

## **Adaptation of Logistics Companies to Functioning under the Restrictions Imposed by Military Operations**

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*Abstract:* - The logistics system serves all areas of life it has a direct impact on ensuring national security. Except for the number of specific risks that logistics naturally faces, it is one of the first to feel the negative consequences of global crisis phenomena. A large-scale military invasion was the most significant test for the logistics system of Ukraine. So, the article aimed to evaluate the financial indicators of logistics companies to determine their ability to adapt to the restrictions imposed by military operations. The research involved the following methods: analysis of coefficients, taxonomic analysis, and matrix analysis. The study found that the studied companies have insufficient adaptation potential in the field of finance. It was determined that the low values of the adaptation potential are associated with the insufficient level of liquidity, financial stability, business activity, and profitability of the studied logistics companies. The main problems are caused by insufficient working capital to cover the current debt, low level of financial stability and independence, diversion of funds, and low profitability.

*Key-Words:* - logistics companies, military operations, supply chains, financial indicators, integrated indicator, adaptation strategy

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## 1 Introduction

Logistics plays a leading role in virtually all areas of life - from everyday life to the country's national security. The need for increased attention to the logistics system is determined, among other things, by the fact that its operation is threatened by constant risks of various origins, [1], [2], [3]. In addition to specific industry risks, the logistics sector is exposed to increased threats on a global scale, [4], [5]. The recent COVID-19-related crisis and its consequences became a significant test for the logistics systems of all countries of the world, [6], [7]. The logistics system has been entrusted with such important functions as the delivery of the vaccine and patients with a positive test for the virus, [8], restructuring of supply chains to increase safety for people, [1], [9]. Disruptions in the logistics system during this period affected both the financial situation of logistics companies, [10], and individual industries, and the economic systems of countries as a whole, [11].

But ensuring the smooth operation of the logistics system is extremely important in wartime. The logistics system is tasked to evacuate people from areas of active hostilities, deliver humanitarian goods, transport military personnel and military equipment, provide the population with necessary goods and services under the threat of shelling, etc. Moreover, logistics companies are among the first to experience all the restrictions and problems associated with military operations: closing the sky and blocking seaports, destruction of highways, railways, and other infrastructure facilities, loss of employees and fixed assets, etc. That is why the issue of adapting logistics companies to function under the restrictions imposed by military operations is not only a problem for certain business entities, but also a matter of national security.

The Ukrainian case is worth noting when speaking about the operation of the logistics system in wartime and its appropriate adaptation. Ukrainian territories have become a training ground in a large-scale war levied by the Russian Federation. This carries numerous risks for the Ukrainian logistics system and also threatens various disruptions in global supply chains. Therefore, the experience of Ukraine is currently the most indicative for other countries and requires increased attention in terms of risks for the national and global logistics system.

The martial law in Ukraine has been in force for almost a year. During this time, Ukrainian researchers have conducted several thorough studies on the adaptation of logistics companies to activities under the restrictions imposed by military operations. Such studies focus on the organizational

aspects, as well as those related to the logistics of changes in the legislative framework, [12]. Some works deal with the need for changes in the strategy of logistics companies, [13], as well as other management problems related to restrictions imposed by military operations, [14]. Analysing and comparing such studies in terms of their content, it can be noted that they relate, for the most part, to the following areas:

- organizational aspects, as well as changes related to the logistics of the legislative framework;
- the need to make changes in the strategies of logistics companies;
- management problems associated with military restrictions.

That the changes in the logistics system primarily relate to the transformation of the supply structure: the transportation of commercial goods has significantly decreased, while the volume of humanitarian and military cargo transportation has increased. The researcher focuses on regulatory aspects in this area, in particular, on the introduction of a simplified procedure for importing humanitarian goods from abroad. The optimization of logistics processes is also an important aspect covered in the study. The author took into account the fact that after the invasion, it became possible to transport the cargo previously transported by sea or air by road transport only.

Unlike the previous study, the author, [12], investigates not only urgent problems and some organizational aspects but offers a more comprehensive approach to the optimization of the logistics system — a balanced logistics strategy. The researcher also takes into account not only existing problems but also ways of post-war recovery of the system. The author notes the digitalization strategy as the most effective strategy among those presented. The author also emphasizes the importance of strategic planning but does not propose a specific strategy, providing a methodology for building a matrix of strategic goals for the further development of an appropriate set of project solutions. Focus their research on the problems of the qualification of workers in the logistics sector required for the effective operation of companies in case of emergencies. The researcher considers the marketing aspects of innovative development under external fluctuations and uncertainty.

Other foreign researchers, except for Ukrainian ones, pay little attention to the adaptation of logistics companies to the restrictions imposed by military operations, [15], [16]. Besides, much attention is paid in the studies to the adaptation of

companies providing logistics services to changes in the environment in the context of globalization, digitalization, and the introduction of a green economy. Such concepts as “digital logistics”, [17], [18], [19], “Supply Chain 4.0”, [20], [21], [22], “green deliveries”, [23], [24], [25], logistics in the context of sustainable development, [26], [27], are often covered in the studies. In the author’s opinion, it is also appropriate to analyse those studies in this research, because the problems covered there are relevant both during martial law and during the future post-war restoration.

The aspects considered by the researchers and the recommendations that they developed are essential for the effective adaptation of logistics companies to the restrictions imposed by military operations. However, the studies lack an assessment of their financial capabilities, which have a direct impact on the success of adaptation. So, this study aims to assess the financial indicators of logistics companies to determine their ability to adapt to the restrictions imposed by military operations.

The aim involved the fulfillment of the following research objectives:

- form a sample and identify the main characteristics of logistics companies that are the objects of analysis;
- select and determine the main financial indicators for analysis;
- calculate an integral indicator of adaptation potential in the field of finance for logistics companies;
- formulate recommendations regarding further steps in the development of an adaptation strategy in the field of finance.

## 2 Literature Review

Authors in [13], examine organizational and some legislative aspects of civil logistics during martial law. The researchers note that the approaches to supply chains have changed significantly with the start of hostilities in Ukraine, which relates to the transfer of the main load to the transportation of military and humanitarian cargo.

Researcher in [14], emphasizes the need to adapt and adjust the supply chains and logistics of Ukrainian companies to wartime. In this regard, the researcher considers it necessary to build a matrix of strategic goals to serve as the basis for the development of logistics projects. The author’s work provides a methodology for evaluating indicators of strategic goals with the definition of criteria for selecting the most effective set of project

solutions. In their work, the researchers propose two types of adaptation strategies - reactive and proactive.

The paper, [13], identified the peculiarities of the adaptation of supply chain management during the war. The researcher notes that the issue of logistics development during military aggression by the Russian Federation (RF) has become a key topic for several international conferences, in particular Europe of the Carpathians on May 4, 2022 (Krasiczyn, Poland) and the Conference of European Directors of Roads on May 12-13, 2022 (Budapest, Hungary). At these conferences, attention was focused on issues related to the scope of damage that the war caused to the Ukrainian logistics system (destruction of highways, railway network, etc.). Besides, the problems of the blockade of Ukrainian ports, the “closed sky”, as well as the reform and financing of the reconstruction of the logistics system were discussed. The author in [13], notes that all these are important steps for restoring Ukraine’s logistics, but the choice of optimal strategies for its further development also requires attention. The researcher singles out creating own transport logistics, diversifying suppliers, adequate demand forecasting, improving the range, inventory management, automation, digitization, and robotization of supply chains among the noteworthy strategies that have proven to be the most effective for reforming the logistics system under pandemic restrictions.

Researchers in [15], deal with the transformation of professional competencies of logisticians with the aim of their adaptation to pandemics and wartime. An important development of researchers is detailed lists of new trends in the field of logistics, changes in logistics processes, and requirements for the professional competencies of logisticians in the current conditions.

Continuing the issue of companies’ adaptation to innovation and digitalization, it is appropriate to consider the work of authors, [20], which covers the problems and possibilities of adaptation of companies to the so-called Supply Chain 4.0. The emergence of such a chain is a consequence of the introduction of digital transformation and the Fourth Industrial Revolution. Supply chains are a key element of the logistics system, therefore their improvement and adaptation to the environment and various crisis phenomena (among which war is one of the largest) is a priority task for both logistics and other companies. In their work, the researchers consider the following new technologies that affect the adaptation of companies to Supply Chain 4.0:

big data, cloud computing, and 3D printing. The paper, [21], deals with the study of prospects and problems related to Supply Chain 4.0, studying, among other things, the nature of military Supply Chains 4.0 and how they differ from commercial ones.

A number of studies on the adaptation of logistics companies to the current global trends are focused on the emergence of the concept of green logistics. This direction is also relevant in wartime because military operations can be a source of significant threats to the environment. Among the studies on green logistics, the work of authors, [23], which presented the developed organizational and economic mechanism for implementing the concept of green logistics are worth noting.

The conducted literature review enables concluding that studies on the adaptation of logistics companies in wartime cover the following main directions: organizational and legislative aspects of the adaptation of logistics companies under martial law; development of adaptation strategies of logistics companies under the restrictions imposed by military operations; adaptation of the skills of specialists of logistics companies to work under martial law. Besides, a number of studies cover the adaptation of logistics companies in the context of the introduction of digitalization and the green economy. The analysis determined that the researchers paid the least attention to the financial aspects of the adaptation of logistics companies to the restrictions imposed by military operations. That is why this article deals with an attempt to describe the financial capabilities of logistics companies to adapt to the restrictions imposed by military operations.

### 3 Methods

#### 3.1 Research Design

The methodological approach, which was used during this research, is based on the analysis of the financial ratios of the studied companies and the determination of an integral indicator of adaptation potential in the field of finance by the taxonomy method, followed by drawing conclusions and making recommendations. This approach requires dividing the analysis procedure into several stages.

The first stage of the research is the calculation of the main financial indicators for further analysis. The indicators for the financial analysis of logistics companies were selected considering the importance and influence of financial indicators on the company's operation in times of crisis. The

selected indicators were supposed to reflect in a certain way the reserves of companies that can be used in the conditions of significant shocks, in other words, their potential in terms of adaptation opportunities. These indicators included:

- Coverage Ratio - indicates the sufficiency of working capital to cover short-term liabilities, and therefore indicates the state of liquidity and solvency of the studied companies;
- Financial Autonomy Ratio - indicates the level of financial stability in general, and also the degree of independence of the company from external creditors;
- Receivables Turnover Ratio - shows whether the company's customer lending policy is sufficiently effective in terms of payment for goods sold and services provided on credit;
- Accounts Receivable (AR)/Accounts Payable (AP) Ratio - shows the degree to which the company can credit buyers at the expense of suppliers;
- Rate of Return - demonstrates the profitability of the company's costs, indicating the level of their efficiency.

The identified indicators describe the financial condition of logistics companies in four areas: ensuring liquidity, financial stability, business activity, and profitability. In the author's opinion, the analysis of these indicators can provide the most general understanding of the financial readiness of logistics companies for future shocks, in particular, operations under martial law, and therefore their adaptation capabilities. The selected financial indicators were calculated based on the financial statements of the studied companies. Based on the obtained calculation results, the problems that such deviations may indicate were analysed by analysing the deviations of the actual values of the financial indicators from the normative ones.

The second stage involved the calculation of an integral indicator of adaptation potential in the field of finance for the studied logistics companies based on the calculated financial ratios. The method of taxonomic analysis was used for this purpose, and the levels of adaptation potential of the studied companies were compared and analysed based on the calculation results.

The third stage of the study provides for making recommendations for further steps in the development of an adaptation strategy in the field of finance. For this purpose, it is proposed to use the matrix method of analysis, namely, the matrix of correspondence of adaptation measures to the identified problem factors. This matrix is equal to  $(a_{ij} / p_{ij}; i = \overline{1, m}; j = \overline{1, n})$  and is intended to

determine the compliance of adaptation measures with problem factors. The elements of the matrix are the relationship coefficients between the  $i^{\text{th}}$  problem factor and the  $j^{\text{th}}$  measure. The values of  $a_{ij}$  are determined as follows:  $a_{ij} = 1$ , if the  $j^{\text{th}}$  measure is adequate for the process of neutralization of the  $i^{\text{th}}$  factor;  $a_{ij} = 0$  – in the opposite case. When selecting the  $j^{\text{th}}$  adaptation measure, it is necessary to consider the probability  $p_{ij}$  of transition to the desired state. The determined measures are the basis for building an adaptation strategy for logistics companies in the field of finance.

The entire research process is accompanied by appropriate tables, histograms, and matrices, which are the result of the use of graphic methods to visualize the obtained results.

### 3.2 Sampling

The sample of companies for the research included four international logistics companies that have branches in Ukraine, namely: Kuehne+Nagel Subsidiary Company, Raben Ukraine LLC, FM Logistics Dnipro Subsidiary Company, and DSV Logistics LLC. The choice of these companies is determined by the fact that they belong to the four largest logistics companies operating in Ukraine (according to [28]). The choice of companies operating in Ukraine was made in view of the subject of this research, which reduced the scope of the research to the study of the adaptation of logistics companies to functioning in the restrictions imposed by military operations. Given the fact that

Ukraine is currently under martial law, this country is the most appropriate case study. This is explained, among other things, by the fact that military operations on the territory of the country disrupt not only the Ukrainian logistics system but also global supply chains. Besides, Ukraine has common borders with the EU countries, and these countries are among the first to bear losses caused by the military aggression of the Russian Federation on the territory of Ukraine. Millions of refugees, as well as humanitarian and military cargo, cross the borders of Ukraine and the EU, which creates an additional burden on the logistics system and necessitates the search for adaptation opportunities both within national borders and globally. Table 1 provides a brief description of the companies selected for the study.

Table 1. General characteristics of logistics companies

	Kuehne+Nagel	DSV Logistics	FM Logistics Ukraine	Raben
Revenue (as of the end of 2019, UAH million)	1,100	900	800	600
Country of origin	Switzerland	Denmark	France	Netherlands
Year of establishment	1890	1976	1967	1931
Has offices in countries (number of countries)	109 (1400 offices)	80	14	12 (countries of Europe)
Working in Ukraine since	1992	2013	1996	2003
Main services	Transit, export, and import of goods, container, and intermodal transportation, insurance and customs brokerage services, project logistics, consolidation of goods at the company's warehouses in ports around the world, and delivery of goods.	Auto, air and sea container transportation, design and warehouse logistics, distribution, insurance, and customs brokerage services.	Distribution of consumer goods, cosmetics, beauty products, industrial items, as well as health care products.	Warehouse logistics, international and domestic cargo transportation, customs services, sea freight services, contract, and fresh logistics.

Source: based on [28]

### 3.3 Information Background

The information background of the research is Ukrainian academic periodicals, as well as articles from other foreign researchers. Besides, the researchers used the data publicly available at Lading, [28] and Clarity Project, [29]. The Clarity Project website contains the financial statements of the investigated companies, which were used in the course of the study, and Lading was used to determine the sample of the largest logistics companies for the article.

## 4 Results

### 4.1 Selection and Calculation of the Main Financial Indicators for Analysis

At the first stage of the analysis, it is appropriate to evaluate each individual indicator (see Table 2) for the studied companies. It is worth noting that the values of the Coverage Ratio are within the norm (1.5 - 2) for all companies, except DSV Logistics LLC, which has this value below the norm. This may indicate insufficient working capital to finance short-term debts. In turn, when the coefficient ranges within the norm, this indicates a sufficient level of solvency, implying sufficient own working capital for the settlement of current liabilities. Accordingly, such companies are less likely to become bankrupt and do not incur penalties for late payment of interest on obligations. The Financial Autonomy Ratio, which normally should exceed the value of 0.5, has insufficient values in Kuehne+Nagel (0.45), DSV Logistics LLC (0.23), and Raben Ukraine (only 0.02). The Financial Autonomy Ratio demonstrates the share of equity capital in the total contributions to the company, so its decrease may indicate an increased company dependence on external sources of financing.

The Receivables Turnover Ratio is defined as the ratio of net income to weighted average receivables and does not have clear normative values, so the correspondence of this indicator to a positive trend should be evaluated in comparison with industry average values. Among the studied companies, DSV Logistics LLC (8.38) is the leader in terms of the Receivables Turnover Ratio. This indicates that this company most effectively manages the debts of customers and other debtors. The AR/AP Ratio should be approximately equal to one, which is matched only by the indicator of DSV Logistics LLC. In other companies, the values of this indicator exceed the standard, which may indicate the diversion of funds, and may determine

the need to attract expensive loan funds from banks in the future. The Rate of Return represents the percentage net gain or loss of an investment's initial cost and does not have clear normative values, and the tendency toward its growth is always a positive characteristic of the company. Raben LLC is characterized by the highest Rate of Return.

### 4.2 Determining the Integral Indicator of Adaptation Potential in the field of finance

It is necessary to determine an integral indicator based on the data calculated above to understand the positions of companies relative to each other, as well as to determine their general adaptability. Because the calculated indicators testify to the ability of companies to adapt in times of crisis in terms of the financial aspect, this indicator can be defined as an integral indicator of the adaptation potential in the field of company finances.

It is necessary to standardize the raw data, as well as to determine which of them are stimulators and which are destimulators, to calculate the integral indicator through the taxonomic method. Among all the studied indicators, the AR/AP Ratio can be defined as a destimulator, which is within the norm (about 1) only in DSV Logistics LLC, while its value is significantly higher than the norm in all other companies. Although a significant deviation of this indicator from one in the opposite direction (less than one) is also a negative dynamic. In such a case, this indicator can be defined as a disincentive, because the lowest value of the indicator among the studied companies is at the same time the most desirable. Besides, it is suggested to remove the Receivables Turnover Ratio from further analysis, because it largely depends on the company's policy and the specifics of its activity.

Therefore, its "ideal" value can be individual for each company, and the comparison of such values between different companies can significantly affect the results of the calculation of the integral indicator, distorting them. In other words, if the receivables turnover of one company is many times higher than the same indicator in another company, this does not mean the unconditional advantage of the first company. It may be related, for example, to the fact that the cost of attracting additional loans for the provision of commodity credits of the second company exceeds the profit from increased sales. In this case, a decrease in the receivables turnover will be positive. Therefore, the final matrix of standardized values, calculated in STATISTICA, looks as follows (Table 3). The calculated integral indicators for evaluating

the adaptation capabilities of logistics companies are presented in Table 4.

Table 2. Main financial indicators for assessing the adaptation capabilities of logistics companies

	Kuehne+Nagel Subsidiary Company	DSV Logistics LLC	FM Logistics Dnipro Subsidiary Company	Raben Ukraine LLC
Coverage Ratio	1.67	1.27	1.72	1.71
Financial Autonomy Ratio	0.45	0.23	0.66	0.02
Receivables Turnover Ratio	5.24	8.38	5.33	6.42
Accounts Receivable (AR)/Accounts Payable (AP) Ratio	1.66	0.99	2.43	1.31
Rate of Return	0.14	0.09	0.18	0.36

Source: own calculations based on [29]

Table 3. Initial data for the calculation of integral indicators of adaptation potential in the field of finance for logistics companies

	Coverage Ratio	Financial Autonomy Ratio	Accounts Receivable (AR)/Accounts Payable (AP) Ratio (destimulator)	Rate of Return
Kuehne+Nagel Subsidiary Company	0.365738596	0.393335838	0.107738494	-0.410591409
DSV Logistics LLC	-1.493404312	-0.39558183	-0.980495936	-0.877086491
FM Logistics Dnipro Subsidiary Company	0.572884287	1.160605513	1.343618315	-0.141360641
Raben Ukraine LLC	0.554781429	-1.15835952	-0.470860873	1.429038541

Source: own calculations

Table 4. Integral indicators of adaptation potential in the field of finance for logistics companies

Company	The value of the integral indicator
Kuehne+Nagel Subsidiary Company	0.3781
DSV Logistics LLC	0.054903
FM Logistics Dnipro Subsidiary Company	0.235043
Raben Ukraine LLC	0.352465

Source: own calculations

The maximum value of the integral indicator can reach 1, and the closer the calculated value of the indicator for each company is to one, the higher its adaptation potential in the field of finance. It should be noted that, in general, all companies have a low adaptation potential in the field of finance — its value is even lower than the average (0.5). Analysis of the companies' activities according to the individual components of the integral indicator determined that the main problems of the companies are concentrated around insufficient working capital to cover current debt (DSV Logistics), insufficient financial stability and independence (Kuehne+Nagel, DSV Logistics, Raben Ukraine), diversion of funds, which may cause the need to attract expensive loans

(Kuehne+Nagel, FM Logistics Dnipro, Raben Ukraine), as well as relatively low profitability (DSV Logistics).

### 4.3 Recommendations Regarding Further Steps in the Development of an Adaptation Strategy in the Field of Finance

Further steps in improving the adaptation of logistics companies to the restrictions imposed by military operations should include the determination of measures to increase adaptation in response to the identified problems, as well as building a strategy for the adaptation of companies in the field of finance.

The first stage of the said approach involves determining the existing problems in the activity of logistics companies. According to the results of the conducted research, the main problems can be attributed to:

- insufficient working capital to cover current debt;
- insufficient financial stability and independence;
- low profitability of spending.

It is also necessary to select adaptation measures that can potentially contribute to the improvement of logistics activities and the solution of existing problems. The activities can be selected by using the matrix presented in Table 5.

Table 5. Matrix of compliance of adaptation measures with identified problem factors

		Adaptation measures				
		m <sub>1</sub>	m <sub>2</sub>	m <sub>3</sub>	...	m <sub>n</sub>
Problem factors/ probability of transition to the desired state	k <sup>f</sup> <sub>1</sub> /p <sub>1</sub>	a <sub>1,1</sub> /p <sub>1,1</sub>	a <sub>1,2</sub> /p <sub>1,2</sub>	a <sub>1,3</sub> /p <sub>1,3</sub>	...	a <sub>1,n</sub> /p <sub>1,n</sub>
	k <sup>f</sup> <sub>2</sub> /p <sub>2</sub>	a <sub>2,1</sub> /p <sub>2,1</sub>	a <sub>2,2</sub> /p <sub>2,2</sub>	a <sub>2,3</sub> /p <sub>2,3</sub>	...	a <sub>2,n</sub> /p <sub>2,n</sub>
	...	...	...	...	...	...
	k <sup>f</sup> <sub>i-1</sub> /p <sub>i-1</sub>	a <sub>i-1,1</sub> /p <sub>i-1,1</sub>	a <sub>i-1,2</sub> /p <sub>i-1,2</sub>	a <sub>i-1,3</sub> /p <sub>i-1,3</sub>	...	a <sub>i-1,n</sub> /p <sub>i-1,n</sub>
	k <sup>f</sup> <sub>i</sub> /p <sub>i</sub>	a <sub>i,1</sub> /p <sub>i,1</sub>	a <sub>i,2</sub> /p <sub>i,2</sub>	a <sub>i,3</sub> /p <sub>i,3</sub>	...	a <sub>i,n</sub> /p <sub>i,n</sub>
	k <sup>f</sup> <sub>i+1</sub> /p <sub>i+1</sub>	a <sub>i+1,1</sub> /p <sub>i+1,1</sub>	a <sub>i+1,2</sub> /p <sub>i+1,2</sub>	a <sub>i+1,3</sub> /p <sub>i+1,3</sub>	...	a <sub>i+1,n</sub> /p <sub>i+1,n</sub>
	...	...	...	...	...	...
	k <sup>f</sup> <sub>m</sub> /p <sub>m</sub>	a <sub>m,1</sub> /p <sub>m,1</sub>	a <sub>m,2</sub> /p <sub>m,2</sub>	a <sub>m,3</sub> /p <sub>m,3</sub>	...	a <sub>m,n</sub> /p <sub>m,n</sub>

The following main adaptation measures in response to identified problems in the activities of the logistics companies under study can be distinguished:

1. Increasing the volume of production and sale of goods and services of companies.
2. Improving the quality of manufactured goods and services through technological innovations, re-equipment, as well as the introduction of innovations in the activities of companies.
3. Realization of excess movable and immovable property or leasing of such property.
4. Reduction of the cost of goods and services due to a more balanced and rational use of material resources, areas, labour, and time.
5. Diversification of activity (mastery of new areas of activity, as well as penetration into other areas, coverage of new niches, etc.).
6. Support communication with the scientific sector regarding the organization of scientific research, conducting market analysis, and researching the behaviour of consumers and competitors.
7. A balanced strategy for building mutual relations with suppliers, buyers, intermediaries, etc.
8. Implementation of a more effective policy regarding the costs, their reduction, as well as the application of the latest methods of cost management.
9. Reduction of the time interval between shipment and payment of goods and services or provision of overpayment for them.
10. Acceleration of the turnover of own capital to reduce its deficit through shortening of the commercial cycle, the reduction of inventory balances, the volumes of which exceed the norm, the reduction of unfinished production, etc.
11. Introduction of advanced norms, regulations, modern resource-saving, and ecological technologies.
12. Implementation of effective methods of optimizing the structure of assets, as well as the policy of financing and rational use.
13. Ensuring the maximum possible volume of attracting financial resources at the expense of own sources.
14. Calculation of the optimal maximum amount of borrowed funds.
15. Balanced assessment of the cost of raising borrowed funds from various sources.
16. Selection of the most favourable credit terms, as well as ensuring the most efficient use of credit funds.
17. Application of the optimal policy of financing current assets.
18. Conducting an analysis of the company's current assets for previous periods to optimize their volume, the ratio of fixed and variable parts, ensuring the appropriate level of liquidity, accelerating turnover, etc.
19. Purposeful use of profit and ensuring the achievement of planned indicators.
20. Analysis of cash flows and other directions.

The second stage of the mentioned approach provides for applying the matrix model for selecting the measures that are the most suitable for solving the existing problems. A matrix is built for this purpose, the columns of which correspond to the identified problems, and the lines to the identified adaptation measures. In the matrix cells, the efficiency of the adaptation measure to solve the specified problem is calculated at the intersection of each problem with each measure by using the formula:

$$\text{The effectiveness of the measure} = \frac{\text{correspondence of the } i^{\text{th}} \text{ measure to the solution of the } j^{\text{th}} \text{ problem}}{\text{the probability of transition to the desired state}}$$

The correspondence of the  $i^{\text{th}}$  measure to the solution of the  $j^{\text{th}}$  problem can take the value 1 or 0, where 1 – the measure corresponds to the problem, and 0 – it does not. When the value is equal to 0, this measure is excluded from the list, when the value is equal to one, it remains for further analysis.

The probability of the system transitioning to the desired state shall be determined by the company’s specialists. In other words, it is individual for each specific company or situation. It can take values from 0 to 1, where 0 means that there is no possibility of solving the problem, and 1 — the implementation of the measure will completely solve the problem. Intermediate values indicate a decreased probability of solving or a partial solution to the problem when applying the corresponding measure. If the value is 0.5, the corresponding measure has a 50% probability of solving the problem.

The matrix given in Table 5 with the calculated values of the correlation coefficients between the  $i^{\text{th}}$  measure and the  $j^{\text{th}}$  problem can be an example of the implementation of this method.

Table 6. Matrix of compliance of adaptation measures with identified problem factors for DSV Logistics LLC

	#	Problem factors/probability of transition to the desired state		
		insufficient working capital to cover current debt	insufficient financial stability and independence	low rate of return
Adaptation measures	1	0	0	1
	2	0	0	1
	3	0	0	1
	4	0	0	1
	5	0	0	1
	6	0	0	1
	7	0	0	1
	8	0	0	1
	9	1	0	0
	10	1	1	0
	11	0	0	1
	12	1	0	0
	13	0	1	0
	14	1	1	0
	15	0	1	1
	16	1	1	1
	17	1	0	1
	18	1	0	0
	19	0	0	1
	20	0	0	1

Table 6 shows the matrix of compliance of adaptation measures with identified problem factors

for DSV Logistics LLC as the company with the lowest integral indicator of adaptation potential in the field of finance for logistics companies. The matrix is transposed for more convenient visualization of the results. The upper row of the matrix contains the problematic factors identified for the company, and the left column — a list of adaptation measures. The correlation coefficients between the  $i^{\text{th}}$  problem factor and the  $j^{\text{th}}$  measure were calculated considering the assumption that each adaptation measure, determined as appropriate for individual problem factors, can bring the system to the desired state in full. That is, when the determined measure corresponds to the problem factor, the numerator gets one, and the probability of the system transitioning to the desired state is also equal to one. Therefore, the values at the intersection of problems and corresponding adaptation measures are also equal to one. In practice, such a calculation should contain the probability of the system transitioning to the desired state, determined based on expert assessments and/or information that is internally used by the company.

Evaluating the matrix in Table 5, it can be noted that measures 9, 10, 12, 14, 16-18 can be applied to solve the first problem (insufficient working capital to cover current debt). Measures 10, 13-16 are effective for solving the problem of insufficient financial stability and independence. The problem of low profitability of spending can be solved by applying measures 1-8, 11, 15-17, 19, 20. When implementing this methodology in practice, the probability of the transition of the system to the desired state is also taken into account. The higher it is, the more priority the measure will be from the point of view of the sequence of its implementation.

The next step should be the development of an integrated adaptation strategy taking into account the identified measures. The company should include these measures in its strategic plan, and determine the sequence of their implementation, resources for implementation, time frame, etc.

## 5 Discussion

The analysis carried out in the article gives grounds to note that the adaptation potential of the studied logistics companies is not high enough: the highest of the calculated values is 0.3781, while the maximum possible value is equal to one. This is due to a number of problems existing in the companies’ activities, which are evidenced by the values of the calculated financial ratios. The analysis identified the following problems:

- insufficient working capital to cover the current debt in DSV Logistics;
- insufficient financial stability and independence of the companies of Kuehne+Nagel, DSV Logistics, Raben Ukraine;
- diversion of funds, which causes the need to attract expensive loans from the companies Kuehne+Nagel, FM Logistics Dnipro, Raben Ukraine;
- low rate of return in DSV Logistics.

It is proposed to improve the opportunities for adaptation of the studied companies under martial law by applying the matrix of adaptation measures to the identified problem factors. A few adaptation measures, which can positively affect the solution of the identified problems to the extent that is established by determining the probability of the system's transition to the desired state, were selected for the matrix. The proposed approach and defined measures should be compared with the proposals of other researchers regarding the adaptation of logistics companies during the war and in general in a highly uncertain environment and fluctuations.

Researchers in [13], point out that a fundamental restructuring of supply chains is the only opportunity for Ukrainian logistics to recover and adapt in wartime. This need derives from several problems faced by Ukrainian logistics at the beginning of a full-scale military invasion: the inaccessibility of seaports and flights, problems related to the transportation of humanitarian goods, in particular, the lack of financial opportunities and human resources for this, the change of usual routes, the need for rapid optimization of processes, etc. The problems indicated by the researcher can be partially solved by assessing the financial capabilities of companies, building a matrix of adaptation measures to the identified problem factors, and developing an adaptation strategy according to the methodology proposed in this article.

Matrix models are also used in the research of the author in [14], who examines the process of making project decisions regarding the implementation of projects in the field of distribution logistics under the restrictions imposed by military operations. In the work of researchers, two matrices are the result of the approach to the assessment of indicators of the measurement of strategic goals with the determination of criteria for selecting the most effective set of project solutions. The first describes the strategic goals of the project, and the second contains an assessment of the effectiveness of project decisions while achieving

such goals. Therefore, the application of matrix models while building an effective strategy intended for the adaptation of logistics companies to the restrictions imposed by military operations is one of the most often used and effective tools for optimizing their activities.

The paper, [18], investigated building adaptive strategies of logistics companies against disruptions in their activities. The researchers divide such strategies into two types: reactive, which contributes to the restructuring of the system in response to a failure, and proactive, which involves the use of certain actions against a failure that may occur in the future. Considering that indicators calculated before the crisis were taken for the analysis carried out in the study, it was possible to build an effective proactive strategy based on their assessment - in case companies could foresee a crisis caused by a full-scale invasion. However, as the experience and catastrophic losses of the logistics system show, companies were not prepared for this crisis.

Several researchers emphasize the effectiveness of introducing digitization into the logistics system, in particular, to increase its effectiveness in the course of military operations. The author in [15], notes that the implementation of adequate innovative solutions has the same importance as a balanced reduction of costs by the company. Organizations that were able to find appropriate innovative solutions not only did not lose their positions during the pandemic and with the beginning of the war but also were able to gain a stronger foothold in the market. In the field of digitization, the researcher especially singles out IoT (Internet of Things) technology. Other works of researchers, [17], also note the effectiveness of using such technologies as artificial intelligence, programmatic advertising, chatbots, video marketing, visual search, predictive and augmented analysis, and neuromarketing in the logistics system. An analysis by authors in [24], focuses on the three main technologies used to adapt companies to Supply Chain 4.0 — big data, cloud computing, and 3D printing. Digitalization also plays a significant role in the context of building an adaptation strategy in the field of finance, because the process of building a strategy and preliminary calculations are related to the analysis of a large amount of data, which is much easier and faster to do using the latest software technologies and methods.

Continuing the subject of Supply Chain 4.0, it is appropriate to note that this concept plays one of the leading roles in the context of military operations.

The paper, [25], noted that supply chain 4.0 is the support of military strategy, tactics, and operations, which cannot be sustainable without effective logistics. The researchers also noted that the main difference between the military supply chain and the commercial one is the focus primarily on security, and not on profit maximization. This factor can cause conflicts to arise in joint defense and commercial companies. This can be defined as another reason to attract attention to the financial aspects of adaptation of logistics companies in wartime.

Other current trends, the need to adapt to which is acutely faced by logistics companies, can refer to both peacetime and wartime. Researchers in [16], determined the main trends: increased requirements for security and transparency of supply chains; disruptions in production, delays, limitations of volumes and delivery routes; transition from globalization to localization; development of electronic commerce; remote work in companies; development of green supplies, etc. Foreign researchers from other countries often provide an analysis of the problems of adaptation of logistics companies in the conditions of the spread of green logistics. Authors in [27], proposed an organizational and economic mechanism that allows not only to reduce the costs of managing logistics flows but also to increase environmental safety. Were considered green deliveries not only from the perspective of their impact on ecology but also in the context of ensuring people's safety from infection during the pandemic, [30]. Considering the relevance of the concept of green logistics in the current conditions, its consideration during the development of adaptation strategies of logistics companies in the field of finance is appropriate even under martial law. First, war has a direct negative impact on ecology (fires, air pollution because of burning, destruction of flora and fauna caused by hostilities, disturbance of animals, biological, chemical, and other types of pollution caused by the use of certain types of weapons, etc.). Second, despite the hostilities, the Ukrainian government continues to actively build plans, in particular, in relation to integration, there is the European Union, which has strict rules regarding ecology. Therefore, the financial planning and strategic management in logistics companies must consider the environmental component, which can increase the costs of implementing ecological technologies, but save money in the future through the use of resource- and energy-saving technologies, as well as improve the image of companies and attract the attention of socially conscious consumers. For

example, Kuehne+Nagel studied in the article plans to achieve zero carbon dioxide emissions by 2030.

### 5.1 Research Limitations

This study is limited by the lack, at the time of writing, of the reporting of the companies under study for 2022, the year when the military restrictions came into effect. However, given that the article studied the adaptive capabilities of companies, the reporting for 2021 fully met the goals of the study – the indicators calculated based on its data demonstrated the readiness of logistics companies for the upcoming shocks.

## 6 Conclusions

The research carried out in the article is a thorough analysis of the financial condition of logistics companies to assess their readiness for a shock and the possibilities of adapting to it. Five indicators related to the assessment of financial stability, liquidity, business activity, and profitability of companies were selected for this purpose, namely: Coverage Ratio, Financial Autonomy Ratio, Receivables Turnover Ratio, Accounts Receivable (AR)/Accounts Payable (AP) Ratio, Rate of Return. These indicators were determined by using data from the financial statements of logistics companies for 2021. The studied companies include Kuehne+Nagel, Raben Ukraine, FM Logistics Dnipro, and DSV Logistics, which are the largest international logistics companies with representative offices in Ukraine.

The calculated values of financial indicators for each company were analysed to identify the main problems in their financial activities. An integral indicator was determined by the taxonomy method to get an understanding of the position of companies relative to each other and to determine their adaptation potential in the field of finance. According to the results of the calculation, it can be noted that Kuehne+Nagel has the highest adaptation potential in the field of finance (0.38). Raben Ukraine (0.35) ranks second in the composite rating, FM Logistics Dnipro ranks third (0.24), and DSV Logistics LLC (0.05) is last in the ranking.

At the last stage of the research, further steps are proposed for building an adaptation strategy for logistics companies in the field of finance. The correspondence matrix of adaptation measures to the identified problem factors is provided for this purpose. This matrix is built individually for each company, therefore, the article presents its generalized layout. The matrix is used to select the most effective measures from the initial sample of

adaptation measures to eliminate the identified problematic factors with due regard to the probability of the system transitioning to the desired state. This means that all possible adaptation measures designed to optimize activities/counteract negative factors are offered at the first stage. In the second stage, these measures are evaluated by applying a matrix according to two criteria: the correspondence of the measure to the identified problem and the probability of eliminating the problem through this measure. The correspondence can take a value of 1 or 0, and the probability of elimination ranges from 0 to 1. The ratio of these criteria determines the score for each factor. The higher the score, the more effective the measure. The adaptation measures selected through this matrix are used for the further development of the adaptation strategy of logistics companies in the field of finance. Such adaptation measures have the highest ratings based on the results of the calculation of the ratio of the correspondence of the measures with the problem factors to the probability of eliminating the problem, in other words, the probability of the system transitioning to the desired state. This implies including the most effective measures in the company's strategic plan, and determining the resources, time periods, etc. necessary for the implementation of the measures.

Further research in this field should be related to the analysis of the possibilities of applying innovative technologies during the development of adaptation strategies of logistics companies in the field of finance, including big data technologies.

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