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Iryna Shevchenko

Ph.D. in Economics, Associate Professor,
National Aviation University
orcid.org/0000-0001-7910-0490
e-mail: irina.v2611@gmail.com

Iryna Klyus

Ph.D. in Physics and Mathematics,
Associate Professor,
National Aviation University
orcid.org/0000-0003-1332-316X
e-mail: iryna.klius@npp.nau.edu.ua

PROBLEMS OF TRANSPORT LOGISTICS DEVELOPMENT IN UKRAINE UNDER MARTIAL LAW

Introduction

Today, when Ukraine has been defending its independence for more than a year, when not only the country's economy and infrastructure have been undermined, but also the social life of the population has been disrupted, the issue of restoring the country's effective functioning is very acute. Despite the availability of quite significant military and financial support from the West, Ukraine still needs significant support for its recovery.

Problem statement

Ukraine has found itself in a situation where the global logistics industry has already begun to change rapidly in the post-pandemic period, and at the same time, crisis phenomena have begun to escalate. Thus, as a result of the economic war between the US and China, the logistics market began to localize rapidly to bring supply chains as close as possible to the place of production or sale of the final product. Almost half of North American companies have carried out the so-called "reshore", or returning their business to the country of origin.

Analysis of recent research and publications

Recently, this has become very clear: companies from the energy, automotive, technology and other sectors – the largest and most expensive industries – are opening new facilities on the continent.

The war in Ukraine has accelerated this process. High oil and gas prices, Russia's rapprochement with China, and sanctions restrictions on Russian logistics have all strengthened the localization trend. However, the relocation of production requires considerable time and investment, and therefore will not happen quickly.

Even before the war in Ukraine broke out, international logistics and transport companies were looking for ways to build more flexible supply chains. The industry was pushed to make these changes when the market lost its usual connections due to the coronavirus pandemic, leading to long periods of no flights and significant delays in land transport.

According to McKinsey researchers, it was at this time that the industry began to reform, moving away from the concept of "on-time delivery" to "on-demand delivery" [4]. Many companies surveyed by the agency stressed that they had increased the size of their warehouses to ensure the constant availability of critical products.

The war in Ukraine is another reason to think about their own delivery capabilities.

Previously unsolved problems

Logistics companies are now increasingly using the dual-sourcing approach, when the same product is delivered from two suppliers – dual sourcing. According to McKinsey, in March 2022, twice as many companies switched to this format as a few months earlier [4].

This is another step towards system-wide resilience and flexibility. Perhaps in the future, a more radical shift from goods to services will ease the burden on supply chains. But now the debate about various forms of cooperation, such as nearshoring, onshoring and the transfer of business processes to other regions, is becoming relevant again.

Geopolitical processes have even led to the emergence of forms of "friend-shoring" – cooperation with countries that share the norms and values of the modern global economy.

The purpose of this study is to classify the existing problems of the development of transport logistics in Ukraine under the conditions of martial law and outline options for their possible solutions.

The object of this study is the problems of transport logistics.

The subject of the study is the direct challenges of the external environment to logistics by their processes.

Statement of the research task: to identify and classify the existing problems of transport logistics in Ukraine under martial law conditions, formulate proposals for their solution and justify applying a mathematical basis for the optimization of transport and logistics processes.

Summary of the main research material

The year of war has sharply revealed problems that needed to be addressed even before the war but were hidden, including logistics. Damage to roads and railways, the blocking of Ukrainian ports, the inability to operate flights, and the disruption of flights to Eastern countries all exposed logistical shortcomings. In addition to the global problems, other problems emerged, such as a shortage of rolling stock that was reoriented to military needs and a shortage of personnel who had been rejected by the war. However, some problems were resolved quite quickly: The 70-year-old problem of different railway gauges, the restoration of rolling stock with the help of Western partners and volunteers, and alternative supply routes.

During the first days of the war, the freight forwarding industry faced a difficult challenge. A lot of imports were coming to Ukraine in containers. It had to be unloaded in ports of other countries, and the redirection itself cost a lot of money. As a certain positive consequence, new logistics chains were formed, involving ports of other countries (Constanta, Gdynia, Gdansk, Klaipeda, sometimes even Istanbul and Bremerhaven) [3].

When we talk about it in general terms, at first glance, it doesn't seem that critical. However, it took a lot of human effort to keep the supply chain running smoothly.

In this context, the case of the port of Constanta, which was extremely congested in the first months of the war, is important. This led to numerous disruptions in operations, and the storage of perishable goods was at risk. It was then that AIFFU representatives appealed to the port management and asked for assistance and an increase in the number of staff to handle cargo, from documentary and organizational issues to technical issues. The appeal also concerned the operation of container lines and terminals, customs and other regulatory authorities. By

the way, Ukrainian freight forwarders were surprised that the work in foreign ports was significantly slower than in Ukrainian ports.

Neighboring countries were indeed unprepared at the beginning of the war to handle the volume of cargo being redirected there. Moreover, with the outbreak of hostilities, almost all of its potential was blocked.

Most of the cargo was redistributed using rail transport. This is indeed a fairly effective solution, but it is also accompanied by some problems. For example [5]:

- Lack of established logistics routes in the first phase of the war. This is not so relevant now, but the formation of these routes cost the Ukrainian forwarding industry a lot of effort and long non-stop work.

- Different track gauges in Ukraine and Western Europe. This indicates the need for reloading, which complicates the process. It can be especially difficult when it comes to food.

- The inability of the railway infrastructure to handle a significant volume of cargo from Ukraine to European ports. Traction, capacity and the number of marshaling yards were insufficient.

- Fuel price instability. This problem significantly affects the functioning of the industry, increasing the cost of delivery. At one stage of the war, rocket attacks on oil depots led to a crisis that was further exacerbated by currency fluctuations.

The railway has indeed taken on a sufficient load at a time when the port sector is not operating at full capacity. However, it is important to understand the cost of this. At the same time, we cannot ignore the unfortunate fact that the monopolist of the Ukrainian railways industry has raised tariffs significantly.

The following phenomena and processes are worth mentioning when it comes to key changes and factors affecting Ukrainian logistics during martial law [2]:

- Vulnerability of the logistics system close to the frontline regions.

- The instability of the cost of delivery and sometimes its impossibility when it comes to danger.

- The restructuring of logistics routes, which occurs at regular intervals (some routes remain more established, while others change due to the dynamic situation).

- Greater demand for long-term storage products, as they are optimal for food stocks and do not carry a high risk of losses in case of an unavoidable delay in delivery.

- Shortage of drivers, some of whom have joined the ranks of the Armed Forces.

- Rising costs of exports and lower prices for imports (this global trend is because many of the goods leaving Ukraine are humanitarian).

– The trend away from long-term storage of goods in warehouses, and the focus of Ukrainian retailers on working "off the wheels", which helps to minimize stocks.

– More loyal conditions for cooperation between logistics companies and customers, as most people now realize that there may be a delay of up to a day in travel due to objective reasons.

– Demand for the delivery of Ukrainian products abroad, due to the relocation of several million Ukrainians who have evacuated from the war.

– Lack of vehicles in the frontline regions, as foreign vehicles are not allowed to enter Ukraine, and our own vehicles are physically insufficient to fully meet the needs of the logistics industry.

– An additional obstacle is the requirement for container lines to obtain deposits for equipment ranging from \$5,000 to \$25,000. This is a bureaucratic and time-consuming procedure, both for receiving and returning these funds.

– Issues with the efficiency of foreign partners – all of them (freight forwarders, logisticians, container lines, terminals, customs officers and controllers).

In addition to all of the above in the organizational sense, it is important to mention the value aspect of the work. Ukrainian freight forwarders and logisticians understand how responsible their work is. They realize that the logistics front is especially important in times of war. It is invisible at first glance, but it becomes noticeable when supplies are interrupted or disrupted. That's why the specialists work selflessly, and at the beginning of the war this work was carried out continuously.

We can already say that the specialists have learnt to adapt to the new difficult and stressful reality. But at the beginning of the war, when no one knew what would happen next, the companies faced a great challenge in maintaining the continuity of their work and their teams.

Thus, the main logistical challenges faced by Ukrainian business are [7]:

– Refusal to hoard. The more goods are in warehouses, the higher the amount of frozen funds. In addition, it is dangerous to keep goods in warehouses for a long time – in the event of an attack, they can be lost.

– Changing warehouse conditions. The largest hub (70–80% of professional warehouse space) was located in the Kyiv region. With the outbreak of hostilities, companies were forced to move their goods to the west of Ukraine, where there was no warehouse space of this size.

– Difficulties with procurement of goods. The problems are primarily related to a limited range of products and suppliers, blocked ports and the strain on railway infrastructure.

– Complications in logistics operations. Road-blocks, inspections, curfews - all this complicates the transport of goods. In addition, it is necessary to plan backup routes in advance, as there is a risk of new attacks.

However, Ukrainian business remains an active participant in the struggle for Ukraine's independence! 93 % of businesses are involved in helping the country during the war, including 67.1 % who have joined the volunteer movement. In addition, Ukrainian businesses are showing positive signs of recovery. 70 % of businesses are operating fully or partially, while 15.6 % have not changed their workload or even increased it.

Ukrainian small and medium-sized businesses continue to recover. The Ukrainian Business Index (33.9) is growing, indicating that businesses have begun to restore jobs, build inventories, and expand their customer base. 28 % of employees have been laid off by NASMB since the end of February 2022. Business expectations for performance in 2022 remain at half (54 %) of the previous year's revenue. This is also influenced by the unpredictability of developments and government actions, as well as the virtual lack of access to financial resources to replenish working capital and implement development projects. Businesses identify tax reform, deregulation, and the introduction of electronic contracts as priority reforms [9].

The Ukrainian Business Index (UBI) stands at 33.9 (out of 100). The index has risen slightly since June 2022 but remains low, indicating that businesses are uncertain about a rapid improvement in the economic situation, but the growth of the index in recent months shows that negative business expectations are decreasing.

33.8 % of enterprises have completely or almost completely stopped working since 24 February. This is lower than in June, when 46.8 % of enterprises remained completely or almost completely idle. The same situation was observed in May.

At the same time, 8 % of enterprises report that their workload has increased compared to the prewar period [8].

A list of the main obstacles is shown in Fig. 1.

38 % point to unpredictable developments, and 35 % – to unpredictable actions of the state, which may worsen the situation for business.

The share of staff (as of 23.02) that has been laid off has increased to 28 % (in August this figure was 24 %). This means that more than 1,300,000 people have been laid off in NASMB. In addition to this, 18% is hidden unemployment. At the same time, there has been a trend toward hiring new staff (35 % of businesses have hired new staff since the start of the war).

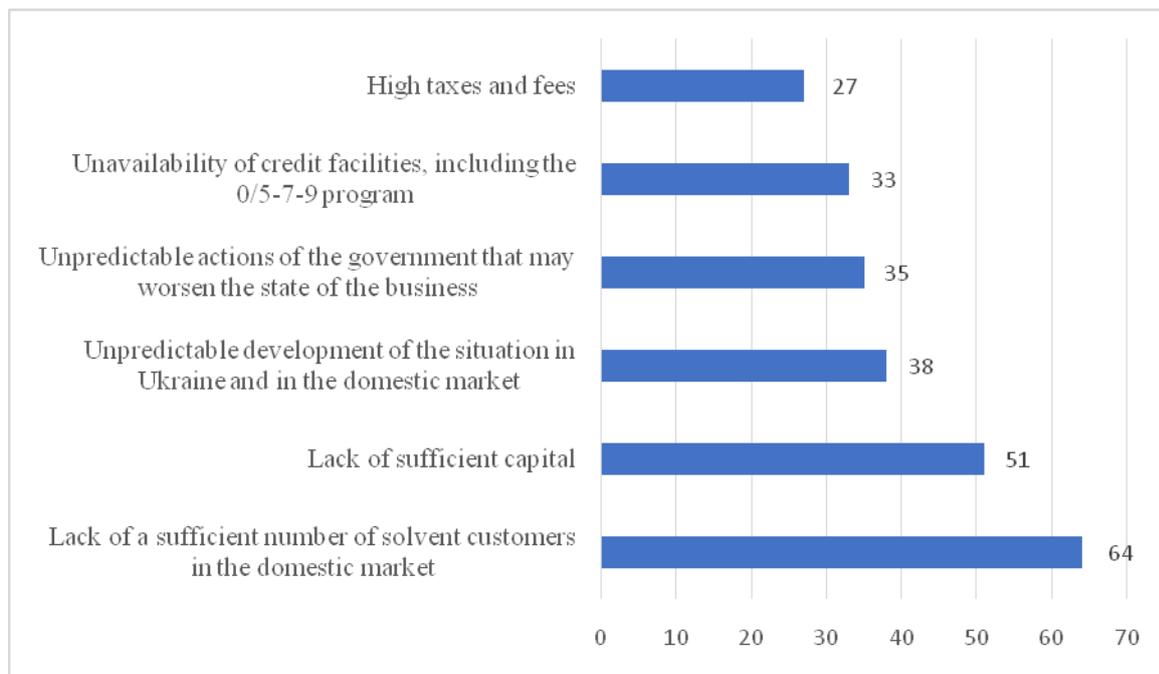


Fig. 1. List of the main obstacles to the development of logistics business

Implementation of tax reform is considered by 59 % of entrepreneurs to be the top priority for the Government. The other two are the acceleration of the movement of goods through customs and the observance of a complete moratorium on business inspections [10].

Undoubtedly, the worst moment for Ukrainian business came in the spring immediately after the start of the full-scale Russian invasion. At that time, analysts observed a drop in economic sentiment in the country to the lowest levels ever recorded. But later, the curve crept up again. According to experts, negative expectations of entrepreneurs still prevail. However, they do not see the situation as catastrophic as it was 7–8 months ago.

Ukrainian business is indeed recovering very quickly. While 85 % of businesses were closed in March, only a third of them are now idle or almost idle. And this number is shrinking very quickly. Domestic business has indeed demonstrated its ability to withstand the most difficult conditions. Among other things, transport companies have proved to be among the most resilient. Indeed, the share of non-operating companies here is already less than 10 %. On the other hand, everyone's expectations for their own income this year are much more modest than last year. Studies show that, on average, Ukrainian businesses expect only 54 % of the turnover they had last year in relatively peaceful times. But even here, the transport and logistics sector are a pleasant surprise, with representatives planning to reach 65 % [7].

At the same time, one of the main reasons why we do not have systemic development is the lack of

strategies. In the transport and logistics sector, more than half of the companies (60 %) do not have development strategies, do not have plans, and live in an adaptive format.

It is also necessary to understand what will happen in the Ukrainian economy in the near future. In particular, unemployment will continue to rise, and we should not expect any significant positive changes in the situation next year. The Ministry of Economy forecasts an unemployment rate of 30 % in 2023. However, this figure has already been exceeded – we are now at 32 %, according to Advancer Group.

Lack of funding is a major obstacle to business development. If we look at the ten biggest problems that prevent Ukrainian companies from developing their business, six of them are related to finance. Customers do not pay on time, there is no access to investment capital, credit programs, etc. Today, Ukraine has two economic models that are completely different. One is a paper model, which is liberal, legal and almost synchronized with European legislation. But in reality, 91 % of Ukrainian businesses optimize their taxes in a grey area. This only shows that the tax system is not in line with reality. For many years, the government has been trying to fight corruption using administrative methods. Specifically, it has been creating new anti-corruption bodies. However, the real problem is that the state's share in the economy is too large, and that all corruption in Ukraine is based on the economic base that currently exists, on corruption rents, which account for one third of the state budget.

Current trends can be described as follows [6]:

- 4.8 million working Ukrainians will receive salaries from the state.
 - The corruption rent for enterprises reaches one third of the state budget and is approximately UAH 450 billion.
 - The tax sector alone generates UAH 140 billion of corruption rent.
 - Another UAH 158 billion is taken away from business through various administrative methods.
- In particular, companies have lost approximately UAH 16 billion this year due to overpayment of

income tax, blocking of tax invoices, etc. That is why "the key idea of modernizing the Ukrainian economy is that we should not try to cut off the heads of this hydra in the form of restructuring the courts or looking for honest MPs or creating something else. The main key task is to remove the economic basis for corruption.

A comparison of the logistics problem in peacetime and wartime is shown in Table 1. Logistics is a dynamic industry that requires experienced management to operate effectively.

Table 1

Comparison of logistics problems in peacetime and wartime

Problems in peacetime	Problems in wartime
<ul style="list-style-type: none"> – inventory management – the more inventory, the higher the amount of frozen financial resources; – procurement and delivery to the warehouse – typical conflicts related to the range of products, delivery terms, and the choice of supplier; – basic terms of supply – risks, costs, exchange of documentation and other issues between the parties to the contract. 	<ul style="list-style-type: none"> – Refusal to store and hoard. Now it is impossible to keep goods in the warehouse for a long time – in the event of an attack, they will be lost; – Changes in warehouse conditions. Typically, it takes about 3 months to deploy a storage hub, but now you need to be ready to set up a secure and integrated warehouse in 7–14 days; – Complication of logistics operations. Roadblocks, inspections, non-transparent traffic control during curfews; – Abrupt route changes. The need to take into account new attacks and plan backup routes in advance.

This way, recommendations can be made on how logistics and business should interact [4]:

- Involve top managers with experience in different niches. The more cases there are, the better the variability of results – the ability to choose the main, backup and emergency options;
- Restore and increase efficiency. Outsource logistics processes to a well-coordinated team. If the company has experience, it will immediately organize the work and people, select workers for linear processes;
- Control every kilometer. When each flight has its manager, any non-standard situations are resolved very quickly;
- Outsource the clearance process. Take care not only of the storage, handling and delivery of goods, but also of customs brokerage and representation of interests in the licensing authorities;
- Find and organize new storage hubs equipped with security and control systems. Secure line workers in advance and have additional locations for shipment in reserve.

The more services are outsourced, the less entropy in the processes. An experienced team that has been working for 13 years and has 10 international branches will not hone the processes in your business. Instead, they will offer a fast, efficient, and effective solution that can be managed during the delivery process.

Thus, businesses were forced to change the warehouse chain and thus increase the complexity

and cost of these operations. Three main factors have influenced business processes related to logistics [11].

1. Refusal to accumulate and store goods.

Previously, goods could be stored in warehouses for a long time, but now the business has started to ship "off the wheels", trying to minimize stockpiling so that in the event of a possible attack on warehouses, there is no loss of goods.

2. Abrupt and rapid changes in warehouse conditions.

Typically, it takes about three months to launch a warehouse: moving the warehouse, deploying an IT system and IT integration, setting up security systems, video surveillance, etc. It is clear that companies did not have that much time, they were forced to migrate in a matter of weeks or even days to unknown areas. In some places, security was lagging, in others, operational processes were lagging. Logistics, especially warehousing, was difficult, to put it mildly, but the companies coped quite well. They switched to the survival mode, starting from scratch, and covered basic needs, such as finding warehouses, drivers, and warehouse staff.

3. Complication of logistics operations.

This was a big problem, especially at first. This is a huge number of checkpoints and inspections. This is the lack of clear rules for movement during the curfew: which logisticians could travel at night and which could not. These are certain actions by the terrorist defense forces, which did not always

respond adequately to the night movements of vehicles delivering food.

The war certainly poses serious challenges to the postal and logistics sector and Ukraine itself. Military operations and possible rocket attacks have imposed restrictions on the activities of logistics companies. But even in such times, the industry has the opportunity to develop qualitatively. In times of war, deliveries to and from Ukraine need to be improved.

For example, the emigration of a large number of Ukrainians abroad is a serious challenge for industry players, including Meats.

Since March, shipments from Ukraine to Europe and the US have been growing steadily by 30 % per month. The most common destinations are Poland, Germany and the Czech Republic. Deliveries to Ukraine are also in demand, although the type of goods has changed slightly. Through the my Meest service, users now order tactical goods, clothing from brands that have been temporarily suspended in Ukraine, vitamins and medicines from Europe.

The largest marketplaces and clothing brands have already resumed sales and deliveries to Ukraine: Ali Express, NOTINO, ANSWEAR, LPP Group and MODIVO brands. Meast remains their main logistics partner in Ukraine.

Due to the rapidly changing situation in the country, and therefore in the market, it is necessary to look for new ways, partnerships and further integration into the European space. This will benefit not only individual companies, but also Ukrainians and Ukraine as a whole.

Ukraine's customs relations with other countries are also developing. Political and economic projects with Poland have great potential. This is because this country is actually a bridge to the EU for Ukraine.

If a mutually beneficial solution is found, Ukraine's tariffs, and thus its trade and transport competitiveness, will be further enhanced.

But it is necessary to analyze the economy as a whole. Now is the perfect time to finally move to a true market model. Liberalization, privatization and financial sector reforms need to start now to preserve economic stability and lay the foundations for post-war recovery.

In logistics, the optimal route is defined as the route that can deliver products within the permissible timeframe with minimal transport costs, as well as preserve the consumer properties of the products [7].

The problem of building optimal transport routes can be solved using a number of approaches and methods, with the greatest difficulty being taking into account all transport constraints and the number of delivery points, as the complexity and performance of algorithms for calculating the optimal route depend on these factors.

The general name of the class of problems that cover the service of consumers by vehicles is known as the transport routing problem. When transporting products that require special transport conditions, road priority requirements may be of primary importance. The specifics of modeling a delivery route are also manifested in the specifics of the transported goods, the calculation of transportation costs, and the efficiency criterion is usually at least the total transportation costs, which introduces additional complexity into route construction.

This study identifies a set of tasks related to the transportation of products from producers to regional consumers and in the distribution network.

Obviously, the key task of this complex is to solve the problem of vehicle routing, which, at first glance, involves solving several well-known optimization problems using well-known methods. However, this is not entirely true – there are a number of features that create difficulties and impose certain limitations when modeling such transportation of products by road.

These features include the following [1]:

- the vehicle is divided into several sections to ensure that several types of products can be transported simultaneously. The volume of the sections is not standardized, but depends on the customer;
- the transported products are not fully interchangeable with respect to the sections of the vehicle, i.e. the products can be changed in a strictly defined sequence;
- one motor vehicle has the ability to make several trips on the route within the time allocated to meet the needs of consumers;
- the vehicle does not necessarily have to unload all the products from one consumer, but can partially satisfy the demand of several distribution networks, i.e. "circular" routes are allowed, and in some networks the vehicle can leave the trailer for autonomous unloading, picking it up on the way back.

To build the optimal route, the ant colony method is used, which is referred to as the so-called metaheuristic optimization method [1]. Metaheuristic methods allow you to efficiently explore the set of valid solutions to find a solution close to the optimal one.

The Ant Colony Optimization Algorithm (ACO) is a probabilistic technique for solving problems that can be reduced to problems of finding routes in graphs. It is based on the behavior of ants searching for paths from their colony to food sources. The main probabilistic rule for moving from one vertex to another is where $P_{ij}(t)$ is the probability of transition from vertex i to vertex j at the current time; $\tau_{ij}(t)$ is the concentration of pheromone (trace left by ants), which determines the preference for moving along a given path; D_{ij} – its length, and α and β

are some constants that determine the operation of the algorithm, set by the user.

$$P_{ij,k}(t) = \frac{[\tau_{ij}(t)]^\alpha \cdot [D_{ij}]^\beta}{\sum_{l \in J_{i,k}} [\tau_{il}(t)]^\alpha \cdot [D_{il}]^\beta}, j \in J_{i,k},$$

$$P_{ij,k}(t) = 0, j \notin J_{i,k}.$$

The vehicle's route is built step by step by selecting the next destination until all the cities are passed. The ant selects the next city from the list of available ones, after which the objective function is updated and the list of cities available for visiting is changed. Then the next available city is selected again. The ant returns to the initial city if it has passed all the cities.

The total length of the route is calculated as the value of the objective function of the complete route traveled by the ant.

Interpreting the traveling salesman's problem to real-life circumstances, we can say that the objective function is the shortest route found.

When calculating the fuel consumption of a vehicle, it may be necessary to take into account a significant number of parameters that depend on the distance traveled. In particular, one of the key factors in route planning is the quality of the road, which affects the economical and safe transport of goods, as high-quality road conditions determine the vehicle's operating mode, i.e. reduce the wear and tear of components and assemblies. Road conditions can be characterized by the technical classification of the road, the type and quality of the road surface and the terrain. Obviously, the requirements for transport can be strictly regulated.

With data on the distances between the company's warehouses and the average speed on the section, the work of optimizing routes based on average speeds and building delivery routes to take

into account changes in road conditions can be considered dynamic.

It is possible to improve the efficiency of the algorithm by introducing the so-called export of elite ants, which will strengthen the edges of the best current route found from the beginning of the algorithm. Then if there are e elite ants in the colony, then the edges of the route will receive an additional amount of pheromone according to the following formula:

$$\tau_{ij}(t) = \tau_{ij}(t) + e * Q / L$$

where e is the number of elite ants and L is the length of the best current route.

That is, after each iteration, the concentration of pheromone increases on those edges on which the most efficient route is laid. Thus, the convergence to the optimum is accelerated due to an increase in the concentration of pheromone on individual edges. According to the results of the research, the most optimal number of elite ants is 3. This number combines the balance of speed of convergence and accuracy of the obtained solutions. At $e = 1$, the accuracy is the highest, and as this value increases, a smaller and smaller number of iterations is required to obtain a local dead end, when further operation of the algorithm does not lead to an improvement in the result. It is possible to choose the optimal values of parameters α and β experimentally. For the algorithm described above, a study of the influence of these parameters on the effectiveness of the obtained solutions was carried out. For arbitrarily generated 80 vertices of the graph in the table 2 the obtained values are displayed.

Table 2 – Dependence of the efficiency of the solution on the selected parameters on the example of a problem with 80 points

Table 2

Parameters	Best option	Worst option	Average value
$\alpha = 1, \beta = 1$			
100 iterations	6501	7384	6999
1000 iterations	4126	4996	4649
$\alpha = 2, \beta = 1$			
100 iterations	3657	4675	4289
1000 iterations	3506	3814	3708
$\alpha = 1, \beta = 2$			
100 iterations	4015	4464	4219
1000 iterations	3569	3762	3653

It can be seen in the table that changing the values of parameters α and β leads to significant changes in the obtained solutions. Increasing the value of the first parameter (increasing the dependence of the resulting solution on the pheromone

concentration) leads to an increase in the dispersion of solutions, as a result of which the work of the ant algorithm is more heuristic in nature. Increasing the value of the second parameter (increasing the dependence of the resulting solution on the length)

leads to a decrease in the spread of solutions, and the algorithm begins to work primarily as an exact method.

Conclusions

Thus, it can be noted that the war in Ukraine has only exacerbated the problems that have been brewing in international logistics transport during the Covid-19 period. Nevertheless, the research has shown that Ukrainian logistics transport is quite successful in solving these problems and the problems of redeployment of the warehouse network. However, this approach requires the development of a certain algorithm of coordinated actions that should be optimized with regard to the economical use of resources.

Prospects for further research

Further improvement of the suggested algorithm can be considered from the point of view of optimization of any resources entering the logistics chain, both material, financial, informational, spatial and temporal.

REFERENCES

- [1] Drrorigo M., Maniezzo V., Colomi A. (1996). The Ant System: Optimization by a Colony of Cooperating Agents *IEEE Trans. on Systems, Man and Cybernetics*. Part B. 1996. No 1. Vol. 26. P. 29–41 [eng].
- [2] Viina v Ukraini: ekonomika, biznes, lohistyka, dopomoha. Retrieved from <https://trans.info/ru/viyna-v-ukrayini-ekonomika-biznes-logistika-dopomoga-279148> [in Ukrainian] (access data 15/08/2023).
- [3] Viiskova lohistyka. Retrieved from <https://gmk.center/posts/voennaya-logistika-problemyukrainskogo-eksporta-ostajutsya-nereshennymi/> [in Ukrainian] (access data 15/08/2023).
- [4] Vtrata skladiv. Retrieved from <https://rau.ua/novyni/sklad-ritejl-vtratu-logistiku/> [in Ukrainian] (access data 15/08/2023).
- [5] Hryhorenko Yu. (2022). Oktiabr stal khudshym mesiatsem dlia eksporta produktsyyi HMK Ukrainy v 2022 hodu. Retrieved from <https://gmk.center/posts/oktyabr-stal-hudshimmesyacam-dlya-eksporta-produkcii-gmk-ukrainy-v-2022-godu/> [in Ukrainian] (access data 15/08/2023).
- [6] Danchuk, V. D., & Svatko, V. V. (2012). Optymizatsiia poshuku shliakhiv po hrafu v dynamichnii zadachi komivoiazhera metodom modifykovanoho murashynoho alhorytmu [Optimization of the search for paths on the graph in the dynamic problem of the traveling salesman using the method of the modified ant algorithm]. *Systemni doslidzhennia ta informatsiini tekhnolohii – System research and information technologies*, 2, 78-86 [in Ukrainian].
- [7] Kryzova sytuatsiia v lohystytsi. Retrieved from http://www.economy.nayka.com.ua/pdf/3_2020/56.pdf [in Ukrainian] (access data 15/08/2023).
- [8] Lohistyka viiny. Retrieved from <https://biz.nv.ua/ukr/experts/perevezennya-v-ukrajini-pidchas-viyni-gumanitarni-vantazhi-obmezheniya-na-perevezennya-50231625.html/> [in Ukrainian] (access data 15/08/2023).
- [9] Padinnia VVP. Retrieved from <https://biz.nv.ua/ukr/economics/naskilki-znizitsya-vvp-ukrajincherez-rosiyske-vtorgnennya-ocinka-dragon-capital-50247043.html/> [in Ukrainian] (access data 15/08/2023).
- [10] Skladska nerukhomist: pid chas viiny vtracheno 22 % ploshch u Kyivskomu rehioni. Retrieved from <https://cbre-expandia.com/uk/skladska-nerukhomist-pid-chas-vijni-vtracheno-22-ploshh-u-kiyivskomu-regioni/> [in Ukrainian] (access data 15/08/2023).
- [11] Yak zminylas lohistyka v Ukraini za misiats viiny v kompanii Zammler. Retrieved from <https://logist.fm/publications/yak-zminilas-logistika-v-ukrayini-zamisyac-viyni/> [in Ukrainian] (access data 15/08/2023).

Шевченко І. В., Ключ І. С.

ПРОБЛЕМИ РОЗВИТКУ ТРАНСПОРТНОЇ ЛОГІСТИКИ В УКРАЇНІ В УМОВАХ ВОЄННОГО СТАНУ

У дослідженні розглянуто проблеми сучасного логістичного бізнесу в Україні, проведено паралелі з основними тенденціями, що були сформовані в світі на період коронавірусу, розглянуто основні напрями логістичних потоків та шляхи їх трансформації обумовлені загальною міжнародною обстановкою. В дослідженні було визначено, що в світі почала складатися так звана стратегія локалізації логістичного бізнесу, орієнтована на скупчення виробництв, транспортних компаній та особливо споживачів переважно в одному регіоні з метою уникнення ризиків відриву виробництва та неможливості задоволення потреб споживачів. Світ активно переходить від концепції «вчасної доставки» до «доставки на вимогу». Це ще один крок до загальносистемної стійкості та гнучкості. Можливо, в майбутньому більш радикальний перехід від товарів до послуг полегшить навантаження на ланцюги поставок.

Але зараз знову стають актуальними дебати про різні форми співпраці, такі як ніашорінг, оншорінг і перенесення бізнес-процесів в інші регіони. Крім глобальних проблеми з'явилися й інші, такі як нестача

рухомого складу, який переорієнтований на військові потреби, нестача персоналу, відторгнутого війною. Проте, окремі проблеми вдалося досить швидко вирішити: 70 річна проблема різниці залізничних колій, відновлення рухомого складу за рахунок допомоги західних партнерів та волонтерів, альтернативні маршрути постачання.

Таким чином, можна зазначити, що війна в Україні лише загострила ті проблеми, які назрівали в міжнародних логістичних перевезеннях протягом періоду коронавірусу. Проте, проведені дослідження показали, що український логістичний транспорт досить успішно вирішує й ці проблеми і проблеми передислокації складської мережі. Але такий підхід потребує розробки певного алгоритму узгоджених дій, що мають бути оптимізовані з урахуванням економного використання ресурсів.

В подальшому вдосконалення запропонованого алгоритму можливо розглянути з точки зору оптимізації будь-яких ресурсів, що потрапляють в логістичний ланцюг, як матеріальних, фінансових, інформаційних, так і просторово-часових.

Ключові слова: логістика; транспортна логістика; логістичний бізнес; оптимальний маршрут; оптимізація маршрутів.

Shevchenko I., Klyus I.

PROBLEMS OF TRANSPORT LOGISTICS DEVELOPMENT IN UKRAINE UNDER MARTIAL LAW

The study considered the problems of modern logistics business in Ukraine, drew parallels with the main trends that were formed in the world during the coronavirus period, and considered the main directions of logistics flows and ways of their transformation due to the general international situation. In the study, it was determined that the so-called strategy of localization of logistics business began to take shape in the world, focused on the clustering of factories, transport companies, and especially consumers mainly in one region in order to avoid the risks of disruption of production and the impossibility of meeting the needs of consumers. The world is actively moving from the concept of "delivery on time" to "delivery on demand". This is another step towards system-wide resilience and flexibility. Perhaps in the future, a more radical shift from goods to services will ease the burden on supply chains.

But now debates about various forms of cooperation, such as nearshoring, onshoring, and transfer of business processes to other regions, are becoming relevant again. In addition to global problems, others appeared, such as a shortage of rolling stock reoriented to military needs, and a shortage of personnel rejected by the war. However, some problems were solved quite quickly: the 70-year-old problem of the difference in railway tracks, the restoration of rolling stock with the help of Western partners and volunteers, and alternative supply routes.

Thus, it can be noted that the war in Ukraine only exacerbated the problems that were brewing in international logistics transportation during the coronavirus period. However, the conducted studies have shown that Ukrainian logistics transport quite successfully solves these problems and the problems of relocation of the warehouse network. But such an approach requires the development of a certain algorithm of coordinated actions, which must be optimized taking into account the economical use of resources.

Further improvement of the proposed algorithm can be considered from the point of view of optimization of any resources entering the logistics chain, both material, financial, informational, and space-time.

Keywords: logistics; transport logistics; logistics business; optimal route; route optimization

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