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# SEMANTIC MODEL OF THE CONCEPT «BEHAVIOR OF ECONOMIC AGENTS IN THE FIELD OF TRANSPORT LOGISTICS»

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**Key words:**
economic agents, behavior of economic agents, transport logistics, semantic model.

The article is devoted to the study of the concept of "Behavior of economic agents in the field of transport logistics", which is important for modern economic theory. The relevance of this problem is due to the fact that in the context of the rapid development of the information society and the emergence of new scientific terms, there is a need for a deep understanding of the knowledge that characterizes the subject area of research and defines its information model. In a complex dynamic economic environment, economic behavior is a factor of economic efficiency. When studying it, the specifics of the subject area are extremely important. This is especially true for such an area of economic activity as transport logistics. The growth of transportation volumes, rapid technological changes and the constant need to optimize logistics processes create the need to analyze, model and predict the behavior of various agents in this area.

This article uses semantic modeling as one of the approaches to representing knowledge in the field of transport logistics. This representation is an important stage in modeling the behavior of economic agents. The study confirmed the complexity and multidimensionality of transport logistics management processes. As a result of the study, a semantic model (network) has been built that reflects the key aspects of the concept of "behavior of economic agents in the field of transport logistics". The semantic model allows to present knowledge about the behavior of agents in a structured way, to take into account the complex relationships and contexts that influence decision-making in the field of transport logistics. Therefore, this network as an information model of the subject area can be the basis for the development and improvement of decision support systems in the field of transport logistics. The construction of a semantic network also makes it possible to identify key areas for further research and the corresponding analysis and modeling methodologies for optimizing and predicting the behavior of various agents in the field of transport logistics.

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# СЕМАНТИЧНА МОДЕЛЬ ПОНЯТТЯ «ПОВЕДІНКА ЕКОНОМІЧНИХ АГЕНТІВ У СФЕРІ ТРАНСПОРТНОЇ ЛОГІСТИКИ»

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**Ключові слова:**
економічні агенти, поведінка економічних агентів, транспортна логістика, семантична модель.

Стаття присвячена дослідженню важливого для сучасної економічної теорії поняття «поведінка економічних агентів у сфері транспортної логістики». Актуальність цієї проблеми зумовлена тим, що в умовах швидкого розвитку інформаційного суспільства та появою нових наукових термінів виникає необхідність глибокого осмислення знань, що характеризують предметну область дослідження та визначають її інформаційну модель. У складному динамічному економічному середовищі економічна поведінка є фактором ефективності економіки. При її дослідженні надзвичайно важливою є специфіка предметної області. Особливим чином це стосується такої сфери економічної діяльності як транспортна логістика. Зростання обсягів транспортних перевезень, швидкі технологічні зміни та постійна потреба в оптимізації логістичних процесів створюють необхідність аналізу, моделювання та прогнозування поведінки різних агентів у цій сфері.

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У цій статті використано семантичне моделювання як один із підходів до представлення знань у сфері транспортної логістики. Таке представлення є важливим етапом моделювання поведінки економічних агентів. Проведене дослідження підтвердило складність та багатоаспектність процесів управління транспортною логістикою. У результаті дослідження побудована семантична модель (мережа), що відображає ключові аспекти поняття «поведінка економічних агентів у сфері транспортної логістики». Семантична модель дає змогу структуровано представити знання про поведінку агентів, врахувати складні взаємозв'язки та контексти, які впливають на прийняття рішень у сфері транспортної логістики. Тому ця мережа як інформаційна модель предметної області може бути покладена в основу розробки та удосконалення систем підтримки прийняття рішень у галузі транспортної логістики. Побудова семантичної мережі також дає змогу виявити ключові напрями подальших досліджень й відповідні їм методології аналізу та моделювання для оптимізації та прогнозування поведінки різних агентів у сфері транспортної логістики.

## Statement of the problem

Efficient transport logistics management requires a deep understanding of the behavior of economic agents, such as producers, suppliers, carriers and consumers, because the growth of transportation volumes, rapid technological changes and the constant need to optimize logistics processes create the need to predict the behavior of various agents in this area. An effective tool for analyzing this behavior and developing approaches that help improve the efficiency of management decisions made in the field of transport logistics is the use of economic and mathematical models, which in turn are based on the basis of, among other things, behavioral economics.

The development of a system of models of behavior of economic agents in the field of transport logistics allows to improve the planning and management of logistics processes, reduce costs, increase the level of service and ensure competitive advantages in the market. In addition, taking into account the behavioral aspects of economic agents is important in the context of the development of modern technologies, such as autonomous cars, drones, and other innovative solutions in the field of transportation. Analyzing and modeling the behavior of economic agents makes it possible to predict possible scenarios for the introduction of these technologies and their impact on the transport system as a whole.

However, in the context of the rapid development of the information society due to the emergence of new scientific terms and features, the development and application of appropriate models and methods is impossible without a deep understanding of the knowledge that characterizes the subject area of research, constitutes its nomological basis and defines the information model.

## Analysis of latest research and publications

Recent studies and publications show that today much attention is paid to the development and improvement of processes in the field of transport logistics. This is due to the fact that transport logistics is one of the most important infrastructure sectors of material production, which meets production and non-production needs in all types of transportation. Paper [1] analyzes the essence of the concept of "transport logistics", its development, and the impact of globalization and internationalization on modern logistics. The goal of transport logistics, as formulated in this paper, is to ensure that commodity products are in a specific place at a specific time by moving them between sites and participants in the supply chain.

The Report [2], which is based on a global survey of the world's most active freight forwarders and express carriers, provides an assessment and comparative analysis of logistics efficiency from 150 countries. This paper presents the Logistics Performance Index (LPI) and other indicators for the first time, which made it possible to assess the state of development of trade logistics at the global level and provide recommendations for reforms and investments in trade and transport facilitation.

Ukraine has long been not only a part of the civilized world and integrated into global trade, but also a rather important exporter of goods and services to Europe and other countries. In 2018 The Cabinet of Ministers of Ukraine approved the National Transport Strategy of Ukraine for the period up to 2030 [3]. The place and problems of transport logistics in Ukraine have been studied, in particular, in [4-5], and the issues of improving approaches and management methods in this area are urgent. Therefore, in recent years, the rapid development and the need to solve many urgent problems have attracted the attention of domestic and foreign scientists and practitioners to logistics. Their works reveal various theoretical and applied aspects of this field of activity, and take into account new challenges. Thus, paper [6] provides an overview of the existing academic literature on the relationship between sustainable development and the service supply chain (SSC), while [7] addresses the problem of studying the impact of major disasters on supply chains (SC) and developing countermeasure strategies in such cases. Paper [8] is devoted to the use of new technologies to achieve the goals of the circular economy in the logistics sectors during the COVID 19 pandemic. Paper [9] considers the impact of artificial intelligence on the planning processes of logistics systems, taking into account the latest information and digital technologies and methods, analyzes the features of applying intelligent algorithms and machine

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learning methods to optimize key aspects of logistics, such as transport routing, inventory management, and demand forecasting.

The analysis of publications shows that the effectiveness of research significantly depends on the chosen tools, which should take into account the dynamism, stochastic nature of the logistics system, and the effects of many influences of the external and internal environment on the final indicators of its functioning. This is especially true for the behavior of economic agents in the field of transport logistics. This behavior is determined by a complex system of interrelationships, including economic, technological, social and regulatory factors. The study of these interrelationships requires the use of comprehensive approaches and models that can reflect the multidimensionality and dynamism of processes.

The theoretical basis for studying of the behavior of economic agents in the field of transport logistics is behavioral economics [10], and one of the effective tools for researching and analyzing the features of this behavior is the construction of semantic models (networks) [11-14].

A semantic network is one of the ways to represent knowledge. According to [12], a semantic network is an information model of a subject area that has the form of an oriented graph, the vertices of which correspond to the objects of the subject area, and the arcs (edges) define the relationship between them. Objects can be concepts, events, properties, processes.

To describe a mathematical model, a graph G is represented by a set of vertices V and a set of relations between them (arcs) *E: G=(V,E).* To use the apparatus of mathematical logic, it is assumed that each vertex corresponds to an element of the subject set, and an arc corresponds to a predicate. There are two classifications of semantic networks: a) by the number of concepts the network contains (arity); b) by the number of types of relations. As a rule, the number of types of relations in a semantic network is determined by its developer.

## Goals formulation

The semantic model allows not only to present knowledge about the behavior of agents in a structured manner, but also to take into account the complex interrelationships and contexts that influence decision-making in the field of transport logistics.

The purpose of this article is to build a model in the form of a semantic network of the concept "вehavior of economic agents in the field of transport logistics".

## Presentation of the main research material

In order to build a semantic network of the concept of "behavior of economic agents in the field of transport logistics" as a model of the subject area of research, we will clarify its substantive aspects; study its components and links with other important concepts.

In general, the concept of "behavior of economic agents" reflects the actions and decisions they make in the course of their economic activity. In other words, economic agents are households, businesses, governments and other organizations that interact in the market to produce, distribute and consume goods and services [5].

In order to have a certain understanding of economic mechanisms of interaction between agents and effective management of economic processes, it is necessary to understand exactly how economic agents think when making various types of economic decisions. The behavior of economic agents is a series of behaviors, actions and relationships that each subject of economic relations manifests in the process of interaction with the environment.

The behavior of economic agents in the field of transport logistics includes various aspects and decisions they make to ensure efficient and cost-effective movement of goods and services, such as approving decisions on the choice of transport routes, optimising transport costs, managing inventories, selecting of suppliers and partners in logistics chains, as well as interacting with the market and competitors.

Economic agents in this area are (Fig. 1):

• households – individuals or groups of people who live together and running a common household. In the field of transport logistics, households usually act as final consumers of goods and services. Their behavior affects the demand for delivery of goods, especially in the context of the growth of e-commerce;

• enterprises – organisations that produce goods or provide services for profit. They are key agents in the field of transport logistics, as they are responsible for the production, distribution and sale of goods. Enterprises actively use logistics services to efficiently move their goods;

• the state is a political and administrative organization that manages society and regulates activities in the field of transport logistics through legislation, standards and infrastructure investments. It creates conditions for the efficient operation of logistics systems and ensures the safety of transport;

• financial institutions – organizations that manage financial resources. And also provide financial services necessary for the functioning of logistics processes, including procurement financing, infrastructure investments and cargo insurance;

• foreign agents – economic entities that are located outside the national economy, but influence it through international trade, investments and other forms of economic interaction;

• non-profit organizations – organizations that work not for profit, but to achieve social, cultural, educational or other socially useful goals. In the field of transport logistics, they can be involved in humanitarian or environmental projects aimed at improving logistics processes and supporting sustainable development.

In the context of the behavior of economic agents in the field of transport logistics, each of these agents performs specific roles and functions that influence logistics processes and decisions.

In transport logistics and in the modern economy as a whole, one of the most important concepts is the concept of logistics operation. According to [15,16], logistics operations are a set of actions aimed at transforming material and/or information flows. Logistics operations with material flow include loading, transportation, unloading,

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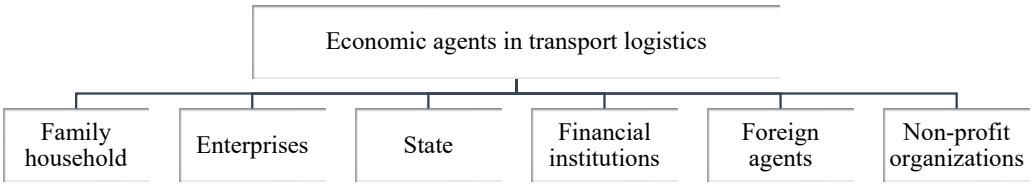


Figure 1 – Economic agents in the field of transport logistics

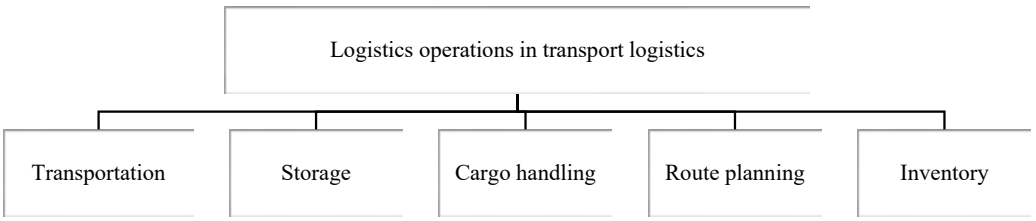


Figure 2 – Logistics operations in the field of transport logistics

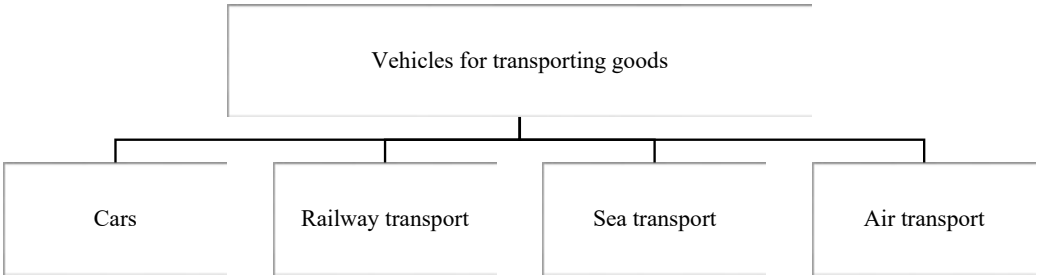


Figure 3 – Vehicles for transporting goods in the field of transport logistics

unpacking, assembly, storage, packaging, etc. Information flow logistics operations include collection, processing and transmission of information. These operations play a key role in ensuring an efficient supply chain that allows companies to meet consumer needs in a timely and efficient manner. Logistic operations (logistics) contribute to the reduction of costs of storing and transporting goods, optimize the distribution of resources and ensure flexibility in production and supply [17].

Logistics operations are carried out by economic agents who can perform, optimize, order and invest in such logistics operations (Fig. 2):

transportation – the movement of goods from the place of production to the place of consumption or storage. It is a key element of logistics that requires optimization of costs, time and resources;

• storage – involves keeping goods in warehouses until they are moved or sold, and is an important aspect to ensure continuity of supply;

• cargo handling – includes all actions related to the preparation of goods for transportation, including packaging, labeling and loading and unloading operations;

• route planning – choosing the most effective ways to transport goods, taking into account costs, time, safety and other factors;

• inventory – information and accounting support of any transport logistics operations.

Each of these processes in the field of transport logistics is critically important and interrelated. Economic agents play different roles, ensuring the efficiency and reliability of logistics operations, which in turn affects the overall productivity of the economy.

Various types of transport are used for logistics operations. Each type of transport has its own characteristics, advantages and disadvantages, which affects the decisions of agents. The most popular among all are cars, railway, sea, and air transport (Fig. 3).

Road transport is one of the most flexible and common ways of transporting goods, especially over short and medium distances. It provides high mobility and availability.

Railway transport is an efficient means of transporting large volumes of goods over long distances. It is characterized by high carrying capacity and economy.

Maritime transport is key to international trade, providing transportation of large volumes of goods between continents. It is characterized by low transportation costs per ton of cargo over long distances.

Air transport is the fastest way to transport goods, but it is also the most expensive. It is used to deliver urgent, valuable or perishable goods.

Each type of transport has its own unique characteristics that determine the behavior of economic agents in the field of transport logistics. The choice of transport depends

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on specific needs, such as delivery speed, volume of cargo, cost of transportation and distance, which affects the decisions and strategies of households, enterprises, the state, financial institutions, foreign agents and non-profit organizations [18].

Each of the listed vehicles consumes resources (Fig. 4) that are important for the efficient operation of logistics processes, namely:

• fuel – is the main resource for all types of transport, determining the cost and efficiency of logistics operations;

• labor force – includes personnel engaged in logistics operations, including drivers, warehouse operators, route planners and other specialists;

• capital – includes financial resources needed for investments in vehicles, infrastructure, technologies and other assets;

• information systems – are key to managing logistics processes, ensuring effective planning, monitoring and control of transportation.

In the field of transport logistics, logistics infrastructure plays an important role in ensuring the efficient performance of logistics operations. Logistics infrastructure includes various objects and systems that create the basis for the movement of goods and the provision of logistics services.

The logistics infrastructure is a set of technical, organizational and economic elements, by means of which all types of economic flows (material, financial, information, labor, energy, return) carry out a cyclical movement with the greatest efficiency from the supplier of resources to the final consumer [19, p. 157].

The main elements of the logistics infrastructure include (Fig. 5):

• warehouses are objects where goods are stored before their further transportation or sale. They play a key role in maintaining stocks, maintaining product quality and ensuring continuity of supply;

• transport terminals are hubs where goods is transshipped between different modes of transport (road, rail, sea, air);

• roads are the main transport arteries that ensure the movement of road and rail transport. They are critical for ensuring efficient transportation of goods over short, medium and long distances;

• ports are transport hubs on the coasts where sea vessels are loaded and unloaded for international trade and the transportation of bulky cargo;

• airports are transport hubs where cargo planes are loaded and unloaded, ensuring fast transportation of goods over long distances.

All these elements of logistics infrastructure are critical, because they influence the behavior of economic agents in the field of transport logistics. The speed, cost and reliability of logistics operations depends on their efficiency, which in turn determines the overall productivity and competitiveness of the economy.

In the field of transport logistics, the behavior of economic agents is largely determined by rules and regulations (Fig. 6), which include laws and regulations, customs regulations, environmental standards and transport safety. Each of these aspects affects different stages of logistics processes and requires appropriate adaptations on the part of agents.

Laws and regulations regulate the legal aspects of logistics activities, defining standards, requirements and procedures that all participants in the logistics process.

Customs regulations determine the rules for the import and export of goods, including tariffs, quotas, licenses and clearance procedures.

Environmental standards establish requirements for reducing the negative impact of logistics operations on the environment.

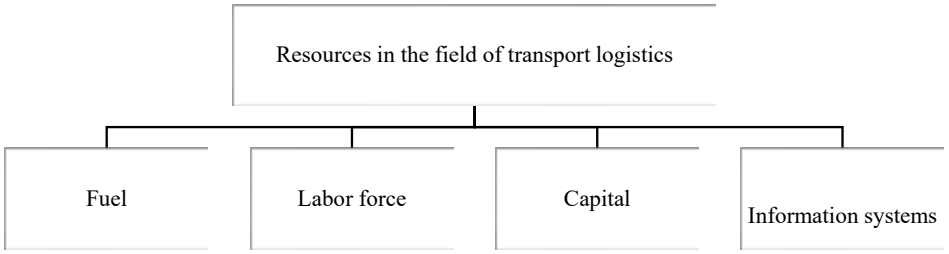


Figure 4 – Resources for the transportation of goods in the field of transport logistics

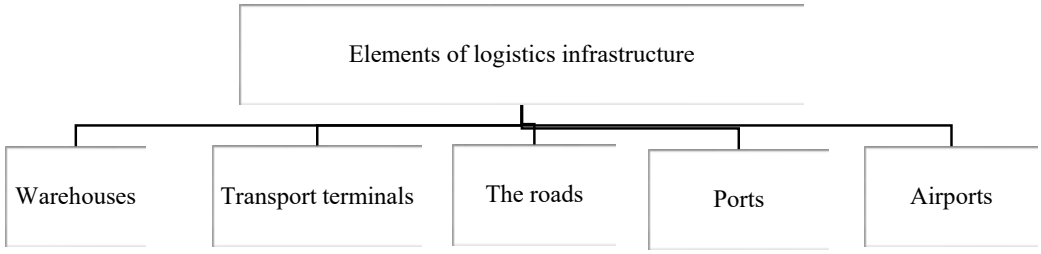


Figure 5 – Elements of logistics infrastructure in the field of transport logistics

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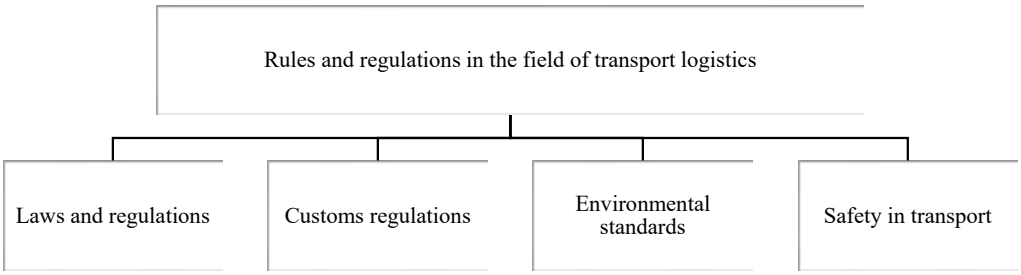


Figure 6 – Rules and regulations in the field of transport logistics

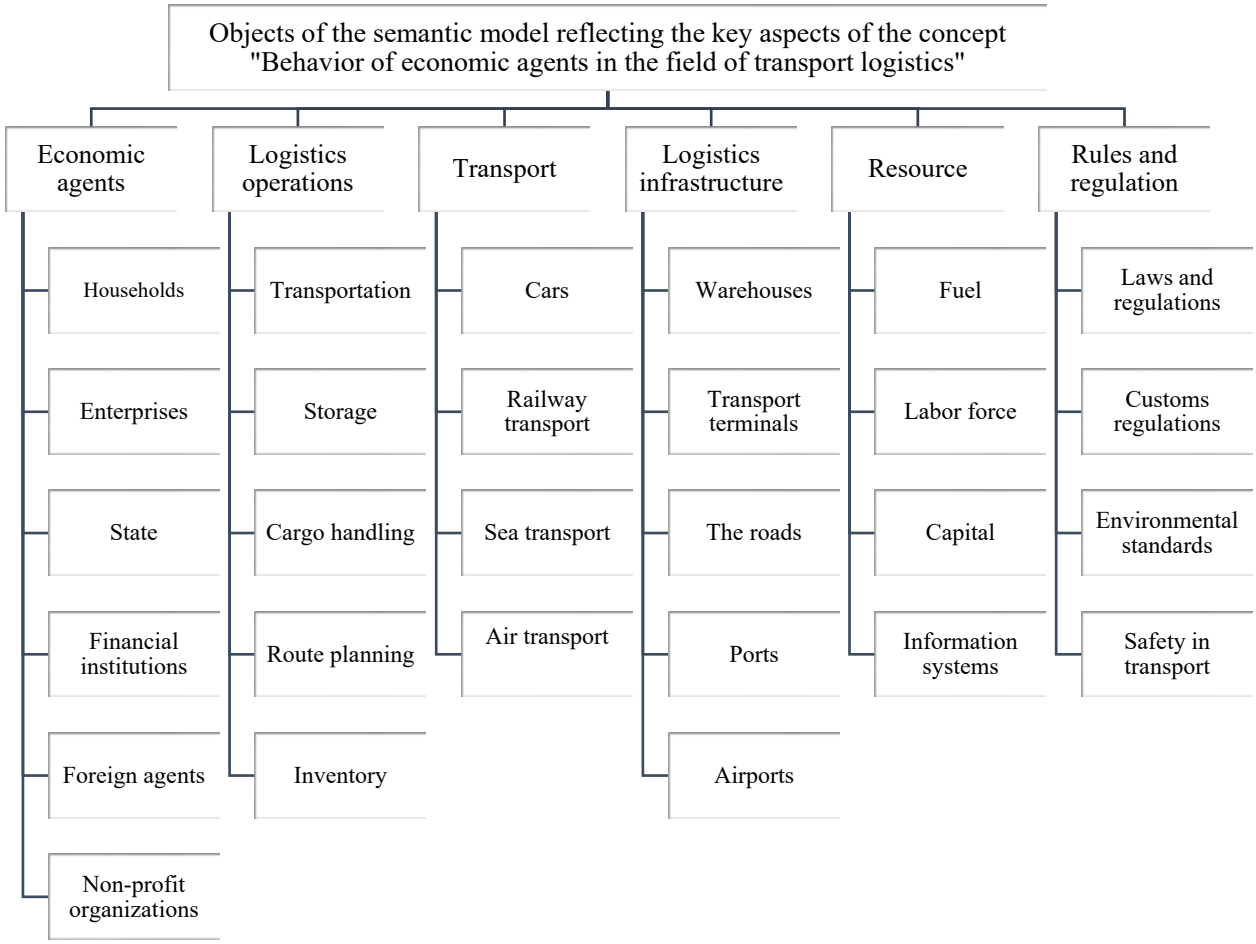


Figure 7 – Objects of the semantic model reflecting the key aspects of the concept "behavior of economic agents in the field of transport logistics"

Source: built by the author personally

Transportation security includes measures aimed at preventing accidents, thefts, and other risks during the transportation of goods.

Compliance with the listed requirements is necessary to ensure the efficiency, safety and stability of logistics operations, which in turn affects the economic development and welfare of society.

Therefore, in Fig. 7 we will present a conceptual semantic model that reflects the key aspects of the concept of "behavior of economic agents in the field of transport logistics" and has the form of a general scheme, where the key concepts are economic agents, logistics operations, transport, logistics operations, resources and rules and regulation.

Each of the objects of the model has its own properties or characteristics (Fig. 8). Economic agents have attributes such as name, type, size, and location; logistics operations have their own cost, execution time and cargo volume; transport – type, carrying capacity, speed and operating costs; logistics infrastructure – capacity, location, technical characteristics; resources – type, quantity and cost; and rules and regulations have a type of regulation, requirements, and responsibilities.

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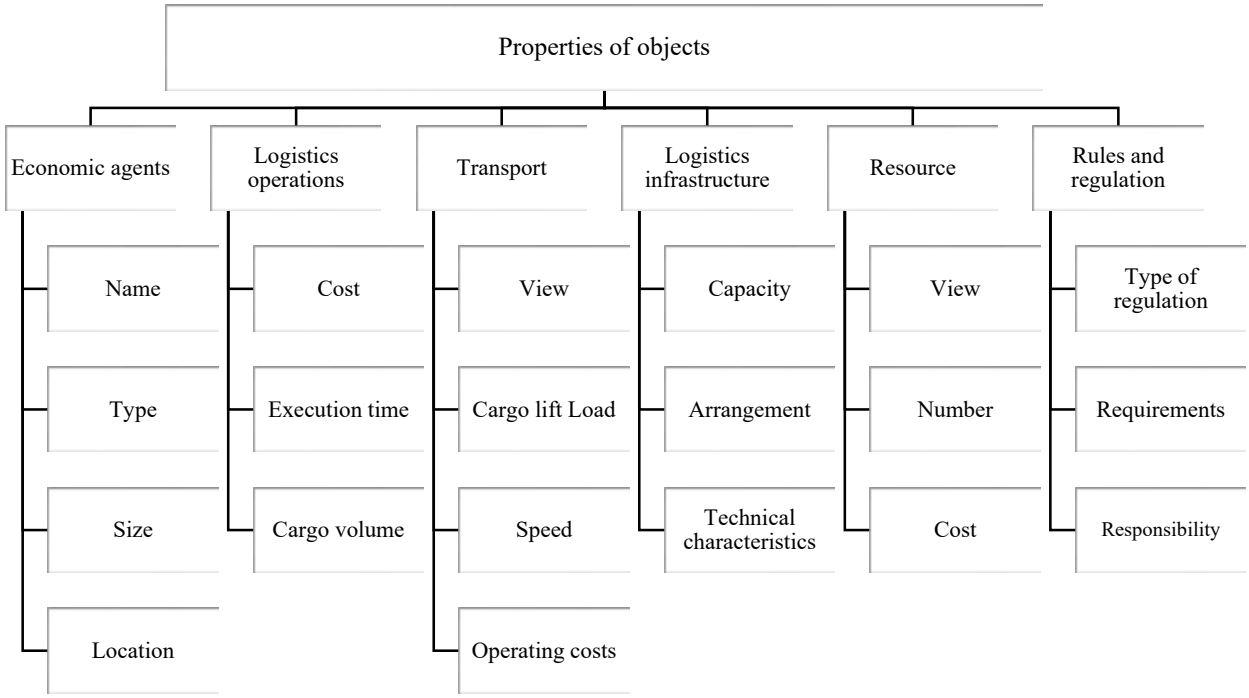


Figure 8 – Properties of objects-semantic model reflecting key aspects of the concept "вehavior of economic agents in the field of transport logistics"

Source: built by the author personally

On the basis of the obtained relations, we will form a general semantic network of the concept of "behavior of economic agents in the field of transport logistics" (Fig. 9), which reflects a complex system of relationships between economic agents, logistics operations, transport, logistics operations, resources and rules and regulations. Understanding these relationships allows you to manage logistics processes more efficiently, optimize costs and increase the overall efficiency of transport logistics.

7 general relationships can be distinguished between model objects, namely:

- economic agents perform logistics operations;
- economic agents order logistics operations;
- logistics operations use transport;
- logistics operations are carried out in the logistics infrastructure;
- transport consumes resources;
- logistics infrastructure uses resources;
- economic agents follow rules and regulations.

These relationships describe how different elements and agents in the field of transport logistics interact with each other, forming a complete system where each element has its own role and affects the overall efficiency of logistics processes. Compliance with rules and regulations, efficient use of resources and infrastructure, as well as the correct organization and execution of logistics operations ensure the stability and productivity of the logistics system.

## Conclusions

The behaviour of economic entities is a complex and multifaceted socio-economic phenomenon that has a significant impact and sometimes directly determines the results of economic activity. The importance of studying this particular phenomenon is confirmed, in particular, by the fact that the 2017 Nobel Prize in Economics was awarded to American Richard Thaler "for his contribution to the study of economic behavior".

The current complex and dynamic economic environment, economic behaviour is a factor of economic efficiency. When studying it, the specifics of the subject area are extremely important, in which a set of actions and deeds reflecting the internal attitude of agents to the conditions and results of economic activity is considered.

In this article, semantic modeling is used as one of the approaches to the representation of knowledge in the subject area of transport logistics. Such a representation is an important stage in modeling the behavior of economic agents in this area. The research confirmed the complexity and multidimensionality of transport logistics management processes.

As a result of the research, a semantic model (network) has been built that reflects the key aspects of the concept of "вehavior of economic agents in the field of transport logistics". This network is an information model of the subject area, which can be the basis for the development and improvement of decision support systems in the field of transport logistics.

The construction of the semantic network makes it possible to identify key areas for further research and the corresponding analysis and modeling methodologies to optimize and predict the behavior of various agents in the field of transport logistics.

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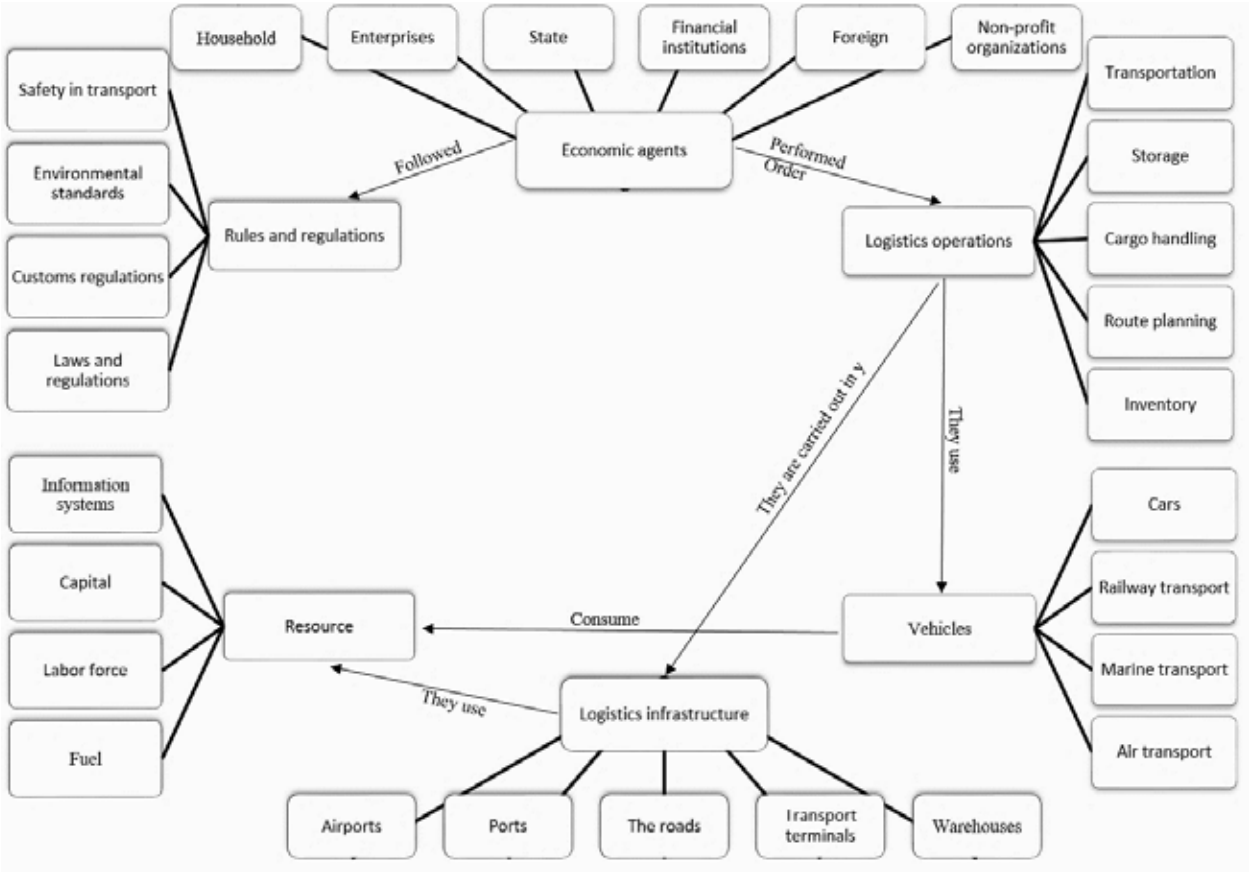


Figure 9 – Semantic model reflecting the key aspects of the concept "behavior-economic agents in the field of transport logistics"

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