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METHODOLOGICAL SUPPORT FOR EVALUATING ECONOMIC EFFICIENCY FOR REALIZATION OF LOGISTICS IN AVIATION SPHERE

Volodymyr Reznik. "Methodological support for evaluating economic efficiency for realization of logistics in aviation sphere". Calculation and estimation of economic efficiency of the logistics activity is essential for further operation of every enterprise. It should be noted, that logistics composes one of the main expenditures of every enterprise. In order to optimize the operating processes of manufacturing and increase the effectiveness of the enterprise's activity, the main approach is investigated by the author. The approaches can be relied on costs correlation analysis, Direct and indirect costs are also investigated. Analysis of costs and benefits and estimation of coefficient of logistics performance index in the scale of enterprise are also investigated. All the noted methods of economic efficiency of logistics were compared and recommendations for choosing an optimal variant depends on enterprises requirements and priorities were also developed.

Keywords: Economic efficiency, neural networks, method of analysis and comparing, economic indicators, economic efficiency indicator, profitability level, economic feasibility.

Володимир Резнік. "Методичне забезпечення оцінки економічної ефективності реалізації логістики в авіаційній сфері". Розрахунок та оцінка економічної ефективності логістичної діяльності є важливим для подальшого функціонування кожного підприємства. Слід зазначити, що логістика становить одну з основних статей витрат кожного підприємства. З метою оптимізації операційних процесів виробництва та підвищення ефективності діяльності підприємства автор досліджує основний підхід. Підходи можуть спиратися на аналіз кореляції витрат, також досліджуються прямі та непрямі витрати. Також досліджується аналіз витрат і вигод та оцінка коефіцієнта логістичної ефективності в масштабі підприємства. Було порівняно всі зазначені методи оцінки економічної ефективності логістики, а також розроблено рекомендації щодо вибору оптимального варіанту залежно від потреб та пріоритетів підприємства.

Ключові слова: Економічна ефективність, нейронні мережі, метод аналізу та порівняння, економічні показники, показник економічної ефективності, рівень рентабельності, економічна доцільність

Introduction. Estimation of the economic return on logistics processes is an

integral part of the economy of the enterprise and it's operating activity, because logistics

usually accounts for a large share of financial costs and can significantly change a company's position in the market. A key method for determining this efficiency is based on comparing the costs required by logistics activities with the benefits that these activities generate. This article is the logical continuation of the number of publications, which were devoted to the evaluation of the economic efficiency of the logistics at enterprises of scientists as: Petryk I.V., Bochko O.Yu. [3, 5, 6], Molnar O.S., Paliychuk E.S., Kovtyuk Y.I. [7, 8, 9] and other Ukrainian and foreign scientists.

The purpose of the article is to provide the research of the theoretical foundation of methodological recommendation of estimation the economic efficiency of aviation logistics on the average enterprise's example. Comparing the methods of forecasting and calculation of the economy effectiveness of the enterprise and developing the recommendations of choosing the most optimal variant according to values and financial characteristics of the enterprise.

Presentation of the main results.

Methodological support for evaluating economic efficiency for realization of logistics in aviation sphere

Evaluating how economically effective a company's logistics processes are constitutes a crucial aspect of overall enterprise economy, business administration, given that transportation and warehousing expenditures frequently represent a substantial portion of overheads and possess the capacity to greatly influence market standing.

The evaluation framework centers on several vital components: expenditure related to moving goods, warehousing, managing freight, administrative overhead, and various supplementary logistical activities. Conversely, it also accounts for the income stemming from optimized logistical performance. Expenses are categorized as either immediate (such as fuel expenditure or leasing warehouse space) or deferred (for

instance, financial impacts from failing to meet scheduled deliveries, expenses linked to surplus stock, etc.) [1-4]

According to observations made by A. Suleymanov in 2021, various techniques exist for gauging the economic effectiveness of logistics operations. Specifically, the cost-benefit analysis stands out as a highly prevalent and readily graspable technique, enabling organizations to straightforwardly juxtapose the aggregate expenditures associated with logistics functions against the resultant gains. This particular methodology proves advantageous for preliminary evaluations and making swift, near-term determinations. Nevertheless, its primary drawback lies in its failure to incorporate non-monetary advantages, for instance, enhancements to a company's standing or a superior customer journey.

Modern artificial neural networks represent a powerful instrument capable of handling substantial volumes of information and accounting for intricate dependencies among various factors. Their utility shines particularly brightly within fluid market environments that necessitate immediate, up-to-the-minute data interpretation. Nevertheless, deploying these systems brings with it considerable demands on computational power and necessitates personnel possessing the requisite technological expertise.

The logistical performance indicator offers a rapid gauge of how effectively logistics operations are functioning, employing a straightforward calculation comparing revenue against expenditures. This approach proves particularly handy for swift evaluations when achieving a result promptly takes precedence over detailed scrutiny. Nevertheless, its scope is restricted because it fails to incorporate variables originating externally, like shifts in market dynamics or broader economic climates. Conversely, employing economic and mathematical simulation techniques delivers superior forecast precision and facilitates the streamlining of logistical workflows.

For further investigation and more concrete analysis the Table of comparing of the evaluation method of economic efficiency is performed by the author.

Table 1. Comparison of methods for assessing the economic efficiency of logistics

Estimation method	Advantages	Disadvantages
Analysis of loses and benefits	Clearance of the results, absence of difficulties during the application	Financial benefits cannot be taken into account
Logistics coefficient indicator	It is applicable for rapid results evaluation	Internal factors cannot be taken into account
Economy and mathematical modelling	It has the possibilities of being optimized, higher accuracy of forecasting	Difficulties in model construction, requiring complex database
Neural network	Ability to process large amounts of data, taking into account complex relationships	High requirements for computing resources, need for specialized skills

Source: Developed by the author.

Consequently, selecting the appropriate technique for gauging the economic viability of logistics operations is contingent upon the organization's distinct requirements, the resources at its disposal, and the required granularity of the investigation. Straightforward approaches, like evaluating costs against benefits or employing performance metrics, work well for rapid evaluations, whereas techniques such as econometric modeling or employing neural networks offer greater efficacy for intricate and protracted.

To evaluate performance, a composite metric is employed, merging economic, functional, ecological, and societal dimensions of supply chain functions. Specifically, the Logistics Performance Index (LPI), tailored for the air transport sector, might incorporate metrics like the swiftness of freight handling, adherence to green guidelines, and cost-effectiveness. Following this performance appraisal, avenues for improvement are pinpointed, such as implementing mechanized systems for freight movement, refining stock control methods, or streamlining transport pathways. These suggestions, derived from the collected evidence, aim to resolve critical constraints hindering the smooth functioning of logistics frameworks.

From the outset, establishing a set of crucial performance metrics that capture the entirety of logistical operations is paramount. These metrics specifically encompass expenditure, the timeframe required for logistics tasks, the standard of service delivery, and ecological considerations. Expense analysis should cover operational overhead, fuel expenditures, costs associated with aircraft upkeep, storage fees, and customs processing charges. Time-related metrics evaluate the length of time needed for freight handling, the rapidity of transport, and compliance with established timetables. Service excellence is evaluated by gauging customer contentment levels, the frequency of service disruptions, and instances of lost freight. Pertaining to environmental impact, metrics should track the amount of carbon dioxide released and overall energy utilization [5-10].

Contemporary digital instruments, including transport management systems (TMS) and warehouse management systems (WMS), serve the purpose of gathering and refining information. Information pertaining to expenditures, throughput, established pathways, and the client roster undergoes meticulous scrutiny to facilitate sound administrative choices. This process yields an exhaustive examination of logistical

operations, forming the foundation for subsequent simulation [11].

Simulating logistics flows necessitates scrutinizing diverse hypothetical situations, particularly those factoring in shifts in market demand, meteorological factors, and regulatory shifts. A crucial phase involves deploying a cost-benefit evaluation, which furnishes an appraisal of the financial viability associated with logistical activities. This

methodology enables the quantification of the aggregate expenses incurred during the execution of the logistics chain and their comparison against the advantages secured, for instance, augmented earnings, quicker fulfillment durations, or enhanced patronage contentment.

For deeper analysis and complex forecasting the results, the Table 2 was developed by the author.

Table 2. Visualization of key indicators of economic efficiency of logistics in the aviation industry

Category:	Indicator	Units of measurement	Goal and meaning
Economic indicators	Fuel costs	UAH per tones per kilometer	Minimization of costs on transportation
	Operational costs	UAH per year	Reducing of general costs
	Profitability level	%	Profitability increment
Time indicators	Average delivery time	hours	Reducing the transportation time
	Cargo handling time	hours	Optimization of cargo handling processes (loading and unloading)
Quality indicators	Level of customer's satisfaction	%	Increasing of quality of servicing
	Share of timely delivered cargo	%	Following the schedule of delivery
	Frequency of loses and damages of cargo	Cases per year	Reducing the incidents number
Ecological indicators	Volume of CO ₂ emissions	Kg/tonnes * kilometer	Reducing the negative effects
	Energy consumption	mJ/per year	Increasing the efficiency of the energy
Composite indicators	Logistics performance indicator (LPI)	Points	Complex estimation of the logistic system efficiency
	Economic advisability of the logistics processes	UAH per year	Maximization of financial benefit from logistics

Source: developed by the author

The formalization of the methodology for assessing the economic efficiency of logistics in the aviation industry consists in developing an integrated approach that takes into account the economic, operational and environmental aspects of airline activities.

In order to systematically evaluate how logistics functions economically in air transport, one must establish a comprehensive framework. This requires

devising a unified methodology that simultaneously considers the financial performance, the operational execution, and the ecological footprint associated with an airline's entire scope of work.

For further understanding of the principles of estimation of the economic efficiency, the evaluation example is represented by the author.

1) Integral Efficiency Indicator (IEI)

$$IEI = \sum_{i=1}^n W_i \cdot P_i$$

where:

W_i – weighting factor of the i -th indicator (defined by expert judgment or based on the company's strategic priorities);

P_i – standardized value of the i -th indicator;

n – number of indicators included in the analysis.

2) Calculation of Standardized Values P_i

Standardization is applied to transform indicators with different units of measurement into a unified scale [0;1].

2.1. For maximizing indicators (higher values indicate better performance)

$$P_i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}$$

2.2. For minimizing indicators (lower values indicate better performance)

$$P_i = \frac{X_{\max} - X_i}{X_{\max} - X_{\min}}$$

where:

X_i – actual value of the indicator;

X_{\min}, X_{\max} – minimum and maximum values of the indicator within the analyzed period or sample.

Mandatory methodological rule

To ensure the validity of the standardization procedure, the following condition must be satisfied:

$$X_{\max} \neq X_{\min}$$

If $X_{\min} = X_{\max}$, the indicator shows no variability and must be excluded from the analysis or replaced with an alternative

indicator, as standardization would otherwise result in division by zero and distort the integral assessment.

3) Selection of Indicators for Analysis

Economic indicators

1. Cost of transportation (C_{tr}), UAH/t – *minimization indicator*.
2. Operational profitability (R_{oper}), % – *maximization indicator*.
3. Investment payback period (T_{inv}), years – *minimization indicator*.

Operational indicators

4. Cargo processing time (T_{pro}), hours – *minimization indicator*.
5. Capacity utilization rate (R_{ut}), % – *maximization indicator*.

Environmental indicators

6. CO₂ emissions per 1 ton of cargo (CO₂), kg/t – *minimization indicator*.
7. Share of energy-efficient technologies used (E_{energ}), % – *maximization indicator*.

4) Weighting Factors W_i

Weighting factors are assigned according to the company's strategic priorities. An example distribution is:

Economic indicators – 50%
 Operational indicators – 30%
 Environmental indicators – 20%
 Weight normalization condition

$$\sum_{i=1}^n W_i = 1$$

The total weight of each group is distributed proportionally among the indicators within that group.

5) Step-by-Step Algorithm for Applying the Methodology

Step 1. Indicator definition

Select relevant economic, operational, and environmental performance indicators.

Step 2. Data collection

- Collect actual values X_i for the reporting period.
- Determine X_{min} and X_{max} for each indicator.

Step 3. Standardization

Calculate standardized values P_i using the appropriate formula for maximizing or minimizing indicators.

Step 4. Assignment of weighting factors

Define weighting factors W_i in line with strategic priorities and verify $\sum W_i = 1$.

Step 5. Calculation of the integral indicator

$$IEI = \sum_{i=1}^n W_i \cdot P_i$$

Step 6. Results analysis

- Interpret the obtained IEI value.
- Compare results with previous periods and/or competing companies.

Step 7. Formulation of recommendations

Based on the contribution of individual indicators and their weights, identify weaknesses and develop measures to improve overall efficiency.

Table 3. Calculation of standardized values of logistics efficiency indicators in the aviation industry taking into account weighting factors for further convenience and understanding

Indicator	Means (X_i)	X_{min}	X_{max}	Standartd means (P_i)	Weight (W_i)
C_{tr}	250	200	400	0.75	0.2
P_{oper}	20%	10%	30%	0.5	0.3
CO_2	50	30	80	0.67	0.1
T_{pro}	3	2	5	0.33	0.2
R_{ut}	80%	50%	90%	0.75	0.2

Source: Developed by the author.

Next step is the calculation the integral performance indicator by using the formula

$$IEI = \sum_{i=1}^n W_i \cdot P_i$$

Substituting the calculated weighted standardized values into the formula:

$$IEI = \sum_{i=1}^n W_i \cdot P_i = 0.15 + 0.15 + 0.067 + 0.067 + 0.15$$

$$IEI = 0.584$$

The obtained value of the integral efficiency indicator equals 0.584, which reflects the aggregated level of economic and operational performance based on the selected indicators and assigned weighting factors.

In our case, this result means that the effectiveness requires to be improved, at current it is at the average level. There are the following steps for further increasing the efficiency, such as:

Deployment of novel technologies.

Current inventive solutions are a principal element in streamlining logistics. Mechanization of logistics procedures, specifically via introducing supply chain management (SCM) suites and analytical frameworks, permits considerable performance gains.

Streamlining of logistics procedures.

Rationalizing logistics activities leads to a considerable lowering of expenses. A review of current freight transport paths permits minimizing the span and delivery duration, thus cutting down on fuel and vehicle running charges.

Personnel instruction. Efficient logistics administration is unachievable without capable employees able to adjust to novel circumstances and methods.

Conclusions. The implementation of these recommendations will allow aviation enterprises to reduce operating costs, improve the level of customer service and ensure competitive advantages in the conditions of dynamic market changes. It is also worth noting that the economic efficiency of logistics operations in the aviation industry is formed under the influence of a number of internal and external factors. Internal factors are related to the organization of the enterprise's work, its resources and technologies. In particular, one of the key factors is the organizational structure of the enterprise. A clear division of responsibilities between departments, coordination of actions and an effective management system allow achieving high efficiency in work, reducing the likelihood of errors and improving the quality of customer service. Continuous improvement of personnel knowledge in the field of advanced logistics practices, the use of breakthrough tools and electronic systems ensures their increased efficiency. Additionally, training programs focused on the implementation of changes will allow the team to more easily perceive changes and more successfully implement the latest developments into routine work processes.

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