, it is proposed to use an integral indicator of investment adequacy, the calculation method of which is based on combining the dependencies between the volumes of capital investments and other resource parameters of the activities of enterprises (depreciation deductions, long-term loan capital, non-current assets, equity, etc.). The second component reflects the ratio of material and other operating costs to the total income of logistics activities in organizations.

The study was carried out on the example of motor transport enterprises. The proposed methodological approach was tested, which showed low resource capacity of enterprises. The dynamics of the integral indicator of investment adequacy showed that in general for enterprises engaged in road freight transportation, its level is significantly lower than the normative value, which is equal to 3. Its value on average fluctuated at the level of 1.2–1.7, that is, it was in the range of the absence or limited resources for economic development. This indicates the dominance of survival strategies, not development, among motor transport enterprises, and weak state policy, which does not stimulate investment activity in a legal transparent environment.

The results obtained can be used both at the level of individual logistics organizations and organizational networks, and for an aggregated assessment of the industry as a whole. An additional advantage of the developed two-component methodological approach to assessing the state and readiness of an enterprise for development is the possibility of using different components for each component, differentiating their importance in an integrated assessment, and adjusting target ranges.

As a result of the study, several possible strategies for managing the development of logistics activities in organizations were identified, such as a reserve management strategy, an asset diversification strategy, a profit reinvestment strategy, a strategy for optimizing liabilities and obligations, a risk-oriented liquidity management strategy, and an active liquidity management strategy.

KEYWORDS

Strategic management, development strategies, organizations and organizational networks, logistics activities, motor transport enterprises, indicator of investment adequacy, level of material costs.

2.1 ASSESSMENT OF SUSTAINABILITY AND READINESS OF LOGISTICS ACTIVITIES IN ORGANIZATIONS FOR DEVELOPMENT: PROBLEMS AND SOLUTIONS

The difficult period of adaptation to modern conditions and requirements for the transport sector will accelerate the processes of transition to a new level of competition in the freight transportation market. Digital transformation is accelerating, consumer preferences are changing, new business models are being introduced [1]. In the future, the competitive environment will be determined by technological modernization, in fact, the restart of infrastructure in general, and transport in particular.

Most organizations have weak financial stability. Despite overcoming the ongoing crisis of unprofitability of motor transport enterprises in the freight transportation market, their profitability remains low, which does not allow forming enough capital to finance development [2].

This situation has led to the emergence of economic and social problems: aggravation of the deficit of working capital; low level of competitiveness and attractiveness for foreign investment; lack of effective policies aimed at stimulating the growth of financial resources; insufficient level of financial potential and economic base.

The negative impact of the ongoing processes has significantly increased the requirements for ensuring the sustainability of commodity supply chains, and in this market the processes of logistics optimization, mergers and acquisitions of transport companies have intensified. A growing trend is the development of e-commerce, wh ich stimulates the control of transport and logistics companies at all links of the supply chain — manufacturer, warehouse, sales centers [3–5]. Increasing investments in modern technologies of logistics supply chains is considered as a tool for improving the quality of transport services, reducing operating costs, and reducing environmental impact.

European initiatives on transport development strategies are supported by large-scale financial resources and various financial instruments for the restoration of the transport sector. The budget of the relevant funds for these purposes is estimated at over 1.8 trillion euros. This further emphasizes the conclusions of this study that the success of the transport sector development critically depends on a consistent state incentive policy, supported by the formation of powerful financial funds and instruments [6–8].

The priority innovative direction of the transport industry development is its digitalization. Accordingly, investments in the implementation of digital technologies in the business processes of transport enterprises will become increasingly important to ensure the maintenance of competitive positions in the market. At the same time, there is a wide range of digital technologies and tools, and their application depends on the type and functional area of logistics activities in organizations. In general, two main models of their activity can be distinguished:

1) organizations that provide goods transportation services;

2) organizations that manage a fleet and provide rental or outsourcing services.

For the first type of organizations, the priority areas of investment in digital technologies are digital tools that allow real-time receipt of data on the delivery of goods, possible obstacles and delays, etc. Such technologies are needed for a quick and timely response to possible problems or changes in the needs of service consumers to avoid delays and unplanned expenses.

For organizations of the second type, investments in digital solutions for monitoring the condition of their vehicles, their intended use, location, etc. are a priority. Such investments are necessary both for control and for the ability to meet modern standards of safety and environmental friendliness of the use of road transport.

Scientific research on the topic under study is important because the economic development of organizations cannot be achieved without innovative development. Low efficiency of spending on technological innovations does not provide opportunities for development. Therefore, it is necessary to take into account not only equipment and technology, but also the organization of the production process. The introduction of innovations requires an increase in sources of capital investment, the expansion of which is impossible without the use of state innovation policy instruments: public-private partnership programs, technological development, and preferential taxation [7, 8].

The current task is to develop a methodological approach to assessing the readiness of organizations for development and recommendations for expanding investment opportunities. The results of such studies are needed in practice, because they are determined by the need for organizations to update fixed assets, the need to transition to modern technologies, the introduction of innovative products and the growth of demand for qualitatively new transport services.

2.2 SCIENTOMETRIC ANALYSIS OF EXISTING PUBLICATIONS ON THE DEVELOPMENT OF METHODOLOGICAL APPROACHES TO ASSESSING THE SUSTAINABILITY AND DEVELOPMENT OF ORGANIZATIONS

International experts note that the development of sustainable transport infrastructure will be based on four dimensions of sustainability: environmental (climate change resilience), social (inclusiveness), institutional (technological development) and economic (productivity and flexibility) [9]. According to their estimates, by 2040 the need for investment in transport infrastructure will amount to up to 2 trillion USD. This is considered a "golden era" of transport infrastructure.

Among the main trends that will determine the development of transport in the EU countries for 2021–2024, the following are highlighted [10]:

1) prioritizing the transition to alternative fuels;

2) ensuring competition in the aviation industry;

3) a modal-neutral approach that promotes sustainable transport development;

4) green financing to increase the sustainability of the EU transport sector.

It should be noted that the current action plan for the implementation of the Transport Strategy provides for the development of multimodal transport technologies and infrastructure complexes to ensure interaction between different modes of transport. And, in particular, paragraph 21 of the plan provides for the partial reorientation of road freight transport to rail and inland waterway transport [11].

In general, the trend in the development of intermodal and multimodal transport also determines the priority for road transport enterprises to invest in projects that will allow them to quickly adapt and integrate into such technologies. The objective priority for investing in development is projects to prepare for

the transition to renewable fuels through the renewal of the transport fleet and ensuring compliance with new environmental standards.

The complexity and multifaceted nature of economic development determine the presence of a wide range of scientific interpretations and understandings of such development, for the disclosure of which various algorithms and methods of its assessment are developed and applied. Domestic and foreign researchers use various methodological approaches to assess the financial condition of enterprises, their readiness to implement various strategies of economic development. Thus, the author of the work [12], systematizing methodological approaches to enterprise development, distinguishes the following types: innovative, economic, strategic, marketing and competitive. The author concludes that each of the above approaches or their combination has its own advantages for application, but at the same time reflects only a separate specific effect associated with the development of the enterprise. But the effectiveness of their application will depend primarily on the readiness to implement development strategies on an alternative basis and adapt to new operating conditions. This occurs under the influence of internal and external changes, which complicates the process of assessing the readiness of enterprises for development.

Considering the functioning and development of an enterprise through the prism of competitiveness, methodological approaches are developed to assess the level of such competitiveness. Thus, some researchers note that the competitiveness of an enterprise depends on many factors: technical and technological, organizational and managerial, financial and economic, socio-psychological, natural and geographical, transport, environmental, industry and market. Therefore, competitiveness cannot be measured by a single statistical indicator [13]. Accordingly, the authors' approach to the need to apply different assessment methods, which are systematized according to two criteria: the degree of objectivity/subjectivity and the type of assessment (quantitative and qualitative), is justified. They thus distinguish 4 groups of methods for assessing competitiveness: objective-quantitative (calculated and calculated-graphic), objective-qualitative (models of structural and strategic analysis), subjective-qualitative (matrix methods) and subjective-quantitative (methods of expert assessments).

Different methods have their advantages and disadvantages, and accordingly, their application must correspond to the goals and possibilities of their effective use. Difficulties arise due to the fact that some assessment methods require complex algorithms for calculating performance indicators, and hence more costs for their application. Other methods are less complex, but also with a lower probability of accuracy and validity of their results. This complicates the choice of the optimal method.

Often, the development of an enterprise is considered in the context of assessing its potential. The implementation of this approach is based on the application of various methods for assessing such potential, which, in turn, is also considered by its individual types, in particular: innovative, investment, technological, competitive, marketing, labor, etc.

In the work [14], the author singled out the following principles for assessing the potential for economic development of an enterprise:

1) determining the key properties of the enterprise;

2) considering the potential for economic development of an enterprise as a set of its properties;

3) identifying a criterion functional property;

4) identifying the controllable basic properties of both the enterprise and its components;

5) identifying the uncontrollable basic properties of the enterprise and its components;

6) taking into account external environmental factors;

7) organizing the process of searching for reserves for the enterprise's economic development.

Despite the rather broad interpretation of these principles, they show the systematicity and complexity of the enterprise's potential and, accordingly, methodological approaches and tools for its assessment.

The author also emphasizes the need to use three levels of potential assessment indicators: partial, general, generalizing. Partial will characterize the possibilities of improving the basic properties of the enterprise (in particular, consumer properties of products or services). General will characterize key properties (in particular, financial results, sales volumes, etc.). Generalizing will characterize the criterion properties of the enterprise (for example, its market value).

The author's grouping of methods for assessing the potential of economic development of enterprises includes: the use of individual indicators or their combination; quantitative and qualitative assessment; absolute and comparative assessments; different levels of the hierarchy of assessment indicators, etc. Such diversity opens up wide possibilities for finding effective tools and indicators for assessing the current state or potential of the enterprise at the appropriate stage of its development. But the issue of determining the optimal methodology remains unresolved due to the fact that excessive overload can blur the accuracy and validity of the results of their application when making management decisions regarding strategic and tactical tasks of enterprise development.

In the context of assessing the potential of enterprises, traditional methods are to determine the effectiveness and feasibility of investments, investment projects for individual enterprises. In particular, this involves assessing the payback period of investments, the level of net present value, investment profitability, and systematization of risks for the relevant industry or market of goods/services. Undoubtedly, assessing the effectiveness of investments is critically important for the development of an enterprise, but it is advisable to apply it to specific investments, relevant target goods, services, and markets. The problem remains that such methods should be preceded by an integrated assessment of the state and readiness of the enterprise for development. But investments should serve as the basic criterion and indicator for conducting such assessments.

A number of studies are aimed at developing methodological tools for assessing the state and potential of development, which take into account industry specifics and aspects of the functioning of business entities. In particular, such an approach is disclosed in the works: [15] on the development of agricultural enterprises, [16] on the development and livelihoods of food industry enterprises, etc. There is no single methodological approach to assessing the development of motor transport enterprises, so this issue remains relevant.

In general, it should be noted that the development of methodological approaches to assessing various aspects of the activities and development of enterprises is carried out in accordance with the theoretical basis of the issues under study. And, accordingly, the application of existing and new criteria, indicators, characteristics should be adapted to management tasks, the existing information base for the use of such methodological approaches and tools.

Most researchers justify the need to combine different assessment methods that will provide an acceptable level of validity of conclusions and recommendations regarding the analysis of the current and potential state of development of the enterprise, but this issue remains unresolved.

All this allows to argue that it is advisable to conduct a study dedicated to optimizing the assessment of the readiness of enterprises for development based on the development of a two-component methodological approach that takes into account investment adequacy and material costs. This methodological approach determines the logic of monitoring the sustainability of motor transport enterprises based on the consistency of key economic indicators with the level of investment and achievement of target parameters of structural cost balance. The advantage of this methodological approach is the possibility of using different components for each component, the possibility of adjusting target ranges and establishing different specific weights in the integral assessment [17].

2.3 RESULTS OF THE DEVELOPMENT OF A METHODOLOGICAL APPROACH FOR ASSESSING THE SUSTAINABILITY AND DEVELOPMENT OF ORGANIZATIONS

The aim of the study is to optimize the assessment of the readiness of road transport enterprises for economic development based on a two-component methodological approach. This will make it possible to investigate the level of investment adequacy and balance of the enterprise's costs, as well as develop recommendations for solving existing problems and outlining strategies for further development.

To achieve the aim, the following objectives were set:

— to propose a methodological approach to assessing the readiness of enterprises for development based on the calculation of an integral indicator of investment adequacy and the level of material costs;

— to test the proposed two-component approach to assessing the state and readiness of enterprises for development;

— to develop strategies for managing the development of enterprises.

The object of the study is to assess the financial sustainability and readiness of road transport enterprises for development. Enterprises engaged in freight transportation chronically lack working capital, which increases risks for current activities and blocks investment opportunities in their development strategies. Thus, in general, net working capital for such enterprises has been negative for the last 10 years, which requires the introduction of modern instruments for financing their activities, which will be accessible and effective [18].

The imbalance in the financing model of motor transport enterprises is further exacerbated by the dominance of material intensity of cost price and operating costs. The share of material costs and services takes up about 80 % of all operating costs of the enterprise, which forms a dependence on working capital and the settlement system at enterprises. But the problem of settlements for the provided services for cargo transportation is acute for the studied industry enterprises, whose current assets consist of accounts receivable on average by 2/3. About 20 % is accumulated in inventories, highly liquid assets are quite limited [18]. Such a cost structure requires additional working capital to pay VAT and excise duties when making

material costs, although it reduces the real burden of value added tax. At the same time, it increases the dependence of enterprises on the level of tax burden by direct taxes – on profit, on property, on the payroll.

The study used methods of generalization (to systematize modern mechanisms for the formation and implementation of economic development), statistical observations (to structure data on the financial activities of motor transport enterprises in Ukraine), a systematic approach (to study the principles of implementing economic development), and the method of expert assessments (to determine the criteria for the economic development of motor transport enterprises and internal indicators of the effectiveness of their activities).

The proposed methodological approach to assessing the state and readiness of motor transport enterprises for development consists, on the one hand, in determining a sufficient level of investment for development, and on the other, a balanced level of activity costs. To take into account the first component, it is proposed to use an integral indicator of investment adequacy, compliance with the minimum regulatory level of which will confirm the accumulation of a sufficient and sustainable level of investment at the enterprise. The components of the integral indicator of investment adequacy are the ratio of capital investments with such parameters as: depreciation, long-term loan capital, non-current assets and equity. The normative minimum level of the integral indicator of investment adequacy of the enterprise will depend on the specified parameters of its components, which allows for multivariate calculations. The proposed integral indicator can be used both at the level of individual enterprises and for an aggregated assessment of the industry as a whole. Taking into account the second component involves determining the level of material costs as the ratio of material and other operating costs to the total amount of income from all types of activity at the enterprise.

2.4 RESULTS OF RESEARCH ON THE USE OF THE PROPOSED METHODOLOGICAL APPROACH BASED ON A TWO-COMPONENT MODEL

The methodological approach to assessing the state and readiness of motor transport enterprises for development consists in determining two components: a sufficient level of investment for development and a balanced level of activity costs.

Definition of the integral indicator of investment adequacy.

The integral indicator of investment adequacy is calculated as follows:

$$IS_t = \sum_{i=1}^{n} \frac{CI_t}{SD_{it}} \cdot P_{it} + \sum_{j=1}^{m} \frac{SD_{jt}}{CI_t} \cdot P_{jt}, \tag{2.1}$$

where IS_t – integral indicator of investment adequacy in the t-th period; CI_t – capital investment in the t-period; P_{it} – weight of the i-th type of resource for the integral indicator of investment adequacy for development in the t-th period; $i = 1, 2, \ldots, n$; SD_{it} – indicators of the i-th type of development resources in the t-th period; SD_{jt} – indicators of the j-th type of development resources in the t-th period; P_{jt} – weight

of the *j*-th type of resource for the integral indicator of investment adequacy for development in the *t*-th period; $j = 1, 2, .., m$.

One of the options for the normative level of the integral indicator of investment adequacy is given in **Table 2.1**.

Table 2.1 Normative level of the integral indicator of investment adequacy

Components of the integral indicator of investment adequacy	Calculation of indicators	Minimum level	Weight	Contribution to the integrated indicator
1	2	3	4	5 (gr.3*gr.4)
Depreciation adequacy	Ratio of capital investments to depreciation deductions	2.5	0.25	0.625
Adequacy of long-term loan capital	Ratio of capital investments to long-term debt capital	4	0.25	1.0
Production adequacy	Ratio of non-current assets to capital investments	3.5	0.25	0.875
Equity adequacy	Ratio of equity to capital investments	2	0.25	0.5
Integral indicator of investment adequacy	–	–	1	3.0

Source: compiled by the authors

The first component of the integral indicator of investment adequacy allows to assess depreciation adequacy through the ratio of the annual volumes of capital investments of the enterprise and the volumes of depreciation deductions. The target minimum level for this ratio is set at 2.5, based on the logic of the formation of its components. Thus, depreciation deductions show only the actual level of wear and tear of existing means of production (fixed assets) formed in previous years. Accordingly, capital investments at the level of depreciation deductions will not ensure even a simple reproduction of fixed assets. Especially in conditions of their fairly rapid depreciation, both moral and technological, and physical.

Therefore, capital investments should not be less than 2.5 times higher than the annual volumes of depreciation deductions. There are certain risks for enterprises that have practically worn out fixed assets and, accordingly, minimal depreciation deductions. This can lead to a wide range of values for this component. This feature is generally inherent in indicators that reflect the ratio between different financial and economic indicators of the activities of enterprises. Therefore, it is advisable to use limit levels of the ratio, in particular, if they exceed 3–4 times the minimum target standard, then such a three-fold minimum is applied, and not the actual result.

The second component of the integral assessment allows to assess the adequacy of long-term loan capital through the ratio of annual volumes of capital investments and accumulated long-term liabilities of the enterprise. Similarly to the previous ratio, capital investments should exceed such liabilities several times, which will indicate an active investment strategy aimed at the economic development of the enterprise.

The next component of the integral assessment is aimed at determining production adequacy through the ratio of the cost of non-current assets and capital investments. The inverse ratio is used here, since this allows to apply comparable weighted rates and target standards. The proposed target standard may be a 2–4-fold excess of assets over capital investments and will depend on the need for fixed assets for the production of goods or the provision of services. Thus, for motor transport enterprises, especially medium and large ones, the presence of a modern transport fleet and its renewal is a critically important condition for maintaining competitiveness, market positions and implementing development strategies.

The next component of the integral assessment is the adequacy of equity, which is assessed through the ratio of equity and capital investments. Similarly to the previous ratio, compliance with the parameters of financial autonomy requires an adequate level of equity. Accordingly, a multiple excess of equity over capital investments is acceptable.

In general, the use of different regulatory limits allows for multivariate calculations and evaluation of results in accordance with the goals and strategies of economic development of enterprises.

To calculate the integral indicator of investment adequacy, the same specific weight of its individual components (ratio) was used, i.e. each of them was 25 % (0.25). At the same time, different specific weights can be used for research, as well as expanding the components of the integral indicator. Four components of the integral indicator were used. Accordingly, the minimum normative value of the integral indicator of investment adequacy is 3. And the higher the value of this indicator, the better the potential of the enterprise to implement its economic development strategy, and therefore, a more effective mechanism for managing its economic development is used.

In this case, it seems appropriate to supplement the minimum target level with a sufficient level, in particular, which will be twice as high as the minimum. Conceptually, this is shown in **Fig. 2.1**.

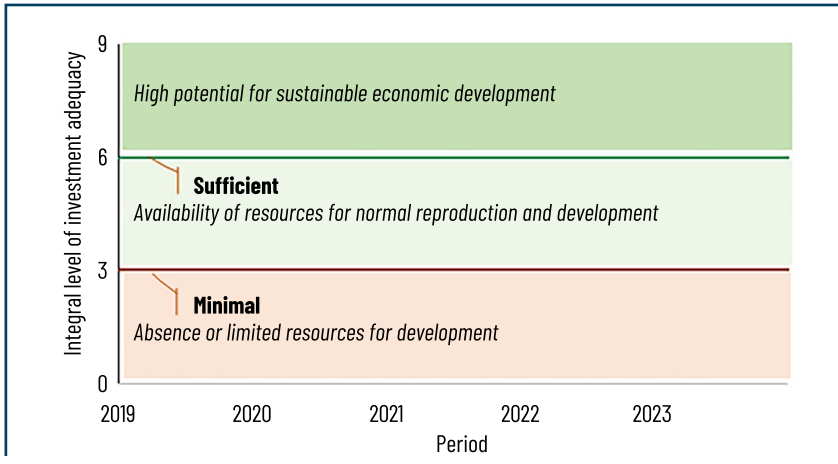

Fig. 2.1 Ranges of the level of the integral indicator of investment adequacy

Source: developed by the authors

This will allow to obtain three ranges for the integral indicator:

1) less than the minimum level – the actual value in this range will indicate the absence or significant limitation of resources for development at the enterprise;

2) between the minimum and sufficient levels – the actual value in this range will demonstrate the availability of resources for normal reproduction and development of the enterprise;

3) above the sufficient level – the actual value in this range will demonstrate a high potential for sustainable development of the enterprise.

Determining the level of material costs.

Taking into account the second component of the methodological approach to assessing the state and readiness of enterprises for development involves determining the level of material costs, the calculation of which is proposed to be carried out as follows:

$$CL_t = \frac{MC_t + OC_t}{I_t} \cdot 100\%, \tag{2.2}$$

where CL_t – level of material costs in the t-th period; MC_t – volume of material costs and costs for payment of services used in production in the t-th period; OC_t – volume of other operating expenses in the t-th period; I_t – total amount of income from all types of activities in the t-th period.

Thus, the level of material cost is the ratio of material and other operating expenses to the total amount of income of the enterprise. As with the first component, it is possible to apply only the minimum target standard or to apply several ranges (**Fig. 2.2**).

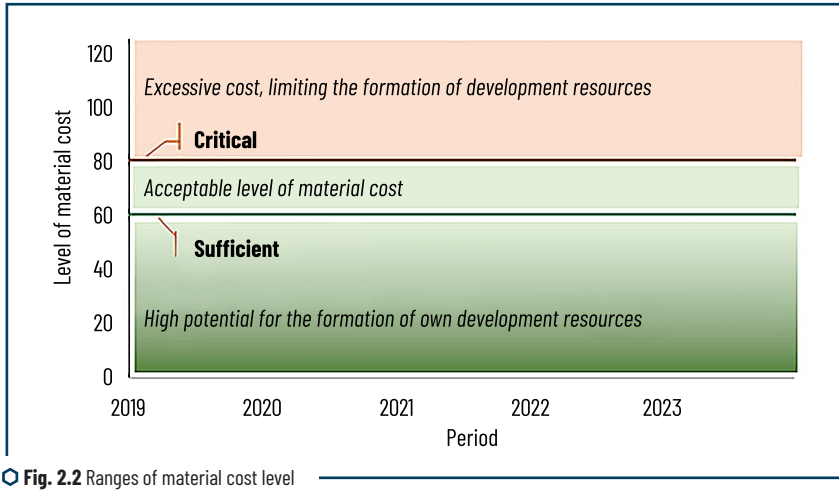

Fig. 2.2 Ranges of material cost level

Source: developed by the authors

So, actual values of the material cost level less than 50 % will indicate the presence of a high potential for the formation of the enterprise's own development resources. Values at the level of 50–75 % will indicate an acceptable level of material cost, and above 75 % will mean a critical level and excessive cost, which limits the formation of sufficient development resources at the enterprise.

The information base for calculating the material cost level is the data of the report on the financial results of the enterprises [19]. Sources of input data for applying the proposed methodological approach to assessing the state and readiness of enterprises for development are given in **Table 2.2**.

Table 2.2 Input data for assessing the state and readiness of enterprises for development

No.	Indicator	Reporting form	Line code
1	Integral indicator of investment adequacy		
1.1	Capital investments	Notes to the reporting	–
1.2	Depreciation and amortization	Financial statement (form 2)	2515
1.3	Profit before tax		2290/2295
1.4	Non-current assets	Company balance sheet	1095
1.5	Equity		1495
1.6	Long-term debt capital		1595
2	Level of material costs		
2.1	Material costs and costs of services	Financial statement (form 2)	2500
2.2	Other operating expenses		2520
2.3	Net income from sales of products (goods, works, services)		2000
2.4	Other income from operating activities		2105, 2110, 2111, 2112, 2120, 2121, 2130, 2180
2.5	Income from financial activities		2200, 2220
2.6	Other income		2240

Source: compiled by the authors

A certain problem for assessing the state and readiness of enterprises for economic development for external experts and researchers is the rather veiled data on investments in general, and capital investments in particular, in the financial statements of enterprises. On the one hand, such data are quite confidential and require proper protection of commercial interests.

2.5 TESTING THE PROPOSED TWO-COMPONENT METHODOLOGICAL APPROACH TO ASSESSING THE READINESS OF ORGANIZATIONS FOR DEVELOPMENT

The testing of the methodological approach showed low resource capacity of the studied enterprises.

Thus, the dynamics of the integral indicator of investment adequacy showed that in general for enterprises engaged in road freight transportation, its level is significantly lower than the target normative value.

In particular, in 2013 it was 2.1 points with a minimum level of 3 points. And during 2015–2023 its value on average ranged from 1.2 to 1.7, that is, it was in the range of absence or limited resources for economic development [18]. This confirms the widespread practice of domestic enterprises in general to rely on internal resources for financing investments. In particular, in 2020, only 6.6 % of capital investments in the economy as a whole were financed by bank loans and other loans [18].

The calculation of the second component of assessing the state and readiness of enterprises for development based on aggregated data for freight road transportation enterprises in Ukraine showed the following. The overall level of material costs of the specified type of economic activity is quite moderate and during 2013–2023 did not exceed 40 % [18]. This confirms the presence of the potential for ensuring the efficiency and profitability of providing freight transportation services by road transport. At the same time, the application of the developed approach to the reporting of individual motor transport enterprises showed results that differ from industry-wide calculations.

The calculations were carried out using data from three motor transport enterprises from different regions of Ukraine and with different potential: Kyiv Production Company Rapid, PJSC ATP 11263, Dnipro, PJSC Chernihiv Motor Transport Enterprise 17462. The calculation of the integral indicator of investment adequacy showed that during 2018–2023 the studied enterprises did not reach the target regulatory level (**Table 2.3**).

Table 2.3 Average level of indicators for assessing the state and readiness for development for individual enterprises during 2018–2023

Indicators / enterprises	Value
Integral indicator of investment adequacy	Standard level > 3
PJSC "Kyiv Production Company "Rapid", Kyiv	2.4
PJSC "Chernihiv Motor Transport Enterprise 17462"	2.0
PJSC "ATP 11263", Dnipro	2.7
Level of material costs of the enterprise's activities	Standard level < 60
PJSC "Kyiv Production Company "Rapid", Kyiv	63.9
PJSC "Chernihiv Motor Transport Enterprise 17462"	54.5
PJSC "ATP 11263", Dnipro	74.3

Source: compiled by the authors based on enterprise reporting [19]

In addition, more powerful enterprises from Kyiv and Dnipro generally have a higher level of the investment adequacy indicator, which confirms the feasibility of building potential and investment opportunities.

Analysis of the integral indicator of investment adequacy by individual components in the context of the studied enterprises shows significant differences in their business models and ability to implement development strategies (**Table 2.4**).

Table 2.4 Assessment of compliance with the regulatory level of individual components of the integral indicator of investment adequacy for individual enterprises during 2018–2023

Indicators / enterprises	Depreciation adequacy	Long-term debt capital adequacy	Production adequacy	Equity adequacy
Standard level	> 2.5	> 4	> 3.5	> 2
PJSC "Kyiv Production Company "Rapid", Kyiv	4.79	2.24	1.36	0.91
PJSC "Chernihiv Motor Transport Enterprise 17462"	1.23	2.13	5.03	3.41
PJSC "ATP 11263", Dnipro	0.98	0.40	5.47	3.68

Source: compiled by the authors based on enterprise reporting [19]

So, PJSC "Kyiv Production Company "Rapid" in 2018–2023 has a high level of depreciation adequacy, which was achieved primarily due to active investment activity. The enterprise, while maintaining a traditionally low share of depreciation deductions in the structure of operating expenses for the industry, directs resources to capital investments that are several times higher than the annual depreciation of fixed assets. The enterprise also uses long-term loan resources more actively, although their volumes are somewhat lower than capital investments.

The greatest influence on the formation of the integral indicator of investment adequacy for PJSC "Chernihiv Motor Transport Enterprise 17462" and PJSC "ATP 11263" was production adequacy and equity adequacy. In particular, during the period under study, these indicators exceeded the target standard. Probably, enterprises are serious about maintaining an appropriate level of financial autonomy and minimizing risks associated with obligations to creditors.

Analysis of financial statements of transport enterprises showed that most of them do not provide open data on their capital investments, which complicates the analysis of their activities by external experts. Therefore, their investment activity can be evidenced by data on the renewal of fixed assets, cash flows from investment and financial activities, etc.

For PJSC "Chernihiv Motor Transport Enterprise 17462", the results of assessments of the integral indicator of investment adequacy by components are largely comparable with the studied enterprise from the city of Dnipro. In general, it should be noted that an important aspect of applying the developed methodological approach is a sufficient information base, primarily regarding the volumes of capital investments or another aggregate indicator of investment volumes.

The assessment of the studied enterprises showed that the problem of excessive cost is quite relevant. Thus, the level of material costs for enterprises is almost twice as high as that calculated for the freight road transportation industry as a whole. In particular, for PJSC "ATP 11263" it is almost 75 %, that is, the costs of fuel, spare parts and other material costs make up almost 3/4 of the total revenue of the enterprise.

The minimum target standard of the level of material costs is not observed for PJSC "Kyiv Production Company "Rapid". And only PJSC "Chernihiv Motor Transport Enterprise 17462" has a level of material costs lower than 60 %, but also significantly exceeds the average industry level.

Calculation of the integral indicator of investment adequacy and the level of material costs for individual ATPs confirms the conclusions obtained about their weak investment readiness to implement ambitious strategies of economic development in the freight transportation market. This increases the risks of further technological lag of enterprises in the industry, the preservation of non-equivalent exchange and pressure of the transport sector on all other related sectors of the economy and markets, and the limitation of the resource base for the formation of budgets at various levels.

2.6 DISCUSSION OF THE RESULTS OF IMPLEMENTING A TWO-COMPONENT METHODOLOGICAL APPROACH TO ASSESSING THE READINESS OF ORGANIZATIONS FOR DEVELOPMENT

A methodological approach to assessing the sustainability of organizations based on a two-component assessment is substantiated, which consists, on the one hand, in determining a sufficient level of investment for development, and on the other, a balanced level of activity costs.

For the first component (2.1), it is proposed to use an integral indicator of investment adequacy. The methodology for its calculation is based on combining the dependencies between the volumes of capital investments and other parameters of activity (depreciation deductions, long-term loan capital, non-current assets, equity, etc.). The normative minimum level of the integral indicator of investment adequacy will depend on the specified parameters of its components, which allows for multivariate calculations. One of the options for the normative level of the integral indicator is given in **Table 2.1**. The calculation was carried out on the basis of four components, such as: depreciation adequacy, adequacy of long-term loan capital, production adequacy, adequacy of equity. Under these conditions, the integral indicator of investment adequacy is determined at the level of 3.0. The ranges of the level of the integral indicator of investment adequacy are proposed: minimum, sufficient, high (**Fig. 2.1**).

The second component (2.2) reflects the ratio of material and other operating costs to the total income of the enterprise. It is possible to apply the minimum (critical) target standard, which is set at 60 %, or to apply several ranges (**Fig. 2.2**): sufficient, acceptable, critical.

An assessment of the dynamics of volumes and the level of material costs for freight road transportation enterprises in Ukraine was carried out, based on the results of which it can be concluded that during 2013—2023 the level of material costs did not exceed 40 %. This confirms the potential for ensuring the efficiency and profitability of providing freight transportation services by road. At the same time, the application of the developed approach to reporting by individual road transport enterprises showed results that differ from industry-wide calculations.

The sustainability of road transport enterprises was monitored based on the consistency of key economic indicators with the level of investment and the achievement of target parameters of the structural balance of its costs. It was found that the majority of road transport enterprises have weak financial stability.

Three road transport enterprises from different regions of Ukraine and with different potential were selected for the study: PJSC "Kyiv Production Company "Rapid", Kyiv, PJSC "ATP 11263", Dnipro, PJSC "Chernihiv Road Transport Enterprise 17462".

Testing of the proposed two-component assessment of the state and readiness of enterprises for development showed their low resource capacity and the presence of the problem of excessive cost (**Table 2.3**). Thus, the level of material costs for enterprises is almost twice as high as that calculated for the freight road transportation industry as a whole. The assessment of compliance with the regulatory level of individual components of the integral indicator of investment adequacy for the studied motor transport enterprises in 2018–2023 is presented in **Table 2.4**.

The dynamics of the integral indicator of investment adequacy showed that, in general, for enterprises engaged in road freight transportation, its level is significantly lower than the normative value. This indicates the dominance of survival strategies among enterprises, rather than development, and weak state policy that does not stimulate active investment in a legal transparent environment.

It is proposed to take into account the developed approach in the implementation of state support for enterprises that actively invest, increase legal turnover, income and labor costs. Benefits can be introduced for enterprises that have higher than the normative values of the developed indicators and will adhere to such conditions for a long period. In particular, if they are fulfilled for three or more years, such enterprises may be exempted from paying income tax if they are invested in development.

The developed two-component methodological approach makes it possible to optimize the assessment of the readiness of motor transport enterprises for economic development. Based on the interpretation of economic development as a transition to a new qualitative state and new possibilities for the functioning of the enterprise, the basis for its implementation is a sufficient level of investment and the availability of sources of their financing. And the necessary result of the success of such investments should be a more balanced structure of operating costs, which will confirm the systematicity, long-term nature and durability of changes.

The development of research using the proposed methodological approach is that its use will allow rationalizing the mechanism of economic development management and more clearly identifying the correspondence of current and projected performance indicators of both domestic and foreign enterprises to their development goals.

The limitations of the developed methodological approach include the impossibility of including profitability as the main internal resource for financing the development of the enterprise in the integrated assessment of the adequacy of profitability. This component quite organically corresponds to the task of assessing the integral indicator of investment adequacy. But its practical application is complicated by possible losses of the enterprise or minimum profit values. This is a fairly typical situation for many motor transport enterprises, which will actually lead to excessive values of this ratio and distortion of the results obtained. Therefore, its application requires the availability of adequate data on the profit of enterprises and their proper calibration.

The disadvantages include the fact that the problem for assessing the readiness of enterprises for development for external experts is the rather veiled data on investments in general and capital investments in particular in financial statements.

2.7 STRATEGICALLY-ORIENTED MANAGEMENT OF ORGANIZATIONAL DEVELOPMENT

Strategically-oriented management of organizational development is a scientifically substantiated influence of management on the socio-economic development of an organization, which ensures long-term, sustainable growth of the results of production and commercial activities. The development management system consists of interconnected subsystems: production, technological, financial, innovation, communication, structural and organizational, marketing, personnel, legal support, economic, socio-psychological, motivational subsystems [20].

The main tools of strategically-oriented management of development in order to achieve the main target benchmarks are the development and implementation of appropriate strategies. Organizations that have a strategy and implement strategically-oriented management of activities always have the opportunity to act consistently and systematically both in the internal environment and in the conditions of a changing external environment, which increases the likelihood of achieving the set goals for further development.

Let's consider the strategies that can be implemented by an organization to ensure financial stability and optimize resources:

1. The reserve management strategy involves an active process of accumulating and managing financial reserves to ensure financial stability and the ability to meet its obligations. The main provisions of this strategy are presented in **Fig. 2.3**.

2. The asset diversification strategy consists of distributing investments between different asset classes in order to reduce risk and ensure greater liquidity. The main provisions of this strategy are presented in **Fig. 2.4**.

3. The profit reinvestment strategy involves the redistribution of profit received from activities in order to maintain or increase the organization's liquid assets. The main goal is to use the cash that the enterprise already has to generate additional profit. The main provisions of this strategy are presented in **Fig. 2.5**.

4. The strategy of optimizing liabilities and obligations is aimed at balancing the structure of the organization's liabilities and assets in order to ensure an optimal balance between the liquidity of assets and their financial stability. This strategy can help reduce financial costs, increase profitability and improve financial risk management. The main provisions of the strategy are presented in **Fig. 2.6**.

5. The risk-based liquidity management strategy emphasizes control over risks associated with liquidity, in particular ensuring financial stability in a changing financial environment, and helps manage the liquidity of assets in conditions of increasing risk and financial uncertainty. The main provisions of the strategy are presented in **Fig. 2.7**.

6. The strategy of active asset liquidity management involves active investment and management of liquid assets to ensure maximum efficiency and profitability, as well as optimization of the organization's risk. The main provisions of the strategy are presented in **Fig. 2.8**.

The study determined that the implementation of combined strategies can be a key factor in achieving financial stability and ensuring the development of organizations. The need for further improvement of resource management strategies, careful monitoring and risk management, as well as the development of the ability to adapt different strategies to the unique conditions and needs of their activities is important.

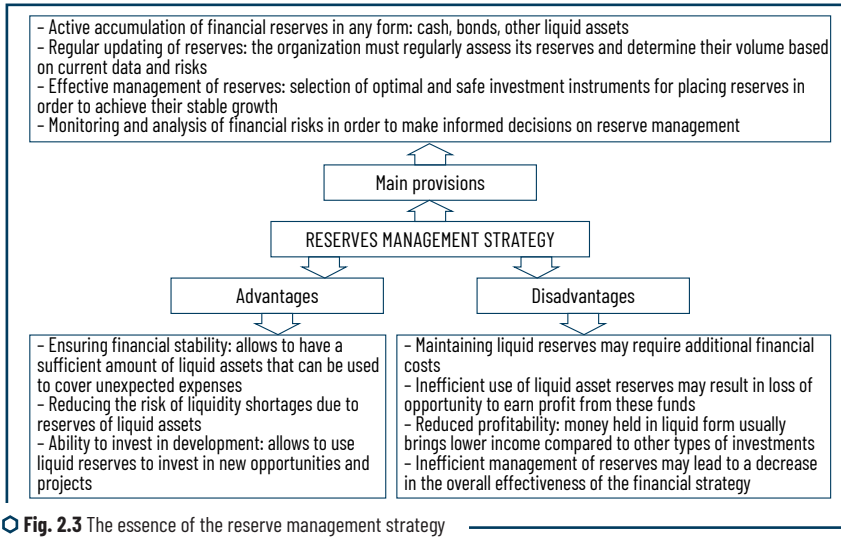

Fig. 2.3 The essence of the reserve management strategy

Source: compiled by the authors

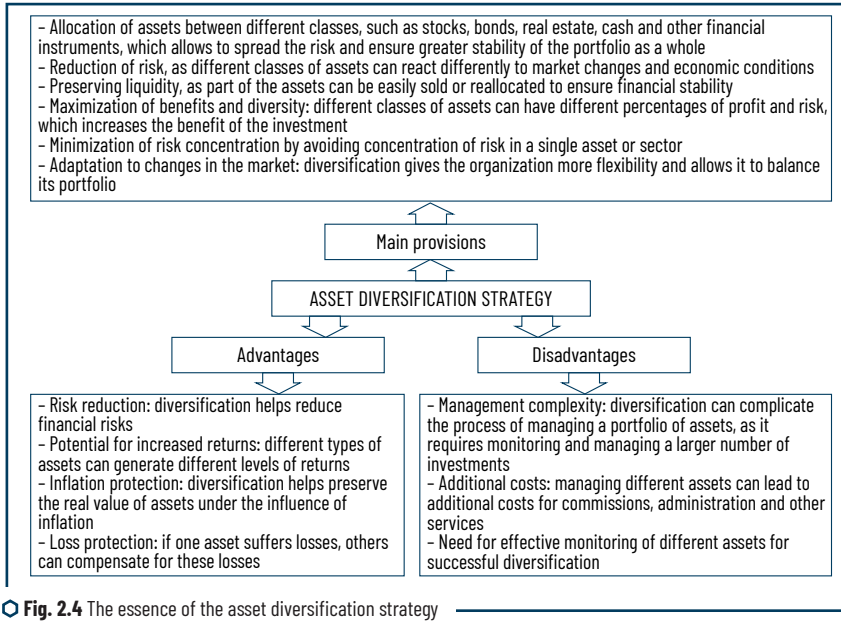

Fig. 2.4 The essence of the asset diversification strategy

Source: compiled by the authors

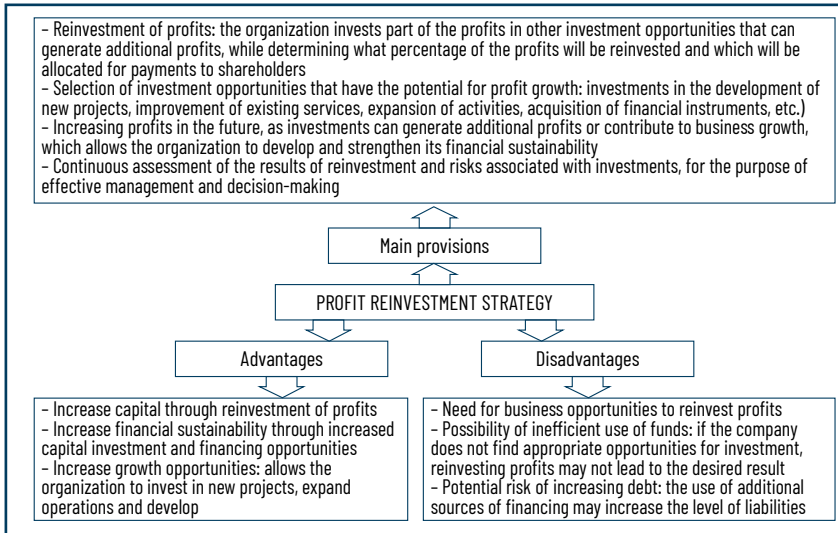

Fig. 2.5 The essence of the profit reinvestment strategy

Source: compiled by the authors

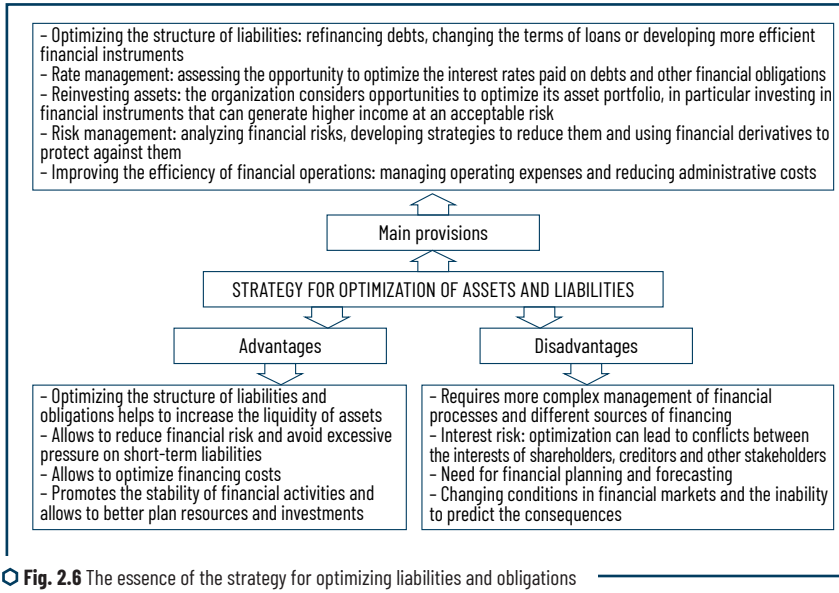

Fig. 2.6 The essence of the strategy for optimizing liabilities and obligations

Source: compiled by the authors

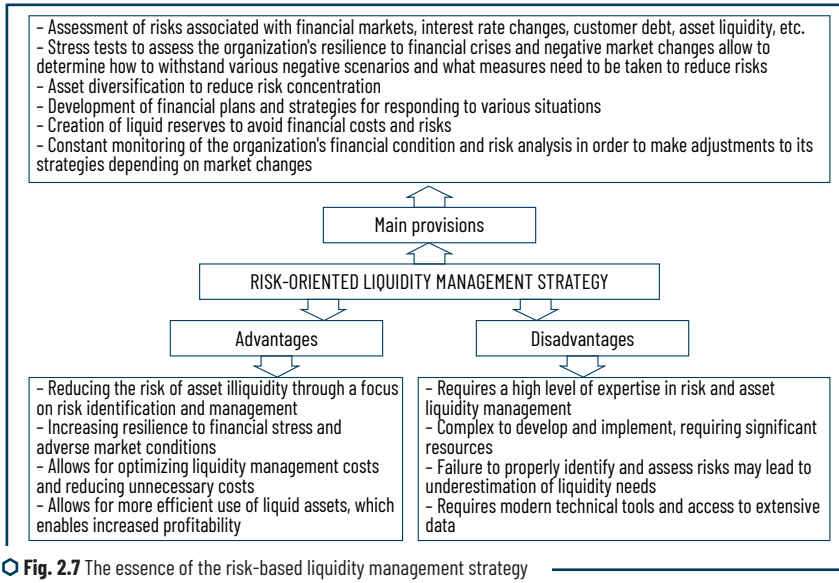

Fig. 2.7 The essence of the risk-based liquidity management strategy

Source: compiled by the authors

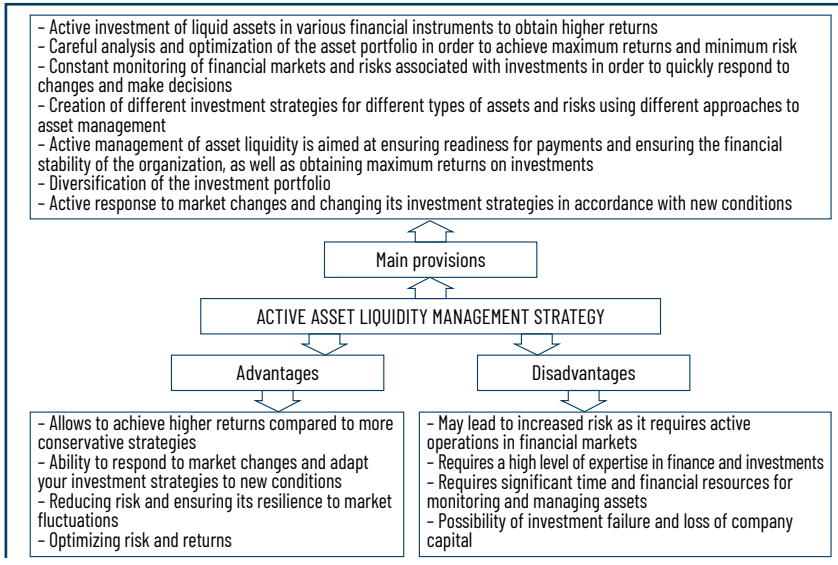

Fig. 2.8 The essence of the active asset liquidity management strategy

Source: compiled by the authors

To further strengthen financial stability and maintain competitiveness, it is worth considering opportunities for the implementation and improvement of innovative strategies. The emphasis on the implementation of advanced technologies can not only provide an advantage in the market, but also help solve possible challenges and make any organization less vulnerable to fluctuations in the external environment. The key drivers of success and sustainable development in the future may be the expansion of markets and the ability to implement innovations.

2.8 DISCUSSION OF THE RESULTS OF THE DEVELOPMENTS ON THE ASSESSMENT OF FINANCIAL STABILITY AND READINESS OF LOGISTICS ACTIVITIES IN ORGANIZATIONS FOR DEVELOPMENT

As a result of the study, a two-component methodological approach was developed, which makes it possible to optimize the assessment of the readiness of enterprises for development based on the calculation of the integral indicator of investment adequacy and the level of material cost. The integral indicator of investment adequacy was calculated based on the comparison of depreciation charges, equity, long-term loan capital, non-current assets with the size of capital investments. The level of material cost was determined based on the comparison of material and other operating costs with the income of the enterprise.

The proposed methodological approach was tested, which showed the low resource capacity of enterprises. The dynamics of the integral indicator of investment adequacy showed that in general for enterprises engaged in road freight transportation, its level is significantly lower than the normative value. This indicates the dominance of survival strategies, not development, among motor transport enterprises, and weak state policy, which does not stimulate investment activity in the legal environment. The advantage of the developed methodological approach is the possibility of using different components for each component, setting different weights in the integral assessment, and the possibility of adjusting target ranges.

Strategies for managing the development of the organization have been developed: a reserve management strategy, an asset diversification strategy, a profit reinvestment strategy, a strategy for optimizing liabilities and obligations, a risk-oriented liquidity management strategy, and an active liquidity management strategy. The implementation of combined strategies can be a key factor in achieving financial stability, optimal risk management, and the possibility of further development of organizations.

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3 IMPLEMENTATION OF INNOVATIVE MECHANISMS TO ENSURING ECONOMIC GROWTH OF REGIONS BASED ON THE DEVELOPMENT OF TRANSPORT INFRASTRUCTURE

Oleksandr Mordovtsev, Oksana Dmytriieva, Inna Shevchenko, Anton Kholodov, Yerik Nugman

ABSTRACT

The destabilization of the geopolitical, socio-economic and security situation in the world has exacerbated the issue of sustainable development of regional economies and deepening their interaction. Ensuring the growth of the national economy as a whole and individual regions in particular makes the search for mechanisms aimed specifically at internal sources relevant. Spatial development is gaining particular importance due to the increasing role of transport infrastructure in ensuring the economic growth of regions.

The socio-economic heterogeneity of regional systems plays a decisive role in the formation of mechanisms for ensuring economic growth, which determines the diversity and contradictions of the effects of transport infrastructure on them. This is expressed in the fact that similar infrastructure facilities in different regions can have different organizational and economic effects. Thus, the appearance of a road can lead to the acceleration of material flows, thereby contributing to the development of the region's economy, and on the other hand, can stimulate an accelerated outflow of population. At the same time, the principles of managing social development and economic growth of regions obtained in practice do not allow to take into account the functional diversity and inconsistency of the effects of transport infrastructure and thereby complicate the search for effective mechanisms for ensuring regional development. growth based on the development of transport infrastructure.

Therefore, the study focuses on the actualization of the need to introduce innovative mechanisms into the economy of regions by determining the conditions necessary and sufficient for the implementation of the role of transport infrastructure as one of the sources of sustainable economic growth. In this regard, the knowledge of the essence and patterns of the mutual influence of transport and regional economic development is of great theoretical and practical interest.

KEYWORDS

Destabilization, geopolitics, socio-economic development, transport infrastructure, regional economy, economic growth, innovative mechanisms, sustainable development.

3.1 CONDITIONS AND FEATURES OF ENSURING ECONOMIC GROWTH OF TRANSPORT INFRASTRUCTURE

At the beginning of our study, the task is to understand the conditions that allow transport infrastructure to be interconnected with regional economic systems, and to formulate a general concept of

improving mechanisms for ensuring economic growth of regions based on the development of transport infrastructure.

It should be noted that one of the conditions, in particular, is the need to take into account the stability of the inflationary or recessionary gap in which various regional territorial entities are located. The state when prices in some regions exceed the equilibrium, and aggregate demand consistently lags behind supply, is accompanied in other regions by a state when prices are lower than the equilibrium, and demand is constantly not satisfied.

The difference in conditions also requires different mechanisms for activating economic growth. The main mechanism for stimulating growth in regions with insufficient supply is the stimulation of aggregate demand. It is characteristic of such regions that infrastructure development is carried out by private agents.

As an example, it is possible to cite the process of formation in the transport infrastructure of the function of ensuring the movement and distribution of goods (associated with the development of logistics and trade). Successful resolution of issues of stimulating growth on the basis of this mechanism in individual regions has initiated interest in it as a basis for regional development [1]. However, this mechanism, as a national practice of managing regional development, cannot always ensure the growth and development of the entire complex of regional economic systems.

The main feature of regions in the inflationary gap is that stimulating demand negatively affects their economic system, since demand already exceeds supply. Such regions need targeted state investments, including for the development of transport infrastructure. The main mechanisms here should be aimed at expanding the capabilities of regional industrial production, taking into account the established industry specifics and stimulating interregional industrial cooperation.

In addition to the above-mentioned features of infrastructure development in different regions, one should not lose sight of the implementation of state interests in general. An important factor in the formation of an economically integrated space is the transport infrastructure, which provides living conditions and economic activity in the regions, contributes to the creation of a favorable investment environment and is a condition for the expansion of industrial and social structures. The formation of economic integrity and the establishment of regular interactions mean the strengthening of interdependence and the development of interregional production interactions.

Thus, it can be noted that the dynamics of the development of transport infrastructure in some regions and the parameters of the economic situation in other regions are mutually determining (the situation in each region depends on decisions and events in other regions). At the same time, it is not possible to forget about the internal property of regional economic systems, namely the possibility of mutually beneficial exchange. And here the development of transport infrastructure expands the possibilities of beneficial interaction for all regions through the formation of a single economic space and the deepening of interregional cooperation.

In addition to the tasks of the global and national division of labor and the state task of connecting the country's territory, there are tasks of lower territorial levels. In this context, the development of transport infrastructure should be linked to the economic level of the regional system, the goals set for it, the scale

of the existing and prospective production potential. During periods of crisis and post-crisis stages of development, the need for state participation in economic regulation increases sharply, since the state is the only agent capable of focusing on systemic goals under any circumstances. By implementing infrastructure projects and ensuring the integrity of the territory, the state contributes to reducing uncertainty and lays the basic foundation for overcoming crisis phenomena.

Next, it is possible to highlight the following essential condition that must be taken into account when forming mechanisms for activating regional growth. It consists in the mutual influence of economic systems of different levels and different regions, which can manifest itself in the interregional movement of population, resources, and investments. Thus, when implementing some regulatory influences in the field of transport infrastructure, it is necessary to take into account both internal and interregional flows of population and investment. In particular, the construction of highways in remote and depressed areas of the country is often accompanied by an outflow of population. That is, measures to develop transport infrastructure to achieve the goal of its attraction and consolidation should be accompanied by additional solutions that could stimulate such effects.

In addition to taking into account the conditions of regional economic systems and the specifics of interregional cooperation, another necessary condition for activating regional growth through the development of transport infrastructure is the inclusion of the regional aspect in the system of public administration. Studies show that the effectiveness of the same measure can be assessed differently by different agents. That is, the effectiveness of measures cannot be assessed according to conditional principles. For example, the construction of a relevant infrastructure facility may have a negative commercial effect, but a positive budgetary effect, for example, in the case when the city (regional) authorities decide to introduce a fee for the passage of commercial transport. Otherwise, the construction of a highway may require the demolition of some industrial building, but it can increase the transport accessibility and attractiveness of the territory for the population, stimulate the organization of new service enterprises along the route (public catering, car workshops), which can lead to an increase in the standard of living, income, population, land value and an increase in tax revenues. Thus, with negative effects for one entity, there are positive effects for others, including for local (regional) authorities. This indicates the importance of harmonizing different opinions and interests in planning and organizing the development of transport infrastructure. Therefore, it is advisable to involve regional and local administrations, as well as the local community, in assessing the effectiveness of measures and developing mechanisms for their implementation.

Thus, for the effective organization of transport infrastructure and improving the mechanisms for managing its impact on the economic development of regions, it is necessary to take into account all the above conditions, they are reflected in **Fig. 3.1**.

Thus, solving the above tasks allows ensuring the effectiveness of management mechanisms and the applicability of this toolkit for any regional territorial entities. A natural consequence of the existence of various connections and the complexity of the subject of research is the diversity of approaches to assessing the role of transport infrastructure and to the formation of mechanisms for ensuring economic growth of regions based on the development of transport infrastructure.

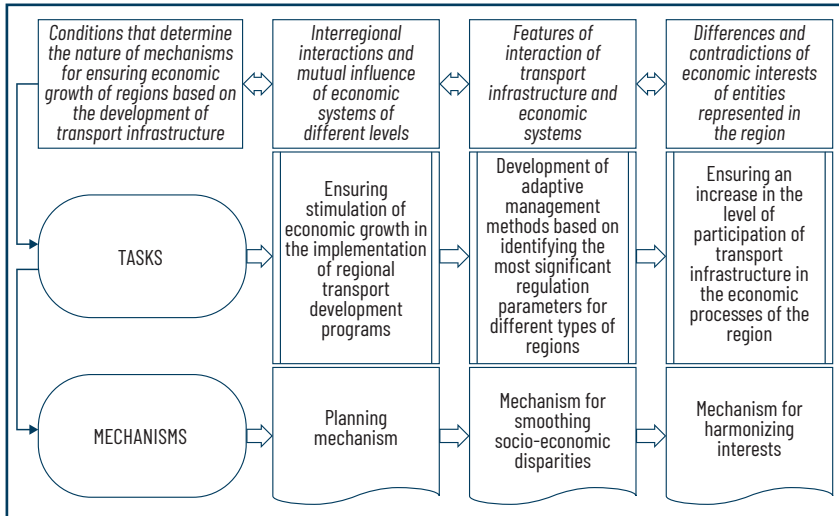

Fig. 3.1 General concept of improving mechanisms for ensuring economic growth of regions based on the development of transport infrastructure

Source: [2–4]

3.2 METHODOLOGICAL SUPPORT OF TRANSPORT INFRASTRUCTURE DEVELOPMENT MECHANISMS

At the next stage of the study, it should be noted that the complexity of the transport infrastructure system, the multidirectional impact on both the economic and social systems determined a wide range of tools for forming mechanisms for ensuring regional growth based on the development of transport infrastructure. Having studied and generalized international experience, a systematization of methodological approaches and methods for forming mechanisms for the development of transport infrastructure was obtained (**Table 3.1**).

Therefore, it is possible to conclude that there are theoretical premises that are the basis for further research and analysis. Initially, it is assumed that the territorial location and economic significance of transport infrastructure are extremely heterogeneous, the level of its development differs significantly between regions. This necessitates the structuring of regions according to the ratio of economic characteristics and transport infrastructure indicators.

Therefore, for an adequate analysis and assessment of the impact of transport infrastructure on economic growth and, ultimately, for the formation of adaptive management methods, it is necessary to take into account the spatial structure in order to correctly understand the scale, nature of the inclusion of transport infrastructure in the regional economic system, the level of interregional connections. that it provides. On the other hand, it is important to take into account the main characteristics of the economic system within which the analysis of transport infrastructure takes place.

Table 3.1 Systematization of methodological approaches and methods for forming mechanisms for the development of transport infrastructure

Main aspects of the methodology	Development of management mechanisms	Advantages of approaches	Disadvantages of approaches
Descriptive approach — Technocratic method			
Analysis of the state and technical parameters of transport networks	Organization of interaction between modes of transport, harmonization of network operation	Systematization of transport activities	Complexity of comparison and quantification
Descriptive approach — Economic and geographical method			
Description, assessment of quantitative indicators proceed from economic sense	Regulation of the provision of infrastructure facilities in various territories	Comparison possibilities (ranking, assessment of dynamics)	Lack of consideration of spatial characteristics
Economic and analytical approach — Balance method			
Transport is considered as one of the branches of the economy through cost indicators	Improving the planning of the distribution of costs for the development of transport infrastructure	Depth of assessments and ideas about the parameters of the interconnections of industries	Laboriousness; the balanced scenario does not seem realistic enough
Economic and analytical approach — Capital method			
Cost and quantitative assessments of transport infrastructure as a capital resource	Regulation of interregional interactions on the use of transport infrastructure	Assessment of the role of transport in comparison with other resources (labor and capital)	Complexity of modeling spatial aspects
Economic and analytical approach — Investment method			
Cost assessments of transport infrastructure as an investment, providing for the return of invested funds	Organization of principles of joint financing of transport infrastructure development	Possibility of assessing the time horizon of the implementation of the Transport Infrastructure Development Project; the effectiveness of transport infrastructure development for individual companies	Contradictions between the guidelines for increasing the efficiency (return) of investments and stimulating regional development processes

Source: [5–7]

The essence of the analysis in this approach is not limited to the study of individual aspects of transport infrastructure or the economic environment. Spatial prerequisites for the formation and support of economic interactions have been identified, which, together with the assessment of the main parameters of the economic system, allows to put forward adequate hypotheses regarding the determination of the main factors and conditions of the economic development of the region and further determine the mechanisms by which this development can be carried out. Thus, the conditions considered above that allow transport

infrastructure to be interconnected with regional economic systems and methodological approaches and methods for forming mechanisms for the development of transport infrastructure make it relevant to improve the mechanisms for implementing management functions presented in **Fig. 3.1**. Let's consider it an important scientific and managerial task to determine the parameters and conditions for the functioning of transport infrastructure necessary to stimulate the growth and development of a specific regional economic system. Thus, a fundamental basis is formed for the implementation of these mechanisms in practice, since the required state of transport infrastructure significantly depends on the current structure of the economy.

3.3 TRANSPORT INFRASTRUCTURE DEVELOPMENT PLANNING MECHANISM

To increase management efficiency, it is necessary to create and develop an information and analytical system for managing the implementation of programs at different levels [8]. The main tasks of such a system are: registration of analytical information in various forms (in terms of basic indicators; planned indicators, territories, etc.); design of transport development programs both in territorial and temporal terms with a breakdown into objects, nodes, directions and corridors with their current and prospective characteristics.

Such a large-scale and intensive process of forming programs in the system of public administration and local self-government was designed to solve problems related to determining the goals of regional and local authorities in terms of stimulating the economy and ensuring the focus of the territorial development process. However, it is worth saying that this mechanism is not completely perfect, since the formally approved requirements for ensuring territorial development were not properly supported by an understanding of the nature of the impact of transport infrastructure on the economic growth of individual territories, ways to enhance growth through transport infrastructure. One way to overcome such planning difficulties is to transfer planning goals from higher-level programs. In general, this approach corresponds to the established practice of setting management tasks from top to bottom.

It should be noted that the transformation of the principles of public administration will allow to increase awareness of significant interrelationships and develop mechanisms that will have a tangible impact on the development of territories. This will make it possible to increase the degree of compliance of the planned process of state and local administration with the goal of regional growth. It should be expected that the priority of the principle of territorial development will contribute to the most complete achievement of the goal of activating regional growth. At the same time, the system of indicators that will reflect the stages and levels of achieving the goal needs to be improved. The relevance of such improvement is dictated by the need to monitor the process of stimulating growth through the development of transport infrastructure, as well as the need for an objective assessment of the existing reality and options for territorial development.

The principle of purposefulness in application to planning activities for the development of territories provides that for territories with different characteristics a set of special actions or measures will be developed that will increase the efficiency of transport infrastructure as a source of growth. Efficiency here should be understood as the most close to the goal of economic growth of the territory through the use of material, labor and energy resources of the transport industry.

No less important is the group of principles related to an adequate description of existing socio-economic systems and the study of the features and patterns of their development, which provides for the strengthening of the regional vector and the systematization of knowledge about the genesis of socio-economic systems of various types. A substantial and meaningful understanding of the trends in the development of socio-economic systems, obtaining reliable ideas about their reactions to external influences is the most important condition for the implementation of the scientific principle in the process of territorial development planning. Based on reliable data, it is possible to develop measures that will be effective in different conditions for different regions. This ensures the implementation of the principle of reality. In the absence of scientific research of systemic reactions, it is impossible to develop effective mechanisms for improving socio-economic systems, it is impossible to determine the level of resource provision that can lead to solving problems. The choice of methods according to any other principle, such as the introduction of best practices, does not remove the question of understanding and assessing the consequences of implementing certain decisions. At the same time, the implementation of the principle of connection with the socio-economic life of the territory is not achieved, as indicated in the source [9]. Only under the condition of a meaningful analysis of the conditions for the development of regional economic systems and their connections with the transport infrastructure is it possible to select and develop such managerial influences that can significantly affect the system in a certain direction [10], which makes it possible to successfully implement the planned function of managing the development of transport infrastructure.

Another group can be those principles that contribute to the formation of the sustainability of the planning process for the development of organizational and economic relations of transport infrastructure. These include the principles of continuity and flexibility. Continuity should be understood as the ability of the management system at any time to determine the development process with varying degrees of success. It is obvious that in conditions of crisis, with changes in national and/or international macroeconomic trends, with changes in priorities and key principles of national policy, manageability and predictability may decrease, which requires a new scientific understanding and coordination with reality. Reproducing this stage in new, changed conditions and developing actions corresponding to the prevailing circumstances will be an expression of the principle of continuity. The flexibility of the public administration planning process is expressed in the ability to perceive and take into account such transformations in the current and subsequent planning cycles.

Therefore, it is possible to conclude that when implementing the priority of territorial development, it is necessary to deepen the established programs for the development of transport infrastructure through objective assessments of connections with socio-economic systems of different levels [11].

3.4 MECHANISM FOR SMOOTHING SOCIO-ECONOMIC DISPARITIES IN THE DEVELOPMENT OF TRANSPORT INFRASTRUCTURE

Earlier in our study, the need to perceive regional economic systems as complex and heterogeneous elements of the national system, in which multidirectional trends can operate, was substantiated. The features

of economies in conditions of inflationary and recessionary gaps were highlighted. The essence of this division is that different properties of economic systems imply different mechanisms for activating economic growth. Since the territories of the recessionary gap are characterized by a state of overproduction, the main vector of approaching the equilibrium state is determined by economic theory to stimulate demand. Unlike recessionary territories, territories in the inflationary gap have a price level below the equilibrium, which hinders production processes, which ultimately leads to a significant excess of demand over supply. Therefore, the use of mechanisms for stimulating demand turns out to be detrimental for such territories due to the intensification of negative trends and an increase in deviations from the equilibrium state. It was also proven that this property of economies is systemic and affects not only the sphere of transport infrastructure.

For this reason, the formation of mechanisms for stimulating economic growth through the development of transport infrastructure should be adapted to the current situation in the regions. Such unevenness of the national economy makes it necessary to develop mechanisms that would improve the proportions of regional development and reduce gaps.

Based on the study of the conditions of economic growth in regions of the inflationary gap, it is possible to conclude that it is necessary to take into account important organizational conditions to ensure economic growth. Based on this, let's highlight the main groups of measures and areas of improvement for stimulating the economic growth of regional territorial entities in the inflationary gap through the development of transport infrastructure, in particular:

1. Stimulating the organization of primary processing of the flow of raw materials with coordination between private and regional business entities at the highest level of management; state support for industrial and infrastructure development. Mechanisms for harmonizing industry interests and interests of regional and local development in the formation of transport infrastructure:

— legislative registration of incentives for the creation of industrial transport networks taking into account the potential for regional growth; financial support for transport infrastructure development projects; control over targeted spending of funds; coordination of national-level interests in industrial development and regional-level interests in economic growth;

— development of transport infrastructure projects to ensure regional growth; financing; control over the technological and technical level of transport infrastructure project implementation; implementation of measures invested in stimulating industrial development;

— development of transport infrastructure projects at the regional level to ensure regional growth; interregional cooperation in the formation of transport infrastructure development projects; organization and implementation of a transport infrastructure development project; development of measures to stimulate the development of industry on the basis of the created infrastructure.

2. Stimulation of the production of final demand products, organizational work by local and regional administrations, production associations. Mechanism for the development of public transport infrastructure networks based on state funding:

— legislative provision of opportunities for interregional cooperation on infrastructure and industry development; financial support for transport infrastructure development projects; control over targeted spending of funds;

— development of transport infrastructure projects to ensure regional growth; organization and implementation of a transport infrastructure development project; development of measures to stimulate economic growth on the basis of the created infrastructure.

3. Purposeful formation of territorial and economic relations for the organization of production. Creation of conditions for attracting flows of technological transfers from highly developed regions. Mechanisms for preserving transport infrastructure and increasing its level of improvement and quality. At the initial stage, the construction of better roads and the organization of roadside service. Involvement of the most convenient places in economic turnover:

— financial support for projects to improve the existing transport infrastructure system; control over targeted spending;

— development of the regional level and financial support for projects to improve the existing transport infrastructure system; organization and implementation of projects to improve transport infrastructure; development of measures to stimulate economic growth based on the infrastructure being created.

Thus, it is possible to conclude that most regions have significant potential for significant economic growth. However, its implementation is associated with the implementation of a set of measures, and specialized for different groups of regions. Therefore, the next step is to develop mechanisms that ensure the most complete consideration of the interests of local communities in the growth of the local economy. The importance of developing a coordination mechanism is due to the fact that it is also necessary to ensure that national interests and the interests of individual manufacturing companies and industries are taken into account.

3.5 MECHANISM FOR HARMONIZING INTERESTS IN THE TRANSPORT INFRASTRUCTURE DEVELOPMENT SYSTEM

Transport infrastructure projects, oriented towards end-use, implement social functions and ensure the expansion of consumer demand. Thus, the involvement of local private entities in investment activities in the transport construction sector will contribute to the mitigation of the recessionary gap. The functioning of the mechanism for harmonizing the interests of stakeholders should be aimed at harmonizing two blocks of issues.

BLOCK I. This block is related to the conditions of investment activities, in particular, specific measures for the construction of transport infrastructure facilities should be determined (quantitative measurement of the expected length of roads of a certain class, special structures, etc.). On the other hand, these measures should be reflected in the financing part. Determine the terms and stages of direct implementation of infrastructure construction measures. Implementation of the project by a private agent with the involvement of its investment potential can contribute to increased savings due to more economical use of materials and increased labor productivity. During the implementation and upon completion of construction, the state's efforts should be aimed at monitoring the planned passage of construction stages and achieving the required level of quality of infrastructure formation. This is necessary because the private investor will focus on the fastest and most economical solution, which, in turn, may lead to disruption of

a number of technological operations and a general decrease in the quality of facilities, and this is designed to make state control impossible at this stage.

BLOCK II. Determining the conditions for the return of investment to private agents. Here, the state as a stakeholder formalizes its interests in creating the prerequisites for socio-economic development. And, accordingly, the more significant the external positive effects of creating a transport infrastructure project, the higher the concession payments can be. To implement such impulses, taking into account the specifics of the territories, transport construction should be accompanied by measures to improve the urban environment, expand development and increase the accessibility and availability of transport infrastructure. To this end, organizations implementing an infrastructure project should interact with local authorities on issues of increasing the significance of the transport facility in social terms.

At the end of our study, it is possible to determine the positive effects of the practical implementation of improved mechanisms for ensuring economic growth of regions based on the development of transport infrastructure:

– change in the ratio of the number of enterprises in the regional center and in the rest of the region (reduction of concentration in the capital);

– increase in the number of companies localized in a certain industrial zone on the "periphery" of the region;

– decrease in the specific costs of each enterprise located on the periphery;

– reduction of negative consequences in areas of overconcentration of production while simultaneously reducing it;

– development of production cooperation due to an increase in the number of regional suppliers and contractors;

– increase in the share of meeting the needs of transport construction at the expense of local goods, resources, components;

– increase in industrial production in terms of volume;

– expansion of the range of own products, components, parts, etc., as an element of the country's national security in the field of goods;

– reduction in the physical volume of imports of certain categories of industrial goods;

– increase in the labor intensity and depth of raw material processing;

– growth in private investments (public finances) attracted to the production sector;

– increase in the physical volume of production of innovative products;

– increase in the introduction of innovative equipment and technologies.

3.6 DISCUSSION OF THE RESULTS OF THE IMPLEMENTATION OF INNOVATIVE MECHANISMS FOR ENSURING ECONOMIC GROWTH OF REGIONS

Currently, an active scientific search is underway for tools and mechanisms for ensuring economic growth of regions at the expense of the country's internal forces. Transport infrastructure is considered one of the most important engines. The study:

– theoretical provisions were generalized and practical recommendations were developed for ensuring economic growth of regions based on the development of transport infrastructure;

– the main theoretical concepts of the role of transport infrastructure as a source of regional growth and development were considered and the conditions that must be taken into account for the formation of effective mechanisms for ensuring economic growth of regions based on the development of transport infrastructure were identified and described: the need to take into account the mutual influence of economic systems at different levels; the need to analyze the interrelationships of transport infrastructure and the regional economic system; the need to coordinate the interests of various agents (stakeholders) represented in the region;

– an analysis and generalization of existing approaches to the formation of mechanisms for ensuring growth based on the development of the transport infrastructure of the system was carried out and it was established that they mainly take into account to a small extent the participation and nature of the prevailing organizational and economic relations of the transport infrastructure and the local economic system.

The above-described conditions, in combination with the tasks set and their solution, allowed to improve and form a number of mechanisms that took shape in the concept of improving the mechanisms of economic growth of regions based on the development of transport infrastructure.

The proposed mechanisms can serve as the basis for the development of management decisions that will be different in content (attraction of private or public investments in infrastructure projects; development of industrial transport or transport infrastructure of final demand; development of the distribution functions of transport infrastructure or transport). interactions that provide integration and cooperative interregional production links) for each individual regional or local economic system, but are united by the goal of ensuring economic growth of regions based on the development of transport infrastructure.

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4 ANTI-CRISIS MANAGEMENT OF TRANSPORT ENTERPRISES IN MODERN ECONOMIC CONDITIONS

Viktoriia Ilchenko, Roman Sharanov, Kyrylo Ilchenko

ABSTRACT

This study is devoted to the development of a system of anti-crisis management of transport enterprises to ensure their effective functioning in modern economic conditions.

The state of the transport industry of Ukraine was studied, where the following indicators were analyzed: the number of operating business entities, the number of employees, the volume of products sold (goods, services), the level of profitability of enterprises. It was determined that most of the analyzed indicators are decreasing in dynamics, which is primarily due to the consequences of military aggression against Ukraine. The main problems that hinder the development of the transport industry of Ukraine were identified. The prerequisites for the emergence of crisis phenomena in the activities of transport enterprises were studied – internal and external factors that can lead an enterprise to a crisis were identified.

The need for the implementation of anti-crisis management to overcome crisis phenomena in the activities of transport enterprises was substantiated. A system of anti-crisis management is proposed, which is represented by four main consecutive stages: diagnostics of the state of the enterprise, formation of an anti-crisis strategy and program, application of anti-crisis methods and measures and assessment of the effectiveness of the proposed methods and measures. Each component of this system is disclosed in detail.

It is found that the crisis caused by war is a special type of crisis phenomena. A comparison is made between the traditional and "war" crisis at the enterprise. In particular, it is determined that the second is systemic, long-term, carries not only financial losses, but also a threat to people's lives, destruction of infrastructure and loss of assets. This necessitated the adaptation of traditional anti-crisis management to the conditions of the war period. The features of anti-crisis management of transport enterprises during the war period are considered, in particular diagnostics, strategies, methods, measures and performance assessment.

KEYWORDS

Transport industry of Ukraine, military aggression, anti-crisis management, enterprise crisis, state diagnostics, anti-crisis strategy, military crisis, enterprise profitability.

4.1 STATE OF THE TRANSPORT INDUSTRY OF UKRAINE AND PREREQUISITES FOR THE EMERGENCE OF CRISIS PHENOMENA IN THE ACTIVITIES OF TRANSPORT ENTERPRISES

Today, transport plays a key role in ensuring the effective functioning of the economy and meeting the needs of society. Transport enterprises ensure the movement of goods, services and people both within the

country and at the international level. However, the functioning of transport enterprises in a market economy is influenced by various factors of the external and internal environment. In Ukraine, the conditions of martial law open up new challenges and threats for transport enterprises, which significantly affects the stability and functioning of this industry. The introduction of anti-crisis management in the activities of transport enterprises will make it possible to avoid or reduce the negative impact of crisis phenomena and ensure their sustainable functioning in modern economic conditions.

In order to be able to apply anti-crisis management, it is important to timely identify the symptoms of crisis phenomena and establish the factors that led to the emergence of a crisis situation at the enterprise. To clarify the prerequisites for the emergence of crisis phenomena in the activities of transport enterprises, it is first necessary to examine the current state of the transport industry of Ukraine. The general state of the transport industry in 2022 deteriorated significantly, as evidenced by the following indicators:

1. Number of operating business entities.

According to the State Statistics Service [1], the number of operating business entities in the "Transport, warehousing, postal and courier activities" industry began to decline starting in 2020. In 2022, the reduction process intensified due to the war (**Fig. 4.1**).

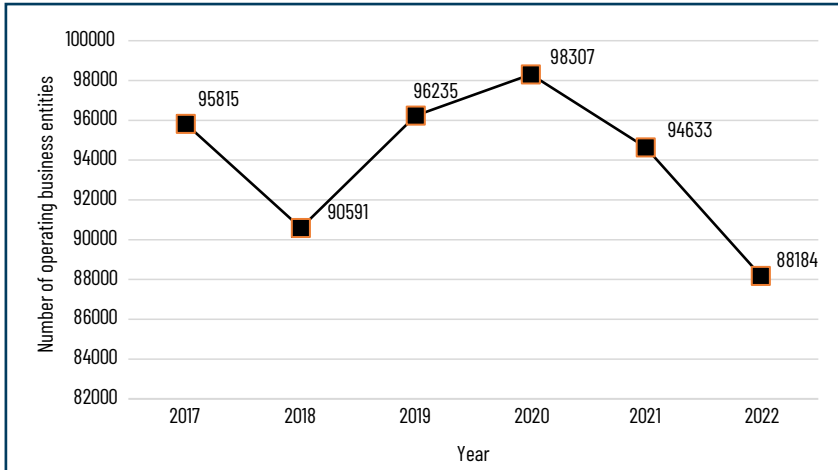

Fig. 4.1 Number of operating economic entities in the transport sector for 2017–2022, units

Source: [1]

2. Number of employees.

The number of employees in the transport sector in 2022 decreased by 102,620 people (**Fig. 4.2**) [1]. Due to the consequences of the war, many enterprises were forced to reduce their activities or lose their infrastructure, which led to a decrease in the number of employees.

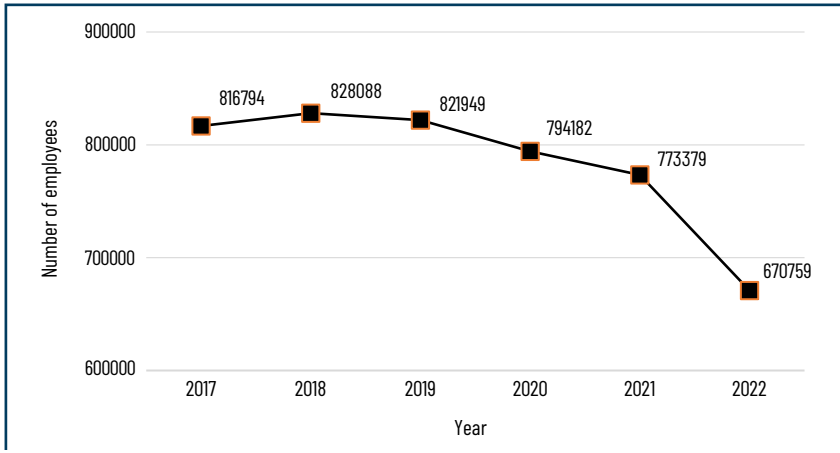

Fig. 4.2 Number of employees in economic entities of the transport industry for 2017–2022, units

Source: [1]

3. Volume of products sold (goods, services).

Before the start of the war in 2022, the volume of products sold (goods, services) was constantly increasing, as evidenced by the data (**Fig. 4.3**) [1]. In 2022, the volume of products sold decreased by 112,539,339.3 thousand UAH.

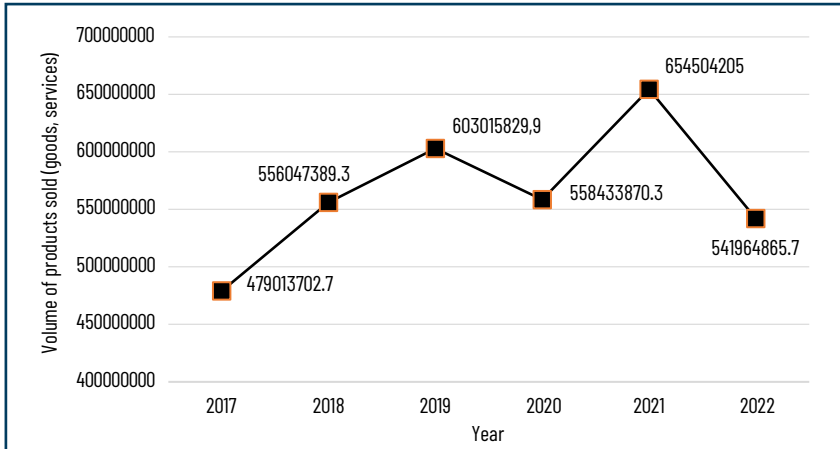

Fig. 4.3 Volume of sales (goods, services) of transport sector entities in 2017–2022, thousand UAH

Source: [1]

4. Level of profitability of enterprises.

This indicator indicates how effectively transport enterprises use their resources to generate profit. The overall level of profitability of transport enterprises in Ukraine has always been low, however, in 2022 [1] the industry suffered large-scale losses (**Table 4.1**, **Fig. 4.4**) due to reduced demand, increased costs, currency fluctuations, etc.

Table 4.1 Profitability of transport enterprises in Ukraine in 2017–2022 by their size, %

Year	Overall profitability	Large enterprises	Medium enterprises	Small enterprises	Micro-enterprises
2017	–3.5	–6.7	2.3	–5.2	–14.0
2018	–4.3	–9.3	1.3	2.2	1.3
2019	1.4	–2.2	6.4	2.9	1.7
2020	1.6	2.4	1.9	–0.9	0.6
2021	3.7	4.5	3.6	2.0	2.1
2022	–4.2	–4.1	–5.5	–2.6	–11.9

Source: developed based on data [1]

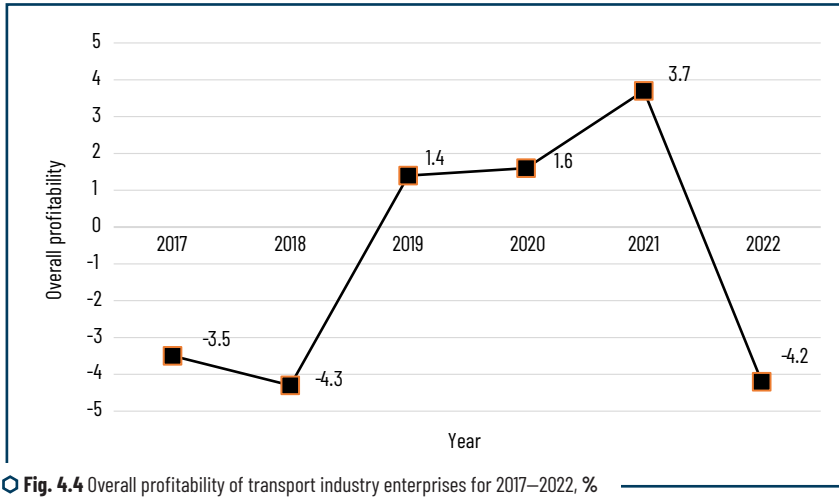

Fig. 4.4 Overall profitability of transport industry enterprises for 2017–2022, %

Source: [1]

The latest survey conducted by Advanter Group [2] at the end of 2023 on general problems that prevent the restoration and development of business shows: the biggest problem of enterprises is

uncertainty (unpredictability of the development of the situation in Ukraine and on the domestic market – 56.2 %), followed by unpredictable actions of the state that can worsen the state of the business (47.7 %), lack of a sufficient number of solvent customers (47.6 %), lack of a sufficient number of qualified employees (34.3 %), lack of sufficient capital (30.7 %), obstacles from regulatory and/or fiscal authorities (30.1 %), high taxes and fees (27.9 %), dumping by competitors, and overall decrease in profitability in the market (25.2 %) (**Fig. 4.5**).

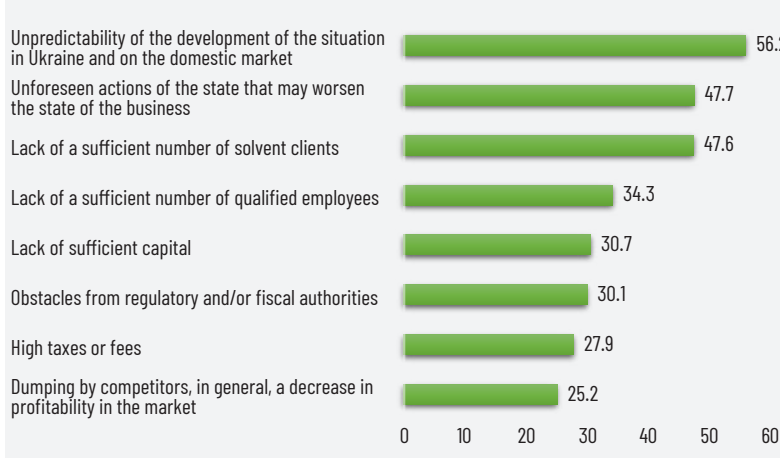

Fig. 4.5 Main problems hindering the restoration and development of business in Ukraine in 2023

Source: [2]

Thus, the general state of the transport industry in Ukraine has declined since 2022. This was undoubtedly a consequence of military aggression against Ukraine. Thus, in particular, the aviation industry suffers the most due to the run ban. However, as can be seen in previous years, most of the analyzed indicators were at a fairly low level. This is due to a number of problems of transport enterprises.

Firstly, this is outdated equipment and infrastructure. A large number of transport enterprises, especially municipally owned, have outdated buses, trams, trolleybuses and other transport, which leads to an increase in maintenance and repair costs, and also reduces the quality of such services.

Secondly, there is a lack of funding and investment in this industry. Many enterprises have limited financial resources, investors have no incentive to invest in the transport sector due to low profitability, and government support is almost non-existent.

Thirdly, high prices for fuel and other resources. Fuel is the main component of costs for many transport enterprises, especially in road transport. The increase in prices for petroleum products, which is especially observed during the war, leads to a significant increase in the cost of refueling cars, buses, minibuses,

taxis and other vehicles. Because of this, the transport business has to increase tariffs, for example, for travel, or the prices of its services to compensate for costs, which can lead to a decrease in demand from consumers.

All these problems lead to the emergence of crises and crisis phenomena in the activities of transport enterprises.

According to scientists, solving the problems of transport enterprises can be achieved through the following measures [3]:

— reducing the tax burden or partial compensation for the costs of resource provision for enterprises engaged in international freight transportation;

— lobbying by the state to increase the quota for issuing permits for international transportation for Ukraine;

— carrying out high-quality reconstruction of transport routes to increase the transit attractiveness of Ukraine and reduce the costs of domestic enterprises for the repair of vehicles;

— introducing an anti-crisis management system to effectively counteract the impact of external and internal threats.

Thus, the prerequisites for the emergence of crisis phenomena in transport enterprises of Ukraine are associated with the peculiarities of the functioning of the domestic transport industry and the cumulative effect of a number of negative macroeconomic factors that have accumulated over a long time and whose influence intensified during the period of the full-scale invasion of Ukraine.

That is, the entire set of factors that can lead an enterprise to a crisis can be divided into two groups:

— external — on which the enterprise is unable to influence or its influence is limited;

— internal — arise as a result of the activities of the enterprise itself.

The prerequisites for the emergence of crisis phenomena in the activities of transport enterprises (**Fig. 4.6**) are:

External:

— political instability — low trust in government institutions, uncertainty of the political course, instability of legislation, unpredictable actions of the state, obstacles from regulators;

— economic instability — economic or financial crises, rising inflation, budget deficit, devaluation of the hryvnia, credit restrictions, rising unemployment, high level of taxes;

— currency fluctuations — increasing cost of imported raw materials, materials, equipment;

— low level of demand — decrease in sales volume, necessity of reducing activities, increase in inventories of goods;

— low level of investment attractiveness — limited access to capital, lack of innovation, high level of risk.

Internal:

— equipment wear and tear — increase in maintenance costs, decrease in productivity, risks of accidents and downtime, limited opportunities for development;

— outdated infrastructure — low productivity, increased maintenance and repair costs, limited opportunities for development;

– lack of free funds and financing – risk of insolvency, delayed project development, reduced liquidity, loss of investment opportunities;

– ineffective management – inability to adapt, inability to make quick decisions, loss of potential opportunities, low level of staff motivation;

– personnel problems – low qualifications and skills of employees, lack of motivation, outflow of qualified employees, conflicts in the team, ineffective distribution of duties and responsibilities.

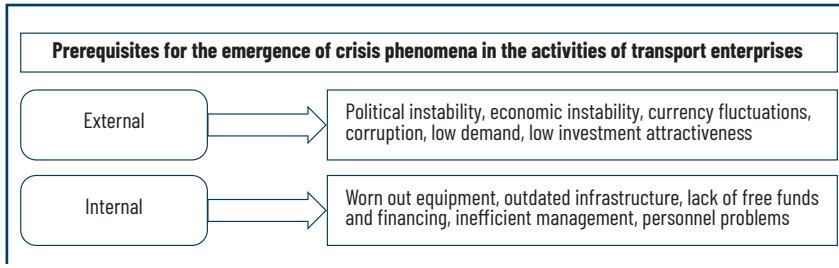

Fig. 4.6 Prerequisites for the emergence of crisis phenomena in the activities of transport enterprises

Source: author's development

4.2 THE SYSTEM OF ANTI-CRISIS MANAGEMENT OF TRANSPORT ENTERPRISES AND ITS COMPONENTS

The development of transport enterprises in Ukraine occurs under the influence of many negative internal and external factors, therefore, predicting and avoiding crisis phenomena and minimizing their consequences is one of the priority tasks.

Overcoming the crisis state of the enterprise requires the comprehensive application of anti-crisis management, the implementation of which will be carried out throughout the entire period of operation of the enterprise, because the possibility of a crisis occurs at all stages of its development. Elimination of crisis phenomena in the transport industry is possible through the formation and application of the system of anti-crisis management of transport enterprises.

Such a system can be represented by four main stages: diagnostics of the state of the enterprise, formation of an anti-crisis strategy and program, application of anti-crisis methods and measures, assessment of the effectiveness of the proposed methods and measures (**Fig. 4.7**).

Successful problem solving should be preceded by a thorough analysis of the situation. The basis of the anti-crisis management system of the enterprise should be conducting research and identifying weaknesses in the functioning of the enterprise. In order to identify crisis phenomena at the enterprise and prevent bankruptcy in the future, a permanent system of monitoring and diagnostics of the enterprise is necessary. The basis for assessing the factors of the crisis situation is the analysis of the external and internal environment.

Stage I	*Diagnostics*
	Comprehensive analysis of financial and economic condition (liquidity, solvency, profitability indicators); analysis of revenue growth rate, sales profitability, availability of own working capital; analysis of models for assessing the probability of bankruptcy, etc.
Stage II	*Formation of an anti-crisis strategy and program*
	Growth strategies (concentration, integration, diversification), marketing strategy, production strategy, cost minimization strategy, stabilization strategy, financial strategy, restructuring strategy, offensive strategy, harvesting strategy, etc.
Stage III	*Application of anti-crisis methods and measures*
	Methods: autosourcing, benchmarking, regularization, downsizing, restructuring, rehabilitation, etc. *Measures:* cost reduction, marketing activities to increase sales, tax optimization, stopping secondary production, etc.
Stage IV	*Assessment of the effectiveness of the proposed methods and measures*
	Assessment methods: *Economic analysis* – analysis of key financial and economic indicators *Expert assessments* – qualitative or quantitative assessment of expert opinions *Comparisons* – comparison of crisis indicators with actual ones

Fig. 4.7 Anti-crisis management system of the enterprise

Source: author's development

The process of anti-crisis diagnostics of the state of enterprises (**Stage I**) includes various methods and tools. First of all, the main performance indicators should be analyzed, such as the growth rate of revenue, profitability of sales, availability of working capital. Factor analysis can be used to study the impact of various factors on financial results. These indicators allow to track key aspects of the enterprise's activities. Thus, a decline in revenue or a decrease in profitability may indicate problems in management or ineffective sales strategies.

For a comprehensive assessment of the financial and economic condition, indicators should be used that cover various aspects of the enterprise's activities, such as property status, liquidity, profitability, solvency, business activity, logistics, etc. This provides an overall assessment of various aspects of the activities of transport enterprises, which allows identifying problems in the financial sphere of the enterprise.

In addition, enterprises can use various models of assessing the probability of bankruptcy to predict crisis situations in order to prevent possible problems and take timely measures. Such a comprehensive approach to diagnosing the enterprise's activities helps to effectively manage its activities and make informed decisions to ensure sustainable development.

It is worth noting that anti-crisis diagnostics of an enterprise can cover not only the analysis of financial indicators. It should also include checking other important aspects of the enterprise's functioning, such

as business processes, organizational structure or HR direction, which will also allow identifying possible weaknesses in the management and functioning of the enterprise.

Along with quantitative methods of financial analysis, it is advisable to use qualitative methods, such as PEST and SWOT analysis. These methods allow to take into account external and internal factors that can affect the activities of the enterprise, and identify opportunities, threats, strengths and weaknesses. The results of these methods can also help in developing strategies, which will only increase the quality of anti-crisis decisions taken.

If deviations are detected during diagnostics that can lead to a crisis state of the enterprise, the next stage is the development of an anti-crisis strategy and program (**Stage II**). This strategy is a set of actions aimed at overcoming crisis phenomena and strengthening the enterprise's position in the market.

An anti-crisis strategy is a specially developed action plan for managing crisis situations in order to overcome crisis phenomena and prevent bankruptcy. The main goals of the anti-crisis strategy should be focused on eliminating the main causes of the crisis by reducing the impact of relevant factors, taking into account the existing limitations of the enterprise. The main goal is to restore financial stability and ensure the stable functioning of the business.

The development of an enterprise's anti-crisis strategy consists of the following stages: analysis of the crisis situation at the enterprise; review of the mission and system of goals; analysis of alternatives and selection of an anti-crisis strategy [4].

The entire set of possible strategies from the point of view of anti-crisis management can be divided into two groups:

1) strategies for ensuring crisis prevention within the framework of preventive anti-crisis management;

2) strategies for ensuring survival in crisis situations and minimizing possible losses.

Strategies for ensuring crisis prevention within the framework of preventive anti-crisis management should be applied at the stage of identifying minor deviations in the enterprise's activities or in the case of preventive actions to prevent future crisis phenomena. Strategies for ensuring survival in crisis situations are applied already during an ongoing crisis at the enterprise.

Table 4.2 lists possible anti-crisis strategies that can be used to overcome a crisis at a certain stage [4–6]. Their diversity allows the enterprise to choose the one that is most appropriate at a certain stage of the organization's development and corresponds to the formed general strategy of the enterprise.

The means of implementing an anti-crisis strategy is the development and implementation of an anti-crisis program. An anti-crisis program is a document that defines the main measures to overcome crisis phenomena at an enterprise. Within one anti-crisis strategy, there may be several anti-crisis programs that include a set of measures to achieve goals. This document may be developed at the level of the entire enterprise or have subprograms for individual divisions and functional services.

The structure of the anti-crisis program should include the following components: a list of planned measures; determination of start and end dates; resources required for implementation; expected results from implementation; responsible persons and executors for each measure.

After the strategy and anti-crisis program are developed, the next step is the direct implementation of anti-crisis methods and measures (**Stage III**). This stage includes the implementation of specific actions

aimed at overcoming crisis situations and restoring the stability of the enterprise. The set of anti-crisis measures is unique for each enterprise, as it must take into account various factors, such as the stage of the crisis process, the specifics of the industry, the size of the enterprise, etc.

Table 4.2 Anti-crisis strategies according to the crisis stage of the enterprise

Stages of crisis	Signs of manifestation	Anti-crisis strategies
Strategic crisis	Lack or insufficient development of the strategic management system, shortcomings in marketing activities, decrease in the market value of the enterprise	Organizational, personnel, marketing, investment, crisis prevention, anticipation, cost reduction
Structural crisis	Deterioration of the financial condition of the enterprise, decrease in sources and potential for development, reduction in activity volumes, loss of market share, decrease in the number of personnel	Marketing, production, cost minimization, turnaround, stabilization, diversification, innovation, cost leadership, counteraction, anticipation, concentration, cost reduction
Operational crisis	Decrease in the most important economic indicators, loss of profit of the enterprise	Marketing, cost minimization, turnaround, stabilization, offensive, defense, defensive, counteraction, restructuring, transformation
Liquidity crisis	Increase in the enterprise's debt to creditors, deterioration in the indicators of liquidity and solvency of the enterprise	Financial, cost minimization, restructuring, reduction, harvesting, growth
Insolvency (threat of bankruptcy)	Deficit of liquid funds for the fulfillment of external financial obligations (repayment of debts), production is constrained by a shortage of materials, the period for repayment of receivables increases	Financial, merger, liquidation, reduction, restructuring, exit, survival
Bankruptcy	Initiation of bankruptcy proceedings, excess of obligations over the enterprise's own capital	Liquidation, exit, merger, reorganization

Source: author's development based on [4–6]

Measures (which are specified in the anti-crisis program) are formed in the form of specific tasks that must be taken. It is worth remembering that for the successful implementation of these measures, it is necessary to determine not only responsible persons, but also specific deadlines, necessary resources and expected results from each measure. Such an approach will help the enterprise effectively achieve its goals.

Anti-crisis methods are approaches to crisis management. They include a wide range of measures. In particular, the methods include: autosourcing, benchmarking, regularization, downsizing, restructuring, rehabilitation, etc. [4].

Anti-crisis measures are actions and steps to overcome the crisis. Measures, in turn, can also be specified in tasks and objectives. All measures should be divided into two categories: measures when symptoms or a "mild" crisis occur; measures in case of acute crisis [4].

When symptoms or a "mild" crisis occur, the following options for anti-crisis measures can be used: reducing or optimizing costs, optimizing the capital structure, improving the quality and competitiveness of products, increasing marketing efficiency, reducing the share of obsolete equipment, optimizing the credit policy of the enterprise, etc.

In case of acute crisis, the following measures can be used: modernization or stopping unprofitable secondary production, implementation of non-production facilities, strict control of all types of alternative costs, reviewing the organizational structure to eliminate unnecessary levels of management, measures to release funds for product improvement, etc.

The final stage of the anti-crisis management system is an assessment of the effectiveness of the implementation of the implemented measures (**Stage IV**). The effectiveness of anti-crisis management of an enterprise consists in the ability to achieve the optimal effect from the implementation of relevant anti-crisis programs while preserving all preferences as much as possible with minimal expenditure of funds and resources.

The criteria for assessing the effectiveness of anti-crisis measures include [7]:

1. *Has a change been achieved in the most important indicators of economic and financial activity and the financial condition of the enterprise during the period of anti-crisis management?* This criterion measures what changes have occurred in the financial indicators of the enterprise after the implementation of anti-crisis measures compared to the initial values.

2. *What is the speed of obtaining positive changes per unit of time?* Measures how quickly positive changes have occurred in the activities of the enterprise after the implementation of anti-crisis measures.

3. *What is the cost-effectiveness of obtaining a positive effect?* This criterion is the ratio between the achieved increase in the results of economic and financial activity and the amount of costs associated with achieving this result.

4. *What is the sufficiency of changes to restore the viability parameters of the enterprise?* This criterion determines how much the achieved changes are sufficient to restore the viability of the enterprise and compares the actually achieved indicators with reference values.

If the measures to overcome the crisis were ineffective, and the crisis continues to develop or the measures taken have not had an adequate effect, the enterprise should return to the starting point of searching for the causes and developing a new program or strategy for overcoming the crisis.

Thus, the general process of anti-crisis management of the enterprise, taking into account the stage of the crisis, can be presented as follows (**Table 4.3**) [4–6].

Table 4.3 Anti-crisis management according to each stage of the crisis at the enterprise

Crisis stage	Diagnostic methods, tools	Recommended anti-crisis management
1	**2**	**3**
Strategic crisis	Analysis of the strategic and marketing activities of the enterprise	Review of strategy, restructuring, increase in market value of the enterprise

Continuation of Table 4.3

1	2	3
Structural crisis	Analysis of the production and economic indicators of the enterprise	Normalization of the enterprise's activities: reducing costs, increasing productivity, increasing the economic added value of the enterprise
Operational crisis	Balance sheet analysis, express analysis of the financial condition of the enterprise	Eliminating the causes of the crisis: minimizing losses, increasing the profitability of the enterprise's capital
Liquidity crisis	Analysis of the liquidity, financial stability and solvency of the enterprise	Preventing the development (deepening) of the crisis: finding funds to continue financing activities, directing part of the working capital to repay losses
Insolvency (threat of bankruptcy)	Comprehensive assessment of the enterprise's activities, analysis of equity and solvency	Preventing the initiation of bankruptcy proceedings (settlement): finding liquid funds to fulfill immediate financial obligations, attracting new external financial capital, obtaining a temporary deferral or prolongation of previously received loans
Bankruptcy	Determination of supercritical solvency, analysis of debt security with real assets, assessment of business activity and investment attractiveness of the enterprise	Removing the enterprise from bankruptcy (rehabilitation): partial mobilization of available assets to settle obligations, going through the bankruptcy procedure with minimal losses for the owners of the enterprise

Source: author's development based on [4–6]

Thus, the proposed anti-crisis management system will allow transport enterprises to respond in a timely manner to changes in the economic environment, will help ensure financial stability, and also increase their competitiveness in the transport services market.

4.3 FEATURES OF ANTI-CRISIS MANAGEMENT OF TRANSPORT ENTERPRISES DURING WARTIME

A regular (traditional) crisis at an enterprise most often arises due to various factors, such as economic instability, market instability, internal management problems, etc. Such a crisis is usually characterized by a limited time frame and can be completely overcome with the help of the right management anti-crisis solutions.

In the case of a crisis caused by war, the situation becomes much more complicated and unpredictable. War is a complex and unpredictable factor that significantly affects the activities of all enterprises. Signs of war in the context of enterprise activities include:

— reduction in production capacity;
— possible interruptions in the supply of energy, water, and communications;
— increased risks, including security-related;
— reduced demand for products or services;
— loss of suppliers of raw materials, components, finished products;
— increase in resource prices;
— problems with logistics;
— reduced investment and development;
— loss of personnel (mobilization, migration, reduced motivation).

For transport enterprises, signs of war can have a special impact due to their dependence on the functioning of transport infrastructure and transport safety, namely for them it is possible to include: threat to transport safety, obstacles in logistics and supply, reduced demand for transport, loss of vehicles and infrastructure.

Thus, war is an objective factor that can lead to the destruction of infrastructure, interruptions in supplies, reduced consumer demand and a threat to the safety of employees. The main distinguishing feature of such a crisis at the enterprise is that its consequences can be long-lasting and difficult to recover from [8].

The difference between a traditional crisis and a crisis caused by war is as follows (**Table 4.4**) [9].

Table 4.4 Differences between a traditional crisis and a crisis caused by war

Symptom	Traditional crisis	Crisis caused by war
Duration	Has a clear beginning and end, lasts from several weeks to several years	May last for years, without a clear end date. Its impact on business can be felt even after the end of the war
Character	Caused by various factors, both internal (management errors) and external (economic recession)	Caused by an external factor — military actions that cannot be predicted or planned
Speed of spread	Localized after identifying the causes	Global chain reaction
Consequences	Leads to financial losses, staff reductions, strategy changes	Carries not only financial losses, but also a threat to people's lives, destruction of infrastructure, loss of assets
Impact on personnel	Can lead to demotivation, fear for the future, staff turnover	Creates a risk to people's lives and health, increases emotional stress, requires additional support from the employer
Possibility of overcoming	Can be completely overcome and emerge from the crisis with minimal losses	It is impossible to completely overcome the consequences of war at the enterprise. It is only possible to adapt to new conditions, minimize the negative impact and look for opportunities for development

Source: own development based on [9]

That is, the differences are primarily related to the severity and duration of the war, which forces enterprises to go beyond the framework of traditional anti-crisis management. The anti-crisis management

system should take into account these challenges and help adjust the functioning of enterprises in martial law conditions [4].

The main goal of anti-crisis management of an enterprise during the war is to minimize the negative economic and social consequences of the enterprise's activities. Given that such a crisis is characterized by an acute shortage of time to respond and a limitation on the terms of overcoming the crisis, the main task of anti-crisis management is to make decisions promptly and with the least risk, which would make it possible to achieve the desired result with minimal additional efforts and minimal negative consequences [9].

At the initial stages of the war, such a desired result is to ensure the uninterrupted operation of the enterprise and its survival in new war conditions. At this time, it is important to respond quickly to changes, ensuring the safety of employees and the stability of production and supply of products. As the war progresses, the priorities of anti-crisis management may change. The task of ensuring the survival of the enterprise turns into adaptation and adjustment of functioning in war conditions.

It is clear that the impact of war on enterprises is different and anti-crisis management requires an individual approach. However, in all cases, the main principles of anti-crisis management in wartime remain efficiency, risk minimization and priority of ensuring the uninterrupted operation of the enterprise.

Thus, in times of war, especially in the first "period of shock", all decisions must be made very quickly, since the situation changes every day and in such a case, untimely response can be costly for the enterprise. In this case, increasing the speed of making anti-crisis decisions in war conditions involves reducing the levels of management, a limit on the approval of decisions, within which decisions can be made without the approval of a senior manager, or decentralization, so that decisions are made not only from the top down, but also on missions, for the rapid resolution of local problems. As one of the managers whose business survived the first stages of the war notes: "It is better to make a mistake quickly than to think long" [8].

The main goal of anti-crisis diagnostics in wartime is to identify the impact of war on the activities of the enterprise: assessing the current situation and identifying the causes of deviations.

Assessment of the current state of the enterprise includes an analysis of financial indicators, resources, personnel and other aspects of the activity. It is also important to assess the current level of risks and opportunities of the enterprise.

In addition to the analysis of standard indicators, as in a traditional crisis, for transport enterprises in wartime it is important to assess: logistics, transportation safety, material and technical base, operational indicators of activity (volume of transportation, use of vehicles, etc.).

The tools of anti-crisis diagnostics in wartime can be: financial analysis, operational analysis, scenario modeling, SWOT analysis, personnel analysis, etc.

Due to the constant change in the situation in wartime, enterprise diagnostics must be carried out as often as possible. The most effective is the implementation of a system of constant monitoring. The more often diagnostics are carried out, the greater the chance of timely identification and overcoming problems that, in the context of a crisis caused by war, can lead to serious consequences.

Anti-crisis diagnostics will allow to identify the reasons for deviations from the normal functioning of the enterprise during the war period. For example, problems in the supply of raw materials, reduced demand

for products or changes in market conditions. Identifying these reasons will allow the enterprise to develop effective anti-crisis strategies for adapting to war conditions.

Forming a strategy in wartime is a difficult task at the beginning due to high uncertainty. Therefore, at the beginning of the war, in the "shock period", the enterprise should skip this stage and quickly implement anti-crisis measures. After adapting and adjusting its functioning in war conditions, the enterprise can apply various anti-crisis management strategies, in particular, protective, stabilization, survival, cost reduction, marketing, financial, etc. will be effective.

At the beginning of the war or during its exacerbation, the most effective anti-crisis strategy is the survival strategy. This strategy is aimed at helping enterprises survive during the active phase of the war, reduce costs and preserve critical resources. The main measures of this strategy may be to optimize liquidity and current asset management, restore financial stability, restore or increase production volumes. After adapting to wartime conditions, it is worth applying growth strategies that can increase the competitiveness of the enterprise.

Among the important methods that should be used in anti-crisis management in wartime, the following should be highlighted [4]:

— outsourcing — can free the enterprise from processes that do not bring direct income, but require time and human resources. Outsourcing can help ensure uninterrupted operation in the event of the loss of employees (due to layoffs, migration) who were entrusted with certain business processes;

— diversification — expanding the product range, developing new markets. This method can provide the enterprise with growth points if the main directions become irrelevant and unprofitable. In wartime, transport enterprises can expand their geographical coverage, introduce new vehicles, expand the provision of services;

— reorganization — the most effective way can be considered a merger. The merger of several enterprises can help them survive and increase the economic efficiency of their activities;

— downsizing — reducing the size of the enterprise, production facilities, and the number of personnel to increase the level of its functioning, reduce costs and the cost of products. Although reducing activity is an unpleasant step, sometimes in conditions of reduced supplies, reorientation of production, changes in logistics chains, this is the only way to maintain the previous pace of work and its resources and continue operating in the market;

— modernization — updating or improving an object or process. For transport enterprises, modernization is especially important, since most enterprises need to update equipment, modernize the sales system, improve management systems, etc. The importance of this method during wartime is that modernization increases the competitiveness of the business, labor productivity, and ensures the transition to new systems and methods of doing business.

Anti-crisis measures must be taken to successfully adapt to wartime conditions. The measures are individual for each business. Common anti-crisis measures, such as freezing areas of work, closing projects, abandoning development plans and placing employees on unpaid leave, can indeed help at the beginning of the war. However, later these measures can have a negative impact on the further development of the enterprise. After the initial "shock period", it becomes important to create long-term strategies and plans

that will allow the enterprise to adapt to new conditions and resume its activities during the war period. Let's list possible anti-crisis measures [4].

One of the important measures is communication with staff. Maintaining contact with employees and explaining the current situation to them helps to avoid panic and creates a favorable climate in the team. Regular briefings, dialogue and openness about plans and prospects allow to maintain trust and motivation of employees. informed employees about the physical condition of the company every day. Some also regularly informed clients about the situation and their current plans. These managers reported that it was important for them to return employees to work after the first days of complete instability in order to create a certain level of normal life.

Retraining employees — allows the company to retain valuable personnel potential. For example, transferring employees to other departments or positions or, if there is not enough money and it is necessary to lay off people, it is possible to reduce everyone's salary, because during the war it is important for employees to have at least some stable income.

It is necessary to pay attention to more careful work with customers — analyze the impact of the war on the client base and respond quickly to changes. For example, in case of problems with logistics, offer new delivery methods, if the problems are financial, then offer postponement, payment in installments or discounts.

Optimization of routes and resources is important especially for transport companies. Given the possible restrictions on movement and logistics during the war, it is necessary to review the optimal routes, it is possible to reduce the number of transport units in operation or introduce the use of alternative delivery routes.

One of the measures is also a reorientation to the most demanded services — expanding geographical coverage, introducing new vehicles, expanding the provision of services that are relevant.

Entering international markets is also an effective means of expanding sales markets and increasing the profitability of the enterprise. With international contracts, it is possible to provide additional sources of income and reduce dependence on the domestic market.

In war conditions, digitalization also becomes a necessity. Automation of processes or the transition to remote work will help reduce business costs and physically protect employees. Also important are technological innovations — the introduction of new technologies, such as cargo tracking systems, remote control, electronic platforms and marketplaces, etc. Thus, artificial intelligence is increasingly used in business to automate tasks, forecast, recognize patterns and obtain insights. It can be used in various industries, including finance, marketing and supply chain management, to increase efficiency, accuracy and reduce costs. Some examples of the application of artificial intelligence in business include fraud detection, stock market forecasting, consumer behavior analysis and risk management. It can be concluded that artificial intelligence plays an important role in almost all areas of human activity [10]:

The effectiveness of anti-crisis management in wartime consists in [4]:

— achieving a change in the most important indicators of the financial and economic activity of the enterprise during the period of anti-crisis management (compared to the beginning of the war or the implementation of anti-crisis measures);

— speed of obtaining positive changes per unit of time;

— speed of making management decisions;

– stabilization of the enterprise's activities;

– speed of adaptation of the enterprise to the war;

– cost-effectiveness of obtaining positive results;

– survival of the enterprise (at the beginning of the war or in the event that the enterprise is on the front line).

One of the important sectors in the country's economy, which has significant potential, is the transport sector. However, at the present stage, the vast majority of transport enterprises have low efficiency, which indicates the presence of crisis phenomena [11]. Despite the war conditions, most of the reasons for the low efficiency of transport enterprises lie in themselves, which only intensifies the effects of external factors. Thus, reducing the impact of factors on the activity requires the transport sector enterprises to implement effective anti-crisis management.

4.4 DISCUSSION OF THE RESULTS OF THE STUDY OF ANTI-CRISIS MANAGEMENT OF TRANSPORT ENTERPRISES IN MODERN BUSINESS CONDITIONS

The proposed anti-crisis management system consists of four stages. During the diagnosis, the current state of the enterprise's activities, risks and causes of the emergence of crisis phenomena are analyzed. The formation of an anti-crisis strategy and program involves the development of an action plan and specific measures aimed at reducing the impact of crisis phenomena and maintaining the stability of the enterprise. The stage of applying anti-crisis methods and measures is key, as it involves the direct implementation of measures that can lead the enterprise out of the crisis. The last stage is an assessment of the effectiveness of the proposed methods and measures, which determines the effectiveness of the goals and objectives set, how effective the applied methods and measures are in overcoming the crisis phenomenon. If the crisis is not overcome, the enterprise must return to reviewing the strategy and adjusting it.

A crisis caused by war is a special type of crisis phenomenon. Unlike a traditional crisis, it is systemic, long-term, rapidly spreading with a chain reaction and carries not only financial losses, but also a threat to people's lives, destruction of infrastructure and loss of assets. Accordingly, anti-crisis management must take into account these challenges, in particular through the application of the considered strategies, methods and measures aimed at minimizing the impact of military actions on the activities of enterprises. Such an approach will allow to ensure more effective management in war conditions, minimize risks and maintain the stability of the functioning of transport enterprises.

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5 MODELING OF TRANSPORT LOGISTICS DURING THE PERIOD OF SPECIAL LEGAL REGIME

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ABSTRACT

The problems of relocation of high-tech enterprises, cargo and people under martial law, as well as optimization of supply of components after changing the location of production, are studied.

Logistics planning models are proposed that take into account the risks caused by military actions, disruptions of transport chains and resource shortages.

The key stages of relocation are identified: selection of a safe location, adaptation of logistics infrastructure, establishment of new supply channels.

Factors affecting the supply of components are analyzed, in particular the availability of transport corridors, ensuring the stability of supplies and minimizing transportation costs.

It is determined that effective modeling of relocation processes and supply logistics is an important factor for maintaining the competitiveness and stability of high-tech enterprises during crisis situations.

KEYWORDS

Relocation of enterprises, martial law, high-tech production, supply of components, logistics of the crisis period, supply optimization, logistics modeling, transport chains.

5.1 MODELING OF RELOCATION LOGISTICS OF HIGH-TECH ENTERPRISES IN THE CONDITIONS OF MARTIAL LAW IN THE COUNTRY

The special legal regime of the country forced to review the logistics processes of transportation [1–6]. New directions in logistics have appeared, which need to be explored for effective planning of transportation in conditions of military threats.

The logistics of transportation of industrial cargo to the rear has its own characteristics [7, 8], which are associated with the movement of enterprises from the frontline zone to a relatively safe location, to establish the production of high-tech products, including weapons and military equipment. Transport routes are formed in advance and are associated with the choice of the location of the enterprise. The choice of location depends on the availability of supporting infrastructure, energy supply, remoteness of suppliers of components, as well as the availability of qualified personnel [9]. Therefore, it is necessary to take into account a number of factors when locating an enterprise in conditions of military threats [10, 11]. Transport logistics should contribute to the efficiency of the enterprise relocation and the formation of new routes for the supply of components for the stable functioning of high-tech production, in conditions of martial law. To assess the possible and rational routes for moving goods of a high-tech enterprise, it is necessary

to form logistics indicators of transportation taking into account the risks of military threats [12]. It is advisable to use the following logistics indicators:

1. The time required to move the enterprise from the frontline zone to the rear (transportation of technological equipment, building structures, etc.) — T.

2. Costs for relocation of the enterprise to the rear — V.

3. Risks of transporting goods, with the enterprise's technological equipment, in conditions of military threats — R.

When modeling the relocation of the enterprise, from the frontline zone to the rear, it is necessary to take into account the available opportunities for choosing a relatively safe location for the enterprise, as well as possible routes for transporting technological equipment, in conditions of military threats.

To form optimization models regarding the relocation of an enterprise under martial law, let's introduce a Boolean variable x_{epl}:

$$x_{epl} = \begin{cases} 1, \text{ if for the relocation of the enterprise} \\ \text{to } e\text{-th possible location the } p\text{-th way for transportation of} \\ \text{goods with technological equipment is chosen} \\ \text{with } l\text{-th possible composition of logistics components} \\ \left(\text{temporary storage city, transshipment, parking areas, etc.}\right); \\ 0, \text{ otherwise.} \end{cases}$$

Then, taking into account the variables x_{epl}, let's present the logistics indicators of the enterprise to the rear in the form:

$$T = \sum_{e=1}^{M} \sum_{p=1}^{m_e} \sum_{l=1}^{n_p} t_{epl} x_{epl}, \tag{5.1}$$

where l — the number of possible location of the enterprise when it is relocated to the rear; m_e — the number of possible ways of moving the enterprise to e-th new location; n_p — the number of possible compositions of logistics components that can be used on the p-th way of moving the enterprise; t_{epl} — the time required to relocate the enterprise to the rear when choosing the e-th location, the p-th way of movement and the l-th composition of logistics components.

$$V = \sum_{e=1}^{M} \sum_{p=1}^{m_e} \sum_{l=1}^{n_p} v_{epl} x_{epl}, \tag{5.2}$$

where v_{epl} — evaluation of the costs that are necessary for the realization of the enterprise with moving it to e-th location, taking into account the choice of the p-th path of movement and the l-th possible composition of logistics components.

$$R = \sum_{e=1}^{M} \sum_{p=1}^{m_e} \sum_{l=1}^{n_p} r_{epl} x_{epl}, \tag{5.3}$$

where r_{epl} – the risk that is associated with the possible occurrence of a military threat in the relocation of the enterprise, taking into account the choice of the e-th location of its location, the p-th way of movement and the selected l-th composition of logistics components.

In the state of martial law, it is extremely important that the enterprise's relocation to the rear is carried out in the shortest time, which is related to the possible actions of military threats and the need for faster production of weapons and military equipment (WME).

Therefore, as the main logistics indicator let's use the time of movement of the enterprise (T), which must be minimized. Let's optimize with the use of integer (Boolean) programming. It is necessary to find:

$$\min\ T,\ T = \sum_{e=1}^{M} \sum_{p=1}^{m_e} \sum_{l=1}^{n_p} t_{epl} x_{epl}. \tag{5.4}$$

It is necessary to take into account the possible risks of action of military threats that arise when moving the enterprise to a new location:

$$R \le R^*,\ R = \sum_{e=1}^{M} \sum_{p=1}^{m_e} \sum_{l=1}^{n_p} r_{epl} x_{epl}, \tag{5.5}$$

where R^* – the permissible risk of military threats in the relocation of the enterprise.

Also, it is necessary to consider the possible cost of relocation of the enterprise:

$$V \le V^*,\ V = \sum_{e=1}^{M} \sum_{p=1}^{m_e} \sum_{l=1}^{n_p} v_{epl} x_{epl}, \tag{5.6}$$

where V^* – the permissible (planned) costs of moving the enterprise to the rear.

5.2 MODELING THE SUPPLY OF HIGH-TECH COMPONENTS AT THE NEW LOCATION OF THE ENTERPRISE

When moving the enterprise to the rear, it is necessary to form the composition of suppliers of components required for the production of high -tech products, including WME. Also, it is necessary to choose rational ways of supplying accessories to a new location of the enterprise.

Therefore, let's form a logistics indicators for analyzing the process of supplying components in the form:

1. The cost of supplying components that depend on the new location of the enterprise, the composition of suppliers and the selected delivery routes – W.

2. The time required for the formation of inventories of components that will ensure a stable functioning of the enterprise at a new location — T.

3. Risks related to the supply of components in martial law — R.

Let's introduce Boolean variable x_{efy}:

$$x_{efy} = \begin{cases} 1, \text{ if for } e\text{-th new location of the enterprise } f\text{-th composition of suppliers and} \\ y\text{-th composition of ways of supplying components are chosen, otherwise.} \end{cases}$$

Taking into account variables x_{efy}, logistical indicators of supply components look like:

$$W = \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} w_{efy} x_{efy}, \tag{5.7}$$

where w_{efy} — the costs of formation of inventories of components, taking into account the e-th location of the enterprise, the f-th composition of suppliers and the y-th composition of supply routes; M — the number of possible location of the enterprise in the rear; s_e — the number of possible compositions of suppliers of components; q_f — the number of possible compositions of ways of supplying components.

$$T = \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} t_{efy} x_{efy}, \tag{5.8}$$

where t_{efy} — the time required to form the inventories of components to ensure the sustainable functioning of the enterprise at a new e-th location, taking into account the f-th composition of suppliers and the y-th selected composition of the ways of supplying components to the enterprise.

$$R = \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} r_{efy} x_{efy} m, \tag{5.9}$$

where r_{efy} — the risk of supplying components in the face of military threats, taking into account the choice of the e-th location of the enterprise, f-th composition of suppliers and the y-th composition supply routes.

In the state of martial law, it is extremely necessary to quickly adjust the work of a high-tech enterprise at a new location. Therefore, as the main, most significant, logistics indicator, let's use the time (T) required to form the inventories of components, to ensure the restoration of the enterprise at a new location.

It is necessary:

$$\min\ T,\ T = \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} t_{efy} x_{efy}, \tag{5.10}$$

taking into account the restrictions:

$$W \le W^*,\ W = \sum_{e=1}^{M}\sum_{f=1}^{s_e}\sum_{y=1}^{q_f} w_{efy} x_{efy}, \tag{5.11}$$

where W^* – the permissible costs for the formation of inventories of components for the sustainable functioning of the enterprise at a new location.

$$R \le R^*,\ R = \sum_{e=1}^{M}\sum_{f=1}^{s_e}\sum_{y=1}^{q_f} r_{efy} x_{efy}, \tag{5.12}$$

where R^* – the permissible risks of supplying components in the face of military threats.

Multicriterial problem is possible to find the rational composition of suppliers and ways of supplying components at the new location of a high-tech enterprise. Let's introduce a comprehensive logistics supply indicator:

$$Q = \alpha_W \overset{\vee}{W} + \alpha_T \overset{\vee}{T} + \alpha_R \overset{\vee}{R}, \tag{5.13}$$

where α_W, α_T, α_R – «scales» of indicators W, T, R.

$$\alpha_W + \alpha_T + \alpha_R = 1, \tag{5.14}$$

where $\overset{\vee}{W}$, $\overset{\vee}{T}$, $\overset{\vee}{R}$ – normalized values of the indicators W, T, R.

$$\overset{\vee}{W} = \frac{W - W_{\min}}{W^* - W_{\min}}, \tag{5.15}$$

where $W_{\min}$ – the minimum cost value.

$$\overset{\vee}{T} = \frac{T - T_{\min}}{T^* - T_{\min}}, \tag{5.16}$$

where $T_{\min}$ – the minimum value of supply time.

$$\overset{\vee}{R} = \frac{R - R_{\min}}{R^* - R_{\min}}, \tag{5.17}$$

where $R_{\min}$ – the minimum value of supply risks.

In order to solve the multicriteria task of searching suppliers and ways of supply is required:

$$\min Q = \alpha_W \overset{\vee}{W} + \alpha_T \overset{\vee}{T} + \alpha_R \overset{\vee}{R} = \frac{\alpha_W}{W^* - W_{\min}} \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} w_{efy} x_{efy} + \frac{\alpha_T}{T^* - T_{\min}} \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} t_{efy} x_{efy} +$$

$$+ \frac{\alpha_R}{R^* - R_{\min}} \sum_{e=1}^{M} \sum_{f=1}^{s_e} \sum_{y=1}^{q_f} r_{efy} x_{efy} - \frac{\alpha_{W_{\min}}}{W^* - W_{\min}} - \frac{\alpha_{T_{\min}}}{T^* - T_{\min}} - \frac{\alpha_{R_{\min}}}{R^* - R_{\min}}. \quad (5.18)$$

5.3 DISCUSSION OF THE MODELING RESULTS OF TRANSPORTATION LOGISTICS IN THE PERIOD OF SPECIAL LEGAL REGIME

The study of logistics processes of transportation during the martial law of the country has been conducted. Separate relevant areas of study related to the relocation of high-tech enterprises in the country of martial law, as well as the supply of high-tech components at the new location of the enterprise, have been determined.

The basic logistics indicators have been formed for the necessity of evaluation of the transportation processes in the conditions of military threats (the time required to move the enterprise from the frontal zone to the rear; the cost of relocating the enterprise to the rear; the risks of transportation of goods, with technological equipment of the enterprise, in the conditions of military threats for supply; formation of stocks of components that will ensure the stable functioning of the enterprise at a new location).

Optimization models have been created to choose rational relocation and the supply of high-tech components. Local optimization of logistics indicators, taking into account restrictions, has been carried out. A multicriterial model has been created to find the rational composition of suppliers and ways of supplying accessories at the new location of a high-tech enterprise.

The proposed approach is the basis for the creation of applied information technology for planning logistics of transportation, taking into account possible military threats during the martial law of the country.

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6 SCIENTIFIC AND METHODOLOGICAL PRINCIPLES OF FORMATION OF FINANCIAL SUPPORT STRATEGIES FOR THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF PASSENGER TRANSPORT ENTERPRISES

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ABSTRACT

This section analyzes the current state of passenger transportation in Ukraine and evaluates the main sources of its financing. It has been found that in addition to traditional problems with insufficiency of financial resources, the activities of the enterprises have caused the consequences of war. In particular, the volume of passenger transportation decreased by 47.2 % compared to the pre-war 2021. Transport infrastructure lost part of the functional capacity. The fall of passenger income has further aggravated the situation.

In view of these challenges, the relevance of the development of the strategy of financial support for the functioning of passenger transport enterprises is substantiated. The proposed strategy is based on the principles of sustainable development, which provide for a harmonious combination of economic, social and environmental aspects.

The study defines the key stages of formation of a comprehensive strategy for financing transport enterprises. Its implementation will help to create a high quality, environmentally friendly and socially responsible transport system. This will not only improve the quality of services and ensure the financial stability of enterprises, but also contribute to the overall socio-economic development of the country, maintaining the balance between economic benefits, citizens' needs and environmental protection.

KEYWORDS

Passenger transportation, financial support, sustainable development, transport infrastructure, economic efficiency, social responsibility, environmental cleanliness, development strategy.

6.1 ASSESSMENT OF THE CONCEPT OF FINANCIAL SUPPORT FOR THE SUSTAINABLE DEVELOPMENT OF PASSENGER TRANSPORT ENTERPRISES: PROBLEMS AND SOLUTIONS

Passenger transport is one of the main components of the infrastructure of each country, and its development has always been closely linked to the economic well-being and success of the state. Historically, the transport sector has acted as an important indicator of economic development, and its condition and efficiency directly affected the rates of economic growth, social progress and national security [1]. That is why the sustainable development of passenger transport enterprises is a key element of the strategy for the sustainable development of society as a whole. In the context of growing urbanization and increasing load on transport systems, it is important to ensure the efficient, environmentally safe and economically sustainable functioning of passenger transport enterprises.

Financial support for the sustainable development of passenger transport enterprises is an important component for achieving efficiency, environmental safety and economic sustainability of this industry [2]. Financing is a key factor that allows enterprises to innovate, modernize infrastructure, reduce negative environmental impacts and ensure the accessibility of transport services for the population.

For passenger transport enterprises, it is important to make optimal use of financial resources to improve the quality of service and introduce new technologies. Since these enterprises often operate in the field of public services, it is important to ensure their financial stability in order to reduce costs and increase efficiency. Investing in new vehicles, process automation and improved logistics can significantly reduce operating costs and improve the level of service.

In today's conditions, the introduction of environmentally friendly technologies is a major challenge. This requires significant financial resources, since the re-equipment of the transport fleet with environmentally friendly models, such as electric or hydrogen buses, requires large capital investments. This also applies to the modernization of infrastructure, in particular the creation of charging stations for electric vehicles or hydrogen refueling stations. Without adequate financing, such initiatives may become impossible or economically inefficient for enterprises.

Financial stability allows passenger transport enterprises not only to perform their basic functions, but also to provide flexibility in responding to changes in the economic situation, such as fluctuations in energy prices or changes in tariff policy. A key factor is the ability of the enterprise to ensure stable income through the effective use of available resources and cost optimization.

Today, most passenger transport enterprises face problems of lack of financial resources to cover their costs and ensure their development. Problems with financial resources of passenger transport enterprises are a serious challenge to their sustainable development [3, 4]. Insufficient funding, high operating costs, low profitability, difficulties in attracting investments and inefficient financial management — all this requires a comprehensive approach to solving. The introduction of modern financial instruments, attracting additional sources of financing, cost optimization and improving financial transparency can help overcome these problems and ensure sustainable development of passenger transport enterprises.

6.2 SCIENTOMETRIC ANALYSIS OF EXISTING PUBLICATIONS ON THE DEVELOPMENT OF METHODOLOGICAL APPROACHES TO THE FORMATION OF A STRATEGY FOR FINANCIAL SUPPORT OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF PASSENGER TRANSPORT ENTERPRISES

Financial support for the sustainable development of passenger transport enterprises is one of the main factors determining the success and efficiency of this industry. Reliable and stable financing allows enterprises not only to support their current activities, but also to invest in future development, introduce innovations, modernize infrastructure and comply with environmental standards. However, most passenger transport enterprises in Ukraine lack funds to cover their costs. Due to insufficient financing, many enterprises cannot afford to purchase new vehicles or modernize existing ones. This leads to the use of outdated equipment that has high fuel consumption and frequent breakdowns. Old vehicles do not meet modern

standards of comfort and safety, which negatively affects passenger satisfaction. The lack of investment in improving infrastructure and maintenance also reduces the quality of services. The lack of proper financing forces enterprises to operate at a loss. This leads to the accumulation of debts, which complicates further functioning and development. To overcome these problems, comprehensive solutions are needed, which include attracting additional sources of financing, optimizing costs, introducing modern technologies and improving the skills of personnel. Only in this way can the sustainable development of passenger transport in Ukraine be ensured and its competitiveness increased.

However, the ways of finding financial resources for passenger transport enterprises should be considered in the context of their further sustainable development.

The issue of expanding traditional sources of financing for the enterprise is addressed in the work of O. Solodovnik [5] In her work, she notes that financing the sustainable development of enterprises should be carried out with the involvement of a wide range of participants on the basis of cooperation and partnership, taking into account their interests. One of such sources is proposed to consider public-private partnership, which is defined as cooperation between public authorities and the private sector for the purpose of implementing socially significant projects in a wide range of economic activities and is carried out taking into account the interests of all stakeholders. However, to implement the involvement of private-public partnerships to finance passenger transport development projects, it is necessary to create a clear legal basis for PPP, which defines the rights and obligations of both parties, financing mechanisms, risk sharing and dispute resolution methods. The partnership must also comply with all regulatory requirements, including environmental standards, safety standards and other regulatory acts. It is important to ensure its compliance with local, national and international standards.

The paper also highlights the characteristic features of financing sustainable development of enterprises, namely, the implementation of sustainable development goals in the functioning of enterprises creates positive social and environmental effects; creates the opportunity to involve a wide range of participants — international financial organizations, supranational state administration bodies (within the framework of integration associations), state administration bodies, state and non-state enterprises, banks and non-bank financial institutions, individuals, etc. is carried out on the basis of cooperation and partnership, taking into account the interests of all interested groups of stakeholders; expands the range of sources of financial resources formation — allows to mobilize not only own and nationally attracted financial resources, but also international public and private financial resources; ensures the emergence and dynamic development of new methods and tools for the formation and use of financial resources, taking into account global priorities and development trends.

The work [6] is devoted to the issue of determining the economic essence and features of financial support for sustainable development of the enterprise.

A special place in the process of forming sufficient sources of financing for the enterprise's activities is occupied by the strategy of financial support. In the work [4] it is determined that the financial strategy should be aimed at implementing such areas of the company's activity as attracting financial resources, balanced placement (investment) of financial resources, ensuring the necessary level of financial security and achieving high quality management of financial activities.

6.3 RESULTS OF THE DEVELOPMENT OF SCIENTIFIC AND METHODOLOGICAL PRINCIPLES FOR THE FORMATION OF STRATEGIES FOR FINANCIAL SUPPORT OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF PASSENGER TRANSPORT ENTERPRISES

The aim of the study is to develop and substantiate methodological approaches that will contribute to the formation of effective strategies for financial support of sustainable development of passenger transport enterprises. This includes an analysis of the current state of financial support, identification of key problems and barriers, as well as the development of recommendations for overcoming them, taking into account modern trends and innovations in the field of financing transport systems.

To achieve the aim, the following objectives were set:

— analysis of the current state of financial support of passenger transport enterprises and identification of the main sources of financing and assessment of their adequacy to ensure sustainable development;

— identification of internal and external factors affecting the financial stability of passenger transport enterprises;

— identification of key problems associated with insufficient funding, high operating costs, low profitability and other aspects;

— determination of scientific and methodological principles for the formation of effective strategies for financial support;

— development of models and tools that will contribute to the optimization of financial flows, cost reduction and increase in profitability of passenger transport enterprises.

The object of the study is passenger transport enterprises that operate in conditions of increasing load on transport systems and the need to ensure sustainable development. The object of the study covers a wide range of aspects of the activities of passenger transport enterprises that determine their financial support, efficiency, environmental safety and social responsibility. The study of these aspects will allow developing scientifically sound methodological principles for the formation of financial support strategies aimed at ensuring the sustainable development of passenger transport enterprises.

To achieve the set aim, a set of well-known scientific methods was used in the study. Generalization methods were used to generalize modern approaches to the implementation of sustainable development goals in the activities of passenger transport enterprises and to determine the sources of their financing, as well as to form conclusions and recommendations [7, 8]. The logical synthesis method was used to theoretically substantiate the importance of studying the financial support of sustainable development of passenger transport enterprises. The use of analysis and synthesis methods allowed to show the features of ensuring the functioning of passenger transport enterprises in conditions of sustainable development. For a clear presentation of the research results and their schematic interpretation, the method of constructing schemes and models was used.

The proposed general approach to the formation of a financial support strategy [9, 10] is based on the goals of sustainable development and provides for a comprehensive approach to developing a strategy taking into account economic, social and environmental aspects to ensure the sustainable development of the passenger transport industry. Such an approach will ensure not only the financial stability of enterpris-

es, but will also contribute to improving the quality of transport services, preserving the environment and meeting the social needs of the population

6.4 RESULTS OF THE ANALYSIS OF THE CURRENT STATE OF FINANCIAL SUPPORT FOR PASSENGER TRANSPORT ENTERPRISES

Passenger transport plays an important role in the economy of any country. Its importance goes far beyond the simple movement of people from one place to another. This industry is the foundation for many economic, social and environmental processes, influencing various aspects of society and contributing to its development. Efficient passenger transport contributes to the mobility of the workforce, providing workers with the opportunity to quickly and conveniently get to their workplaces. This increases labor productivity, stimulates economic activity and contributes to GDP growth. However, its impact on the economy [11, 12] is much broader and includes several key aspects:

— the presence of a well-developed transport system allows workers to reduce the time spent traveling to and from work. This reduces stress, increases overall job satisfaction and improves the balance between work and personal life;

— thanks to reliable transport, people can consider work in a wider radius from their place of residence. This expands employment opportunities, reduces unemployment and promotes a more even distribution of the workforce across regions;

— efficient public transport allows employees to arrive at work on time, reducing tardiness and loss of working time. This contributes to increasing the productivity and efficiency of enterprises;

— reducing travel time and improving travel conditions helps reduce fatigue and stress among employees, which has a positive effect on their health and efficiency;

— accessibility increases the attendance of shopping centers, restaurants, cultural and entertainment institutions. This contributes to the growth of local business income and the creation of new jobs;

— the development of the transport system requires significant investments, which stimulates economic activity in the construction industry, production and transport services;

— developed transport allows for the integration of labor markets of different regions, reducing regional imbalances in the level of employment and wages. This contributes to a more even economic development of territories. Accessibility of transport makes cities and regions more attractive for highly qualified specialists, which contributes to the growth of innovative potential and the development of new industries.

The economic activity and development of the country are largely reflected in the volume of passengers transported by passenger transport. The dynamics of gross domestic product (GDP) is one of the key indicators that affects the transport sector (**Fig. 6.1**). The crises that occurred in the country's economy also significantly affected the passenger transport industry. But the industry suffered the greatest shocks in connection with the war. The volume of passengers transported by urban passenger transport in 2022 decreased by 47.6 % compared to the pre-war year 2021. Passenger transport enterprises themselves also suffered significant losses as a result of the war. According to analytical calculations, direct

losses caused to municipal enterprises and private carriers, in particular to destroyed transport, amount to 0.83 billion USD — these are destroyed trolleybuses, trams, buses [11, 13].

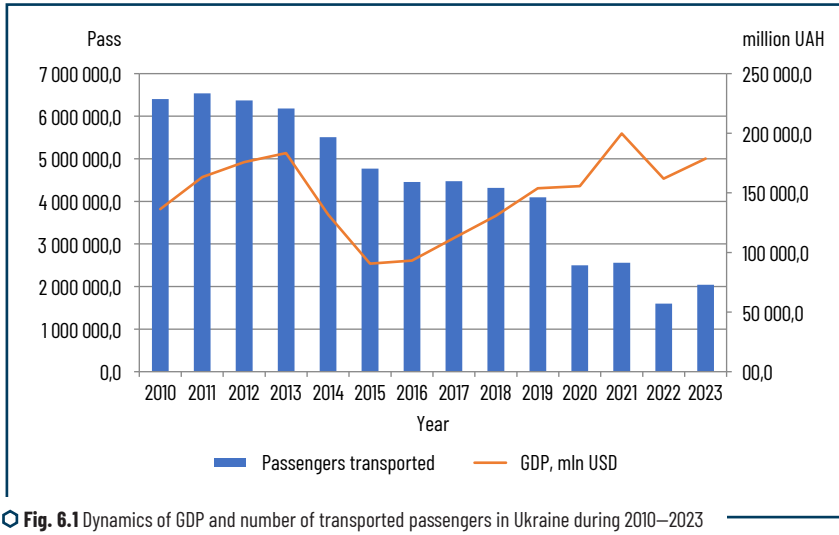

Fig. 6.1 Dynamics of GDP and number of transported passengers in Ukraine during 2010–2023

Table 6.1 presents the losses of rolling stock of passenger transport enterprises of Ukraine. As of January 2024, 11 % of trolleybuses, 7.9 % of trams and more than 5 % of buses from their total number were lost. And these losses are not final, since every day the cities of Ukraine suffer from enemy missile attacks.

Table 6.1 Losses of rolling stock of passenger transport enterprises of Ukraine

Types of damaged rolling stock	Units	Initial number of objects	Number of damaged objects
Trolleybuses	Units	2 980	344
Trams	Units	1 922	152
Buses	Units	241 426	13 182

The largest enterprise in the city of Kyiv, which carries out passenger transportation by both buses and electric transport, is the Municipal Enterprise "Kyivpastrans". The financial resources of the enterprise are presented in **Fig. 6.2**. The enterprise is dependent on borrowed credit resources. Over the past three years, the amount of bank loans of the enterprise has increased threefold. There has also been a sharp increase in the enterprise's accounts payable for goods, works and services to its counterparties.

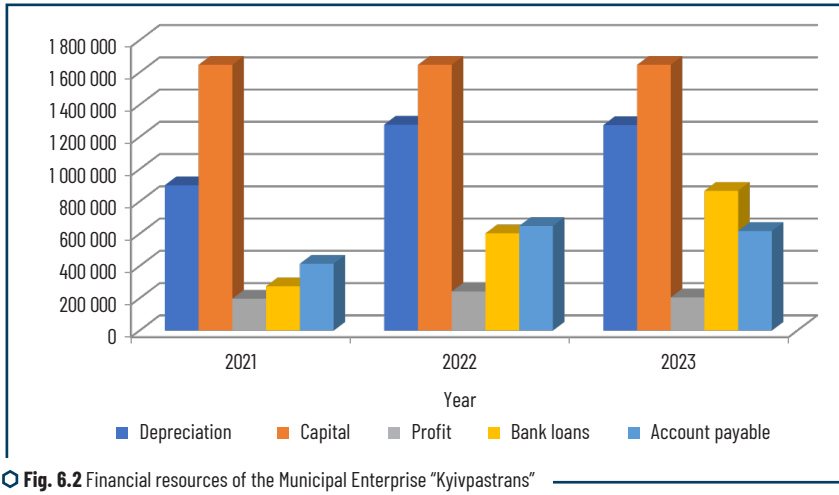

Fig. 6.2 Financial resources of the Municipal Enterprise "Kyivpastrans"

Source: [14]

Therefore, the enterprise operates mainly at the expense of borrowed funds, which indicates a lack of its own financial resources. This creates significant pressure on the financial stability of the enterprise, since high dependence on external financing can lead to increased financial risks. Attracting loans or other external resources may be necessary to ensure current activities, but it also increases debt servicing costs and reduces the flexibility of the enterprise in managing financial flows. Therefore, to achieve financial stability and reduce dependence on external sources, the enterprise needs to develop a strategy for increasing its own financial resources, optimizing costs and increasing profitability. It should be noted that this situation is observed in most passenger transport enterprises.

Analysis of the current state of financial support of passenger transport enterprises shows that they face a number of financial problems, in particular, a lack of own resources and high dependence on external financing. To ensure financial sustainability and support long-term development, it is necessary to implement comprehensive strategies aimed at optimizing costs, diversifying sources of financing and strengthening the role of state support. Only in this way will enterprises be able to improve their financial situation, improve the quality of services and contribute to the sustainable development of the transport sector.

6.5 RESULTS OF DETERMINING SCIENTIFIC AND METHODOLOGICAL PRINCIPLES FOR THE FORMATION OF EFFECTIVE STRATEGIES FOR FINANCIAL SUPPORT OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF PASSENGER TRANSPORT ENTERPRISES

The concept of "strategy" is key in various fields of activity, including business, public administration, social sciences and others. A strategy is a long-term action plan aimed at achieving certain goals or

objectives in conditions of uncertainty and limited resources. It includes an analysis of the current state, defining goals, developing ways to achieve them and monitoring implementation. A strategy is a fundamental tool for achieving long-term success. That is why there is a need to form an effective strategy for financial support of the concept of sustainable development. Forming a strategy for financial support of the concept of sustainable development of passenger transport enterprises is a critical element for achieving long-term success and stability of this industry. In modern conditions of urbanization and increasing load on transport systems, it is important to ensure the efficient, environmentally safe and economically sustainable functioning of passenger transport enterprises. The purpose of forming a strategy for financial support of the concept of sustainable development of passenger transport enterprises is to create an effective and reliable financial base to support the long-term and balanced development of transport enterprises, as well as to ensure environmentally responsible and economically efficient functioning of this industry. It should also be noted that when developing this strategy, it is necessary to take into account the goals of sustainable development in order to ensure a comprehensive and balanced approach to the development of the passenger transport industry (**Fig. 6.3**). A fundamental aspect of sustainable development is economic sustainability, as it provides the basis for the long-term and balanced growth of enterprises and society as a whole. It determines the ability of economic systems to withstand internal and external shocks, adapt to changes and ensure sustainable development in the long term.

Fig. 6.3 Interaction of sustainable development goals and financial support strategy of the concept of sustainable development of passenger transport enterprises

The basis of economic stability is financial stability, which provides for:

– effective financial management through optimization of financial flows, control over costs and ensuring a sufficient level of liquidity;

— diversification of financing sources;

— financial risk management through the implementation of mechanisms for identifying, assessing and minimizing financial risks.

Economic stability is an integral part of the competitiveness of enterprises. It allows enterprises not only to survive in a competitive environment, but also to thrive, ensuring stable and effective functioning in the long term.

Effective use of resources is a key factor in ensuring economic stability and competitiveness of enterprises. Cost optimization and increasing the efficiency of operational activities allow enterprises not only to reduce costs, but also to increase the productivity and quality of their services. Cost optimization consists in analyzing and reducing costs at all stages of the enterprise's operational activities. Increasing the efficiency of operational activities allows enterprises to use their resources more productively and provide high quality services. This is achieved through process automation, optimization of logistics processes, and the implementation of advanced management practices.

Environmental responsibility is an integral part of the concept of sustainable development. It consists in ensuring the use of natural resources and waste management in a way that minimizes the negative impact on the environment, preserves it for future generations, and promotes the harmonious coexistence of man and nature. Reducing emissions of harmful substances into the atmosphere, water, and soil is an important component of environmental responsibility, which is especially relevant for passenger transport enterprises. Environmental responsibility of passenger transport enterprises is a critical aspect of their activities aimed at reducing the negative impact on the environment and promoting sustainable development. Ensuring environmental responsibility includes several main areas, such as optimizing resource use, implementing environmentally friendly technologies, reducing emissions, waste management, and raising environmental awareness among employees and passengers. Implementation of this principle involves optimizing and rational use of fuels and lubricants, implementing energy-efficient technologies, implementing environmentally friendly technologies, reducing harmful emissions and raising the environmental awareness of enterprise employees.

The social responsibility of passenger transport enterprises involves taking into account the needs and interests of different groups of the population that use their services. This includes creating comfortable and accessible conditions for all passengers, ensuring safety, supporting social programs and initiatives, and promoting community development. Social responsibility is an important aspect of the activities of enterprises, which allows increasing the trust and satisfaction of customers, as well as strengthening their reputation in society. The social responsibility of passenger transport enterprises includes the following components:

— accessibility and inclusiveness. passenger transport should be accessible to all segments of the population, therefore vehicles and infrastructure should be equipped with ramps, elevators and special places for passengers with disabilities. This also includes accessibility for the elderly and families with children;

— passenger safety. Transport companies must adhere to high safety standards through regular maintenance of vehicles, the implementation of modern security systems [15], such as surveillance cameras, GPS trackers, emergency communication systems. Also, the implementation of this requirement involves regular training and courses for drivers and other personnel on passenger safety, first aid and emergency response;

– social programs and initiatives. This component involves providing discounts on travel for pensioners, students, large families and other socially vulnerable categories of the population;

– environmental initiatives involve the implementation of measures aimed at reducing harmful emissions, saving energy and resources, as well as conducting information campaigns among passengers on the environmental aspects of using transport and supporting environmentally conscious behavior.

The social responsibility of passenger transport enterprises covers a wide range of measures aimed at ensuring accessibility and safety, improving the quality of service, supporting social programs and environmental initiatives. Taking into account the needs and interests of different groups of the population is a key element of social responsibility, which contributes to increasing the level of trust in the enterprise, improving its reputation and ensuring sustainable development. The implementation of socially responsible practices allows passenger transport enterprises to effectively use their resources, adapt to changes and achieve long-term success. Innovation is a key factor contributing to the sustainable development of passenger transport enterprises. They allow introducing the latest technologies, improving the quality of services, reducing costs and environmental impact, as well as increasing competitiveness. In the context of rapid technological development and growing requirements for environmental and social responsibility, innovations are becoming an integral part of the sustainable development strategy. The financial strategy of passenger transport enterprises should be focused on creating favorable conditions for the implementation of innovations. This includes investments in research and development, attracting external investments, optimizing costs, creating internal innovation funds, supporting environmental and social innovations. An effective financial strategy will allow enterprises not only to implement advanced technologies, but also to increase competitiveness, ensure environmental and social responsibility, and promote sustainable development of the industry as a whole.

Institutional capacity and effective management play a key role in ensuring the sustainable development of passenger transport enterprises. Development of the regulatory framework, organizational structure, professional resources, strategic and financial planning, operational management, monitoring and evaluation – all this contributes to achieving sustainable development goals. Effective management ensures optimal use of resources, improving the quality of services, reducing risks and increasing the competitiveness of enterprises, which, in turn, contributes to the sustainable development of society as a whole [16]. These components contribute to the proper functioning of enterprises, ensuring the quality of services, efficient use of resources and adherence to the principles of sustainable development.

It should also be noted that the formation of a strategy for the financial support of passenger transport enterprises should be closely correlated with the goals and objectives of the general strategy for the development of the industry, the region and the economy of the country as a whole. This ensures consistency of actions at all levels, contributes to the effective use of resources and allows for comprehensive development. Therefore, when forming a strategy, the goals and objectives of the general strategy for the development of the transport industry should be taken into account, namely, harmonization with industry priorities, coordination with infrastructure projects.

The formation of a strategy for the financial support of sustainable development of passenger transport enterprises is a multi-stage process that requires careful planning, analysis and coordination [17].

The main stages of the formation of a strategy for the financial support of the concept of sustainable development of passenger transport enterprises are presented in **Fig. 6.4**. The first initial stage of the formation of the strategy is the formulation of its mission. The mission of the strategy for the financial support of the concept of sustainable development of passenger transport enterprises is to create conditions for sustainable, environmentally responsible and socially oriented development of the industry. This includes ensuring financial stability, supporting innovation, reducing environmental impact and improving the quality of life of the population through the accessibility and quality of transport services. It also means creating conditions that allow transport enterprises not only to survive in the face of economic challenges, but also to develop, responding to the modern needs of society and the environment.

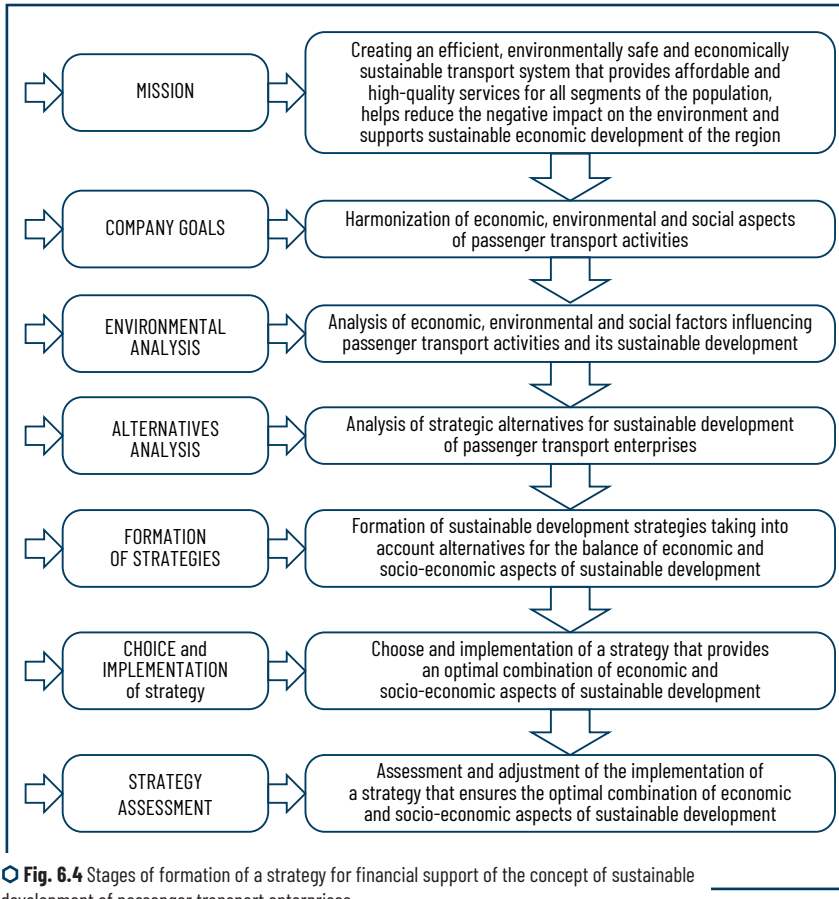

Fig. 6.4 Stages of formation of a strategy for financial support of the concept of sustainable development of passenger transport enterprises

Accordingly, the mission objectives should be:

– ensuring long-term financing involves creating conditions for stable financing of sustainable development projects through diversification of income sources, attracting investments and implementing financial instruments;

– increasing competitiveness through efficient use of resources, optimizing costs and implementing innovations;

– preserving and improving the environment by reducing environmental impact through the implementation of environmental initiatives and technologies;

– supporting social equality – involves ensuring accessibility and quality of transport services for all segments of the population, with an emphasis on social justice and inclusiveness.

The phased implementation of the stages of formation of a strategy for financial support of the concept of sustainable development of passenger transport enterprises will contribute to the development of a high-quality, environmentally friendly, cost-effective and SOCIALLY responsible transport system. This will not only improve the quality of services, but also contribute to the overall economic and social development of the country, while maintaining a balance between the needs of citizens, economic benefits and environmental protection.

A generalized scheme of the strategy for financial support of the concept of sustainable development of passenger transport enterprises is presented in **Fig. 6.5**.

The generalized scheme of the financial support strategy of the concept of sustainable development of passenger transport enterprises is an important tool for systematizing and optimizing financial flows in this area. The proposed strategy should take into account not only economic aspects, but also social and environmental factors, since sustainable development requires a balance between work efficiency, environmental care and social needs of citizens.

The economic aspects of the financial support strategy are aimed at ensuring stable and effective use of enterprise resources. Their components are:

1. Financial sustainability of enterprises. Passenger transport faces high costs for infrastructure maintenance (roads, stops, depots), technical maintenance of vehicles (buses, trolleybuses, trams, trains), personnel remuneration, fuel and energy. On the other hand, the main sources of income are fares from passengers, budget financing and other payment sources. Cost optimization and revenue growth are important for achieving financial sustainability of enterprises. In many countries, including Ukraine, passenger transport often requires state subsidies due to low transportation tariffs. This is due to the fact that passenger transport is a socially important service, and tariffs often do not cover all costs.

2. Pricing policy and tariffs. Setting tariffs that correspond to the level of costs and revenues of the enterprise is one of the most important economic aspects. Determining fair and affordable tariffs, as well as ensuring their flexibility depending on demand, is of great importance for achieving economic efficiency.

3. Investments in infrastructure development. Investments in new, more efficient vehicles (electric buses, low-floor trams, new routes) can reduce fuel and maintenance costs, increase the level of safety and comfort for passengers.

4. Productivity and efficiency. Proper route planning, including determining the frequency of runs and load levels, can significantly increase transport efficiency. Route optimization can reduce service costs and reduce waiting times for passengers.

5. Attracting private investment. In conditions of limited budget financing, private investment can become an important source of capital for the development of passenger transport. For large infrastructure projects, bond loans or other forms of financing can be used, which allows attracting private investors and minimizing dependence on the state budget.

6. Economic impact on the region and the country's economy. Passenger transport directly affects the economy of a city or region, ensuring labor mobility, supporting the labor market, and promoting the development of trade and tourism. Increasing the availability of transport contributes to increased economic activity, improving access to jobs, and maintaining economic stability in regions.

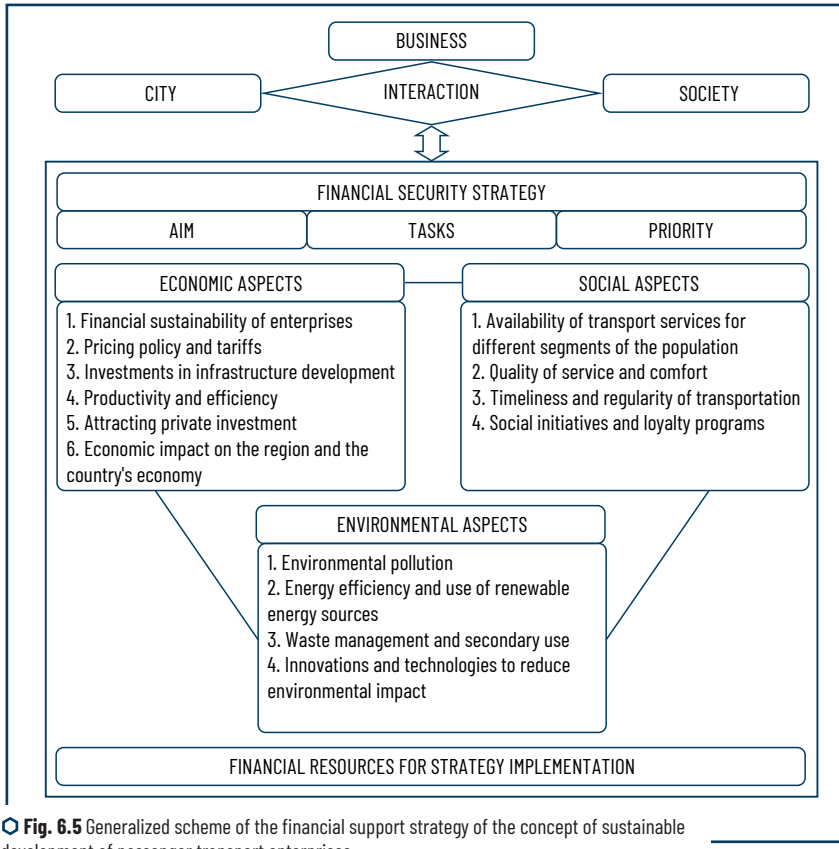

Fig. 6.5 Generalized scheme of the financial support strategy of the concept of sustainable development of passenger transport enterprises

Social aspects of passenger transport activities focus on ensuring accessibility and quality of services for all segments of the population. This includes:

1. Accessibility of transport services for different segments of the population. Passenger transport should be accessible to all segments of the population, including people with disabilities, pensioners, children, students, as well as socially vulnerable groups. Adaptation of infrastructure (ramps, elevators, special places for wheelchairs) and ticket benefits are important.

2. Quality of service and comfort. High quality of service and comfort during trips are of great importance for citizens using passenger transport. This includes cleanliness, availability of air conditioning, comfortable seats, provision of Wi-Fi and access to other amenities.

3. Timeliness and regularity of transportation. For passengers, it is important that transport runs regularly and the schedule is convenient and predictable. Irregular or delayed runs can lead to increased travel time, which creates significant social inconvenience.

4. Social initiatives and loyalty programs. The development of loyalty programs, in particular for frequent travelers or for students and pensioners, encourages citizens to use public transport. This may include cards with bonuses, discounts or free trips after a certain number of uses.

The environmental aspects of the financial security strategy are aimed at preserving the environment and reducing the negative impact of transport on the environment. They include:

1. Environmental pollution. Passenger transport is a significant source of carbon dioxide (CO_2) emissions, which contribute to climate change. CO_2 emissions depend largely on the type of transport (buses, trams, trolleybuses, trains). Transport running on fossil fuels (diesel, gasoline) is the main source of these emissions. In addition to CO_2, traditional vehicles also emit nitrogen oxides (NO_x), sulfur dioxide (CO_2), particulate matter and other harmful substances that cause air pollution, impair human health and can lead to the formation of acid rain.

2. Energy efficiency and the use of renewable energy sources. The use of energy from renewable sources, such as solar, wind and hydropower, to charge electric vehicles is an important component of reducing the negative impact on the environment. For example, electric buses or trams powered by energy produced from renewable sources significantly reduce emissions of pollutants into the atmosphere.

3. Waste management and recycling. One aspect of environmental responsibility is the proper management of waste generated during the operation of vehicles. This includes the disposal of old vehicles, batteries and other components that can pollute the environment.

4. Innovation and technologies to reduce environmental impact. The introduction of new technologies, such as automation, unmanned vehicles and intelligent transport systems, can significantly increase the efficiency of transport and reduce its environmental footprint.

The overall strategy for financial support for the concept of sustainable development of passenger transport enterprises is complex and multifactorial. It should synthesize economic, social and environmental aspects to ensure the sustainable development of the industry.

Such an approach will ensure not only the financial sustainability of enterprises, but will also contribute to improving the quality of transport services, preserving the environment and meeting the social needs of the population.

6.6 DISCUSSION OF THE RESULTS OF DETERMINING THE SCIENTIFIC AND METHODOLOGICAL PRINCIPLES OF THE STUDY

The state of the passenger transport industry was analyzed and the main sources of financing were assessed. In addition to the problem of lack of financial resources, the war made significant adjustments to the activities of passenger transport enterprises. The decline in passenger transport volumes was 47.2 % compared to the pre-war year of 2021. The infrastructure of passenger transport enterprises also suffered significant losses. The decrease in passenger income also negatively affected the volume of transportation. In view of this, the development of a strategy for financial support for the activities of enterprises is particularly relevant. However, the development processes of passenger transport enterprises should take place taking into account the concept of sustainable development and based on the principles of sustainable development.

As a result of the study, the main stages of forming a strategy for financial support for the concept of sustainable development of passenger transport enterprises were formed. The implementation of the stages of forming a strategy for financial support for the concept of sustainable development of passenger transport enterprises will contribute to the development of a high-quality, environmentally friendly, cost-effective and socially responsible transport system. This will not only improve the quality of services, but also contribute to the overall economic and social development of the country, while maintaining a balance between the needs of citizens, economic benefits and environmental protection.

A generalized strategy for financial support of the concept of sustainable development of passenger transport enterprises has been developed. The general strategy for financial support of the concept of sustainable development of passenger transport enterprises is comprehensive and multifactorial. It is based on the principles of sustainable development and synthesizes economic, social and environmental aspects to ensure sustainable development of the industry. Such an approach will ensure not only the financial sustainability of enterprises, but will also contribute to improving the quality of transport services, preserving the environment and meeting the social needs of the population.

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7 QUALITY MANAGEMENT OF PASSENGER TRANSPORT BY ROAD TRANSPORT IN TIME DEFICIT CONDITIONS

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ABSTRACT

This section examines the theoretical and methodological aspects of assessing the quality of passenger transportation by road under time constraints. The standards for customer time expenditure on passenger transportation by road under time constraints in urban conditions are substantiated by quality levels (high; medium; low) and groups of cities (Group I – cities with a population of over 1 million people; Group II – cities with a population of 500 thousand to 1 million people; Group III – cities with a population of 250 thousand to 500 thousand people; Group IV – cities with a population of less than 250 thousand people). Attention is paid to the methodological aspects of assessing the quality of domestic regional passenger transportation by road under time constraints. The methodological and applied aspects of managing the quality of passenger transportation by road under time constraints are highlighted. Alternatives for improving the quality of passenger transportation by road transport in conditions of time shortage are identified: optimization of the density of the road network and bus intervals on routes; optimization of the length of the stages and the speed of connections on bus routes. Examples of solving the problem of choosing the optimal directions for increasing the density of the road network and reducing the intervals of bus movements on routes are considered. Variations of solving the problem of optimizing the length of the stages and the speed of connections on bus routes are considered, provided that a high-speed mode and an express mode of bus movement are introduced alongside the usual modes of movement of passenger road transport rolling stock. The key stages of the methodology for surveying the route bus network and implementing methods for managing the quality of passenger transportation by road transport in conditions of time shortage are characterized. Attention is paid to planning (including standardization) of indicators and sub-indicators of the quality rate of passenger transportation by road transport, in particular the rate of bus fleet utilization and bus operating speed.

KEYWORDS

Quality, passenger transportation, road transport, time deficit, bus route.

7.1 THEORETICAL AND METHODOLOGICAL ASPECTS OF ASSESSING THE QUALITY OF PASSENGER TRANSPORTATION BY ROAD TRANSPORT IN CONDITIONS OF TIME DEFICIT

Today, road transport is the undisputed leader of land transport in passenger transportation in the world (**Table 7.1**).

Table 7.1 Passenger transportation by road transport in some countries of the world

Countries	Passenger transportation by road, million passenger-km	% of passenger transportation by land transport*
Australia	275309	96.89
Azerbaijan	16892	99.39
Croatia	25529	97.93
Czech Republic	93335	93.19
Finland	69600	96.00
France	777509	90.00
Georgia	5212	95.02
Germany	836625	93.57
Hungary	80447	93.67
Iceland	7557	100.00
Italy	657691	95.96
Japan	750471	72.14
New Zealand	53658	98.65
Norway	59211	97.08
Poland	252807	94.08
Spain	348402	95.22
Sweden	98813	92.49
Switzerland	99197	87.39
Turkey	336188	96.93
United Kingdom	584032	94.98
USA	6171807	99.75

Source: compiled by the authors

*Note: *calculated by the authors based on data [1]*

And in Ukraine, road transport traditionally provides transportation of more than 90 % of passengers [2], so the issue of improving the quality of passenger road transportation remains relevant.

Of course, the quality of passenger transportation by road is a complex, comprehensive concept that includes many diverse aspects, such as:

– highly qualified professional drivers and fair tariffs for transporting customers by bus routes [3–8];

— perfect design characteristics of buses [9, 10];

— regularity, rhythm, uninterruptedness and convenience of transporting customers by bus routes [11–15];

— accessibility and safety of services for transporting customers by bus routes, in particular in accordance with the Sustainable Development Goals [16–26];

— information support for customers, automation of business processes of partner interaction [27–33], etc.

In this study, the authors are based on the thesis that the most valuable and scarce human resource in the modern world is time, therefore the key criterion for the quality of passenger transportation by road transport should be the time spent by customers on movement and its minimization.

Let's believe that the time spent by customers on movement consists of:

— time to move to/from the bus stop (t_1);

— time of initial waiting for the bus (t_2);

— time of the next waiting for the bus (in case of refusal of transportation after the initial waiting for the bus) (t_3);

— direct time of transportation by road transport (buses) (t_4);

— time for transfers (t_5).

The quality of passenger transportation by road transport in conditions of time shortage is proposed to be assessed by the quality rate as the ratio of the estimated value of the time spent on movement in reference conditions (t_m^e) and the estimated value of the time spent on movement in actual conditions (t_m^a):

$$K_q = \frac{t_m^e}{t_m^a}. \tag{7.1}$$

The elements of time spent by road transport companies' customers on travel are calculated as follows:

1) travel time to/from the bus stop:

$$t_1 = 0.0075\left(\frac{2000}{\delta} + \frac{1000L_{tot}}{N_{stop}}\right), \tag{7.2}$$

where δ – density of the road network, km/km^2; L_{tot} – total length of the bus route, km; N_{stop} – number of stops on the bus route;

2) initial waiting time for the bus:

$$t_2 = \frac{i}{2}\left[3 - 2K_{rp} + 2K_{rp}\left(1 - K_{rr}\right)\left(\frac{\Delta i}{i}\right)^2\right], \tag{7.3}$$

where i – weighted average interval of bus movement along the route, min.; Δi – deviation from the time of arrival and departure of buses at the control points of the route, min.; K_{rp} – run performance rate:

$$K_{rp} = \frac{N_r^a}{N_r^{pl}}, \tag{7.4}$$

where N_r^a – actual number of runs performed on the bus route; N_r^{pl} – planned number of runs provided for by the bus route schedule; K_{rr} – run regularity rate:

$$K_{rr} = \frac{N_r^r}{N_r^a}, \tag{7.5}$$

where N_r^r – the number of regular runs performed on the bus route

3) the time of the next waiting for the bus (in case of refusal of transportation after the initial waiting for the bus):

$$t_3 = \frac{T}{2} d \left(2 - K_{rp} - \frac{1}{Y_d} \right), \tag{7.6}$$

where T – duration of the peak period, min.; d – transfer rate; Y_d – dynamic rate of bus capacity utilization;

4) direct time of transportation by road transport (buses):

$$t_4 = \frac{60 l_t^{av} d}{V_r}, \tag{7.7}$$

where l_t^{av} – average distance of a client's trip on a bus route, km; V_r – speed of buses on the route, km/h;

5) time for transfers:

$$t_5 = (d - 1)(0.015 l_t + t_2), \tag{7.8}$$

where l_t – average distance of the client's transfer, m.

In this case, the time spent by clients of road transport enterprises on movement is determined during peak hours and by average daily values:

– by peak hour indicators:

$$t_4^p = 11.75 + 3\left(1.2 + 0.17\sqrt{F}\right), \tag{7.9}$$

where F – built-up area of the city, km^2;

– by average daily indicators:

$$t_4^{av} = 12.25 + 3\left(1.2 + 0.17\sqrt{F}\right). \tag{7.10}$$

Based on the above-mentioned patterns, the norms of customer time expenditure for passenger transportation by road transport in conditions of time deficit in urban conditions were determined by quality levels (high; medium; low) and groups of cities (Groups I–IV) (**Table 7.2**).

Table 7.2 Norms of customer time expenditure for passenger transportation by road transport in conditions of time deficit in urban conditions

Groups of cities by the "population" criterion	Quality level	Time spent, min.
Group I cities with a population of over 1 million people	– high – medium – low	32 40 49
Group II cities with a population of 500 thousand people to 1 million people	– high – medium – low	28 35 43
Group III cities with a population of 250 thousand people to 500 thousand	– high – medium – low	24 30 37
Croup 4 cities with a population of less than 250 thousand people	– high – medium – low	20 25 32

Source: developed by the authors

While in the regional context, the quality of passenger transportation by road transport in conditions of time deficit includes the time spent on moving to the bus stop (t_1), waiting for the bus (t_2) and direct transportation of customers (t_4).

In this case, the time of moving customers to the bus stop is determined as a weighted average value per resident of the region as follows:

$$t_1 = \frac{7.5}{P_{tot}}\left(3P_o + \frac{1}{\delta}P_{no}\right), \tag{7.11}$$

where P_{tot} – the total population of the region, people; P_o – the population of the region that uses regular bus services, people; P_{no} – the population of the region that does not use regular bus services, people.

The waiting time for bus customers will be calculated as follows:

$$t_2 = 7K_{rp}\left(1-K_{rr}\right) + i\left(1-K_{rp}\right) + 5. \tag{7.12}$$

The time for customer transportation will be determined as follows:

$$t4 = \frac{60l_t^{av}}{V_r}. \quad (7.13)$$

Thus, the total time spent by customers on trips using the regular bus network within the region will be:

$$t_t = \frac{7.5}{P_{tot}}\left(3P_o + \frac{1}{\delta}P_{no}\right) + 7K_{rp}\left(1-K_{rr}\right) + i\left(1-K_{rp}\right) + 5 + \frac{60l_t^{av}}{V_r}. \quad (7.14)$$

The developed methodology for assessing the quality of passenger transportation by road transport in conditions of time deficit allows solving the following tasks:

– to assess the quality of passenger transportation by road transport in conditions of time deficit in urban conditions and within the region;

– to determine by calculation the actual time costs of customers for transportation using the regular bus network;

– to analyze the time costs of customers for transportation by road transport by elements and, thanks to this, to comprehensively form a list of measures to improve the quality of passenger service, in particular by minimizing the time costs of customers for transportation to/from the bus stop, initial waiting for the bus, subsequent waiting for the bus (in case of refusal of transportation after the initial waiting for the bus), transportation by road transport, making transfers;

– to determine the optimal structure of the bus fleet for a specific route, group of routes or a separate region.

7.2 METHODOLOGICAL AND APPLIED ASPECTS OF MANAGING THE QUALITY OF PASSENGER TRANSPORTATION BY ROAD TRANSPORT IN CONDITIONS OF TIME SHORTAGE

The goal of managing the quality of passenger transportation by road transport in conditions of time shortage is to minimize the time spent by customers on travel.

In this context, two complexes of methods for improving the quality of passenger transportation by road transport should be distinguished, aimed at:

– optimizing the density of the road network and bus intervals on routes;

– optimizing the length of stages and the speed of connections on bus routes.

Let's consider these methods in more detail.

The replenishment of the bus fleet, as well as the redistribution of the existing rolling stock of passenger road transport, is aimed at developing the route network, reducing travel intervals or their simultaneous change.

An increase in the density of the road network has a positive effect on reducing the time spent by customers on traveling to/from the bus stop.

Reducing the intervals of bus movements on routes reduces the time spent by customers on waiting at the bus stop.

The criterion for choosing the optimal use of passenger road transport rolling stock is the minimum of the total time spent by customers on moving to/from the bus stop and the time spent by customers on waiting at the bus stop:

$$t_1 + t_2 \rightarrow \min. \tag{7.15}$$

The effectiveness of management decisions in the context of the need to minimize customer time spent traveling to/from the bus stop is determined by the annual savings of this indicator:

$$E_{t_1} = \left(t_{1(1)} - t_{1(2)}\right)\frac{P}{d}, \tag{7.16}$$

where $t_{1(1)}$, $t_{1(2)}$ – time to travel to/from the bus stop before and after the implementation of management decisions, respectively, min.; P – annual volume of passenger transportation, passengers.

In this case, the transfer rate (d) is taken depending on the group of cities according to the "population" criterion (**Table 7.2**) in the following amount:

– Group I: d = 1.4;
– Group II: d = 1.3;
– Group III: d = 1.2;
– Group IV: d = 1.1.

The amount of annual savings in customer time spent on travel to/from the bus stop, achieved due to an increase in the density of the motor transport network, will be determined as follows:

$$E_{t_1} = \left(\frac{15}{\delta_1} - \frac{15}{\delta_2}\right)\frac{P}{d}, \tag{7.17}$$

where δ_1, δ_2 – the density of the motor transport network before and after the implementation of management decisions, respectively, km/km^2.

The annual savings in customer time spent waiting at the bus stop, achieved by reducing bus intervals on routes, will be determined as follows:

$$E_{t_2} = \frac{i_1 - i_2}{2K_{rp}}\frac{P}{d}, \tag{7.18}$$

where i_1, i_2 – the weighted average intervals of bus traffic on routes before and after the implementation of management decisions, respectively, min.

Let's consider the solution to the problem of choosing the optimal directions for increasing the density of the motor transport network and reducing the intervals of bus traffic on routes using a specific example.

In the city of Group I, the average interval of bus traffic on routes is 7 min, the density of the motor transport network is 2 km/km^2. The planned volume of transportation for the next year is 200 million passengers and an increase in the number of buses by 10 %. It is necessary to determine which of the indicators – the density of the motor transport network or the interval of bus traffic on routes – should be developed first.

To solve this problem, it is necessary to determine points on the following lines:

$$\Delta t_1 = f\left(\delta = 2\right) = 0.350 \text{ min}, \tag{7.19}$$

$$\Delta t_2 = f\left(i = 7\right) = 0.245 \text{ min}. \tag{7.20}$$

Comparing the obtained values according to the criterion of minimizing customer time costs, it is possible to that under the given conditions it is more rational to increase the density of the motor transport network.

The planned increase in the number of buses by 10 % will logically allow to increase the density of the motor transport network by 10 % with unchanged bus travel intervals along the routes:

$$\delta_2 = \delta_1 \cdot 1.1 = 2.0 \cdot 1.1 = 2.2 \text{ km/km}^2. \tag{7.21}$$

Thus, the annual savings in customer time costs for moving to/from the bus stop will be:

$$E_{t_1} = \left(\frac{15}{2.0} - \frac{15}{2.2}\right)\frac{2 \cdot 10^8}{1.4} = 97.4 \text{ million min} \approx 1.6 \text{ million h}. \tag{7.22}$$

Let's conduct an experiment and slightly transform the initial data of the problem: assuming that the city group, the planned volume of passenger transportation and the increase in the number of buses are maintained, let's imagine that the interval of bus traffic along the routes is 10.1 min, the density of the motor transport network is 2.92 km/km^2. In this case, let's take the run performance rate as 0.97.

Under the given conditions, it is more rational to reduce the intervals of bus traffic along the routes.

The planned increase in the number of buses by 10 % will logically allow reducing the intervals of bus traffic along the routes by 10 % without increasing the density of the motor transport network:

$$i_2 = 10.1 \cdot \frac{1}{1.1} = 9.2 \text{ min}. \tag{7.23}$$

Then the annual savings in customer time spent waiting at the bus stop will be:

$$E_{t_2} = \frac{10.1 - 9.2}{2 \cdot 0.97} \cdot \frac{2 \cdot 10^8}{1.4} = 66.3 \text{ million min} \approx 1.1 \text{ million h}. \tag{7.24}$$

Increasing the speed of passenger transportation by road transport can be achieved through the modernization of rolling stock, improvement of the route bus network, improvement of road conditions, automation of the road traffic management system, etc.

Of course, the above measures require an integrated approach, significant material costs and, as a rule, cannot be implemented only by the resources of road transport enterprises that provide passenger transportation services.

In turn, road transport enterprises can contribute to increasing the speed of customer transportation by introducing a high-speed mode and an express mode of bus traffic alongside the usual modes of traffic of passenger road transport rolling stock.

In the high-speed mode of traffic, buses stop only at individual stops along the route.

In the express mode of traffic, buses move between the initial and final destinations without other stops along the route.

Increasing the speed of customer transportation by road when implementing high-speed and express bus traffic is achieved by increasing the length of the stages:

$$V_2 = V_1 + V_s \lg \frac{l_2}{l_1}, \tag{7.25}$$

where V_1, V_2 — speed of buses on the route before and after the introduction of the high-speed mode and express mode, respectively, km/h; V_s — standard change in speed of buses on the route (V_s = 10 km/h); l_1, l_2 — length of the stages before and after the introduction of the high-speed mode and express mode of buses on the route, respectively, m.

The effectiveness of the introduction of the high-speed mode and express mode of buses alongside the usual modes of movement of passenger road transport rolling stock is determined by the annual savings in customer time spent on trips:

$$E_{t_4} = \left(\frac{1}{V_1} - \frac{1}{V_2} \right) l_t^{av} \cdot P_2, \tag{7.26}$$

where P_2 — the annual volume of passenger transportation by buses in high-speed mode and express mode on the route, passengers.

Let's consider an example of calculating the annual savings in customer travel time in the event of the introduction of high-speed mode and express mode of bus traffic at a road transport enterprise alongside the usual modes of traffic of passenger road transport rolling stock.

A bus route with a length of 24 km in the forward and reverse directions is characterized by the following technical and economic indicators: average speed of buses on the route — 18 km/h; average distance of a client's trip — 4.5 km; average length of stages — 600 m; annual volume of passenger transportation — 2 million passengers. It is planned to introduce transportation in high-speed mode (with a total number of stops — 6) and express mode on the route. It is expected that 500 thousand passengers will use the high-speed and express services during the year.

Let's determine the average length of the stages in the high-speed mode of bus traffic on the route:

$$l_2 = \frac{l}{N_{stop}} = \frac{24}{6} = 4 \text{ km}. \quad (7.27)$$

Next, let's determine the speed of the bus route:

$$V_2 = 18 + 10 \lg \frac{4}{0.6} = 26.23 \text{ km/h}. \quad (7.28)$$

Thus, the implementation of a high-speed mode on a bus route will contribute to an increase in the speed of passenger transportation by road:

$$\Delta V = \frac{V_2 - V_1}{V_1} \cdot 100 = \frac{26.23 - 18}{18} \cdot 100 = 45.7 \ \%. \quad (7.29)$$

Accordingly, the efficiency of the introduction of a high-speed mode on a bus route will be:

$$E_{t_4} = \left(\frac{1}{18} - \frac{1}{26.23} \right) 4.5 \cdot 5 \cdot 10^5 = 39.2 \text{ thousand h}. \quad (7.30)$$

In the case of the implementation of an express mode on the route, the following speed is expected:

$$V_2 = 18 + 10 \lg \frac{12}{0.6} = 31 \text{ km/h}. \quad (7.31)$$

The implementation of express traffic on a bus route will contribute to an increase in the speed of passenger transportation by road:

$$\Delta V = \frac{31 - 18}{18} \cdot 100 = 72.2 \ \%. \quad (7.32)$$

The efficiency of the introduction of express traffic on a bus route will be:

$$E_{t_4} = \left(\frac{1}{18} - \frac{1}{31} \right) 4.5 \cdot 5 \cdot 10^5 = 52.4 \text{ thousand h}. \quad (7.33)$$

The required number of runs in high-speed mode and express mode is determined by the actual passenger flow on the bus route. In this case, it is important that the use of bus capacity is the same as in the

normal mode of bus traffic on the route, or that the decrease in the level of bus occupancy correlates with the increase in the speed of the connection.

The developed methodology for examining the route bus network and implementing methods for managing the quality of passenger transportation by road transport in conditions of time shortage can be conditionally divided into the following stages:

Stage I. Collection of the following data for each bus route:

— length of the bus route;
— time of the return run on the bus route;
— daily duration of the bus route;
— number of return runs per day by bus brand;
— number of return runs during peak hours by bus brand;
— maximum passenger flow on the busiest section of the bus route during peak hours;
— daily passenger flow of the bus route;
— average distance of a client's run on a bus route;
— number of bus stops on the route.

In addition to the specified data for the city as a whole and for each district of the city, the following information is required:

— area of the built-up part of the city;
— density of the motor transport network;
— total length of bus routes;
— total number of stops on bus routes;
— run performance rate;
— run regularity rate;
— average distance of a passenger's trip;
— daily volume of passenger transportation.

Stage II. Drawing up motor transport schemes for the city as a whole and for each district of the city separately without interruption of bus routes. Residential areas, industrial zones, bus stops are indicated on the schemes, on the basis of which the possibility of organizing the movement of buses of different sizes along the streets of a certain district of the city is determined.

Stage III. Study of the density of the motor transport network and intervals of movement on bus routes, determination of optimal values of these indicators. Based on the values of the density of the road network and the intervals of movement on bus routes, a management decision is made on the need to change them. In the event of a need to reduce the intervals of movement on bus routes by reducing the density of the road network, bus routes are combined on parallel intervals. However, in modern conditions of the development of the road network, the optimal value of its density significantly lags behind the optimal value of the intervals of bus movement, which leads to the need to increase the density of the road network by proportionally reducing the intervals of bus movement, which becomes possible due to the replenishment of the fleet of passenger road transport.

Stage IV. Study of the length of bus route runs and the selection of their optimal value. Based on data on the absolute value of the length of bus route runs, the speed of connection and the average distance of the

customer's trip, the optimal length of the run for a particular bus route is determined. Then, initially on the bus route diagram and subsequently on the ground, the required number of bus stops and their placement are determined. The number and location of bus stops should ensure that customers can easily and safely approach them and transfer to another bus route. After the number and location of bus stops are finally determined, the speed of service on the route is adjusted.

Stage V. Comparison of the carrying capacity of the buses of the road transport enterprise and the actual passenger flow during peak hours, taking into account their unevenness in time, direction and sections of the route. At the same time, the possibility of replacing buses with more capacious ones is considered on those sections of the route where the excess of the passenger flow over the carrying capacity of the buses of the road transport enterprise is detected. This replacement can be carried out both by increasing the number of buses on the routes and by more rational distribution of buses between the routes. Such a measure allows to equalize the values of the occupancy of buses during peak hours throughout the route network and, accordingly, to improve the quality of customer transportation.

Stage VI. Research and improvement of bus traffic regimes on routes during peak hours. Such a study is carried out in order to identify the possibilities of organizing high-speed runs, express runs or shortened runs, which will allow to increase the speed of communication on the bus route, balance the occupancy of buses during peak hours and, thereby, increase the carrying capacity of buses of the road transport enterprise.

Stage VII. Drawing up a scheme of bus routes and developing proposals for changing the bus schedule on the routes. Schemes are drawn up separately for each bus route, district of the city and the city as a whole. This stage ends with the formation of a draft bus schedule for routes.

Stage VIII. Practical implementation of the developed bus schedules for routes.

Stage IX. The developed methodology for managing the quality of passenger transportation by road transport in conditions of time shortage is completed by calculating the total economic effect of the implemented measures according to the formula:

$$E = \frac{\left(t_{(n1)} - t_{(n2)}\right) \cdot \varepsilon' \cdot P}{60}, \tag{7.34}$$

where $t_{(n1)}$, $t_{(n2)}$ – time spent by customers on travel before and after the implementation of management decisions, respectively, min.; ε – cost expression of passenger-hour, monetary unit.

7.3 METHODOLOGICAL ASPECTS OF PLANNING THE QUALITY OF PASSENGER TRANSPORTATION BY ROAD IN CONDITIONS OF TIME SHORTAGE

An integral element of managing the quality of passenger transportation by road is the planning of indicators and sub-indicators, which form the planned value of the quality rate of passenger transportation by road (**Table 7.3**).

Table 7.3 Indicators and sub-indicators of the quality rate of passenger transportation by road

	Indicators	Sub-indicators
Quality rate of passenger transportation by road transport	1. Bus fleet utilization rate	1.1. Average age of the bus fleet
		1.2. Mileage of the bus fleet since the beginning of operation
		1.3. Technical equipment of road transport enterprises
		1.4. Availability of resources for the transportation process
	2. Bus operating speed	2.1. Road condition
		2.2. Traffic intensity on the roads
		2.3. Terrain
		2.4. City group
	3. Changes in bus fleet structure	3.1. Commissioning of new, more technically advanced buses
		3.2. Decommissioning of technically obsolete buses
	4. Optimization of operational indicators	4.1. Length of stages and speed of service
		4.2. Density of the road network and traffic intervals

Source: compiled by the authors

Planning of quality indicators of passenger transportation by road transport consists in determining their absolute value for the planned period, taking into account the forecasted operating conditions, composition and mode of movement of the bus fleet, and the availability of unused reserves.

Thus, the system of planning the quality of passenger transportation by road transport should be based not on a dynamic series, but on reasonable standards.

In this case, the initial stage is planning the increase in passenger capacity taking into account the rates of movement (input and output) of the bus fleet, on the basis of which a possible reserve for increasing the number of buses on routes is determined by bringing the rate of use of the bus fleet to the normative value.

In this context, the normative value of the bus fleet utilization rate is determined by the formula:

$$K_{bfu(n)} = K_{trb(n)} \cdot \alpha, \tag{7.35}$$

where $K_{trb(n)}$ – the normalized rate of technical readiness of buses; α – the rate that takes into account the degree of use of technically serviceable buses.

In turn, the rate of technical readiness of buses is normalized depending on the sub-indicators of the rate of utilization of the bus fleet, namely:

– the average age of the bus fleet (T_{bf});

– the mileage of the bus fleet since the beginning of operation (L_{bf});

– the technical equipment of road transport enterprises (TE).

The normalized value of the rate of technical readiness of buses depending on the average age of the bus fleet is determined as follows:

$$K_{trb(n)f(T_{bf})} = 1 - 0.005 \cdot T_{bf} - 0.002 \cdot T_{bf}^2. \quad (7.36)$$

The normalized value of the coefficient of technical readiness of buses depending on the average age of the bus fleet and the mileage of the bus fleet since the beginning of operation will be determined as follows:

$$K_{trb(n)f(T_{bf};L_{bf})} = K_{trb(n)f(T_{bf})} \cdot K_L, \quad (7.37)$$

where K_L – the correction rate.

The correction rate K_L is determined using **Table 7.4** depending on the average mileage of 1 bus since the beginning of operation at the road transport enterprise.

Table 7.4 Dependence of the correction coefficient K_L on the average mileage of 1 bus since the beginning of operation at the road transport enterprise

Average mileage of 1 bus since the beginning of operation, thousand km	0–175	175–262	262–350	More than 350
K_L value	0.92	0.89	0.88	0.84

Source: compiled by the authors

The normalized value of the rate of technical readiness of buses, depending on the average age of the bus fleet, the mileage of the bus fleet since the beginning of operation and the technical equipment of road transport enterprises, is formed as follows:

$$K_{trb(n)f(T_{bf};L_{bf};TE)} = K_{trb(n)f(T_{bf};L_{bf})}\left(0.05 \cdot TE + 0.95\right). \quad (7.38)$$

The obtained value of the change in passenger capacity must be distributed by type of transportation (urban, suburban, intercity). This value can be used for:

– creating a reserve of the bus fleet;
– reducing the number of unfulfilled runs;
– developing the route network;
– increasing the density of the route network;
– reducing the intervals of movement in the existing route network.

An important component of the quality of passenger transportation by road transport is the operating speed. For cities with identical traffic conditions, a single value of the connection speed is normalized, which may differ only for individual routes depending on road conditions and traffic conditions. For this purpose, cities are divided into groups according to a number of characteristics, such as geographical

location, terrain, population, etc. At the same time, the connection speed for each group is normalized by the leader, that is, by the maximum value of the operating speed in the group.

The normative value of the connection speed is adjusted by the actual stage length:

$$V_{c(s)} = V'_{c(s)} + 10 \lg \frac{l_n}{l_a}, \tag{7.39}$$

where $V'_{c(s)}$ – the initially established connection speed standard, km/h; l_n – the normative stage length for a particular city, km; l_a – the actual stage length for the leader city in the group, km.

$$i_n = i_a \frac{V_{c(a)}}{V_{c(n)}}, \tag{7.40}$$

where $V_{c(a)}$, $V_{c(n)}$ – the actual and standard speed of service, respectively, km/h; i_a – the actual bus travel interval, min.

When normalizing the actual value of passenger flows and the carrying capacity of the bus fleet, changes in the speed of communication and the number of urban residents are taken into account.

An increase in operating speed is a significant reserve for increasing the efficiency of using the bus fleet.

At the same time, there are two ways to increase the operating speed without increasing the speed of movement on the routes:

– introducing high-speed runs and express bus traffic modes;

– introducing variable bus traffic modes during the day (in particular, reducing bus parking at terminal stops to a minimum during peak hours).

It is advisable to introduce high-speed runs and express runs on routes with a small passenger turnover at intermediate stops or on routes with a limited number of stops with a significant passenger turnover.

The rationality of the organization and justification of the specific weight of high-speed runs and express runs are determined on the basis of an analysis of passenger flows, which is a rather laborious process. At the same time, there is a certain relationship between the specific weight of passengers on the main part of the route and the passenger turnover rate on the route.

In this context, the passenger turnover rate on the route can be represented by the expression:

$$K_{pt} = \frac{L_{tot}}{l_t^{av}}, \tag{7.41}$$

where L_{tot} – total length of bus route, km; l_t^{av} – average distance of client's trip on bus route, km.

The smaller the value of passenger variability coefficient on route, the greater is the specific weight of those passengers who follow from initial to final stop point or the majority of route.

Using the established dependence allows road transport enterprises to organize express and express runs on routes without laborious process of passenger flow research.

The rational number of high-speed and express runs on city bus routes is determined based on dependence on passenger variability coefficient at stop points (**Table 7.5**).

Table 7.5 Dependence of the number of high-speed and express runs on city bus routes on passenger variability rate

Passenger turnover rate	1.0–1.2	1.2–1.8	1.8–2.5	More than 2,5
Number (frequency) of high-speed and express runs	100 %	50 %	33 %	0 %

Source: compiled by the authors

The implementation of high-speed and express routes increases the operating speed of buses by 10–40 %, depending on the number of intermediate stops on the route before and after, as well as a number of other factors characterizing the bus fleet, road conditions, etc.

In order to maximize the carrying capacity of the bus route during peak hours, a variable bus traffic regime is established, which involves minimizing the duration of bus stops at intermediate and final stops. For this, the actual and required parking time at each stop is timed. At least 50 measurements are made on each bus route (preferably on different buses and during the shifts of different drivers).

According to the results of the study, the standards for the required duration of stops are established as arithmetic averages for groups of measurements for each stop. 10% of measurements with minimal downtime at the stop and 10 % of measurements with maximum values are excluded from the group.

These standards are used to standardize operating speeds, establish bus intervals and the number of trips during peak periods. During the off-peak period, the duration of bus stops at the final stops is increased according to the scheduled schedule in order to provide bus drivers with short-term rest to relieve fatigue (both physical and psychological).

When implementing variable bus traffic modes during the day, the dependence of the increase in the operating speed of buses during peak hours on the length of the route should be taken into account (**Table 7.6**).

Table 7.6 Dependence of the increase in the operating speed of buses during peak hours on the length of the route

Route length, km	Up to 3	3–5	5–7	7–10	10–15	More than 15
Increase in operating speed of buses during peak hours, %	15–20	10–15	7–10	4–7	2–4	2

Source: compiled by the authors

7.4 DISCUSSION OF THE RESULTS OF PLANNING THE QUALITY OF PASSENGER TRANSPORTATION BY ROAD TRANSPORT IN CONDITIONS OF TIME SHORTAGE

The cycle of work performed using the developed methods of managing the quality of passenger transportation by road transport can be completed by drawing up a bus route scheme and developing proposals for improving the bus schedule.

At the same time, drawing up bus route schemes and developing proposals for improving the bus schedule should be carried out in terms of individual routes, city districts and the city as a whole.

The development of route schemes and improving bus schedules should be based on a detailed analysis of passenger flows, transport demand and the level of road congestion at different times of the day. It is especially important to take into account peak periods to ensure the optimal frequency of runs and reduce passenger waiting time.

In addition, it is worth paying attention to the effective integration of bus routes with other types of public transport, such as trams, trolleybuses and metro (if available), in order to create a single transport network with the most convenient transfers for passengers. This will ensure quick access to key residential areas, industrial zones, business centers and socially important objects of the city.

It is also important to take into account the factors of environmental safety and economic feasibility. Reducing the duplication of routes and optimizing traffic schedules will help reduce the costs of servicing routes and reduce emissions of harmful substances into the atmosphere.

The implementation of modern information monitoring and dispatching systems will allow for prompt adjustment of schedules in real time, taking into account traffic situations and changes in passenger demand.

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CONCLUSIONS

The monograph examines a complex of problems and prospects for the development of the transport industry in the face of modern challenges, including the destabilization of the geopolitical and socio-economic situation, crisis phenomena and the impact of military actions. The proposed scientific approaches are aimed at improving logistics processes, implementing anti-crisis management and ensuring sustainable development of transport sector enterprises.

The study has proven that effective management of the transport industry requires a comprehensive approach that includes planning of logistics processes, adaptation to external challenges, rationalization of resources and integration of innovative technologies. The strategies and methods proposed in the monograph allow to increase the efficiency of transport enterprises, ensure their financial stability and promote stable development even in crisis conditions.

The main scientific results of the study are the following provisions:

— new criteria for risk division are established and the meaning of the concepts of "certainty" and "uncertainty" is clarified, which contributes to a better understanding of the essence of risk. For the first time, the misconception about the existence of absolute certainty and complete uncertainty has been refuted, which allows to abandon illusory approaches to management;

— a four-stage anti-crisis management system has been developed, which involves diagnosing crisis phenomena, forming anti-crisis strategies, implementing stabilization measures and assessing the effectiveness of the proposed measures. Particular attention has been paid to adapting anti-crisis management to wartime conditions;

— conceptual models of enterprise relocation have been proposed, which take into account the risks of disruption of transport chains, resource shortages and the need to quickly establish new supply channels. Key stages of relocation have been identified, such as choosing a safe location, adapting infrastructure and ensuring the continuity of production processes;

— recommendations have been developed on the implementation of monitoring and dispatching information systems for the operational management of transport processes. This allows to flexibly respond to changes in demand and traffic situations, optimize routes and increase the efficiency of logistics operations;

— a two-component methodological approach is proposed to assess the readiness of enterprises for development. It is based on the analysis of investment adequacy and balance of expenditure activities. The testing of the approach showed that enterprises of the Ukrainian motor transport sector have low resource capacity, which requires the formation of new strategies for financial support;

— the importance of integrating transport infrastructure as one of the key factors for ensuring regional economic growth is identified. Mechanisms for the development of transport networks are outlined, taking into account the socio-economic heterogeneity of regions and the potential impact of infrastructure on the mobility of the population and business;

— recommendations are proposed for improving the route network and bus schedules in order to reduce passenger waiting times, increase environmental safety and economic efficiency of transportation.

Based on the research conducted, a number of practical recommendations have been formed:

1. To increase the resilience of transport enterprises, it is necessary to implement anti-crisis management systems taking into account military challenges.

2. Ensuring the financial stability of enterprises requires the development of comprehensive investment development strategies, cost optimization and increasing the efficiency of logistics processes.

3. It is important to stimulate the use of innovative technologies, such as dispatching information systems, automated transport management systems and resource monitoring.

4. It is advisable for state administration bodies to promote the development of transport infrastructure that will ensure sustainable regional development and effective functioning of the transport industry.

5. In the field of passenger transportation, integrated transport solutions should be introduced to create a unified public transport network.

The monograph demonstrates the importance of an integrated approach to transport industry management using the principles of sustainable development and innovative logistics solutions. The results obtained have theoretical and practical value, as they can be used to optimize the activities of transport enterprises, form state transport policy and increase the competitiveness of the industry.

The models and strategies proposed in the work will help overcome crisis phenomena, ensure stability and sustainable development of the transport system both in Ukraine and in other countries facing similar challenges.

Edited by
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LOGISTICS APPROACHES, INNOVATIVE SOLUTIONS AND MANAGEMENT MODELS

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