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MULTIMODAL TRANSPORTATION RISK MODELING IN UKRAINE

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The article examines the organization and development prospects of multimodal transportation in Ukraine amid growing international trade, deeper integration into global supply chains, and the challenges posed by the ongoing war. The study emphasizes that multimodal transport – combining road, rail, sea, and air modes – plays a crucial role in ensuring flexible and efficient cargo delivery while reducing overall logistics costs. Despite its significant potential, multimodal transportation in Ukraine faces substantial constraints, including underdeveloped infrastructure, a shortage of integrated intermodal terminals, incompatibility between transport systems, and an imperfect regulatory and legal framework. Additional difficulties arise from complex border procedures, insufficient digitalization of logistics processes, and the limited use of unified IT systems for real-time cargo monitoring. The paper provides an overview of leading logistics companies – such as DB Schenker, Maersk, DSV, DHL, Nova Global, Kuehne+Nagel, and Meest Express – that currently operate in Ukraine using multimodal solutions. Particular attention is given to the impact of the war on logistics flows, including the closure of Ukrainian airspace, the blockade of seaports, and the reorientation of transportation routes through Poland, Slovakia, Hungary, Romania, and Moldova. The study presents examples of multimodal routes and highlights the importance of adapting logistics strategies to emerging risks, such as infrastructure damage and security threats. A mathematical model is proposed to optimize transportation processes under uncertainty, accounting for unpredictable events such as route blockages, adverse weather conditions, and military risks. The model is formulated as a stochastic optimization problem that minimizes expected costs or delivery time while incorporating the probabilities of risk occurrence. Simulation results demonstrate how delivery times vary depending on distance and the influence of additional risk factors. The findings confirm that multimodal transport remains a strategic tool for ensuring Ukraine's effective participation in global trade flows. Overcoming infrastructural and regulatory barriers, strengthening international cooperation, and implementing advanced digital solutions will significantly enhance the efficiency and resilience of multimodal transportation, contributing to sustainable economic recovery and the country's integration into the global logistics network.

***Keywords**: multimodal transportation, logistics optimization, international trade, infrastructure and tourism problems, risk management.*

Statement of the problem

The advancement of multimodal transportation stands out as a pivotal strategy for developing Ukraine's transport system. This approach facilitates a substantial rise in cargo volumes nationwide by involving domestic transport companies. It not only bolsters Ukraine's competitiveness within the international transport services market but also extends the reach of existing transport corridors while aligning the country's infrastructure more closely with the global transport network. When goods pass state borders, intermodal transportation comes into play. Thanks to its strategically advantageous location, strong ties with Central and Eastern European nations, well-established transport corridors, and developed infrastructure, Ukraine emerges as a key transit hub, effectively bridging Asia with the European Union [1].

The significance of this topic stems from the expansion of international trade and the ongoing necessity to optimize logistics chains, with multimodal transportation serving as a critical component. In today's context, advancing multimodal systems can foster economic growth and draw investments. Improving transport efficiency is vital for minimizing costs and shortening delivery times. The growing complexity of global supply chains and transport networks highlights the importance of effectively managing multimodal transportation, especially under uncertain conditions. Contemporary research focuses extensively on route optimization, risk management, enhancing the resilience of transport networks, and integrating advanced digital technologies.

Analysis of the latest achievements on the identified problem

Transportation today is carried out in multiple combinations on a door-to-door basis, under the conditions defined by international agreements developed by the Working Group on Intermodal Transport and Logistics, jointly formed by ECMT and UNECE [2].

Multimodal transportation in Ukraine has not yet achieved the expected level of development due to several reasons, primarily the imperfection of the regulatory framework, the lack of clear strategic principles for development, and imbalances between port cargo-handling capacities and the railway infrastructure connected to them. These factors slow down container transport growth and limit piggyback (road–rail) transportation.

Multimodal operators also face high risks when organizing combined long-distance transportation. A key challenge is the requirement for the freight forwarder (operator) to assume responsibility for the actions of third parties in international transport and to manage high levels of uncertainty, maintaining coordination and synergy within networks of logistics centers along international transport corridors [3].

Route optimization and uncertainty modeling occupy a significant part of scientific research. Several studies aim to minimize costs and delivery time while accounting for stochastic factors. The authors of [4] combined a genetic algorithm with particle swarm optimization to determine optimal routes for emergency cargo delivery. While the method provides fast results, it oversimplifies reality by considering only two criteria (time and cost), leaving out safety and environmental impacts. Study [2] proposed a method for cold-chain logistics that considers temperature risks and seasonal fluctuations. Although the approach is practical, its validation using only the Chengdu–Shanghai route limits its generalizability. Authors of [6] optimized the transportation of dangerous goods using fuzzy random variables and NSGA-II, but the computational complexity makes the model difficult to apply in practice. Works [7, 8] incorporate fuzzy demand and time windows, which increases adaptability but also makes the results sensitive to the choice of membership functions.

Risk management remains a key component of reliable multimodal systems. In [9], the authors used fuzzy-FMEA to identify critical risk points in multimodal transportation. The method structures risks effectively but relies heavily on subjective expert assessments. The comprehensive risk analyses presented in [10] used Bayesian networks to model risks at transport hubs, revealing that organizational failures often outweigh technical ones. However, the complexity of these models makes practical implementation difficult. A regional example is presented in [11], where a fuzzy risk management model was proposed for agricultural routes between Ukraine and Poland. While useful, the model does not consider political or military factors, which are critical for the region. Study [12] proposed a Reliability-Oriented Route Algorithm that accounts for the probability of network failure. It is promising for practical planning, but it has only been tested within the Yangtze Delta, limiting its applicability.

The integration of digital technologies into transportation opens new opportunities for forecasting and management. A transport digital twin combined with deep learning was introduced in [13], significantly improving travel-time prediction accuracy. However, the approach requires extensive data and computational resources. Physics-informed learning, described in [14], integrates graph neural networks with the Kalman filter — an innovative method still in early stages. A multimodal infrastructure sensor system for safety assessment was proposed in [15], but its high cost and regulatory barriers pose limitations.

These technological developments demonstrate a clear trend: the future of multimodal systems lies in combining transport infrastructure with artificial intelligence. However, the human factor remains significant in transport decision-making. A combined behavioral analysis in [16] showed that even short walking segments can drastically reduce route attractiveness, indicating the need to integrate behavioral models into transport simulations. Group decision-making approaches in [17, 18] applied MULTIMOORA with a trapezoidal cloud model to determine optimal container routes. Although methodologically advanced, such approaches are too complex for practical use by carriers. Therefore, integrating behavioral factors remains limited and requires balancing model complexity with real-world applicability.

Purpose and task statement

The purpose of this study is to identify the specific features of organizing multimodal transportation in Ukraine, analyze existing problems and development prospects amid modern challenges– including the growth of international trade and the impact of military conditions– and develop approaches for minimizing risks during such transportation.

This research provides a comprehensive analysis of multimodal transportation in Ukraine and seeks to address the following objectives:

1) assess the current state of multimodal transportation development in Ukraine, including an analysis of the legislative framework and relevant international agreements;

2) identify key issues hindering effective multimodal transportation, such as infrastructure limitations, an imperfect regulatory framework, and the impact of military operations;

3) examine the practical experience of companies engaged in multimodal transportation in Ukraine and analyze commonly used logistics routes;

4) develop a mathematical model to assess and minimize risks associated with unforeseen events during multimodal transportation.

Materials and methods

The object of the study is the process of organizing multimodal cargo transportation in Ukraine in the context of integration into international transport systems and increasing external risks. The subject of the study is the methods, models, and organizational-technological mechanisms for optimizing multimodal transportation under uncertainty caused by military, economic, and infrastructural factors.

The research methods include:

- analysis and synthesis of scientific publications and regulatory documents;
- comparative analysis of logistics schemes used by leading companies;
- statistical analysis of transportation volumes for 2021–2024 based on data from the Ukrainian Sea Ports Authority (USPA);
- stochastic modeling to assess transport route risks;
- scenario analysis for evaluating the effectiveness of alternative logistics solutions.

Research tools include:

- analytical data from international logistics companies (DB Schenker, Maersk, DSV, DHL, Nova Global, Kuehne+Nagel, Meest Express);
- statistical reports from the State Statistics Service of Ukraine;
- software tools for stochastic model development (Python, Excel Solver);
- visualization tools for plotting route variations and delivery risks.

Summary of the main material

In Ukraine, multimodal cargo transportation involving road, rail, and maritime modes is currently the most widely used [19-20]. Well-known companies engaged in multimodal transportation, which remain active today, are summarized in Table 1 [21-23].

Table 1

Companies that provide multimodal transportation to Ukraine

Company	Services	Offices / Coverage
DB Schenker	solutions, warehousing, transportation to/from Ukraine	Poland, Germany, Ukraine
Maersk Logistics	Sea container transportation + land delivery	Poland, Romania, Ukraine
DSV Global Transport	Multimodal transportation, customs clearance	EU warehouse, Lviv, Kyiv
DHL Global Forwarding	Air, road, rail logistics, express delivery	Warsaw, Kyiv
Nova Global (Нова Пошта)	Auto + international logistics to Ukraine (from B2B to individual cargo)	Ukraine, Poland, Germany
Kuehne+Nagel	Warehouse + logistics + multimodal solutions	EU + support for Ukraine
Meest Express	Delivery from EU, USA, Canada, China to Ukraine	Focus on humanitarian, commercial cargo

The primary challenges facing multimodal transportation are linked to infrastructural deficiencies.

The absence of fully integrated transport hubs (intermodal terminals) and uneven infrastructure development across regions limit the capacity of railway and port facilities.

In addition, incompatibilities between transport systems – such as varying track gauges and differences in container standards – complicate the seamless integration of transport modes.

A significant challenge is the lack of unified IT systems for cargo tracking. This restricts the implementation of electronic document management, while the absence of real-time cargo monitoring systems leads to delays. These are further exacerbated by weather conditions, strikes, vehicle breakdowns, and other factors.

Differences in customs and tax regulations between countries create complex cross-border procedures that slow down delivery. This is mainly due to insufficient harmonization of legal frameworks. As a result, additional costs arise from transshipment, storage, and logistics coordination.

Multimodal transportation under wartime conditions in Ukraine has distinct features that significantly affect logistics, safety, and transportation costs [24–26]. Analysis shows that Ukraine's seaports – especially those in the south, such as Odesa, Mykolaiv, and Kherson – are partially or fully blocked or operate with severe restrictions. Air cargo transport has been suspended entirely due to the closure of Ukrainian airspace. Rail and road transport have therefore become the primary channels for imports, creating heavy pressure on western border crossings. Logistics routes have shifted toward Western countries, with Poland, Slovakia, Hungary, Romania, and Moldova serving as the main gateways. Delivery times have increased due to congestion and customs delays.

Significant security risks have emerged because of ongoing missile threats to infrastructure (rail lines, bridges, warehouses). This has necessitated high-risk insurance premiums (war risk insurance) and the selection of alternative, safer routes – even if longer. Some logistics facilities in the east and south have been damaged or temporarily rendered inaccessible.

The Ukrainian government has simplified several procedures, particularly for humanitarian cargo, equipment, and medical supplies. However, temporary bureaucratic delays still occur due to staff shortages, power outages, and occasional sabotage. There is also a continued need to revise regulations and import procedures, especially for dual-use goods.

At the same time, demand for critical cargo remains very high. Transport companies often prioritize the movement of humanitarian aid, military goods, and medical supplies [27]. This can delay or increase costs for commercial freight. International logistics companies with experience operating in crisis regions – such as DHL, DB Schenker, Maersk, and DSV – remain active. The relative intensity of logistics routes in 2024 compared with 2021 is shown in Fig. 1.

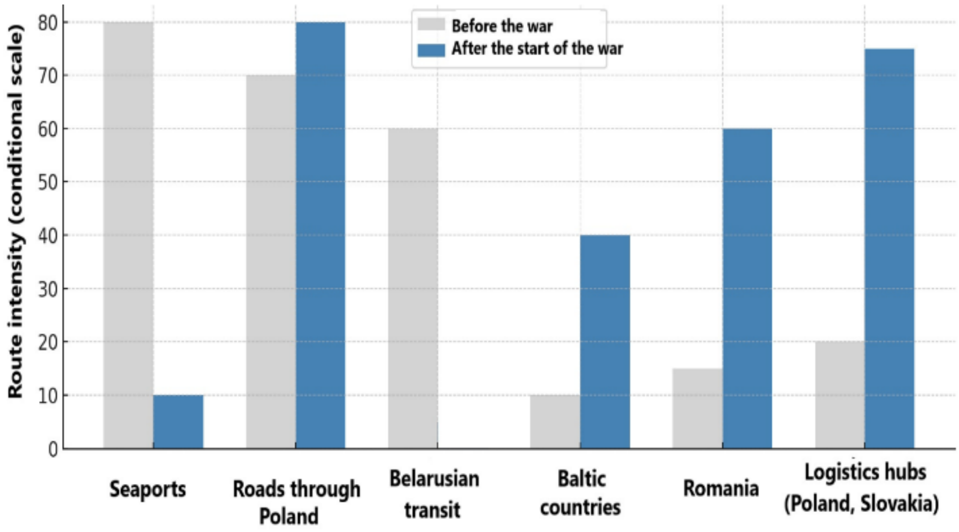

Fig. 1 – Change in delivery routes to Ukraine before and after the start of the war (based on sources [19-26])

According to the State Enterprise «USPA», Ukrainian seaports set a new record in 2024 by handling 97.2 million tons of cargo. This significantly exceeds the 2023 figure of 62 million tons and demonstrates the recovery and further development of maritime logistics in Ukraine despite the difficult geopolitical environment [28].

Changes in cargo volumes during 2022–2024, based on financial reports [29], are shown in Fig. 2 in thousand UAH. As can be seen, nearly 90% of pre-war delivery volumes have now been restored by redirecting cargo flows through alternative logistics hubs. Summary information on the cargo turnover of Ukrainian seaports in 2024 is provided in source [28] and illustrated in Fig. 3.

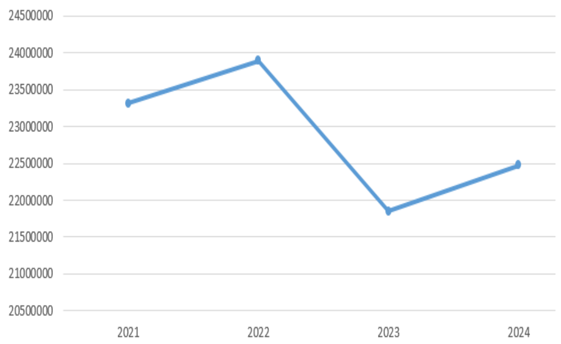

Fig. 2 – Dynamics of multimodal transportation volumes to Ukraine (based on source [29] for 2021-2024)

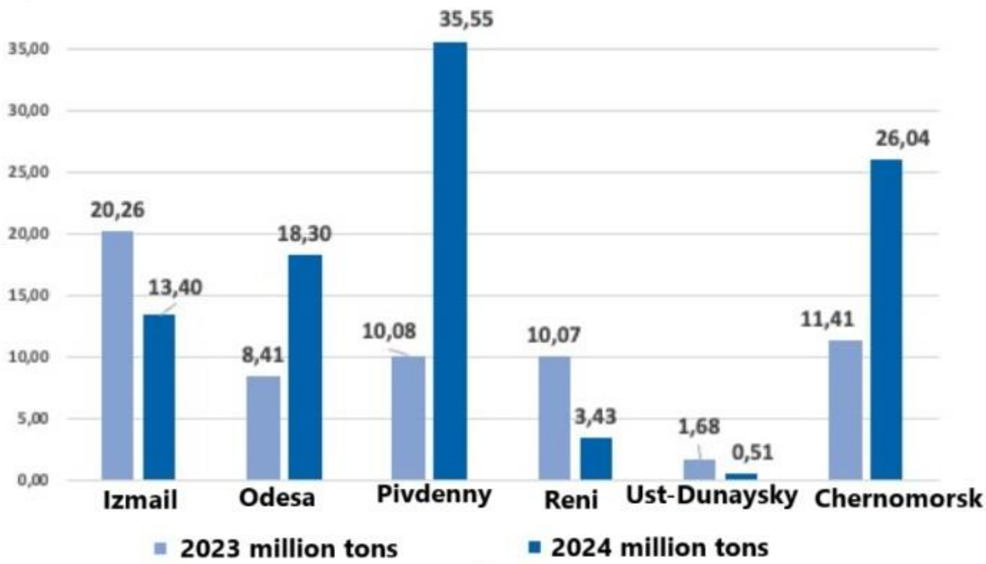

Fig. 3 – Cargo turnover of Ukrainian ports in 2024 (Source [28])

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Let us consider possible examples of multimodal delivery routes to Ukraine and summarize them in Table 2.

Table 2

Examples of multimodal delivery routes to Ukraine

Multimodal route	Routes	Application
Sea + rail + road (via Poland)	By sea: Shanghai (China) → Port of Gdansk (Poland); By rail: Gdansk → Medika (PL) – Mostyska (UA); By car: Mostyska → Lviv → Kyiv / Dnipro / Kharkiv	delivery of equipment, clothing, building materials
Sea + road (via Romania)	By sea: Istanbul → Port of Constanta (Romania) By car: Constanta → Galati → Izmail → Odesa	cargo, food industry, agricultural sector
Aviation + automotive	Air: New York / Frankfurt → Warsaw Car: Warsaw → Yagodyn → Lutsk → Kyiv	express delivery of small batches, medical equipment, electronics

A mathematical model of transportation under uncertainty has been developed to minimize delivery time or cost while accounting for the probability of unforeseen events during transportation (military risks, weather disruptions, route blockages, etc.). The model is formulated as a stochastic optimization problem for a single transportation process.

The objective function aims to minimize the total expected cost or delivery time, incorporating the probability of disruptions:

$$min \sum_{i,j} x_{ij} \left[c_{ij} + r_{ij} \cdot \delta_{ij}\right], \quad (1)$$

where

x_{ij} – binary variable: 1 if the route between points i and j is used, 0 – otherwise.

c_{ij} – the basic cost or transportation time between points i and j.

r_{ij} – probability of a risky event occurring on route i and j (in the form of probability).

δ_{ij} – additional costs or time delay in the event of a risk occurring on the route i and j.

Alternatively, for many scenarios we get:

$$min \sum_{s} p_s Z_s, \quad (2)$$

p_s – probability of scenario s (e.g., blockage, accident, shelling, breakdowns, etc.).

Z_s – total cost or transportation time in the scenario s.

$$\sum_{i,j} x_{ij} \cdot r_{ij} \le R_{max}, \quad (3)$$

x_{ij} – binary variable: 1 if the route between points i and j is used, 0 otherwise.

r_{ij} – the probability of a risky event occurring on route i and j (in the form of probability).

R_{max} – maximum permissible level of risk.

This model can be further extended to include delivery time windows, intermediate transshipment nodes, and multiple transport modes in multimodal logistics chains.

To assess route-related risks, a simulation was carried out based on statistical data on the performance of different route segments.

A full Python script was developed to simulate delivery times under uncertainty, incorporating random events such as roadblocks, inspections, and infrastructure risks. The program also generates a graph and exports the results to an Excel file. These outputs are presented in Fig. 4 and Fig. 5.

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import random

# Model parameters
num_simulations = 50
distances = np.random.randint(100, 1000, size=num_simulations)
cargo_weights = np.random.randint(100, 10000, size=num_simulations)

# Delivery time coefficients
base_speed = 60 # km/h

# Event probabilities
prob_checkpoint = 0.2
prob_damage = 0.1
prob_security = 0.15

# Time delays (in hours)
delay_checkpoint = lambda: random.uniform(0.5, 2)
delay_damage = lambda: random.uniform(2, 5)
delay_security = lambda: random.uniform(1, 3)

# Results
base_times = []
delays = []
total_times = []

for d, w in zip(distances, cargo_weights):
base_time = d / base_speed
delay = 0

if random.random() < prob_checkpoint:
delay += delay_checkpoint()
if random.random() < prob_damage:
delay += delay_damage()
if random.random() < prob_security:
delay += delay_security()
```

Fig. 4 – Part of the program code

```
base_times.append(base_time)
delays.append(delay)
total_times.append(base_time + delay)

# Save to DataFrame
df = pd.DataFrame({
'Distance (km)': distances,
'Cargo Weight (kg)': cargo_weights,
'Base Time (h)': base_times,
'Delays (h)': delays,
'Total Time (h)': total_times
})

# Plot
plt.figure(figsize=(10, 6))
plt.scatter(distances, total_times, c='blue', label='Risk-based delivery time')
plt.xlabel('Distance (km)')
plt.ylabel('Total delivery time (hours)')
plt.title('Risk-based delivery time simulation')
plt.grid(True)
plt.legend()
plt.tight_layout()
plt.savefig("delivery_simulation_plot.png")
plt.show()

# Save to Excel
df.to_excel("transport_simulation_results.xlsx", index=False)
print("Results saved to file 'transport_simulation_results.xlsx'")
```

Fig. 5 – Part of the program code

The generated file *transport_simulation_results.xlsx* contains a table of delivery times across varying distances, with all delays caused by unexpected events included.

The simulation results are summarized in Fig. 6, which demonstrates how delivery time increases nonlinearly with distance when disruptions– such as checkpoint delays, infrastructure damage, or security inspections– are introduced into the model. Architecture assessment metrics of program showed in Table 3.

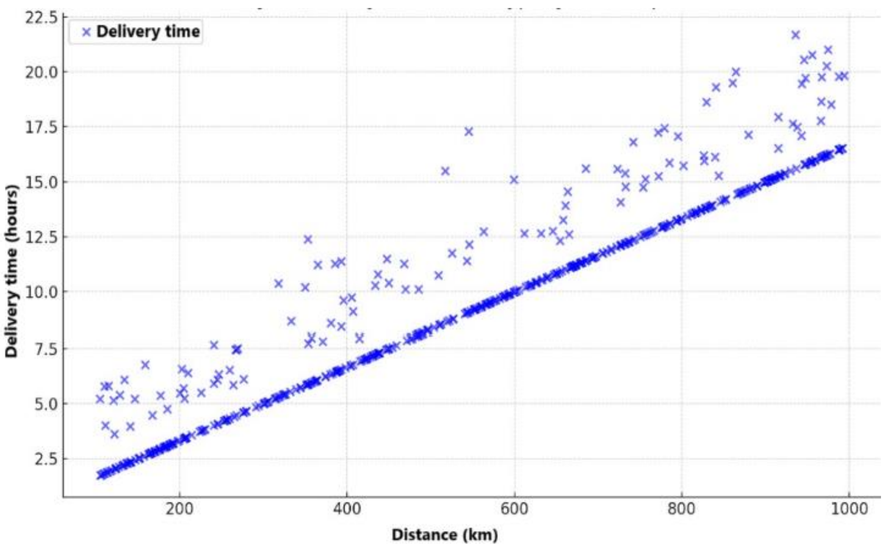

Fig. 6 – Simulation of delivery time taking into account risks (Source developed by the authors)

Table 3

Architecture assessment metrics of program

Technical	MTTR (mean time to recover) MTTD (mean time to detect) Architecture assessment metrics Factor of routes with ETA error <5% Factor of validated IoT events (data confidence level) API throughput (requests/sec)
Logistics	ETA deviation (%) Frequency of emergency situations Route resilience index Total cost of downtime
Economic	ROI, NPV, IRR Delivery cost per 1 ton of cargo Operational savings (€)

Quantitative verification of the proposed architecture of a multimodal digital system and comparison with alternative approaches

The purpose of the verification is to check whether the proposed architecture really increases the reliability and efficiency of multimodal maritime transportation in Ukrainian conditions and to compare it with alternatives.

Objective function. Minimize expected total costs over horizon T (or maximize NPV of savings)

$$\min E(C_{total}) = \mathcal{F}\left[c_f \cdot u \cdot (d_1 + d_2) + c_p \cdot Q + c_h + c_{loss} + c_{dem}\right], \quad (4)$$

where

Q – cargo volume (t) for the considered period;

d_1, d_2 – segment distances (km), here (d_1 = 800, d_2 = 400);

c_f – fuel price (€/t);

u – fuel consumption (t/km).

c_p – port and transit charges (€/t).

c_h – operational costs for transshipment/handling (€/flight),

c_{loss} – cost of losses:

$$c_{loss} = L \cdot Q \cdot P_u. \quad (5)$$

P_u – unit price,

L – cargo losses (fraction);

c_{dem} – additional costs due to demurrage/penalties depending on the delay

As an alternative entry (investment approach) – maximize the NPV of the implementation:

$$NPV = \sum_{y=1}^{T} \frac{\Delta C_y}{(1+r)^y} - I, \quad (6)$$

where

I – investments in architecture;

r – is the discount rate;

ΔC_y – expected annual savings when implementing the system in year y.

Solution Method: Sample Average Approximation (SAA) + Monte-Carlo: generate N scenarios w_i, measure costs $C(w_i)$ and estimate $E(C) = 1/N \sum_i w_i$.

Number of iterations: $N = 500$.

To find the optimal control settings, we can use gradient methods, stochastic optimization. Consider the route:

1) section 1: $d_1 = 800\ km$
2) transshipment
3) section 2: $d_2 = 400\ km$

Delay probabilities before digitalization:

transport section: $P_{d1} = 0{,}25$, $P_{d2} = 0.22$
transshipment: $P_{\text{hub}} = 0{,}32$
After implementation: $\acute{P}_{d1} = 0{,}14$,
$\acute{P}_{d2} = 0{,}12$,
$\acute{P}_{\text{hub}} = 0{,}19$.

Delivery time:

$$T = T_1 + T_{hub} + T_2, \tag{7}$$

where each component is modeled:

$$T_i = t_i \cdot (1 + X_i), \tag{8}$$

X_i – is a random variable delay.

Base durations: $t_1 = 30\ h$, $t_{hub} = 12\ h$, $t_2 = 18\ h$.
Average delay time before digitization: $E(\Delta T) = 11.4\ h$.
After digitization: $E(\Delta T') = 5{,}8\ h$.
Delay reduction: 49,1%.

Next, we calculate the economic variation. Assuming:
Annual volume of transportation: 600.
Investment in digitalization: €95,000.
Horizon: 5 years. $y \in [1, 5]$
Discount: 10%.
Average savings per 1 transportation is €1,050.
Annual savings is $1{,}050 \times 600 = €630{,}000$.
Then NPV:

$$NPV = \sum_{y=1}^{5} \frac{630000}{(1+r)^y} - 95000,$$

$$NPV = 2\,387\,000\ €.$$

Conclusions

The conducted research shows that the development of multimodal transportation in Ukraine is a critical precondition for improving the efficiency, resilience, and competitiveness of national logistics systems. The study demonstrates that the use of integrated multimodal solutions– combining rail, road, maritime, and air transport– allows optimization of delivery time, reduction of operational costs, and mitigation of disruptions caused by infrastructure damage or geopolitical factors.

However, Ukraine's multimodal sector continues to face significant challenges, including insufficient intermodal terminal infrastructure, outdated rolling stock, limited digitalization of logistics processes, and imperfect coordination among transport modes. Addressing these issues will require not only government investment but also active engagement from private logistics operators and international partners.

The study confirms that the application of mathematical and simulation models in planning and managing multimodal transportation under uncertainty is an effective decision-support tool.

The proposed risk assessment model, implemented using Python, allows for estimating disruption probabilities, optimizing route selection, and balancing cost-time trade-offs under dynamically changing conditions. The integration of digital platforms, unified data-exchange standards, and real-time monitoring systems can greatly enhance transparency and coordination within supply chains.

In conclusion, the advancement of multimodal transportation in Ukraine should be seen not only as a logistical necessity but also as a strategic priority for post-war recovery and international trade expansion. Modernization of transport infrastructure, digital transformation of logistics operations, and the creation of resilient and adaptive transport corridors will ensure Ukraine's sustainable reintegration into the global logistics system.

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МОДЕЛЮВАННЯ РИЗИКІВ МУЛЬТИМОДАЛЬНИХ ПЕРЕВЕЗЕНЬ В УКРАЇНІ

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У статті розглядаються перспективи організації та розвитку мультимодальних перевезень в Україні в умовах зростання міжнародної торгівлі, глибшої інтеграції в глобальні ланцюги поставок та викликів, що виникають внаслідок війни, що триває. У дослідженні наголошується на тому, що мультимодальні перевезення, що поєднують автомобільний, залізничний, морський та повітряний види транспорту, відіграють вирішальну роль у забезпеченні гнучкої та ефективної доставки вантажів, одночасно знижуючи загальні логістичні витрати. Мультимодальні перевезення в Україні стикаються зі суттєвими обмеженнями, включаючи нерозвинену інфраструктуру, брак інтегрованих інтермодальних терміналів, несумісність між транспортними системами та недосконалу нормативно-правову базу. Додаткові труднощі виникають через складні прикордонні процедури, недостатню цифровізацію логістичних процесів та обмежене використання єдиних IT-систем для моніторингу вантажів у режимі реального часу. Наведено огляд провідних логістичних компаній, таких як DB Schenker, Maersk, DSV, DHL, Nova Global, Kuehne+Nagel та Meest Express, які наразі працюють в Україні, використовуючи мультимодальні рішення. Особлива увага приділяється впливу війни на логістичні потоки, включаючи закриття повітряного простору України, блокування морських портів та переорієнтацію транспортних маршрутів через Польщу, Словаччину, Угорщину, Румунію та Молдову. У дослідженні наведено приклади мультимодальних маршрутів та підкреслено важливість адаптації логістичних стратегій до нових ризиків, таких як пошкодження інфраструктури та загрози безпеці. Запропоновано математичну модель для оптимізації транспортних процесів в умовах невизначеності, враховуючи непередбачувані події, такі як блокування маршрутів, несприятливі погодні умови та військові ризики. Модель сформульовано як стохастична оптимізаційна задача, яка мінімізує очікувані витрати або час доставки, враховуючи при цьому ймовірності виникнення ризику. Результати моделювання демонструють, як час доставки змінюється залежно від відстані та впливу додаткових факторів ризику. Результати підтверджують, що мультимодальні перевезення залишаються стратегічним інструментом для забезпечення ефективної участі України у світових торговельних потоках. Подолання інфраструктурних та регуляторних бар'єрів, зміцнення міжнародної співпраці та впровадження передових цифрових рішень значно підвищать ефективність та стійкість мультимодальних перевезень, сприяючи сталому економічному відновленню та інтеграції країни у світову логістичну мережу.

Ключові слова: *мультимодальні перевезення, оптимізація логістики, міжнародна торгівля, проблеми інфраструктури та туризму, управління ризиками.*

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