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MODES OF TRANSPORT IN LOGISTICS SYSTEMS, SELECTION CRITERIA AND EFFICIENCY

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The article examines theoretical and practical aspects of different modes of transport functioning within logistics systems. A classification of the main transport modes is carried out, and their advantages and disadvantages are identified. Special attention is paid to the criteria for choosing the optimal mode of transport under current conditions. A methodology for calculating the economic efficiency of logistics decision-making is proposed. The current state of transport logistics in Ukraine, challenges related to port blockades, and prospects for the development of intermodal transportation are analyzed. The research was conducted within the framework of the scientific work of the Department of Transport Technologies at Kharkiv National Automobile and Highway University [3].

In today's globalized economy and with international trade volumes rising steadily, transport logistics plays a decisive role in keeping supply chains stable. Transport affects the final price of goods, how quickly they reach customers, and how competitive businesses can be. According to World Bank data, logistics expenses can account for anywhere from 10% to 30% of a product's final price, and transportation makes up the biggest chunk of that

The topic is also highly relevant because of how fast e commerce is growing in Ukraine. Experts point out that in 2025 the e commerce market expanded by 15 20%, which has created strong demand for speedy delivery, more parcel locker networks, and better "last mile" logistics. This, in turn, means logistics specialists need a solid grasp of how different transport modes work and how to pick the most efficient routes.

The purpose of this article is to classify transport modes used in logistics systems, define the criteria for selecting them, and offer practical suggestions for making transport processes more efficient. The research is part of ongoing scientific work at the Department of Transport Technologies of Kharkiv National Automobile and Highway University (KhNAHU), where integrated transport technologies receive special attention.

Transport logistics is the discipline of managing material flows during cargo movement [2]. It covers planning, organizing, and controlling transport operations while keeping costs as low as possible. The main jobs of transport in logistics include moving cargo, temporary storage (for instance, inside containers), optimizing routes, and managing inventory levels.

Contemporary scientific literature identifies five main transport modes, each with its own distinct characteristics [1]. Which mode works best depends on several factors: what kind of cargo it is, how far it needs to go, how urgently it must arrive, what it costs, and so on. Researchers stress that sound decisions require a well rounded approach that looks at both numbers and qualitative aspects.

Road transport is the most widely used option for domestic shipments. Its main strengths are flexibility and the ability to deliver goods without needing to reload or transfer them along the way. That is especially helpful for smaller loads and for

supplying retail chains. Studies by KhNAHU instructors show that when moving small batches on intercity routes (for example, Kharkiv – Kyiv – Lviv), using parallel loading schemes improves how efficiently vehicles are used and brings costs down. On the downside, road transport has limited carrying capacity, depends heavily on road conditions, and raises the biggest environmental concerns.

Rail transport handles large volumes of freight over long distances. Its pluses include regular service schedules, relatively low transport costs (especially for bulk goods like ore, coal, and grain), and not being affected by weather. However, it is less flexible than road transport because it depends on fixed tracks and needs extra access lines.

Water transport (both sea and river) offers the highest cargo capacity and the lowest transport costs. Container ships can move thousands of TEU (twenty foot equivalent units) in a single trip. The main drawbacks are low speed and reliance on geography, seasonal changes (rivers freezing over), and weather conditions.

Air transport gives the fastest delivery speed, which is critical for urgent shipments, perishable products, and high value goods. But it is also the most expensive mode, with strict limits on size and weight.

Pipeline transport is specialized for pumping liquid and gaseous cargo. Its benefits include low operating costs, a high level of automation, and non stop operation. The downsides are its narrow focus and the high upfront cost of building pipelines.

Choosing the best transport mode is a classic multi criteria optimization problem. Researchers often turn to Saaty's analytic hierarchy process, which makes it possible to weigh criteria such as delivery time, cost, reliability, cargo safety, shipment frequency, accessibility, and others.

For practical use, the comparative table below is helpful (rated on a 5 point scale, where 1 is the worst and 5 the best):

Criterion	**Road**	**Rail**	**Water Air**	**Pipeline**
Speed 3	4	1	5	2

Cost (low) 3	4	5	1	5
Reliability 3	4	1	4	5
Accessibility 5	2	3	2	1
Cargo capacity 2	4	5	1	4
Flexibility 5	2	1	3	1

Table 1. – Comparative table of optimal transport mode selection.

In modern logistics, intermodal (combined) transportation is being used more and more often, since it brings together the strengths of different transport modes. For example, a container might be taken by truck to a rail terminal, then shipped by train over a long distance, and finally moved by truck again to the final recipient. A review of the scientific literature confirms that good planning of intermodal transport helps balance costs and the use of various modes, especially in countries with well developed infrastructure, such as the USA, China, or EU member states.

Let's go through a hypothetical example. A company needs to send a 20 ton cargo shipment from Kharkiv to Berlin. Two options are considered:

1. Direct road transport (truck).
2. Intermodal transport: truck from Kharkiv to Chornomorsk port, then by sea to the port of Rostock (Germany), and finally by truck to Berlin.

Assumed data (for illustration):

- Truck Kharkiv – Berlin: distance ~1800 km, rate €1.5/km = €2700.
- Truck Kharkiv – Chornomorsk: 650 km, rate €1.2/km = €780.
- Sea freight (20 t container): €600.
- Truck Rostock – Berlin: 250 km, rate €1.4/km = €350.
- Delivery time by road: 2 3 days.
- Delivery time intermodal: 7 10 days (including transfers and waiting for the vessel).

Calculation:

- Option 1 (road): €2700.
- Option 2 (intermodal): €780 + €600 + €350 = €1730.
- Savings: €2700 – €1730 = €970 (roughly 36%).

If the delivery deadline is not very tight, intermodal transport is clearly more cost effective. If the goods are urgent (for instance, perishable items), the more expensive road option has to be used. This example shows how choosing the right transport mode affects the final product cost.

Apart from intermodal solutions, logistics professionals also rely heavily on multimodal transport. Although people sometimes use the two terms as if they mean the same thing, they are not identical. Multimodal transport works under a single contract with one carrier (often called a multimodal transport operator, or MTO), who takes full responsibility for the entire shipment from start to finish – even though the journey involves at least two different transport modes, such as truck plus rail or truck plus sea. The main difference from intermodal transport is legal and organizational. In multimodal shipping, the customer deals with just one party, which issues a single transport document and assumes liability for the whole route. With intermodal transport, by contrast, separate contracts are usually signed with each carrier for each segment of the trip.

Multimodal solutions have gained popularity alongside the growth of global trade and the spread of standardized containers. Industries that handle high value or time sensitive goods often appreciate having a single point of contact and unified insurance coverage. That said, multimodal transport still requires careful coordination between different modes, and delays in one leg can disrupt the entire chain. Containerization is just as essential here, because smooth transfers between ships, trains, and trucks depend on uniform cargo units. Many logistics hubs in the USA, China, and EU countries are built specifically to handle multimodal operations, with on site rail terminals, port facilities, and truck loading bays. Deciding between intermodal and multimodal arrangements usually comes down to factors such as cargo value, delivery deadlines, available infrastructure, and whether the shipper prefers single carrier responsibility or more flexible contracting.

Ukrainian logistics is currently going through a deep transformation [4]. The full scale war has fundamentally changed logistics routes. The blockade of seaports – which used to handle 70% of exports before the war – has forced businesses to switch to land routes, mainly road and rail transport through the western borders.

Looking at the current situation reveals several problems. Rail transport, operated by JSC "Ukrzaliznytsia," is in a difficult financial position. Experts note that since 2022, freight volumes have fallen by half (from 312 315 million tons to 150 155 million tons), and attempts to raise tariffs by 37% could push even more cargo onto roads, hurting industrial competitiveness. This creates a vicious circle: without higher tariffs, Ukrzaliznytsia cannot cover its losses, but with higher tariffs, it loses customers.

At the same time, road transport faces a different problem – a shortage of drivers. According to the Ministry of Communities and Territories Development, out of 130,000 trucks involved in freight movement, about 30% are sitting idle because of a lack of drivers with category CE licenses (the shortfall reaches 30,000 40,000 people).

On a more positive note, the industry is becoming more digital. Ukrainian companies are actively adopting Transport Management Systems (TMS), electronic document flow (e CMR), and warehouse automation. As market participants point out, this is not just a trend but a necessity – it helps cut costs and makes operations more transparent.

According to World Bank recommendations, Ukraine needs to develop containerized rail transport and intermodal terminals. This matches the EU strategy, which says that by 2030, 30% of freight traveling over 300 km should be moved by rail or water. Unfortunately, the opposite trend is now happening in Ukraine – because of ineffective tariff policies, cargo is shifting from rails to roads, which goes against European "green" logistics goals.

The research carried out allows us to draw the following conclusions:

1. Each transport mode has its own specific features, strengths, and weaknesses. Choosing the best one should be based on a thorough analysis of criteria such as speed, cost, reliability, cargo safety, and accessibility.

2. Under current conditions, intermodal transportation looks the most

promising, because it combines the advantages of different modes and strikes a good balance between cost and delivery quality.

3. The economic efficiency of logistics decisions can be assessed by comparing alternative delivery options, taking into account all cost components and the time factor.

4. Transport logistics in Ukraine is undergoing a deep transformation due to the war. The main challenges include the port blockade, increased pressure on land corridors, a driver shortage, and the need to modernize railway infrastructure.

5. Promising directions for development include process digitalization (implementing TMS, e CMR), expanding container shipping, and building modern logistics hubs – which is one of the priority research areas at the Department of Transport Technologies of KhNAHU.

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MILITARY LOGISTICS IN UKRAINE

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Today I would like to talk about military logistics in Ukraine, especially in the context of modern warfare.

Military logistics is the system that ensures an army can function effectively. It includes the transportation of soldiers, weapons, fuel, food, medical supplies, and equipment. Without strong logistics, even the most powerful army cannot operate successfully.

Since 2022, Ukraine has faced large-scale military challenges. One of the key factors in its defense has been the ability to organize and adapt its logistics system