Electronic scientific and practical journal

INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

#17 (2023)
February '23

WWW.SMART-SCM.ORG
ISSN 2708-3195
DOI.ORG/10.46783/SMART-SCM/2023-17

ISSN 2708-3195

Electronic scientific and practical collection
INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Electronic scientific and practical publication in economic sciences

Electronic scientifically and practical journal “Intellectualization of logistics and Supply Chain Management” included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): **Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)**

Field of science: Economic.
Specialties: 051 – Economics; 073 – Management

ISSN 2708-3195
DOI: https://doi.org/10.46783/smart-scm/2023-17

The electronic magazine is included in the international scientometric databases:
Index Copernicus, Google Scholar

Released 6 times a year

№ 17 (2023)
February 2023

Kyiv - 2023

Founder: Viold Limited Liability Company

The electronic scientific and practical journal is registered in international scientometric data bases, repositories and search engines. The main characteristic of the edition is the index of scientometric data bases, which reflects the importance and effectiveness of scientific publications using indicators such as quotation index, h-index and factor impact (the number of quotations within two years after publishing).

In 2020, the International Center for Periodicals (ISSN International Center, Paris) included the Electronic Scientific and Practical Edition "Intellectualization of logistics and Supply Chain Management" in the international register of periodicals and provided it with a numerical code of international identification: ISSN 2708-3195 (Online).

Recommended for dissemination on the Internet by the Academic Council of the Department of Logistics NAU (No. 7 of February 26, 2020). Released 6 times a year. Editions references are required. The view of the editorial board does not always coincide with that of the authors.

Electronic scientifically and practical journal "Intellectualization of logistics and Supply Chain Management" included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): ***Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)***

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DOI: https://doi.org/10.46783/smart-scm/2023-17
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INTRODUCTION

We are happy to invite you to get acquainted with the first issue of the new scientific and practical publication "Intellectualization of Logistics and Supply Chain Management".

We strongly believe that the launch of this magazine indicates the objective need to rethink a wide range of issues related to the development of theory and practice in logistics and supply chain management, awareness of the need to unite the scientific community and logistics practitioners, dissemination of modern knowledge and best practices for innovative development of the logistics services market.

The first issue of the magazine is published at a difficult time. The global coronavirus pandemic and the deep economic crisis have significantly worsened business activity in the world. Currently, global supply chains are collapsing, international trade is declining, and competition between global and regional logistics operators is intensifying. The most common thesis is that the world will never be the same again. Industry experts predict the emergence of new, more flexible and adaptive supply chain management strategies and approaches to logistics business process management. The trend towards collaborations, cooperation and unification of services is emerging, comprehensive proposals for clients are being developed. There is increasing talk about the need to build bimodal supply chains, which involves the development of different decision-making scenarios: the traditional approach - cost-effective efficiency, low risk, high predictability; a new approach "second mode" - rapid recognition of opportunities, adaptability, willingness to solve unexpected problems and look for new opportunities.

Radical transformations of the global and national markets for logistics services require appropriate scientific support. Logistics science has a special role to play in this process. Initiating the emergence of a new journal, we decided to focus on its coverage of problematic aspects of the formation and development of logistics systems at the micro, mezo and macro levels, supply chain management, digitization of logistics, methods and tools for optimizing processes in logistics and supply chains, sociopsychology relations and network interaction of enterprises using cloud technologies, artificial intelligence, e-learning, neural business process management systems, etc.

Therefore, we invite scientists, researchers and business representatives, as well as our colleagues from abroad, to cooperate and present the results of scientific research, to discus and debate on them, to work together to develop the scientific theory of logistics and promote mutual intellectual enrichment.

We hope that the new scientific publication will become a theoretical guide for young researchers and representatives of other fields.

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Chief Editor

UDC 005.935:658.7
DOI: https://doi.org/10.46783/smart-scm/2023-17-1
JEL Classification: L15, O11, Q13.
Received: 04 January 2022

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TRANSFORMATION OF THE ORGANIZATION OF MULTIMODAL TRANSPORTATION UNDER MARTIAL LAW

Dmytro Bugayko, Volodymyr Reznik, Anton Borysiuk, Danylo Bugayko. "Transformation of the organization of multimodal transportation under martial law". *Multimodal transportations plays a huge role in global economy. A lot of manufactures require different components, located in different remote sectors. In order not to discontinue production processes, multimodal transportation is used. Especially, the war influenced on the whole multimodal transportation system in Ukraine. Ports, harbors and sea ports stopped it's further operation. The main role was fallen on road transportation. A plenty of airports were totally destroyed, the most of main harbor became in occupation, it's further operation is impossible until the full victory of Ukraine. The road transportation became as the save link for supply chains and further economy operating. The one of the main problems in this situation is choosing of the optimal way and best-suited carrier for sequel carriage. The truck corporations continue cooperating with the airline agents, but the basic hubs of them were moved to the neighbor countries, it can appear new questions for optimization the delivery. Such factor as price, quality of the services, distance and time always plays a huge role in supply chains. The main aim of the transport*

company and its staff during multimodal transportation is to provide the delivery of goods, that were ordered by the manufacture just in time providing it's safe and integrity. For optimization of all this factors according to the consignee's preferences the expert evaluation methods are used in given research. There are lot of additional services attracted in such cases, such as: loading, unloading, repacking, changing the kind of packing (boxes, pallets, container repacking and other), in which sub-contractors take part. The union of all this processes mentioned above gives the opportunity to create the whole system of supplying the good from its seller to buyer. Every process is unique depending on the current situation and terms of delivery.

***Keywords**:* transport system, cargo transportation, multimodal transportation, optimization processes, routs planning, delivery scheme modelling.

Дмитро Бугайко, Володимир Резник, Антон Борисюк, Данило Бугайко. «Трансформація організації мультимодальних перевезень в умовах воєнного стану». *Мультимодальні перевезення відіграють величезну роль у світовій економіці. Для багатьох виробництв потрібні різні компоненти, розташовані в різних віддалених секторах. Щоб не зривати виробничі процеси, використовуються мультимодальні перевезення. Особливо війна вплинула на всю систему мультимодальних перевезень в Україні. Порти, гавані та морські порти припинили його подальшу роботу. Основна роль припадала на автомобільний транспорт. Багато аеропортів були повністю знищені, більшість головних гаваней опинились в окупації, їх подальша робота неможлива до повної перемоги України. Автомобільний транспорт став рятівною ланкою для ланцюгів поставок і подальшого функціонування економіки. Однією з головних проблем у цій ситуації є вибір оптимального способу та найбільш підходящого перевізника для подальшого перевезення. Автомобільні корпорації продовжують співпрацювати з авіа агентами, але їх основні хаби перенесли в сусідні країни, можуть виникнути нові питання щодо оптимізації доставки. Такі фактори, як ціна, якість послуг, відстань і час завжди відіграють величезну роль у ланцюгах поставок. Основна мета транспортної компанії та її персоналу при мультимодальних перевезеннях – забезпечити доставку вантажів, замовлених виробником, точно в строк, забезпечивши їх збереження та цілісність. Для оптимізації всіх цих факторів відповідно до переваг вантажоодержувача в даному дослідженні використовуються методи експертної оцінки. У таких випадках залучається багато додаткових послуг, таких як: навантаження, розвантаження, перепакування, зміна виду упаковки (ящики, піддони, перепакування тари та інше), в яких беруть участь субпідрядники. Об'єднання всіх цих вищезгаданих процесів дає можливість створити цілу систему постачання товару від його продавця до покупця. Кожен процес є унікальним залежно від поточної ситуації та умов доставки.*

Ключові слова: транспортна система, вантажне перевезення, мультимодальне перевезення, процеси оптимізації, планування маршрутів, моделювання схеми доставки

Дмитрий Бугайко, Владимир Резник, Антон Борисюк, Даниил Бугайко. "Трансформация организации мультимодальных перевозок в условиях военного положения". *Мультимодальные перевозки играют огромную роль в мировой экономике. Многим производителям требуются разные компоненты, расположенные в разных отдаленных секторах. Чтобы не останавливать производственные процессы, используются мультимодальные перевозки. Особенно война повлияла на всю систему мультимодальных перевозок в Украине. Порты, гавани и морские порты прекратили свою дальнейшую работу. Основная роль легла на автомобильные перевозки. Многие аэропорты были полностью разрушены, большая часть основных гаваней оказалась под оккупацией, дальнейшая их эксплуатация невозможна до полной победы Украины. Автомобильный транспорт стал спасительным звеном для цепочек поставок и дальнейшего функционирования экономики. Одной из основных проблем в этой ситуации является выбор оптимального пути и наиболее подходящего перевозчика для последующей перевозки. Компании-перевозчики продолжают*

сотрудничество с авиа агентами, но основные их хабы перенесены в соседние страны, могут возникнуть новые вопросы по оптимизации доставки. Такой фактор, как цена, качество услуг, расстояние и время всегда играет огромную роль в цепочках поставок. Основной задачей транспортной компании и ее сотрудников при мультимодальных перевозках является обеспечение доставки заказанного производителем товара точно в срок при условии его сохранности и целостности. Для оптимизации всех этих факторов в соответствии с предпочтениями грузополучателя в данном исследовании используются методы экспертной оценки. В таких случаях привлекается множество дополнительных услуг, таких как: погрузка, разгрузка, переупаковка, изменение вида упаковки (ящики, поддоны, переупаковка контейнера и др.), в которых принимают участие субподрядчики. Объединение всех вышеперечисленных процессов дает возможность создать целую систему доставки товара от продавца к покупателю. Каждый процесс уникален в зависимости от текущей ситуации и условий поставки.

Ключевые слова: транспортная система, грузовая перевозка, мультимодальная перевозка, процессы оптимизации, планирование маршрутов, моделирование схемы доставки.

Introduction. Multimodal transportation plays huge role, especially nowadays, multimodal transportations are essential as air flow in our global economy. A lot of manufactures require different components, located in different remote sectors. In order not to discontinue production processes, multimodal transportation is used. Multimodal transportation is the transportation of any goods by two or more modes of transport, organized by one Logistics Company. The carrier has permission to attract for delivery vehicles that belong to other companies. Multimodal transportation - transportation of goods under one contract, but performed by at least two modes of transport; the carrier is responsible for the entire transport, even if this transport is carried out by different modes of transport (for example: railway, sea and road, etc.). The main aim of the transport company and its staff during multimodal transportation is to provide the delivery of goods, that were ordered by the manufacture just in time providing it's safe and integrity [1]. The article is a logical continuation of a number of publications devoted to the development of multimodal transportation development of Ukrainian scientists Y. Kharazishvili [2, 3, 5], D. Bugayko [2 – 6], A.Antonova [5], M. Hryhorak [4], Y. Ierkovska [6], O. Ovdiienko [4], V. Marchuk [5], V Lyashenko [3], Polish scientists Z.Zamiar [5] and scientists of other countries.

The purpose of the article is to provide research is to provide the theoretical foundations and problems of managing multimodal transportation and to develop project recommendations for transformation of the organization of multimodal transportation under martial law. Is also choosing the best carrier for delivery (on the example of Freight Forwarding Organization "Freight Transport Partner"

Presentation of the main results. Classification of strategic restrictions affecting efficiency for transport infrastructure represented Table 1.

Forming new delivery routes, the question of finding new car carriers that will carry out transportation from European airports to Ukraine will arise. They may be carriers with which the company has already cooperated, but they also need to be evaluated for whether they will fit the criteria of the new routes.

Various approaches can be used to solve the problem of choosing a carrier, but one of the simplest, but effective methods is expert evaluation. The methods of expert evaluations are a way of forecasting and evaluating the future results of actions based on the forecasts of experts.

Table 1. Offers strategic restrictions affecting efficiency for transport infrastructure.

A group of restrictions	A types of restrictions	Brief description
1	2	3
1. External	1.1. Innovative resources	Restrictions at the state level, restraining the level of development of the technological base, equipment, the use of resource-saving technologies, which determine the presence of a scientific and technical development department for the development of transport infrastructure
	1.2. Financial resources	The availability of financial resources in the state for investing in transport infrastructure, including the possibility of attracting foreign investment
	1.3. Workforce	The availability of engineering, production, and logistics personnel of the necessary qualifications and appropriate level in the studied region, the possibility of involving personnel in the development of transport infrastructure
	1.4. Environmental resources	The possible negative impact of the use of transport infrastructure on the ecological situation, i.e. to what extent transport, development and expansion of the productivity of its infrastructure correspond to the ecological capabilities of the region in terms of air pollution, ecological load on the biosphere, etc.
	1.5. Political resources	They are determined by the economic policy of the state, the political situation at the time of the management decision, etc.
2. Internal	2.1. Financial resources	The availability of financial resources at enterprises for the formation and development of transport infrastructure, for the implementation of measures for the modernization of the transport fleet, etc.
	2.2. Material resources	Availability of enterprise assets that are a necessary component of the transport system
	2.3. Workforce	The availability of personnel of the appropriate level of qualification who are able to develop management decisions and participate directly in the formation and further use of transport infrastructure
	2.4. Innovative resources	Restrictions restraining the level of development of the technological base of the transport infrastructure, which determine the level of scientific and technical developments regarding the development of a new spectrum of transport and logistics services that consumers need more
	2.5. Information resources	Availability of information communication between all participants of the transportation chain; the possibility of functioning of information systems of different levels on a real-time scale with appropriate accuracy, speed and productivity

Source: Developed by Dmytro Bugayko

When applying the method of expert evaluations, a survey of a special group of experts (5–7 people) is conducted in order to determine certain variables necessary for the evaluation of the researched question. The composition of experts should include people with different types of thinking - figurative and verbal-logical, which contributes to the successful solution of the problem [3]. Quality ratings and their corresponding standard ratings on the scale of desirability represented in Table 2.

Table 2. Quality ratings and their corresponding standard ratings on the scale of desirability

№ з/п	Interval	Quality assessment	Mark on the desirability scale	
			range	average value
1	2	3	4	5
1	3-4	Excellent	More than 0,950	0,975
2	2-3	Very good	0,875-0,950	0,913
3	1-2	Good	0,690-0,875	0,782
4	0-1	Satisfactorily	0,367-0,690	0,530
5	(-1)-0	Bad	0,066-0,367	0,285
6	(-2)-(-1)	Very bad	0,0007-0,066	0,033
7	(-3)-(-2)	Unacceptable	Less than 0,0007	-

Source: Reznik Volodymyr

We will apply the methodology based on the calculation of the integral evaluation to the assessment and selection of optimal carriers.

The essence of the method is to divide the criteria into groups:

1. *Relay* - criteria according to which the evaluation can acquire only two values, either "yes" or "no". An example of such criteria can be the presence of a certificate of conformity, specialized TK, permits for the transportation of dangerous goods, etc.

2. *Quantitative* - assessments according to these criteria are presented in digital form. Examples of such criteria can be the reliability of the carrier (probability of delivery "just in time"), the tariff, the total time of transportation (possibility of deviation from the planned duration of transportation, %), financial stability.

3. *Qualitative* - evaluations according to this group of criteria are of a qualitative nature and can mean "excellent", "very good", etc. As an example, you can choose the following criteria: frequency of service, preservation, qualification of personnel, readiness for negotiations.

We will apply the described methodology to the evaluation of motor transport enterprises with which the FTP Company cooperates and to develop recommendations for choosing the most optimal carriers for further work.

The FTP Company cooperates with various carriers; in addition, the development of new delivery schemes requires the consideration of new potential carriers that can perform transportation according to the relevant criteria. Potential carriers that we will evaluate are the following companies: transport company LEGION, LLC ALL TRANS, PE Elite Trans, PE Solovij-Trans, LLC Don-Forrest KFT, SK Techno, DSV Logistics and Trans Logistics. We will evaluate each of the listed carriers according to the specified criteria in order to single out the companies that most satisfy the criteria for finding the optimal carrier.

The quality control department, transport and forwarding department compiled a list of criteria according to which specialists of the transport department evaluated each carrier. The evaluation results are summarized in the Table

The rank of each criterion reflects how important this criterion is in the calculations. The lowest value of the criterion belongs to the most important criterion, the highest rank to the least important criterion. As we can see, the most important criterion when evaluating carriers is the transportation tariff. Other criteria that are used for assessment are follows: Order processing term, Condition of the car park, Probability of lateness, Personnel qualifications, Freight safety, The quality of the service, Loyalty to deferred payments, Flexibility in decision-making.

Among the given criteria, there is one relay criterion - the company's performance of transportation to Ukraine. According to this criterion, all carriers received a "yes" rating, therefore, they all participate in further

calculations. Among the eight motor transport companies, we will single out two that will most closely meet the specified search criteria. Assessments of transport enterprises according to selected criteria represented in Table 3.

Table 3. Assessments of transport enterprises according to selected criteria (the real carriers FTP cooperates with)

№	Criterion	Carriers								a R
		PE Elite Trans	LLC ALL TRANS	PE Solovij-Trans	LLC Don-Forrest KFT	SK Techno	DSV Logistics	Trans Logistics	LEGION	
1	Transportation tariff, USD/km	6,8	10,2	7,7	8,4	6,9	8,4	9,5	11,2	1
2	Order processing term, hours	9	7	7	8	6	7	5	4	7
3	Condition of the car park	satisf.	very good	good	satisf.	excellent	good	very good	excellent	5
4	Probability of lateness, %	12	4	10	8	12	7	10	3	6
5	Transportation to Ukraine	yes	yes	yes	yes	yes	yes	yes	yes	-
6	Personnel qualifications	good	excellent	very good	good	good	satisf.	satisf.	excellent	3
7	Freight safety, %	90	85	75	80	75	88	80	94	4
8	The quality of the service	excellent	very good	satisf.	good	good	very good	good	excellent	2
9	Loyalty to deferred payments	excellent	good	excellent	very good	satisf.	very good	good	excellent	9
10	Flexibility in decision-making	excellent	satisf.	good	very good	excellent	satisf.	very good	good	8

Source: Developed by authors

The evaluation of transport companies is the calculation of the weight indicator of each criterion. We will make the necessary calculations

$$W_1 = \frac{2 \cdot (9-1+1)}{90} = 0{,}200,$$
$$W_2 = \frac{2 \cdot (9-7+1)}{90} = 0{,}067,$$
$$W_3 = \frac{2 \cdot (9-5+1)}{90} = 0{,}111,$$
$$W_4 = \frac{2 \cdot (9-6+1)}{90} = 0{,}089,$$
$$W_6 = \frac{2 \cdot (9-3+1)}{90} = 0{,}156,$$
$$W_7 = \frac{2 \cdot (9-4+1)}{90} = 0{,}133,$$
$$W_8 = \frac{2 \cdot (9-2+1)}{90} = 0{,}178,$$
$$W_9 = \frac{2 \cdot (9-9+1)}{90} = 0{,}022,$$
$$W_{10} = \frac{2 \cdot (9-8+1)}{90} = 0{,}044.$$

Calculation of assessments according to quantitative criteria represented in Table 4.

Table 4 – Calculation of assessments according to quantitative criteria

№	Criteria	Weight	Extremum	Reference value	PE Elite Trans	LLC ALL TRANS	PE Solovij-Trans	LLC Don-Forrest KFT	SK Techno	DSV Logistics	Trans Logistics	LEGION
1	2	3	4	5	6	7	8	9	10	11	12	13
1	Transportation tariff, USD/km	0,200	min	6,8	1,00	0,67	0,88	0,81	0,99	0,81	0,72	0,61
2	Order processing time, hours	0,067	min	4	0,44	0,57	0,57	0,50	0,67	0,57	0,80	1,00
3	Probability of lateness, %	0,089	min	3	0,25	0,75	0,30	0,38	0,25	0,43	0,30	1,00
4	Freight safety, %	0,133	max	94	0,96	0,90	0,80	0,85	0,80	0,94	0,85	1,00

Source: Developed by Reznik Volodymyr

This is the transportation tariff, order processing time and probability of delay. The last criterion, cargo conservation, should acquire maximum importance. Then, among all the evaluations for each criterion, a reference value was chosen depending on where the extremum is directed. For example, for the transportation tariff, the extremum is minimal. Among the eight estimates for 8 carriers, the first carrier PE Elite Trans has the lowest tariff value and it is equal to 6,8 USD/km. We take this value as a reference value. If the extremum is the maximum, as for example in the cargo economy criterion, then among all the estimates we look for the maximum value - it is equal to 94% and belongs to the company LEGION.

When the reference value is determined, then a quantitative assessment is calculated for each criterion for each carrier according to formulas 1.1 and 1.2. For example, let's calculate the quantitative assessment according to the first criterion for the second carrier LLC ALL TRANS:

All other quantitative assessments are calculated in a similar way. When the quantitative estimates are calculated, it is necessary to take into account the weight factor by multiplying the found quantitative estimates by it. Let's bring to these calculations to the Table 5.

Therefore, the calculation of the quantitative assessment, taking into account the weighting factor, was carried out according to formula. For example, let's calculate this indicator for the "order processing time" criterion for the first carrier: [5]

$$D_{21} = 0{,}067 \cdot 0{,}44 = 0{,}030.$$

All other indicators are calculated in the same way. The last line displays the sum of quantitative assessments. The eighth carrier LEGION has the greatest importance, in which the sum of quantitative assessments is 0,41.

After the quantitative scores are calculated, the qualitative scores are calculated. For this purpose, qualitative assessments are converted to a digital format using Table 5. Each value of the quality rating corresponds to the standard average rating on the scale of desirability.

Table 5. Calculation of assessment according to quantitative criteria, taking into account the weight of criterion

№	Criterion	Weight	PE Elite Trans	LLC ALL TRANS	PE Solovij-Trans	LLC Don-Forrest KFT	SK Techno	DSV Logistics	Trans Logistics	LEGION
1	2	3	6	7	8	9	10	11	12	13
1	Transportation tariff, USD/km	0,200	0,200	0,133	0,177	0,162	0,197	0,162	0,143	0,121
2	Order processing time, hours	0,067	0,030	0,038	0,038	0,033	0,044	0,038	0,053	0,067
3	Probability of lateness, %	0,089	0,022	0,067	0,027	0,033	0,022	0,038	0,027	0,089
4	Freight safety, %	0,133	0,128	0,121	0,106	0,113	0,106	0,125	0,113	0,133
5	The sum of quantitative assessments, taking into account the weight		0,380	0,359	0,348	0,341	0,369	0,363	0,336	0,410

Source: Developed by Bugayko Dmytro and Reznik Volodymyr

The construction of new cargo delivery schemes requires the use of scientific approaches to determine the most optimal option. Currently, we will implement the construction of possible schemes for the delivery of the specified cargo from Hong Kong to the city of Stryi in the Lviv region. The cargo to be delivered is video cards packed in boxes. The number of boxes is 92 units. Cargo volume – 5.58 m3, cargo weight – 1104 kg. The cost of the cargo is 532,000 USD.

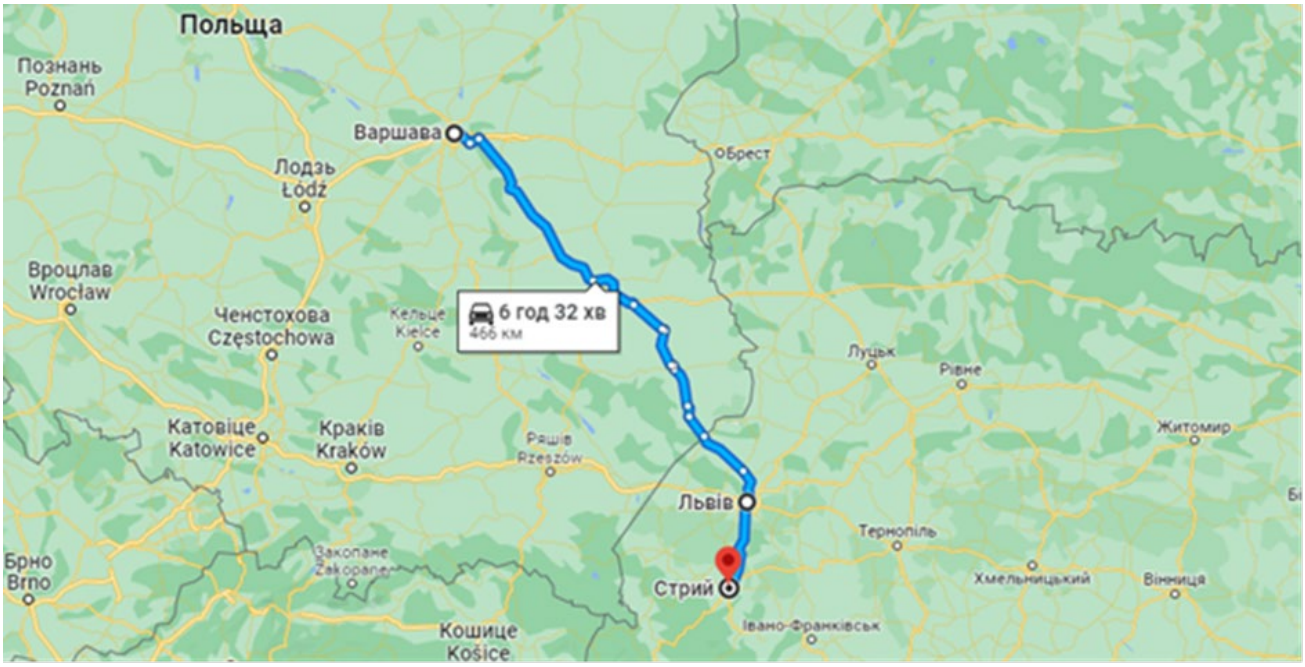

Figure 1. Route from Warsaw to Stryi
Source: Google maps screenshot

From Hong Kong, there is an option of air transport either to Warsaw airport or to Frankfurt airport. The airline that will carry out the transportation is Emirates (IATA code EK). Variability in the formation of delivery schemes will also arise due to the fact that it is possible to receive and transfer cargo to another mode of transport at the destination airports through different agents, with the involvement of different motor carriers.

As we can see, the route from Warsaw to Stryi passes through the Rava Ruska border crossing point.

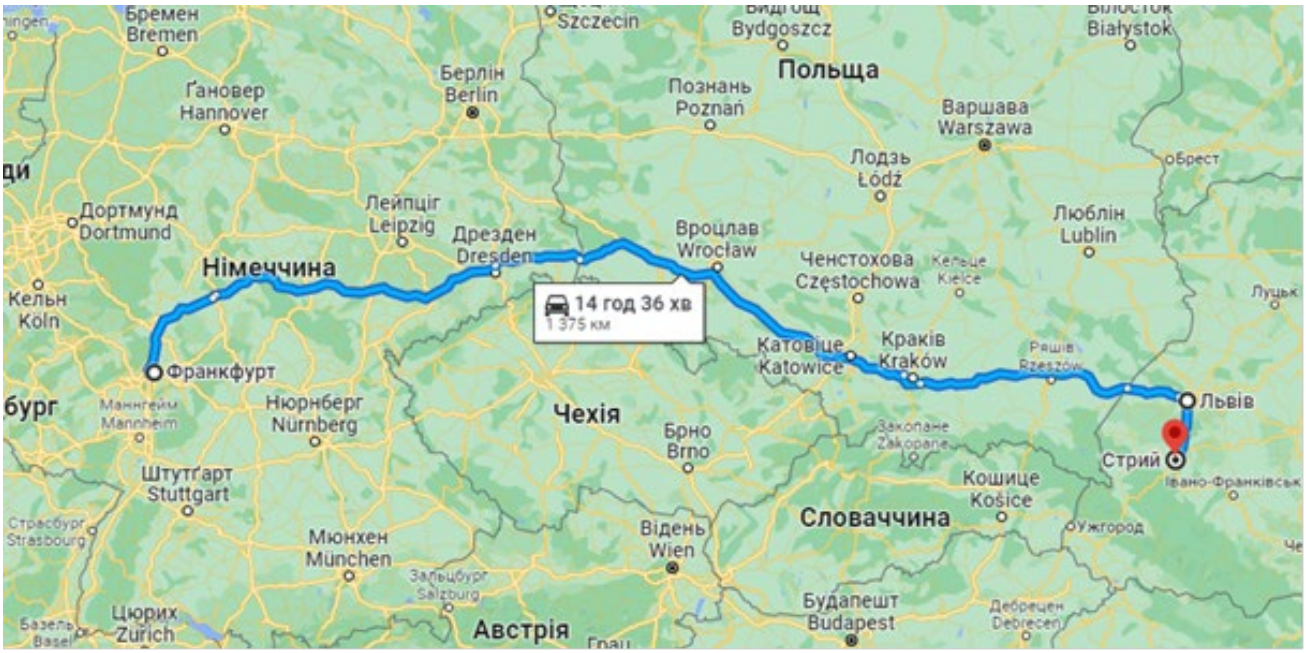

Figure 2. Route from Frankfurt to Stryi

Source: Google Maps screenshot

In this route from Frankfurt, the most optimal point for crossing the border will be Krakovets.

A network graph showing possible delivery schemes is presented in Fig. 3.

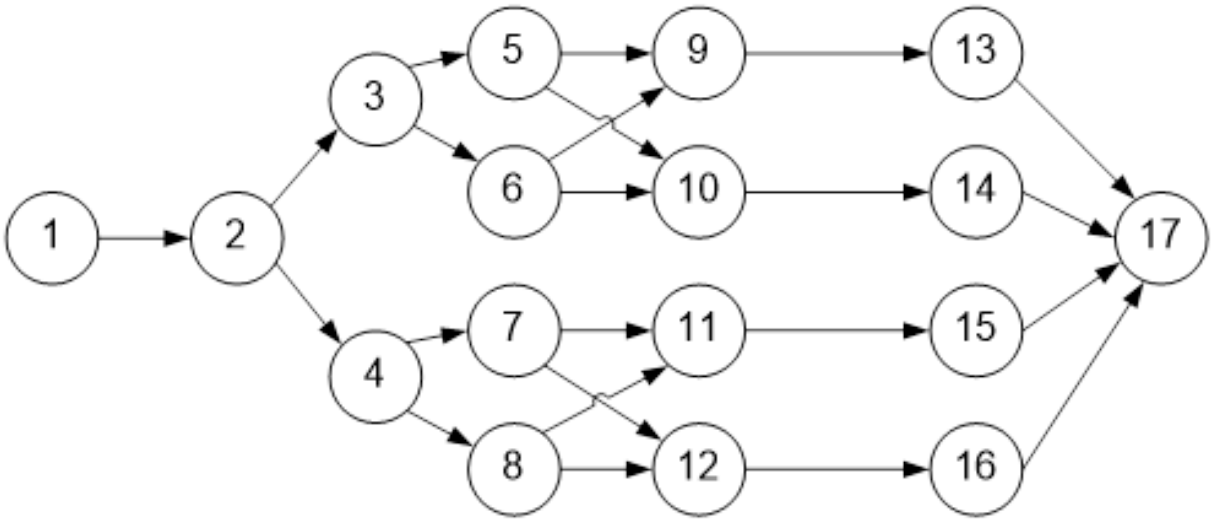

Figure 3 - Network graph of possible delivery schemes

Source: [6]

Works on the delivery of goods by direction Hong Kong to Stryi

The time and cost parameters for each delivery scheme will be defined as the sum of the corresponding values. An additional parameter that takes into account the cost of the cargo, namely the present value it is clear researching the Table 6.

Table 6 - Works on the delivery of goods by direction Hong Kong to Stryi

№ of work		Description of work	Cost, USD	Time, days
1		2	3	4
1	2	Registration of cargo and documents and loading onto the plane	110	1,0
2	3	Delivery by air transport to Warsaw	8534	1,0
2	4	Delivery by air transport to Frankfurt	7507	1,0
3	5	Acceptance of cargo in Warsaw by agent 1	250	1,5
3	6	Acceptance of cargo in Warsaw by agent 2	270	1,0
4	7	Acceptance of cargo in Frankfurt by agent 3	200	1,5
4	8	Acceptance of cargo in Frankfurt by agent 4	245	1,0
5	9	Transfer of the cargo by agent 1 in Warsaw to the carrier LEGION	510	2,5
5	10	Transfer of cargo by agent 1 in Warsaw to the carrier LLC ALL TRANS	510	2,0

Source: Developed by authors

$$C' = (C_{freight} + C_T) \times (1 + \Delta)^n \qquad (1)$$

where C' – assessment of the cost of the cargo and its delivery, taking into account the time factor (integral assessment);

$C_{freight}$ – the purchase price of the cargo;

C_T – transportation costs;

$(1+\Delta)^n$ - multiplier of interest accrual by interest rate Δ by *n* periods.

$$n = T/365 \qquad (2)$$

To calculate the total cost indicator, you need to know the average bank rate parameter. Analysis of the financial market determined that this parameter is equal to 17%.

So, we have calculated the parameters of all possible delivery schemes and the results of the calculations have been summarized in a Table 7.

Table 7 - Results of parameters calculation for various delivery schemes

№ of delivery scheme	Delivery scheme accordingly to network graph	Transportation costs C_T, USD	Delivery time *T*, days	Present value *C'*, USD
1	2	3	4	5
(1)	1-2-3-5-9-13-17	11054	8	544925,96
(2)	1-2-3-5-10-14-17	11124	7,5	544879,00
(3)	1-2-3-6-9-13-17	11059	7,5	544813,79
(4)	1-2-3-6-10-14-17	11129	7	544766,84
(5)	1-2-4-7-11-15-17	*11037*	7,5	544791,72
(6)	1-2-4-7-12-16-17	11077	7,5	544831,85
(7)	1-2-4-8-11-15-17	11092	*6,5*	*544612,59*
(8)	1-2-4-8-12-16-17	11132	7	544769,85

Source: Developed by Reznik Volodymyr

So, the analysis of the calculation results shows that when transporting video cards from Hong Kong to Stryi, the optimal delivery scheme will be:

- according to the "cost" parameter - 5 scheme;

- according to the parameter "time" and "present value" - 7 scheme on the Table 7.

Thus, in the case when all criteria have the same value, it is necessary to use decision-making criteria under conditions of uncertainty. To obtain the comparison results, it is necessary to bring the parameters of Table 1.6 into a relative form by dividing the elements of each column by the minimum value. The results of this transformation are summarized in the Table 1.6. The general appearance of the matrix is shown in Fig.3. Next, the values of the sought criteria for the specified parameters are determined (see Table 8).

Table 8 - Relative parameter values by route Hong Kong – Stryi

№ of delivery scheme	Delivery scheme accordingly to network graph	Relative parameter values		
		T	***C_T***	***C'***
1	2	3	4	5
(1)	1-2-3-5-9-13-17	1,0015	1,2308	1,0006
(2)	1-2-3-5-10-14-17	1,0079	1,1538	1,0005
(3)	1-2-3-6-9-13-17	1,0020	1,1538	1,0004
(4)	1-2-3-6-10-14-17	1,0083	1,0769	1,0003
(5)	1-2-4-7-11-15-17	1,0000	1,1538	1,0003
(6)	1-2-4-7-12-16-17	1,0036	1,1538	1,0004
(7)	1-2-4-8-11-15-17	1,0050	1,0000	1,0000
(8)	1-2-4-8-12-16-17	1,0086	1,0769	1,0003

Source: Developed by Bugayko Dmytro and Reznik Volodymyr

Accordingly to our case the rows (possible actions R_j) of this matrix are possible delivery schemes. The columns (states of nature S_i) are delivery criteria. The elements of the matrix are the result of choosing the *j-th* action and implementing the *i-th* state V_{ji}. [5]

First decision-making criterion that we will apply is Laplace's criterion. The average arithmetic value of losses (M_j) is calculated according to formula bellow for all variants of delivery routes. All states of nature are assumed to be equally probable [6]

$$M_j(R) = \frac{1}{n}\sum_{i=1}^{n} V_{ji} \quad (3)$$

Source where n – the number of states of nature (in our case 3).

Let's calculate the criterion for all delivery schemes:

1 delivery scheme: $M_1 = 1/3 \times (1{,}0015 + 1{,}2308 + 1{,}0006) = 1{,}0776$;
2 delivery scheme: $M_2 = 1/3 \times (1{,}0079 + 1{,}1538 + 1{,}0005) = 1{,}0541$;
3 delivery scheme: $M_3 = 1/3 \times (1{,}0020 + 1{,}1538 + 1{,}0004) = 1{,}0521$;
4 delivery scheme: $M_4 = 1/3 \times (1{,}0083 + 1{,}0769 + 1{,}0003) = 1{,}0285$;
5 delivery scheme: $M_5 = 1/3 \times (1{,}0000 + 1{,}1538 + 1{,}0003) = 1{,}0514$;
6 delivery scheme: $M_6 = 1/3 \times (1{,}0036 + 1{,}1538 + 1{,}0004) = 1{,}0526$;
7 delivery scheme: $M_7 = 1/3 \times (1{,}0050 + 1{,}0000 + 1{,}0000) = 1{,}0017$;
8 delivery scheme: $M_8 = 1/3 \times (1{,}0086 + 1{,}3769 + 1{,}0003) = 1{,}0286$.

Then, among the calculated values, the smallest one is chosen. It will determine the optimal delivery scheme. According to the calculations, the smallest value is 1,0017,

which corresponds to the 7th delivery scheme.

The next criterion that we will apply for decision making is Wald's criterion. It is based on the principle of greatest caution. In the case when the result V_{ji} represents losses, the minimum criterion is used when choosing the optimal strategy. It is necessary to find the largest element in each row at the first stage $\max\{V_{ij}\}$, and then the action R_j (row j) is selected, which will correspond to the smallest element of these largest elements:

$$W = \min_j \max_i \{V_{ij}\} \quad (4)$$

So, we need to determine the largest element in each row:

1 delivery scheme: 1,2308;
2 delivery scheme: 1,1538;
3 delivery scheme: 1,1538;
4 delivery scheme: 1,0769;
5 delivery scheme: 1,1538;
6 delivery scheme: 1,1538;
7 delivery scheme: 1,0050;
8 delivery scheme: 1,0769.

Among the maximum values found, in the last step we determine the smallest one. This is 1,0050 and belongs to 7^{th} scheme.

The third criterion that we will use is Savage's criterion. It is based on the use of a risk matrix, the elements of which are determined by the formula:

$$r_{ij} = V_{ij} - \min_j \{V_{ji}\} \quad (5)$$

That is, r_{ij} - the difference between the best value in column i and the values of V_{ij} at the same i. According to the criterion, it is recommended to choose the strategy in which the value of the risk will take on the smallest value in the most unfavorable situation:

$$W = \min_j \max_i \{r_{ij}\} \quad (6)$$

The results of the calculation of the risk matrix for eight routes are summarized in the Table 9.

Table 9. The risk matrix of Savage's criterion

№ of delivery scheme	Delivery scheme accordingly to network graph	Risk parameter			
		T	C_T	*C'*	max
(1)	1-2-3-5-9-13-17	0,0015	0,2308	0,0006	0,2308
(2)	1-2-3-5-10-14-17	0,0079	0,1538	0,0005	0,1538
(3)	1-2-3-6-9-13-17	0,0020	0,1538	0,0004	0,1538
(4)	1-2-3-6-10-14-17	0,0083	0,0769	0,0003	0,0769
(5)	1-2-4-7-11-15-17	0,0000	0,1538	0,0003	0,1538
(6)	1-2-4-7-12-16-17	0,0036	0,1538	0,0004	0,1538
(7)	1-2-4-8-11-15-17	0,0050	0,0000	0,0000	0,0050
(8)	1-2-4-8-12-16-17	0,0086	0,0769	0,0003	0,0769

Source: developed by Reznik Volodymyr

In the column with the maximum risk value for each scheme, we will look for the smallest element. This is 0,0050 and it belongs to 7^{th} scheme.

The last criterion that we will consider is Hurwitz criterion. It is based on the following two assumptions: nature can be in the most unfavorable state with probability $(1-\alpha)$ and in the most favorable state with probability α, where α is the confidence coefficient. If the elements of the matrix represent losses, then choose an action that fulfills the following conditions: [7]

$$W = \min_j \left[\alpha \min_i V_{ji} + (1-\alpha) \max_i V_{ji} \right] \quad (7)$$

Source [12]

This criterion establishes a balance between cases of extreme optimism and pessimism by weighting these two ways of behavior with the corresponding weights $(1 - \alpha)$ and α, where $0 \leq \alpha \leq 1$. The value of α is determined depending on the tendency of the decision-maker to be optimistic or pessimistic. If there is no pronounced tendency, $\alpha=0.5$ is most often used. [7]

To determine the desired delivery option according to this criterion, you need to find the sum of the products of the smallest and largest value by the coefficient $\alpha=0.5$. [7]

Let's perform calculations:

1 delivery scheme: 0,5×1,0006+0,5×1,2308=1,1157;
2 delivery scheme: 0,5×1,0005+0,5×1,1538=1,0772;
3 delivery scheme: 0,5×1,0004+0,5×1,1538=1,0771;
4 delivery scheme: 0,5×1,0003+0,5×1,0769=1,0386;
5 delivery scheme: 0,5×1,0003+0,5×1,1538=1,0769;
6 delivery scheme: 0,5×1,0004+0,5×1,1538=1,0771;
7 delivery scheme: 0,5×1,0000+0,5×1,0050=1,0025;
8 delivery scheme: 0,5×1,0003+0,5×1,0769=1,0386. [12]

Among the calculated values, we again choose the smallest element. This is 1,0025 and also belongs to 7th scheme.

Let's summarize all the calculations made according to the four criteria into a Table 10.

Table 10 - Choosing a delivery scheme based on decision-making criteria. [7]

№ of delivery scheme	Laplace's criterion, $M_i(R_j)$	Wald's criterion, max(V_{ij})	Savage's criterion, max(r_{ji})	Hurwitz criterion, $\left[\alpha \min_i V_{ji} + (1-\alpha) \max_i V_{ji}\right]$
(1)	1,0776	1,2308	0,2308	1,1157
(2)	1,0541	1,1538	0,1538	1,0772
(3)	1,0521	1,1538	0,1538	1,0771
(4)	1,0285	1,0769	0,0769	1,0386
(5)	1,0514	1,1538	0,1538	1,0769
(6)	1,0526	1,1538	0,1538	1,0771
(7)	1,0017	1,0050	0,0050	1,0025
(8)	1,0286	1,0769	0,0769	1,0386
Minimum value	***1,0017***	***1,0050***	***0,0050***	***1,0025***

Source: Developed by Bugayko Dmytro

Therefore, taking into account the results of calculations based on various decision-making criteria, it will be advisable to choose the 7th delivery scheme. This scheme involves air transportation to Frankfurt, cooperation with agent 4 there and the use of the LEGION company for road transportation to the destination point (Stryi).

Conclusions. In today's unstable conditions of the functioning of enterprises, it is important in formation a logical chain of building an effective organizational and economic mechanism for the innovative development of the transport industry in the system of multimodal transportation, which is able to ensure the efficiency of management and the competitiveness of the industry.

The innovative activities of transport industry enterprises are aimed at:

- ensuring high quality of transport services;

- timeliness of order fulfillment and transportation;
- ensuring safety of cargo transportation;
- implementation of modern information systems;
- use of energy-saving technologies;
- increasing the environmental friendliness of transport services.

The main reasons that hold back the innovative development of the transport industry in the system of multimodal transportation are:

- the imperfection of the legal basis for carrying out cargo multimodal transportation;
- inconsistency of the rules for the transportation of dangerous goods with the EU norms;
- lack of conditions for the creation and operation of domestic operators of multimodal transportation;
- imperfection of the tariff policy in transport;
- high risks of multimodal operators when organizing such long-distance transportation involving two or more modes of transport;
- technological backwardness of transport and infrastructure, low level of introduction of modern technologies and implementation of innovative policy in the transport industry;
- disproportions between the levels of development of railway infrastructure capacities and the capacities of ports for cargo processing;
- the presence of "bottlenecks" in the infrastructure of transit transportation by railway transport;
- lagging behind in the implementation of new information technologies;
- lack of a compensation mechanism for investments in strategic transport facilities;
- lack of a transparent system of accounting for transport costs and an effective control mechanism for the provision and use of funds intended for the repair, reconstruction and construction of transport infrastructure;
- lack of highly professional and experienced specialists in multimodal transportation, etc.

The creation of new multimodal corridors will allow to overcome the infrastructural imbalance in the territories of large integration associations. In particular, the development of multimodal corridors in the East-West and North-South directions is planned on the territory of the European Union, as well as the creation of four diagonal corridors. Multimodal transportation is especially relevant in the context of realizing the potential of European integration, simplifying trade and logistics procedures, and developing international partnerships. Thus, in the presence of negative macroeconomic trends, today foreign trade operations were carried out with partners from 220 countries of the world, and the largest volumes of exports among services were transport services, which accounted for 54.8% of the total volume of exports.

The state of the pre-war transport market was studied. Until February 2022, the market had a heterogeneous structure of development, because the global regressive processes associated with the global epidemic of the corona virus had a significant impact on it. At the same time, it should be noted that the total volume of transportation increased in 2020 compared to 2019. This was mainly due to road transport. Other types of transport either remained at the same level (water transport, aviation) or decreased (rail). With the beginning of the large-scale invasion, the transport infrastructure of Ukraine was significantly affected, many railway and road routes were destroyed, the sky was completely closed for air transport and seaports were almost completely blocked. The increase in passenger and freight flows in the western direction highlighted the problems of the border infrastructure.

Like many commercial enterprises, logistics companies with the beginning of the war were forced to rebuild their activities, developing new schemes of work in the

conditions of martial law. Thus, the FTP Company, having experienced the destruction of many transportation schemes, had to look for ways to build new routes. Those transportations that were in a mixed connection with the participation of air transport are now planned to be delivered to the airports of Poland or Germany, and from there to Ukraine by road transport.

At the enterprise level, it is necessary to solve the tasks of restructuring one's own business processes or modernizing existing ones to adapt to external circumstances. Thus, due to the cancellation of air transportation and the blockade of sea ports, the FTP company is forced to rebuild its multimodal routes. Delivery by air transport will be carried out to the airports of European countries. Thus, the work simulates various delivery schemes for the route Hong Kong - Stryi, considering the involvement of various delivery airports and the involvement of various agents and carriers.

A scientific approach was applied to form the optimal base of the company's partners, namely companies that carry out road transportation, namely the method of export evaluations for ranking carriers according to certain criteria.

To determine the optimal delivery scheme among the developed options, decision-making methods under conditions of uncertainty, namely the Laplace, Wald, Savage and Hurwitz criteria, were applied..

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UDC 338.47, 504.03
DOI: https://doi.org/10.46783/smart-scm/2023-17-2
JEL Classification: E27, O11, O40.
Received: 12 January 2022

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INTERRELATION OF EXTERNAL COSTS OF ROAD TRANSPORT AND FINANCIAL AND LOGISTICS INDICATORS OF THE EU COUNTRIES

Lidia Savchenko, Oleksander Tsapenko. "Interrelation of external costs of road transport and financial and logistics indicators of the EU countries". *Internal costs refer to the direct monetised costs for a person or organisation undertaking an activity. They are costs that a business bases its price on. External costs are not included in price and consist on the cost of disposing of the product at the end of its useful life, the environmental degradation caused by the emissions, pollutants and wastes from production, the cost of health problems caused by harmful materials and ingredients and social costs associated with increasing unemployment due to increasing automation. In such way, external costs or externalities refer to the economic concept of uncompensated social or environmental effects.*

The countries of the European Union have long been engaged in converting indirect losses from transport into financial units. The latest existing 2019 Handbook on External Costs of Transport considers not only marginal external costs, but also total and average external transport costs across the EU, Switzerland and Norway.

Our goals in this research are:

- identification of factors that have a significant impact on the total external costs of transport at the country level;

- determining of the degree of such influence;

- determination of interdependence (multicollinearity) of factors of influence;

- determination of the direction of influence (direct or inverse dependence);

- making conclusions regarding the possibility of determining the external costs of the country based on the selected factors.

On the basis of correlation-regression analysis, factors were determined that have a clear relationship with the external costs of road transport - the country's GDP, the amount of transport work produced by the country in tkm and the amount invested in road infrastructure. Values of Multiple R and R-square of the regression model (very next to 1) allow us to make a conclusion that these three factors are sufficient to explain the variable (external costs) at a reliability level of 95%. All factors are statistically significant and should be

involved in the model. Another important result is the sign with which the coefficients are present in the model: with an increase in % of GDP and transport work, external costs will increase, however, with an increase in investment in road infrastructure, the value of external costs of transport will decrease.

Finally, the regression equation of the country's external transport costs as a function of the three aforementioned indicators was obtained. A very good representation of the statistical data with the resulting regression model can be observed. It can be assumed that this model can be used to predict external costs of road transport and transfer the methodology to countries outside the EU, for example, Ukraine..

***Keywords**:* external costs of transport, road infrastructure, transport work, infrastructure investment, correlation, regression.

Лідія Савченко, Олександр Цапенко. «Взаємозв'язок зовнішніх витрат автомобільного транспорту та фінансово-логістичних показників країн ЄС». *Внутрішні витрати стосуються прямих грошових витрат для особи чи організації, які здійснюють певну діяльність. Це витрати, на яких бізнес базує свою ціну. Зовнішні витрати не входять у відпускну ціну та складаються з вартості утилізації продукту в кінці терміну його корисного використання; втрат від погіршення навколишнього середовища, спричиненого викидами, забруднювачами та відходами виробництва; вартості проблем зі здоров'ям, спричинених шкідливими матеріалами та інгредієнтами; соціальних витрат, пов'язаних зі зростанням безробіття через зростання автоматизації. Таким чином, зовнішні витрати або зовнішні ефекти відносяться до економічної концепції некомпенсованих соціальних або екологічних ефектів.*

Країни Євросоюзу давно займаються переведенням непрямих збитків від транспорту у фінансові одиниці. Останній існуючий Довідник із зовнішніх витрат на транспорті за 2019 рік розглядає не лише маржинальні зовнішні витрати, а й загальні та середні зовнішні транспортні витрати в країнаї ЄС, Швейцарії та Норвегії.

Наші цілі в цьому дослідженні:

- визначення факторів, що мають значний вплив на загальні зовнішні витрати транспорту на рівні країни;

- визначення ступеня такого впливу;

- визначення взаємозалежності (мультиколінеарності) факторів впливу;

- визначення напрямку впливу (пряма чи обернена залежність);

- формулювання висновків щодо можливості визначення зовнішніх витрат країни на основі обраних факторів.

На основі кореляційно-регресійного аналізу визначено фактори, які мають чіткий зв'язок із зовнішніми витратами автомобільного транспорту – ВВП країни, обсяг транспортної роботи, виробленої країною в ткм, та сума інвестицій у дорожню інфраструктуру. Значення Multiple R і R-квадрат регресійної моделі (що є дуже близькими до 1) дозволяють нам зробити висновок, що цих трьох факторів достатньо для пояснення змінної (зовнішніх витрат) з рівнем надійності 95%. Усі фактори є статистично значущими і, отже, повинні бути задіяні в моделі. Іншим важливим результатом є знак, з яким коефіцієнти факторів присутні в моделі: зі збільшенням ВВП і транспортної роботи зовнішні витрати зростуть, однак зі збільшенням інвестицій в дорожню інфраструктуру величина зовнішніх витрат на транспорт зменшиться.

Нарешті, отримане рівняння регресії зовнішніх транспортних витрат країни як залежність від трьох вищезгаданих індикаторів. Можна спостерігати дуже гарне представлення статистичних даних за допомогою отриманої регресійної моделі. Можна припустити, що дана модель може бути використана для прогнозування зовнішніх витрат на автомобільний транспорт і перенесення методології в країни поза ЄС, наприклад, в Україну.

Ключові слова: зовнішні витрати на транспорт, дорожня інфраструктура, транспортна робота, інвестиції в інфраструктуру, кореляція, регресія

Лидия Савченко, Александр Цапенко. "Взаимосвязь внешних издержек автомобильного транспорта и финансово-логистических показателей стран ЕС". *Внутренние расходы касаются прямых денежных затрат для личности или организации, осуществляющих определенную деятельность. Это затраты, на которых бизнес основывает свою цену. Внешние расходы не включаются в отпускную цену и состоят из стоимости утилизации продукта в конце срока его полезного использования; потерь от ухудшения окружающей среды, вызванной выбросами, загрязнителями и отходами производства; стоимости проблем со здоровьем, вызванных вредными материалами и ингредиентами; социальных расходов, связанных с ростом безработицы из-за роста автоматизации. Таким образом, внешние затраты или внешние эффекты относятся к экономической концепции некомпенсированных социальных или экологических эффектов.*

Страны Евросоюза давно занимаются переводом косвенных убытков от транспорта в финансовые единицы. Последний существующий Справочник по внешним расходам на транспорте за 2019 год рассматривает не только маржинальные внешние расходы, но и общие и средние внешние транспортные расходы в странах ЕС, Швейцарии и Норвегии.

Наши цели в этом исследовании:

- определение факторов, оказывающих значительное влияние на общие внешние расходы транспорта на уровне страны;

- определение степени такого воздействия;

- определение взаимозависимости (мультиколинеарности) факторов воздействия;

- определение направления воздействия (прямая или обратная зависимость);

- формулирование выводов о возможности определения внешних расходов страны на основе выбранных факторов.

На основе корреляционно-регрессионного анализа определены факторы, которые имеют четкую связь с внешними затратами автомобильного транспорта – ВВП страны, объем транспортной работы, производимой страной в ткм, и сумма инвестиций в дорожную инфраструктуру. Значения Multiple R и R-квадрат регрессионной модели (которые очень близки к 1) позволяют сделать заключение, что этих трех факторов достаточно для объяснения переменной (внешних затрат) с уровнем надежности 95%. Все факторы статистически значимы и, следовательно, должны быть задействованы в модели. Другим важным результатом является знак, с которым коэффициенты факторов присутствуют в модели: с увеличением ВВП и транспортной работы внешние издержки возрастут, однако с увеличением инвестиций в дорожную инфраструктуру величина внешних расходов на транспорт снизится.

Наконец, получено уравнение регрессии внешних транспортных расходов в стране как зависимость от трех вышеупомянутых индикаторов. Можно наблюдать очень хорошее представление статистических данных с помощью полученной регрессионной модели. Можно предположить, что данная модель может быть использована для прогнозирования внешних расходов на автомобильный транспорт и переноса методологии в страны вне ЕС, например в Украину..

Ключевые слова: внешние расходы на транспорт, дорожная инфраструктура, транспортная работа, инвестиции в инфраструктуру, корреляция, регрессия.

Introduction. Internal costs refer to the direct monetised costs (planning, construction, management, maintenance, disposal) for a person or organisation undertaking an activity [1]. They are costs that a business bases its price on. They include

costs like materials, energy, labour, plant, equipment and overheads [2]. External costs are costs that are NOT included in what the business bases its price on. These include:

- the cost of disposing of the product at the end of its useful life
- the environmental degradation caused by the emissions, pollutants and wastes from production
- the cost of health problems caused by harmful materials and ingredients
- social costs associated with increasing unemployment due to increasing automation [2].

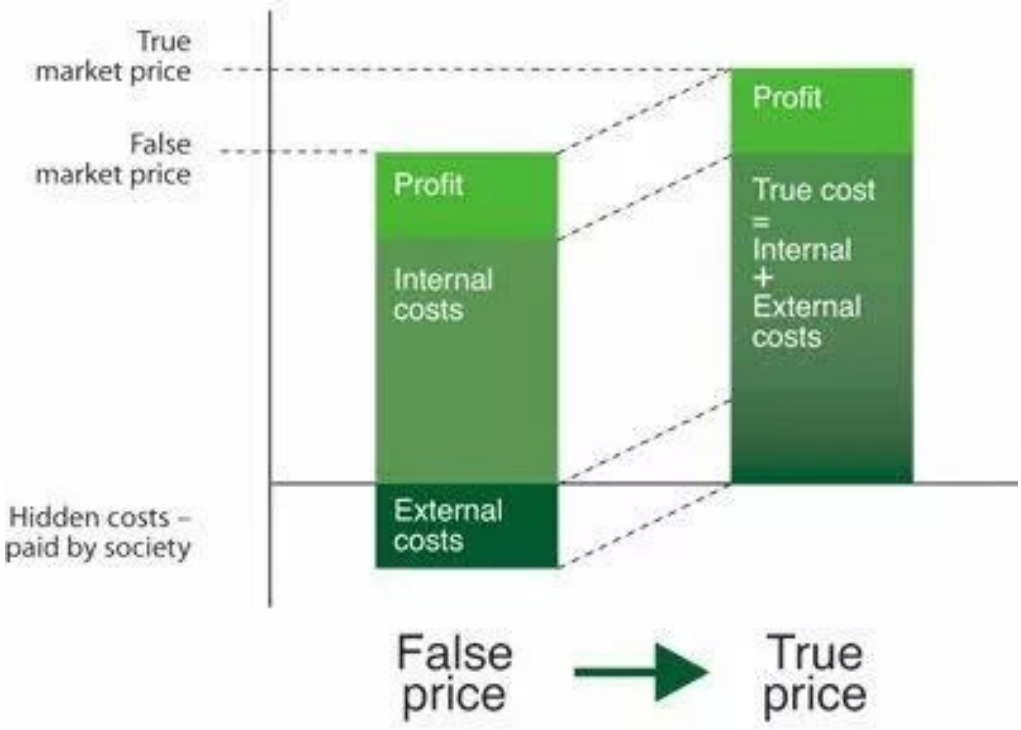

Figure 1 – External costs and true price [2]

The **goals** in this research are:

- identification of factors that have a significant impact on the total external costs of transport at the country level;
- determining of the degree of such influence;
- determination of interdependence (multicollinearity) of factors of influence;
- determination of the direction of influence (direct or inverse dependence);
- making conclusions regarding the possibility of determining the external costs of the country based on the selected factors.

Literature analysis. Two British economists are credited with having initiated the formal study of externalities, or "spillover effects": Henry Sidgwick (1838–1900) is credited with first articulating, and Arthur C. Pigou (1877–1959) is credited with formalizing the concept of externalities. Although Henry Sidgwick (1838-1900) first articulated the idea of spillover costs and benefits (externalities), Arthur C. Pigou (1877-1959) receives most of the credit for formalizing the concept. Pigou, a British welfare economist (meaning that his economic theories focuses on maximizing the well-being of society), studied at King's College in Cambridge and later served as the chair of political economy at Cambridge from 1908 to 1943. The previous chair, Alfred Marshall, significantly influenced Pigou's thinking, as both were concerned about how to use economic theory to promote social well-being [3].

The word externality is used because the effect produced on others, whether in the

form of profits or costs, is external to the market.

External costs (also known as externalities) refer to the economic concept of uncompensated social or environmental effects. For example, when people buy fuel for a car, they pay for the production of that fuel (an internal cost), but not for the costs of burning that fuel, such as air pollution. The aim of the "polluter pays" principle and environmental taxes is that these externalities are internalised (e.g. by putting an eco-tax on fuels) [1].

An external cost is a cost not included in the market price of the goods and services being produced, i.e. a cost not borne by those who create it [4].

An external cost is a negative effect to a third party from the production or the consumption of a good [5].

An external cost is the cost incurred by an individual, firm or community as a result of an economic transaction which they are not directly involved in. External costs, also called 'spillovers' and 'third party costs' can arise from both production and consumption [6].

Most transactions create external costs – examples include [6]:

- Purchasing consumer goods commonly creates waste in terms of packaging, as well as other environmental costs including carbon emissions resulting from travelling to stores and outlets.

- Environmental costs can also arise from the production process, including direct costs from emissions and costs from transportation and distribution.

- Excessive fishing can deplete fish stocks and lead to unemployment in the fishing industry in the future.

Where the goods are 'demerit goods', such as cigarette and alcohol consumption, governments may impose taxes to discourage consumption and reduce external costs. Information failure may result in a lack of awareness of external costs, and hence a sub-optimal level of consumption.

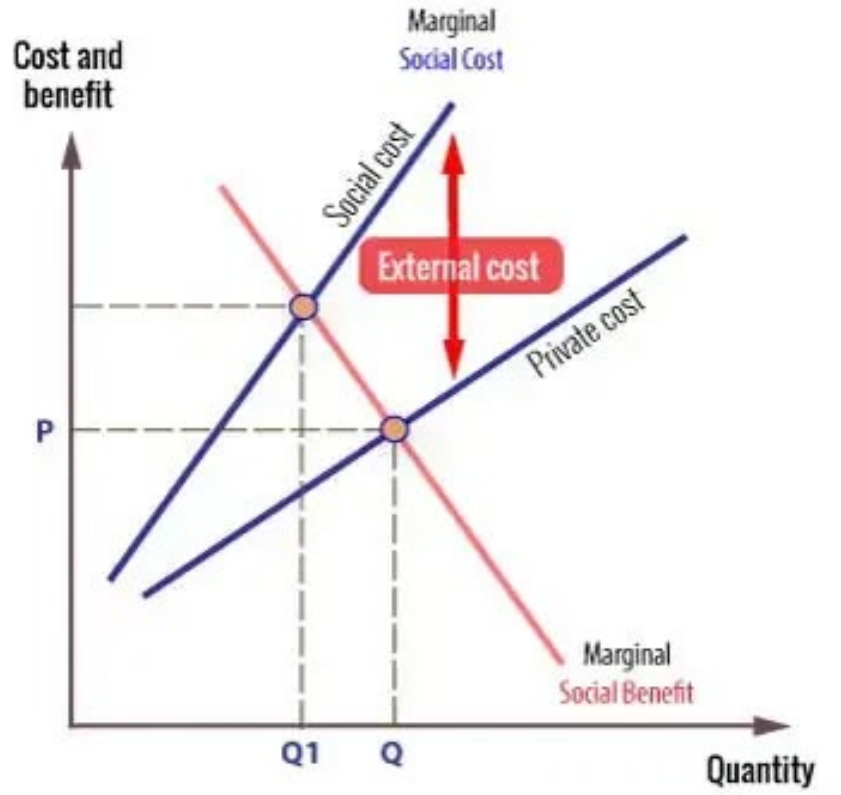

Figure 2 – Dependency between social, private and external costs [6]

An external cost, such as the cost of pollution from industrial production, makes the marginal social cost (MSC) curve higher than the private marginal cost (MPC). The socially efficient output is where MSC = MSB, at Q1, which is a lower output than the market equilibrium output, at Q. Net welfare loss can exist in two situations. Firstly, it exists when the marginal cost to society of a particular economic activity, such as manufacturing 200,000 computers, is greater than the marginal benefit to society. Secondly, it can exist when the marginal benefit of a given economic activity, such as producing 50,000m computers, is greater than the marginal cost. The first situation can occur when the market produces 'too much', and the second when it produces 'too little'. [7].

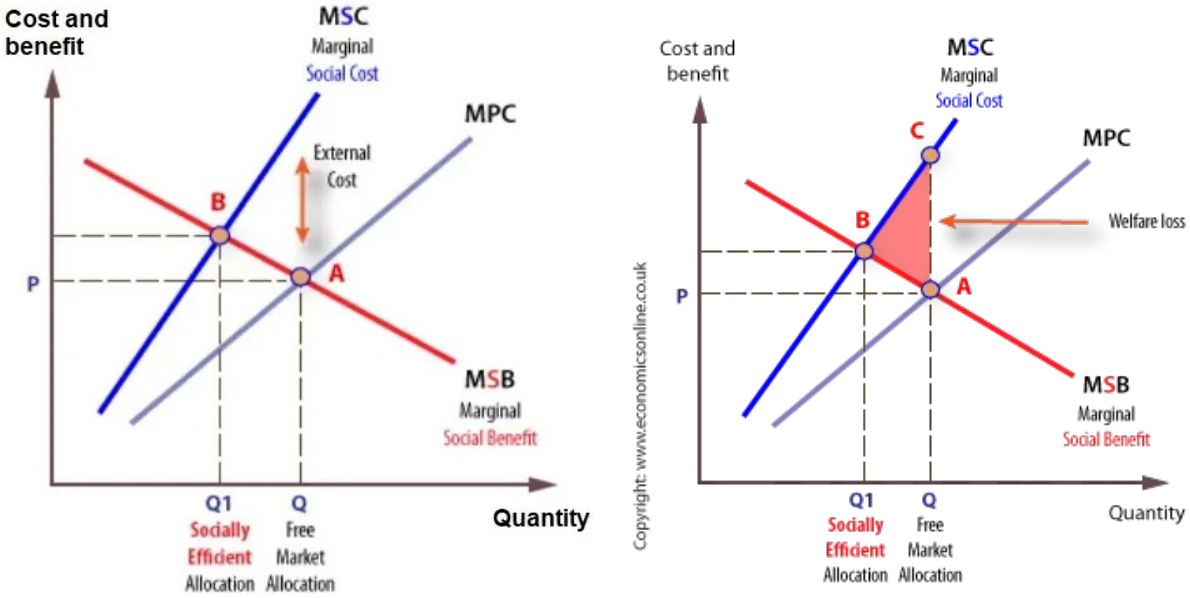

Figure 3 – Formation of welfare loss [7]

The countries of the European Union have long been engaged in converting indirect losses from transport into financial units. In relevant studies, reference books, instructions and regulations, such costs are called external.

In 2008 the European Commission commissioned the first Handbook on External Costs of Transport, as part of the IMPACT study [8]. The 2008 Handbook focus was on marginal external costs of transport as a basis for the definition of internalisation policies (in line with the marginal social cost pricing principle). It covered all main external cost categories, including air pollution, climate change, noise, accidents and congestion.

In 2014, the Handbook was updated to reflect new developments in research and policy [9]. Furthermore, the scope was broadened: next to the external costs of transport, infrastructure wear and tear costs for road and rail transport were covered as well.

The latest existing 2019 Handbook [10] is an update to the 2008 and 2014 versions. It considers not only marginal external costs, as was the focus of previous Handbooks, but also total and average external transport costs across the EU, Switzerland and Norway. In addition, data on external costs were prepared for some non-European countries to compare with European figures.

The latest vision of the European Commission is to take into account these types of external costs of transport:

- costs from traffic congestion;
- costs from traffic accidents;
- costs from traffic noise;
- costs from air pollution;
- costs from climate change;

- other costs that presented in the studies only conceptually, without a verified methodology for their calculating.

The second classification of external costs of transport is their division into total and marginal. According to [5], external marginal cost is the cost to a third party from the consumption/production of one extra unit. In [10] marginal costs show the total costs by their types (congestion, accidents etc.), and the marginal ones allow to determine the value of the costs depending on the road conditions, the distance traveled, the number of passengers and cargo transported.

It should be noted that external costs of transport are determined not only for the most common mode of transport, road transport, but also for other modes of transport, namely:

- aviation;
- railway;
- marine;
- internal water.

Presentation of the main results. Although existing methodologies cover studies on monetization of external costs of non-road modes of transport, however, some difficulties are obvious. One of them is the imperfect statistical database for EU countries for non-road modes of transport. Another is the lack of scientific research, tested on practical examples. Thus, unfortunately, the latest Handbook for determining the external costs of transport do not contain equally verified methodologies for all modes of transport.

Among other, Handbook of 2019 has information about total external costs of road transport in each country of the EU. The latest data is from 2016 but they are supposed to show also current dependency.

These values of external costs of road transport were taken as the resulting indicator (Y).

The following indicators were taken as factors influencing external costs of road transport:

- the country's GDP in % from total EU GPD in 2016 (X1);
- number of tkm performed by country in 2016 (X2);
- the volume of investments in road infrastructure by country in 2016 (X3).

Performed transport tonne-kilometres were taken from [11] and show such numbers by countries (Fig. 4).

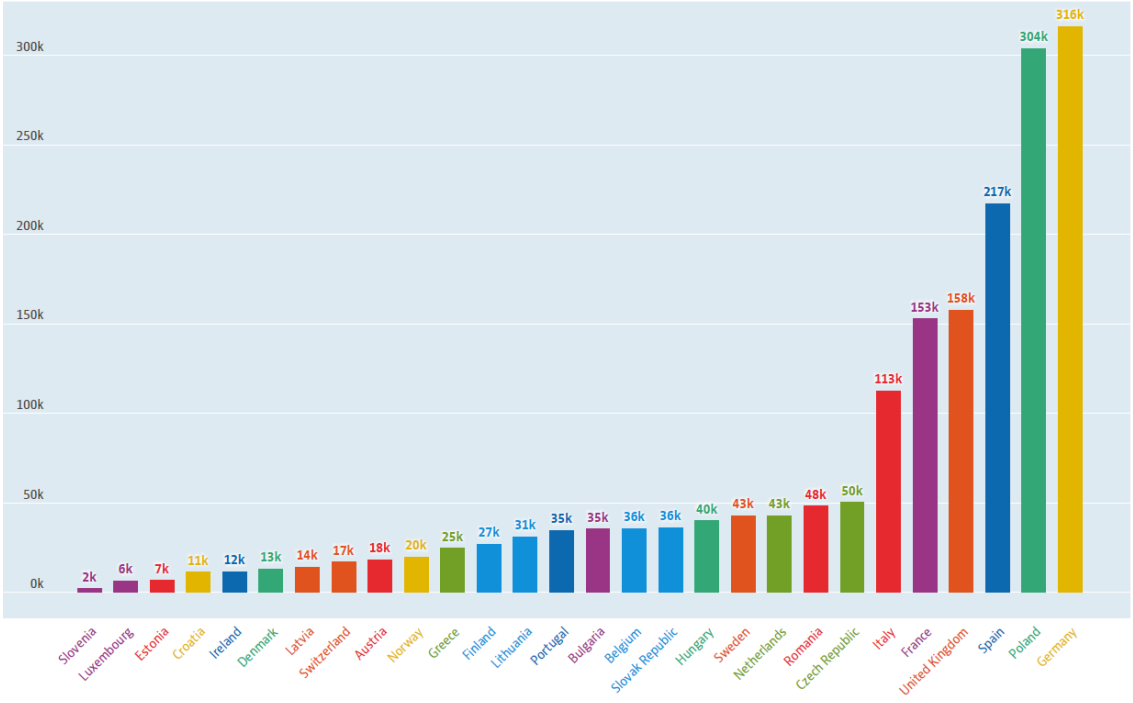

Figure 4 – Freight transport performance (road transport, mln tkm, 2016) [11]

Information about investment into road infrastructure in 2016 is shown in Fig. 5.

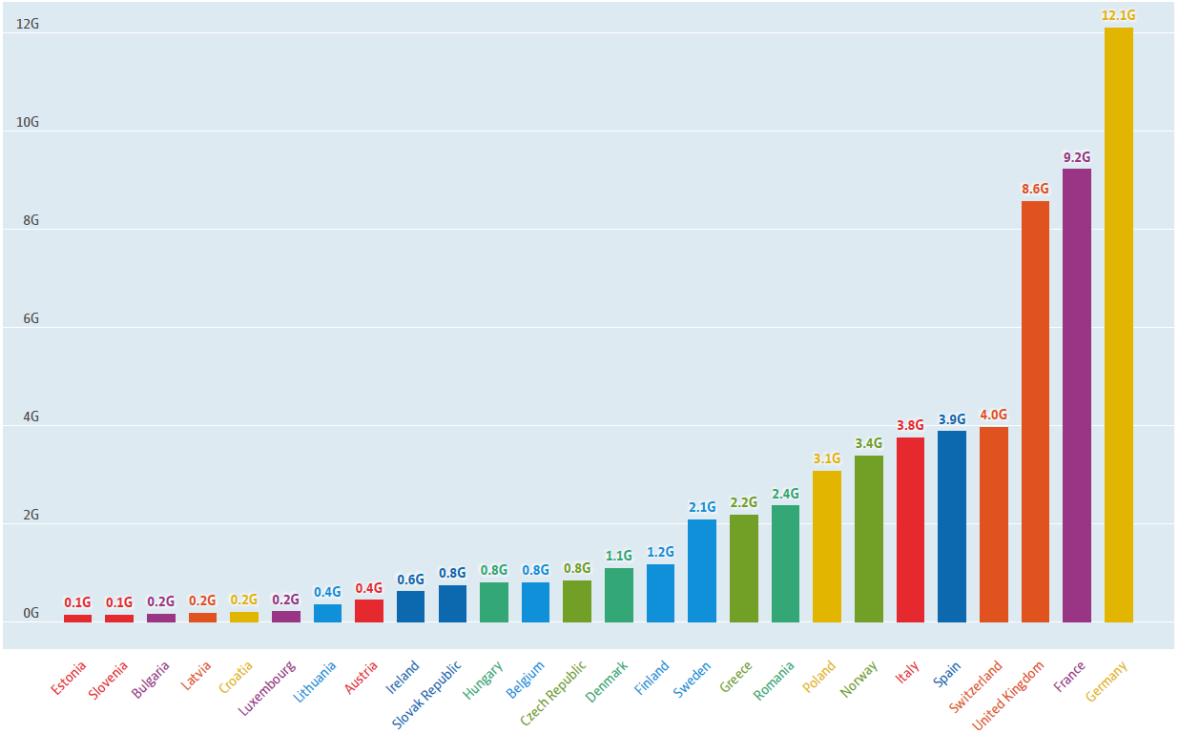

Figure 5 – Infrastructure investment in road transport (euro, 2016) [12]

Financial indicators of GPD in countries of the EU in 2016 was found in the Eurostat website (Fig. 6).

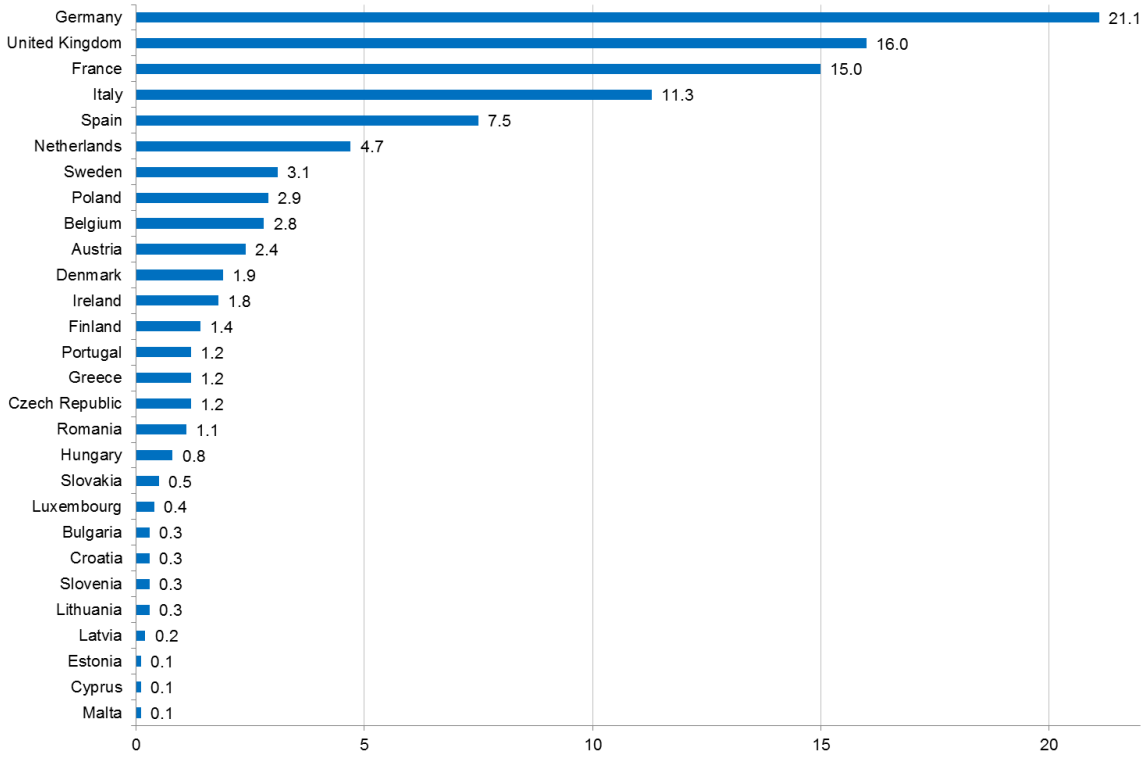

Figure 6 – Share in the EU GPD (%, 2016) [13]

Unfortunately, due to old statistics, information was not found in open sources for all EU countries in 2016. Therefore, the worksheet with initial data contains information only for those countries that belonged to the EU in 2016 and for which it was possible to obtain statistical data on all the above factors of influence (Table 1).

It should be noted that for the possibility of direct comparison of the degree of influence of each factor on external costs, the units of measurement (Fig. 4-6) were transformed to those that made it possible to obtain approximately the same order of numbers for all factors (resulting and influencing).

Table 1. Statistics about external costs of road transport, performed work, investment in the infrastructure and GPD by countries of the EU in 2016

Country	Total external costs (bn €)	% of EU GDP	Performed tonne-kilometres (bn tkm)	Infrastructure investment in road transport (10 mln €)
Austria	18,30	2,40	18,09	44,40
Belgium	26,40	2,80	35,58	81,00
Bulgaria	6,50	0,30	35,40	16,31
Croatia	5,00	0,30	11,34	19,74
Czech Republic	13,60	1,20	50,31	84,92
Denmark	8,20	1,90	12,94	109,95
Estonia	1,50	0,10	6,72	14,86
Finland	7,40	1,40	26,85	117,80
France	109,10	15,00	152,80	921,60
Germany	165,70	21,00	315,77	1209,00
Greece	12,80	1,20	24,56	218,70
Hungary	11,10	0,80	40,01	80,27
Ireland	14,30	1,80	11,56	62,20
Italy	115,00	11,30	112,64	375,50
Latvia	2,30	0,20	14,23	19,00
Lithuania	3,90	0,30	30,97	35,70
Luxembourg	3,20	0,40	6,45	21,35
Poland	40,20	2,90	303,56	307,54
Portugal	16,80	1,20	34,68	7,90
Romania	21,20	1,10	48,18	236,68
Slovakia	5,40	0,50	36,11	75,14
Slovenia	2,70	0,30	2,14	14,90
Spain	64,30	7,50	216,99	388,00
Sweden	15,30	3,10	42,69	208,63
United Kingdom	99,40	16,00	157,66	856,14

Next, regression analysis was performed and such values were obtained (Table 2).

Table 2. Regression statistics

Multiple R	0,99
R Square	0,97
Adjusted R Square	0,97
Standard Error	7,96
Observations	25

Values of Multiple R and R-square (very next to 1) allow us to make a conclusion that these three factors are sufficient to explain the variable (external costs) at a reliability level of 95% (that is by default in the MS Excel).

In our case the F Statistics is less than 0,05 (2,49E-16), which indicates that the explanatory variables (factors X1, X2, X3) have a statistically significant association with external costs.

The most important results were obtained about the coefficients of the regression equation, their boundaries as well as errors and t-statistics (Table 3).

Table 3. Regression Coefficients, Errors, P-values, t Statistics

	Coefficients	Standard Error	t Statistics	P-value	Lower 95%	Upper 95%
Intercept	1,67	2,04	0,82	0,42	-2,58	5,92
Factor X_1	8,86	1,07	8,26	0,00	6,63	11,09
Factor X_2	0,09	0,03	3,20	0,00	0,03	0,15
Factor X_3	-0,05	0,02	-2,22	0,04	-0,09	0,00

P-values tell us whether or not each explanatory variable is statistically significant. All factors are statistically significant (values are from 0,00 to 0,04 that is less than 0,05). It means that all factors should be involved in the model.

The work [14] shows no significant correlation between transport work and infrastructure investment, which confirms the absence of multicollinearity.

The coefficients for each explanatory variable (8,86; 0,09; -0,05) show the average expected change in the response variable, assuming the other explanatory variable remains constant. For example, for each additional % of EU GDP, the external costs of transport are expected to increase by 8,86, assuming that all other factors values remain constant.

As for the coefficient for the intercept, it means that the expected external costs for a country with 0 values of all factors X is 1,67. Of course, this looks like nonsense, since with zero GDP, and with the absence of transport performance and investment in infrastructure, the external costs of transport cannot take place. However, here it should be remembered that the value of this coefficient is only an estimate, that is, an average. If we talk about the interval in which it can change, then its upper and lower limits (at a 95% reliability level) are (-2,6; 5,9).

Another important result is the sign with which the coefficients are present in the model: the factors X_1 and X_2 have a positive sign, and the factor X_3 has a negative sign. This can be regarded as the direction of the influence of the factor on the resulting value. That is, with an increase in % of GDP and transport work, external costs will increase, however, with an increase in investment in road infrastructure, the value of external costs of transport will decrease. This fact should be taken into account by all countries when assessing the feasibility of infrastructure investment projects. If, in addition to the direct economic component, the external costs of transport are taken into account, this may tilt the balance towards the expediency of launching the project.

The last step is to show the regression equation and illustrate the difference (and similarity) between the real values of external costs of transport for each country and the theoretical values calculated using the regression equation.

Regression is:

$$Y = 1,67 + 8,86 \cdot X_1 + 0,09 \cdot X_2 - 0,05 \cdot X_3,$$

where Y is external costs of road transport in bn euros;
X_1 is the country's GDP in % from total EU GPD in %;

X_2 is performed transport work by country in bn tkm;
X_3 is the volume of investments in road infrastructure by country in 10 mln euros.

Now we can show the real and theoretical (obtained using the regression equation) data of external costs of road transport in the graph (Fig. 7).

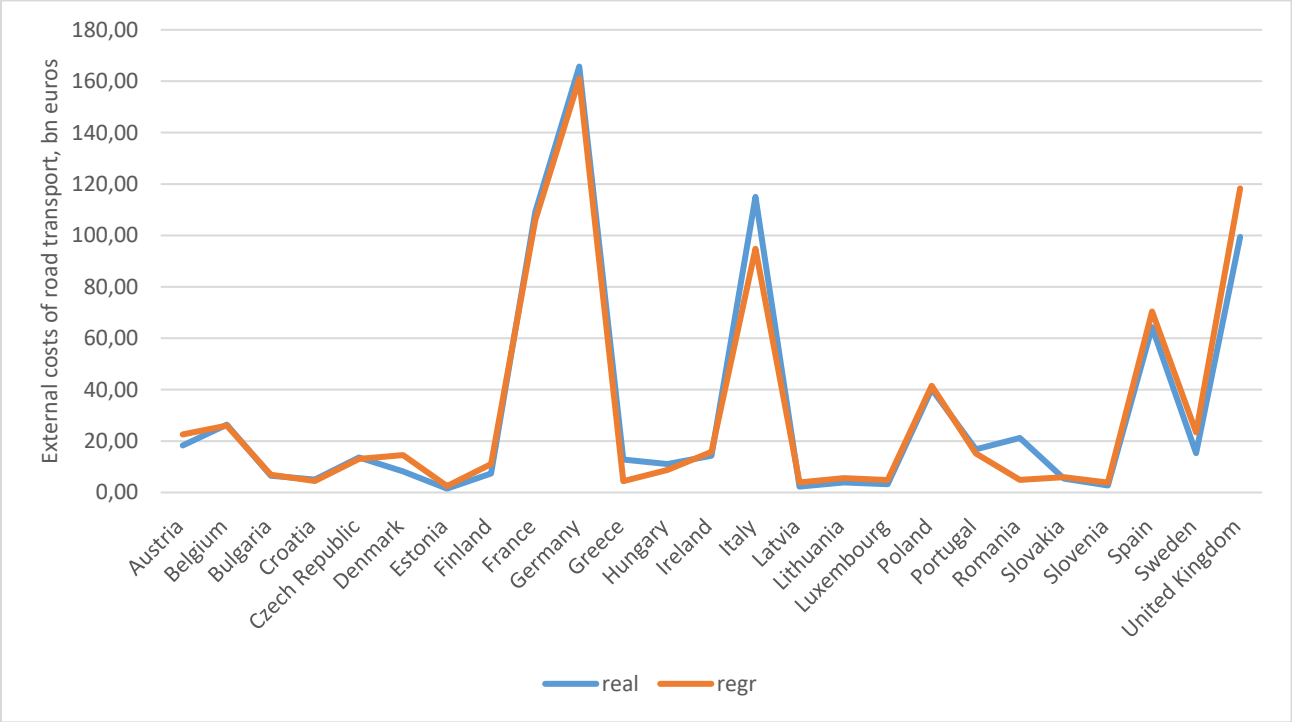

Figure 7 – Real and theoretical values of the external costs of road transport

Conclusions. To sum up, on the basis of correlation-regression analysis, factors were determined that have a clear relationship with the external costs of road transport - the country's GDP, the amount of transport work produced by the country in tkm and the amount invested in road infrastructure. Values of Multiple R and R-square of the regression model (very next to 1) allow us to make a conclusion that these three factors are sufficient to explain the variable (external costs) at a reliability level of 95%. All factors are statistically significant and should be involved in the model. Another important result is the sign with which the coefficients are present in the model: with an increase in % of GDP and transport work, external costs will increase, however, with an increase in investment in road infrastructure, the value of external costs of transport will decrease.

We can observe a very good representation of the theoretical data with the resulting regression model. It can be assumed that this equation can be used both now and in the future to predict external costs of road transport and transfer the methodology to countries outside the EU, for example, Ukraine.

It should be added that in the context of road transport, there is mostly talk of negative externalities, which is undoubtedly necessary, but there is very little discussion of positive externalities, the contribution of transport to country's economic growth (and therefore positive GDP growth).

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UDC 332.1
DOI: https://doi.org/10.46783/smart-scm/2023-17-3
JEL Classification: C51, F63, L92, O33, R58.
Received: 14 January 2022

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DEVELOPMENT OF INTELLIGENT TRANSPORT SYSTEMS OF UKRAINE

Sergiy Grytsenko, Anastasiia Hrechkovska, Mariia Kordyak. "Development of intelligent transport systems of Ukraine". *The article determines that the possibilities of the extensive direction of meeting the needs of society in increasing the volume of passenger transportation by increasing the number of vehicles are largely exhausted, especially in large cities. A generalization of the modern development of intelligent transport systems (ITS) in Ukraine was carried out in two directions. The direction of introduction of advanced driver assistance systems (ADAS) into vehicles is highlighted. Reasonable expediency of the MaaS (Mobility as a service) direction of regulating passenger flows. The importance of ITS implementation in Ukraine is highlighted. The goals of ITS development and the possibility of their application are considered. The main traffic management systems are outlined using the example of GPS tracking in the city of Lviv. Important aspects of the development of ITS in Ukraine are disclosed and the development of ITS of Ukraine is presented, in order to increase road safety. It has been proven that under the conditions of a well-developed intelligent transport system, non-stop synchronized traffic on streets and roads is ensured.*

Keywords*:* intelligent transport system (ITS), GPS tracking, innovative technologies, transport network, ITS development.

Сергій Гриценко, Анастасія Гречковська, Марія Кордяк. «Розвиток інтелектуальних транспортних систем в Україні». *У статті визначено, що можливості екстенсивного напрямку задоволення потреб суспільства в нарощуванні обсягів перевезень пасажирів шляхом збільшення чисельності транспорту в значній мірі вичерпані, особливо в великих містах. Здійснено узагальнення сучасного розвитку інтелектуальних транспортних систем (ІТС) в Україні за двома напрямами.*

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Виділено напрям впровадження в транспортні засоби передових систем допомоги водієві (ADAS). Обґрунтована доцільність напряму регулювання пасажирських потоків MaaS (Mobility as a service). Висвітлено важливість впровадження ІТС в Україні. Розглядаються цілі розвитку ІТС та можливість їх застосування. Окреслено основні системи управління дорожнім рухом на прикладі застосування GPS-трекінг у м. Львів. Розкриті важливі аспекти розвитку ІТС в Україні та представлений розвиток ІТС України, задля підвищення безпеки дорожнього руху. Доведено, що за умов добре розвинутої інтелектуальної транспортної системи забезпечується невпинний синхронізований рух по вулицях і дорогах.

Ключові слова: інтелектуальна транспортна система (ІТС), GPS-трекінг, інноваційні технології, транспортна мережа, розвиток ІТС

Сергей Гриценко, Анастасия Гречковская, Мария Кордяк. "Развитие интеллектуальных транспортных систем в Украине". *В статье определено, что возможности экстенсивного направления удовлетворения потребностей общества в увеличении объема пассажирских транспортных средств за счет увеличения числа транспорта в значительной степени исчерпаны, особенно в крупных городах. Осуществлено обобщение современного развития интеллектуальных транспортных систем (ИТС) в Украине в двух направлениях. Выделено направление внедрения в транспортные средства передовых систем помощи водителю (ADAS). Обоснована целесообразность направления регулирования пассажирских потоков MAAS (мобильность в качестве услуги). Освещена важность внедрения ИТС в Украине. Рассматриваются цели развития ИТС и возможность их использования. Обозначены основные системы управления дорожным движением на примере использования GPS-трекинга во Львове. Раскрыты важные аспекты развития ИТС в Украине, и представлено развитие ИТС Украины для повышения безопасности дорожного движения. Доказано, что в условиях хорошо развитой интеллектуальной транспортной системы обеспечивается непрерывное синхронизированное движение на улицах и дорогах.*

Ключевые слова: интеллектуальная транспортная система (ИТС), GPS-трекинг, инновационные технологии, транспортная сеть, развитие ИТС.

Introduction. Transport is an integral part of the socio-economic development of the country, cities and regions. Meanwhile, in recent decades, the imbalance between the needs for transport services and the real capacity of all types of transport has been growing.

To regulate traffic flows, new technologies are created every day. They are developed in order to make vehicles safer and to improve comfort when using these vehicles.

Such technologies are called - intelligent transport systems (ITS). With proper application of ITS, transport systems are made more efficient, safe and reliable.

ITS is a mixture of developments in the computer field, information technology and telecommunications together with knowledge in the automotive and transport sectors. Key ITS technologies emerge on the basis of major developments in these sectors. ITS can be defined as the application of computer, information and communication technologies to manage vehicles and networks in real time, including the movement of people and goods [1].

To date, the National Transport Strategy of Ukraine for the period until 2030 has been approved in Ukraine, which sets the following tasks: the introduction of new technologies and intelligent transport systems (ITS) to improve the quality of the provision of transport services, information systems about the services provided, the introduction of an electronic and integrated automatic fare payment system [2].

At present, the implementation of the planned scope of work has actually been suspended due to military operations.Also, in

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order to restore, rebuild, modernize transport infrastructure facilities and gradually integrate the transport network of Ukraine into the EU transport network, it is necessary to take appropriate measures and adopt a number of legal acts.

The purpose of the study: to determine the development of ITS in Ukraine and its application in practice.

Research task: determination of the main goals of ITS development, implementation of ITS traffic management in the city.

Presentation of the main results. Intelligent Transport Systems (ITS) have become a vital component of modern transport infrastructure, providing advanced technologies and innovative solutions for efficient, safe and sustainable movement of people and goods. In Ukraine, ITS development has been gaining momentum in recent years, with various initiatives aimed at improving the country's transport systems.

One of the main goals of the development of ITS in Ukraine is to improve the organization of traffic and reduce traffic jams on the country's roads. The Ukrainian government has implemented several projects to achieve this goal, including the implementation of intelligent traffic management systems, the deployment of smart sensors and cameras, and the development of intelligent transportation networks.

Examples of functions that can be performed using ITS are shown in Figure 1.

The use of ITS contributes to the solution of problems related to ensuring road traffic safety, planning the operation of public transport, eliminating traffic jams in transport networks, increasing the productivity of transport enterprises, as well as solving problems related to environmental pollution [4].

ITS has many advantages - high accuracy of determining the location of the position of vehicles for managing them in real time, navigation service of emergency vehicles. However, the creation of a continuous stable navigation service in the conditions of tunnels and high-rise urban buildings cannot be provided by the capabilities of modern satellite navigation systems.

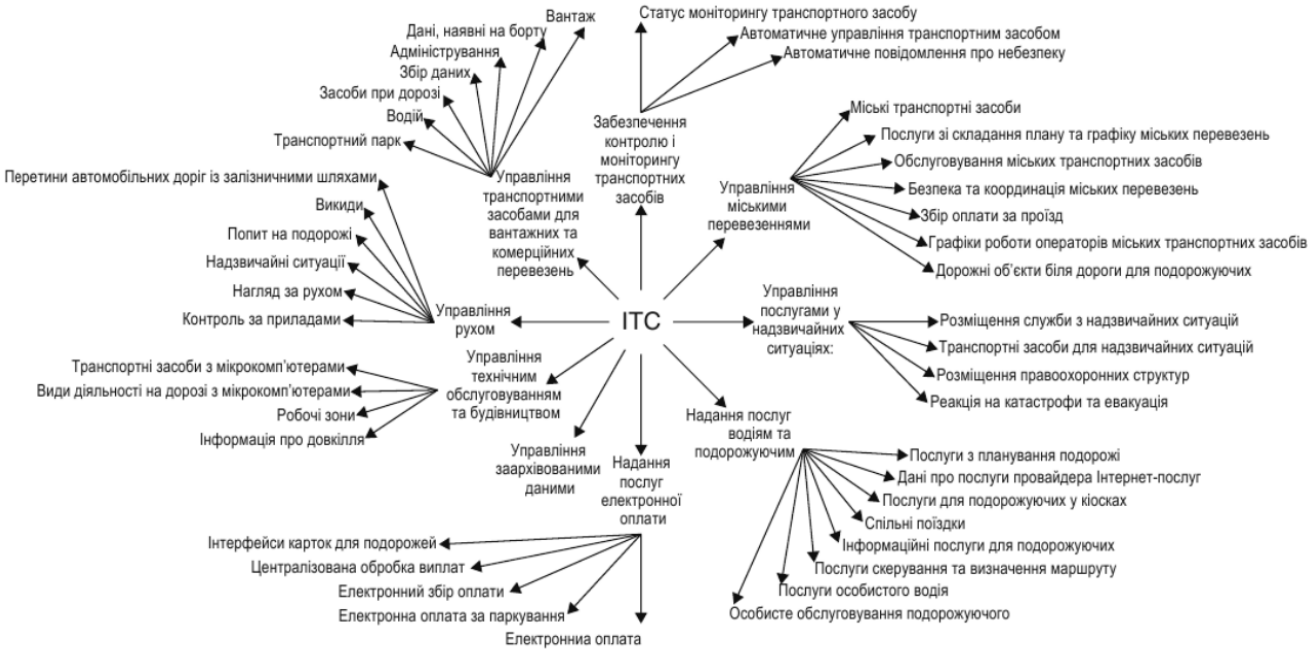

Figure 1 – Functions of the intelligent transport system [3, p. 4]

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The implementation of these requirements requires the integration of positioning technologies with wireless communication technologies in order to create a continuous virtual environment of transport management in any conditions.

The trend of intellectualization and digitalization of transport systems causes certain problems [5] (Table 1).

Also, the disadvantages of ITS include:

- locality of the sources (lack of camera coverage of 100% of the territory);
- the emergence of difficulties with the accumulation of statistics on the basis of existing databases;
- the impossibility of a real assessment of the target efficiency - the ITS pilot zone does not scale to the size of the city;
- increasing the data error when changing the ephemerides, which reaches 30 meters;
- the influence of the terrain on the accuracy of the data;
- periodic disturbances in the continuity of the signal, which are expressed in distortion and delay in determining the signal.

Table 1. Pros and cons of implementing innovative technologies in the field of transport systems of the European Union

Pluses	Cons
Overall road safety is increased through better control and monitoring	The cost of electric cars is higher than conventional ones
A single integrated system with other counter and monitoring services is being created	Payments for violations are reduced and the state treasury is reduced
Reduction of cost of transportation	Loss of jobs for drivers, controllers, cashiers
Saving time on driving a car	The issue of cyber security is intensifying
Reducing emissions of harmful substances and increasing the welfare of the population	The problem of disposal of electric accumulators and their service

Today, there are many reasons that inhibit the widespread use of ITS in the transport system of Ukraine. The main such reasons are: large volume and high organizational and technical complexity of implemented ITS projects; imperfection of the legislative framework; shortage of highly qualified personnel who can simultaneously be experts in the transport industry and able to solve the problem of integration at the junction of various related departments, organizations and services; misunderstanding of the complexity of the tasks to be solved by the customer and contractors, etc. [6, p. 121].

One of the most notable ITS projects in Ukraine is the introduction of an intelligent traffic management system in Kyiv. The system, which is being developed by the city authorities, is designed to provide real-time traffic information, optimize traffic flow and reduce traffic jams. It uses a network of smart sensors and cameras installed throughout the city to collect and analyze traffic data, which is then used to optimize traffic flow and provide drivers with real-time information about road conditions.

In addition to traffic management, the development of ITS in Ukraine also involves the introduction of smart public transport systems. The city of Lviv, for example, has implemented an innovative transport management system that uses GPS tracking to provide real-time information on bus and tram locations, schedules and delays. The

system also includes a mobile app that allows passengers to plan their journeys, buy tickets and track their buses or trams in real time. Another important aspect of ITS development in Ukraine is the promotion of electric vehicles and deployment of charging infrastructure. The Ukrainian government has introduced several incentives to encourage the adoption of electric vehicles, including tax exemptions, reduced parking fees and subsidies for the purchase of electric vehicles. In addition, a network of charging stations has been created in the country, more than 500 charging stations have been installed throughout the country.

In Ukraine, the formation of intelligent transport systems is at an initial stage (standards, legislative framework, technologies and general principles of the system are being developed) [7].

The main financial risk of implementing an improved ITS model is underfunding, which is minimized by staged funding, which requires investing in sufficient volume for the works within each stage of development. The main legal risk is the lack of a legal basis for the construction of IT and standardization in the field of interaction of executive authorities. It is possible to minimize the group of legal risks due to the formation of a legal environment, a methodological complex for the creation of IT, as well as conditions for the coordination of the interaction of various executive authorities. Market and technical risks include the lack of a proven strategy and vision for IT development. To minimize this risk, it is necessary to create a scientific community to develop its own ITS technologies and create a National ITS Development Strategy [7].

Economic efficiency.It consists in creating conditions for ensuring the given mobility of citizens, timely and reliable control of the execution of municipal orders for the implementation of transport work by enterprises that carry out passenger transportation, street cleaning, removal of solid and liquid household waste. The implementation of ITS in regional management bodies will improve the efficiency of state and municipal transport management due to customers and contractors receiving a complete, up-to-date picture of the planning and execution of transport work of enterprises [8].

Ecological effect. An intelligent transport system using technologies for redistribution of road congestion due to the effective operation of a number of subsystems (subsystems for controlling traffic light objects, subsystems for indirect control of traffic flows, subsystems for restricting access to certain sections of roads, subsystems for managing parking loads, other subsystems) allows to solve this the task of transferring or redistributing places of traffic concentration (traffic jams) to places where the ecological situation is not as serious as in residential areas or places of recreation of townspeople [8].

The operation of smart urban transport requires technologies that will allow data exchange between the center of the system and all its components, as well as between individual elements of communication.

In order to understand the quality of transportation, there is also an operational system for controlling the process of passenger transportation. The set of electronic module GSM / GPS system is installed in the bus [9].

In addition, the control system can register the time and place of engine on-off, memory card removal-insertion, other events represented by relay signals, and can also process one analog sensor, for example, to assess the fuel level in the tank. On request, the control of other parameters can be included in the system or an information board for the driver can be introduced. The block architecture of the electronic module allows it to be used in various configurations, for example, only for the accumulation of traffic logs with delayed control (without a built-in modem), or only for operational exchange with the monitoring center (without a memory card) [10].

The included external memory card is an extremely convenient means of collecting and transmitting movement results.

Smart urban transport is the use of electronic, wireless and Internet technologies that provide access to smarter, safer and faster travel between two points in a large city [11].

It provides city authorities with rich information and control over traffic flows. Cities that want to become a smart city often start by building an intelligent transportation infrastructure in the form of an Intelligent Transportation Network (ITN). ITN includes:

- public transport management system;
- route information system and electronic timetable;
- vehicle safety and control system;
- a single tariff [12].

The development of ITS in Ukraine is also aimed at increasing road safety. The Ukrainian government has proposed a number of initiatives to reduce the number of road accidents, including the implementation of a new road safety strategy and the introduction of advanced driver assistance systems (ADAS) in vehicles [13].

ADAS is a driver assistance system based on machine vision. The goal of the ADAS system is to improve traffic safety by informing and drawing the driver's attention. At a minimum, this is a sound or vibration warning to the driver of a potential risk that requires attention. As a maximum - emergency independent decision-making by the system.

ADAS is distinguished by five levels: from zero (only the driver participates in the management) to the fifth (fully autonomous management), that is, an unmanned car is an extreme case of ADAS [14].

ADAS technologies such as lane departure warning, adaptive cruise control and emergency braking are designed to help drivers avoid accidents and reduce the severity of accidents.

Also, MaaS (Mobility as a service) is one of the examples of ITS for regulating passenger flows. Mobility as a service is the integration of various forms of transport services into a single mobile service available on demand [15].

The goal of MaaS is to provide an alternative to the use of private (individual) modes of transport and to meet the growing demand for mobility services with a minimum number of vehicles.To meet the needs of the population, the MaaS operator provides the opportunity to choose different types of transport for the trip, such as public transport, car or bicycle sharing (car-, bikesharing), taxi or rented car; or their combination [16].

In MaaS, there is no need to buy tickets for each trip, an account is enough, which allows the user to freely choose the mode of transport convenient for him and pay for a specific trip or pay a monthly fee [17].

Advantages of MaaS:

- improving the quality of life in the city;
- improving the efficiency of the transport network;
- avoiding costs associated with owning and operating own vehicles;
- possibility of effective movement;
- reduction of harmful emissions;
- reducing the number of traffic jams;
- use of the vacated parking space for other public purposes [18].

The experience of the countries of the European Union, the USA, Japan, China and other countries in the promotion of IT projects shows that in the conditions of a market economy, only a single state policy allows to unite the efforts of the state and its subjects, businesses of all levels and sectors of the economy in solving national goals in transport complex. The implementation mechanisms of ITS projects differ in different countries, but the key components are the same.

Early resolution can lead to a stronger and more detailed understanding of ITS, the benefits it can provide, and the accompanying requirements for successful structure, provisioning, implementation, and operations among decision-makers and professionals at all levels. Intelligent transport systems can be effectively applied also in the

network of multimodal transport and logistics clusters [19, p. 347-350].

Conclusions. In summary, the development of intelligent transportation systems in Ukraine is a vital aspect of the country's efforts to improve transportation infrastructure, reduce congestion, promote sustainable mobility, and increase road safety. Thanks to the implementation of various ITS initiatives, Ukraine is on the way to a developed and efficient transport system. However, there is still much work to be done to realize the full potential of ITS in Ukraine, and continuous investment and innovation will be required to achieve these goals.

The experience of the world practice of introducing ITS is recognized as a general transport ideology of integrating the achievements of telematics into all types of transport activities to solve problems of an economic and social nature: reducing the number of accidents, increasing the efficiency of freight transportation, ensuring general transport safety, improving environmental indicators, etc.

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The electronic scientifically and practical journal
"INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT",
ISSN 2708-3195

43-56
v.17 (2023)
https://smart-scm.org

UDC 005.3, 656.7
DOI: https://doi.org/10.46783/smart-scm/2023-17-4
JEL Classification: M14.
Received: 24 January 2023

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THEORETICAL AND PRACTICAL ASPECTS OF CORPORATE SOCIAL RESPONSIBILITY TOOLS USAGE BY AVIATION COMPANIES

Oksana Ovdiienko. "Theoretical and practical aspects of corporate social responsibility tools usage by aviation companies". *Corporate Social Responsibility (SCR) in aviation refers to the responsibilities and actions that airlines and other aviation-related companies have towards their social, economic, and environmental impacts. These responsibilities can include reducing carbon emissions, promoting sustainable practices, ensuring passenger safety and comfort, and supporting local communities. Airlines can also take part in philanthropic initiatives and volunteer work, such as donating to disaster relief efforts or supporting educational programs. By embracing CSR principles, aviation companies can enhance their reputation and contribute to a more sustainable and socially responsible industry. And the implementation of CSR instruments can positively impact the environment and local communities, while also improving the company's reputation and relationship with stakeholders. The article describes several CSR instruments that can be applied in the aviation industry, including social campaigns, socially responsible marketing strategies, corporate ethics programs, corporate volunteering, social reporting, and propaganda of reducing waste emissions, contamination, and greenhouse gases. The focus is on the practical and theoretical particularities of each instrument, and the article also highlights the increasing public scrutiny that companies are subject to, especially those that operate globally.*

Keywords*:* corporate social responsibility, aviation industry, sustainability, instruments of corporate social responsibility.

Оксана Овдієнко. «Теоретичні та практичні аспекти використання інструментів корпоративної соціальної відповідальності авіаційними компаніями». *Корпоративна соціальна відповідальність (КСВ) в авіації стосується обов'язків і дій, які авіакомпанії та інші пов'язані з авіацією компанії мають щодо свого соціального, економічного та екологічного впливу. Ці обов'язки можуть включати скорочення викидів вуглекислого газу, сприяння сталим практикам, забезпечення безпеки та комфорту пасажирів, а також підтримку місцевих громад. Авіакомпанії також можуть брати участь у благодійних ініціативах і волонтерській роботі, наприклад, робити пожертви на допомогу постраждалим від стихійних лих або підтримувати освітні програми. Дотримуючись принципів КСВ, авіаційні компанії можуть підвищити свою репутацію та зробити внесок у більш сталу та соціально відповідальну галузь. А впровадження інструментів КСВ може позитивно вплинути на навколишнє середовище та місцеві громади, а також покращити репутацію компанії та відносини із зацікавленими сторонами. У статті описано декілька інструментів КСВ, які можна застосувати в авіаційній галузі, включаючи соціальні кампанії, соціально відповідальні маркетингові стратегії, програми корпоративної етики, корпоративне волонтерство, соціальну звітність та пропаганду*

зменшення викидів відходів, забруднення та парникових газів. Основна увага приділяється практичним і теоретичним особливостям кожного інструменту, а також стаття підкреслює дедалі більший громадський контроль, якому підлягають компанії, особливо ті, що працюють у всьому світі.

Ключові слова: корпоративна соціальна відповідальність, авіаційна галузь, сталий розвиток, інструменти корпоративної соціальної відповідальності

Оксана Овдиенко. "Теоретические и практические аспекты использования инструментов корпоративной социальной ответственности авиационными компаниями". *Корпоративная социальная ответственность (КСО) в авиации относится к обязанностям и действиям авиакомпаний и других компаний, связанных с авиацией, в отношении их социальных, экономических и экологических последствий. Эти обязанности могут включать сокращение выбросов углерода, продвижение устойчивых методов, обеспечение безопасности и комфорта пассажиров, а также поддержку местных сообществ. Авиакомпании также могут принимать участие в благотворительных инициативах и волонтерской работе, например, делать пожертвования на помощь в ликвидации последствий стихийных бедствий или поддерживать образовательные программы. Придерживаясь принципов корпоративной социальной ответственности, авиационные компании могут повысить свою репутацию и внести свой вклад в развитие более устойчивой и социально ответственной отрасли. А внедрение инструментов КСО может положительно повлиять на окружающую среду и местные сообщества, а также улучшить репутацию компании и отношения с заинтересованными сторонами. В статье описаны несколько инструментов КСО, которые могут быть применены в авиационной отрасли, в том числе социальные кампании, социально ответственные маркетинговые стратегии, программы корпоративной этики, корпоративное волонтерство, социальная отчетность и пропаганда сокращения выбросов отходов, загрязнения и парниковых газов. Основное внимание уделяется практическим и теоретическим особенностям каждого инструмента, и в статье также подчеркивается возрастающее общественное внимание, которому подвергаются компании, особенно те, которые работают по всему миру.*

Ключевые слова: корпоративная социальная ответственность, авиационная отрасль, устойчивое развитие, инструменты корпоративной социальной ответственности.

Introduction. The implementation of CSR is a mutually beneficial tool, as society receives support in solving significant issues of an economic, social, and environmental nature, and business, in return, improves its reputation, thereby receiving an additional impetus for development, laying a reliable foundation for long-term development. Aviation companies are particularly interested in long-term benefits. After all, this sphere of economic activity requires significant investments with a long payback period (purchase of fixed assets, aircraft leasing, etc.). Thus, companies in the aviation business could receive significant benefits, from implementing CSR instruments. Such as ensuring the public reputation, growth of the customs trust in the company's activities, its products or services, ensuring staff loyalty, compliance with norms and standards of the world economy communities, and the possibility of forming partnership relations with the authorities structures, public and mass media.

The **goals** in this research are:

- to determine the essence of CSR in the aviation industry;
- to learn the works of scientists in recent years in relation to the mentioned topic;
- to give the theoretical aspects of the most used CSR tools;

- to provide examples of the practical implementation of each mentioned CSR tool by aviation companies.

Moreover, research on CSR instruments in aviation can provide valuable insights into the challenges and opportunities of implementing CSR initiatives in the sector. For example, it can help to identify the barriers and enablers of CSR adoption in aviation, as well as the role of stakeholders in promoting sustainable and responsible practices in the industry.

Aviation companies have several options for demonstrating their commitment to sustainability and social responsibility through CSR practices. By adopting sustainable practices, supporting community initiatives, promoting employee volunteerism, working with suppliers that share their values, and engaging with stakeholders, airlines can show their dedication to making a positive impact on the environment and local communities. These instruments of CSR can be tailored to each airline's unique values and goals to achieve the greatest impact.

Literature analysis. Corporate Social Responsibility (CSR) is a critical aspect of sustainable business practices, and its importance in the aviation industry cannot be overstated. As the aviation industry continues to grow and expand, there is an increasing need to address the environmental, social, and economic impacts of air travel. That is why many researchers have examined various aspects of aviation CSR, including the perceptions of travelers, the role of technology, the global airline industry, and the implementation of CSR practices. Their work has contributed to a deeper understanding of the challenges and opportunities for aviation companies to be socially responsible and sustainable.

Thus, the researches Nunkoo and Ramkissoon focused their article on the perceptions of travelers regarding airlines' CSR [1]. The study found that travelers value airlines that prioritize CSR, and that airlines can enhance their image and reputation by engaging in CSR initiatives. However, the research also revealed that travelers have a limited understanding of the specific CSR initiatives undertaken by airlines, indicating the need for more effective communication and marketing of these initiatives. In general, the study highlights the importance of CSR in the airline industry and its potential impact on customer perceptions and loyalty.

Belobaba, Odoni, and Barnhart's book, "The Global Airline Industry," provides a comprehensive overview of the airline industry, including its economic, operational, and social aspects. In particular, the authors discuss the CSR concept and its importance in the airline industry [2]. The authors note that airlines have a significant impact on the environment and society, and as such, they have a responsibility to operate in a socially responsible manner. This includes reducing their carbon footprint, promoting sustainable practices, and investing in local communities. Belobaba, Odoni, and Barnhart also discuss the challenges that airlines face in implementing CSR initiatives, including the high costs associated with implementing sustainable practices, the need for regulatory support, and the difficulty in balancing social responsibility with financial performance.

The other thorough research of Aras and Crowther provides a comprehensive overview of CSR in the 21st century, covering debates, models, and practices across government, law, and business [3]. The book features contributions from leading scholars and practitioners from different fields and regions, offering diverse perspectives on the nature and role of CSR in contemporary society. The book covers a wide range of topics, including the historical evolution of CSR, the role of CSR in different sectors and industries, the challenges and opportunities of CSR implementation, and the emerging trends and innovations in CSR practice.

Simon Bennett's research, "Aviation and Corporate Social Responsibility", offers a comprehensive analysis of the relationship between the aviation industry and CSR. The historical evolution of CSR in the aviation

industry, the impact of aviation on the environment and society, the role of stakeholders in promoting CSR in aviation, and the challenges and opportunities of implementing CSR in the aviation industry are analyzed. Bennett's book also examines the emerging trends and innovations in CSR practice in the aviation industry, including the use of alternative fuels, carbon offsetting, and sustainable tourism [4].

"Consumer Awareness of CSR in the Aviation Industry", a paper conducted at Guru Nanak Institute of Technology by Giorgia Favero, examines consumers' awareness and perception of CSR in the aviation industry. The study explores the factors that influence consumers' decision-making when choosing airlines, including CSR initiatives related to environmental sustainability, social responsibility, and ethical business practices. It also evaluated the effectiveness of CSR communication strategies and the role of information and transparency in shaping consumer perceptions of CSR in the aviation industry [5]. Overall, the study provides insights into the complex relationship between consumers, CSR, and the aviation industry, highlighting the need for more effective communication and engagement strategies to promote sustainable and responsible practices in the sector.

Therefore, the aviation industry is a crucial sector that has a significant impact on the environment and society. In recent years, there has been an increasing emphasis on CSR in the aviation industry as well, with a growing recognition of the need for sustainable and responsible practices. However, despite the importance of CSR in aviation, there is a lack of research, devoted to the specific tools and instruments that companies can use to implement and measure their CSR initiatives.

This lack of information highlights the importance of the study on the theoretical and practical aspects of CSR tools usage by aviation companies. Such research can help to identify and evaluate the effectiveness of different CSR instruments in the aviation industry, including those related to environmental sustainability, social responsibility, and ethical business practices.

Overall, research on CSR instruments in aviation is critical to the development of sustainable and responsible practices in the sector. By identifying and evaluating the effectiveness of different CSR tools and instruments, this research can help to promote more effective and comprehensive CSR strategies in the aviation industry, and ultimately contribute to the long-term sustainability and success of the sector.

Presentation of the main results. The concept of SCR has its theoretical foundation in the 18th century during the period of industrial revolutions and the emergence of modern entrepreneurship. Business owners, guided by their religious or ethical beliefs, assumed responsibility for their own employees at that time. However, enterprises faced increasing pressure from society and institutions, which led to the demand for compliance with certain standards and regulations. As a result, enterprises had to develop new targeted programs, particularly in the fields of ecology and labor protection, to meet the needs of their own activities and establish relationships with the state and society based on new rules. This development also brought the idea of the ethical factor in the economy, emphasizing that the responsibility of enterprises cannot be solely based on economic interests, and the level of ethics should be determined by the system of needs it generates [6].

CSR concept refers to a company's obligation to act in a way that benefits society, the environment, and the economy. CSR is implemented by instruments or tools because it allows companies to take specific actions that align with their values and goals, and demonstrate their commitment to sustainability and social responsibility. By implementing CSR instruments, companies can have a positive impact on the environment and local communities, while also improving their reputation and relationship with their stakeholders. These instruments can also help companies to

identify areas where they can improve their social and environmental impact, and to develop strategies to address those areas.

Aviation companies also have a responsibility to support the communities in which they operate. This can involve supporting local charities, sponsoring community events, and creating job opportunities. Furthermore, airlines have a duty to ensure the safety and well-being of their passengers and employees. This can be achieved through the implementation of safety programs, employee training, and effective communication with customers.

Finally, aviation companies are expected to adhere to ethical business practices, such as fair labor practices, anti-corruption policies, and human rights standards. These practices are essential to building trust with customers, employees, and other stakeholders, as well as enhancing the company's reputation.

Theoretical information on CSR instruments includes their ability to align company values and goals with specific actions that positively impact the environment and local communities, while also improving the company's reputation and relationship with stakeholders. These instruments can be tailored to the specific needs of each company and can take various forms, including sustainable operations, corporate philanthropy, employee volunteerism, supply chain management, stakeholder engagement, and more. The theoretical and practical particularities of the main CSR instruments, which could be applied as well in the aviation industry, are described below.

Social campaigns. A public social announcement, also known as a PSA, is a set of actions that involves mass media to change the attitude or behavior of a selected target group in order to achieve certain goals. This concept is related to social or commercial advertising, aimed at the mass consumer, to achieve socially desirable changes. The purpose of conducting a social campaign is to solve certain social problems by promoting voluntary actions of people to solve them. The PSA is designed to inform the public about issues that are often considered to be in the public interest. Its main goal is to raise awareness and encourage people to take action to address social issues. Through the use of various media channels, such as television, radio, and social media, PSAs can effectively reach a wide audience and promote positive social change.

In today's world, all actions of companies regarding SCR are subject to increasing public scrutiny. This is especially true for large companies or those that operate globally, across several countries or continents (as is the case with companies in the aviation industry), as their decisions can affect the wider public. Therefore, PSA is the notification of the audience through the mass media about the company's CSR actions, which in turn improves its public image. Potential directions and ideas for PSAs include creating content on the importance and relevance of carbon offset tickets. After all, such tickets are more expensive, reducing the negative impact of the carbon footprint is not cheap, and air transport is already one of the most expensive. Therefore, it is essential to communicate with the consumer, to demonstrate the possible consequences of global problems that the company is trying to fight.

Delta Air Lines has Delta Force for Global Good: a long-standing commitment to CSR and has established the Delta Force for Global Good program to support this effort. The program focuses on three key areas: supporting education, promoting global health, and improving the environment. Delta employees volunteer their time and expertise to support these initiatives, and the company provides financial support and resources to make a positive impact on society [7].

Emirates Airlines has launched the "A Greener Tomorrow" campaign to promote environmental sustainability and reduce the company's carbon footprint. The program includes various initiatives, such as the use of biofuels, investing in fuel-efficient aircraft, and reducing waste and emissions. Emirates

also collaborates with local communities and organizations to promote environmental awareness and conservation efforts [8].

These are just a few examples of the social campaigns conducted by aviation companies, but there are many more initiatives underway that aim to make a positive impact on society and the environment.

Socially responsible marketing strategies involve promoting brands while advocating for social values that aim to improve the lives of individuals and society as a whole. These activities are typically related to issues such as ecology, medicine, and charity. Implementing these strategies can lead to increased customer loyalty, enhanced social awareness and motivation among employees, improved reputation and social image, and increased sales. Charity marketing is one possible approach, where a percentage of sales are donated to a charitable cause. Another approach involves promoting a socially significant issue by fundraising, partnering with non-profit organizations, and encouraging employee volunteering. Corporate social marketing can have a positive impact on companies by promoting campaigns that change consumer behavior and improve healthcare, the environment, and public welfare.

Emirates launched a "Hello 2020" campaign that celebrated the company's commitment to sustainability and reducing its carbon footprint. The campaign included a video highlighting the airline's efforts to reduce waste and promote sustainable practices [8].

Etihad Airways partnered with the UAE Red Crescent to provide relief to victims of natural disasters and other humanitarian crises. The company also promotes environmental sustainability through its Eco Residence program, which features a villa powered by solar energy [9].

Delta Air Lines has been recognized for its commitment to diversity and inclusion. The company's marketing campaigns feature a diverse range of employees and highlight its support for LGBTQ+ rights [7].

Qantas has launched a number of initiatives aimed at reducing the airline's carbon footprint. These include investing in renewable energy, reducing waste, and introducing more fuel-efficient aircraft. The company's marketing campaigns promote its commitment to sustainability and encourage customers to make more eco-friendly choices [10].

JetBlue has been recognized for its support of local communities and environmental initiatives. The company's marketing campaigns highlight its commitment to sustainability and social responsibility. JetBlue has also partnered with non-profit organizations to provide disaster relief and support for underserved communities [11].

Corporate ethics programs and corporate volunteering are two initiatives aimed at integrating employees around common values and corporate social responsibility. Corporate volunteering involves the company's support for charitable events and socially significant initiatives, which encourages employees to participate in various programs for the benefit of the local community. These initiatives not only benefit the local community but also bring numerous advantages to the companies themselves. They can help in developing employees' skills, creativity, innovative thinking and leadership, communication and teamwork skills. Research shows that corporate volunteering can support skill building and improve leadership, communication, and teamwork skills. 80% of employees say that corporate volunteering has helped them to improve their leadership, communication and teamwork skills [12].

Delta has a Code of Business Conduct that outlines ethical behavior for employees and a Corporate Responsibility Committee that oversees the company's sustainability and philanthropy efforts. Delta also has a program called Force for Global Good, which includes employee volunteerism and charitable giving [7].

Emirates has a CSR program that includes employee engagement, philanthropy, and sustainability initiatives. The airline has a volunteer program called Time for Giving, which allows employees to participate in community service projects [8].

United Airlines has a Code of Conduct and Ethics that outlines the company's commitment to ethical behavior and compliance with laws and regulations. United also has a CSR program that includes employee volunteerism, charitable giving, and sustainability initiatives. The airline partners with organizations like the American Red Cross and the United Way to provide volunteer opportunities for employees [13].

Air France-KLM has a sustainability strategy that includes reducing the company's environmental impact, promoting diversity and inclusion, and supporting local communities. The airline has a corporate volunteering program that allows employees to participate in community service projects [14].

Social reporting, also known as non-financial reporting, involves the collection and presentation of a company's social impact and activities, typically through specially designed publications and documents [15]. This type of reporting showcases the company's responsible management and business practices in areas such as diversity among customers and employees, women's participation in high-level management, and working conditions for various employee groups such as cabin crew, airport handling, airline representatives, and more. Aviation companies can use social reporting to highlight a wide range of social issues.

For example, Lithuanian Airports (a state enterprise that unites and manages Vilnius, Kaunas and Palanga airports) represents their social responsibility report [16]. They analyzed not only classical parameters, such as equal opportunities regardless of marital status, gender, age and other differences, employees' health and security (including accidence at working place). The entity decided to measure the level of implementing the employees' ideas on how they can improve and better facilitate their daily (Fig.1).

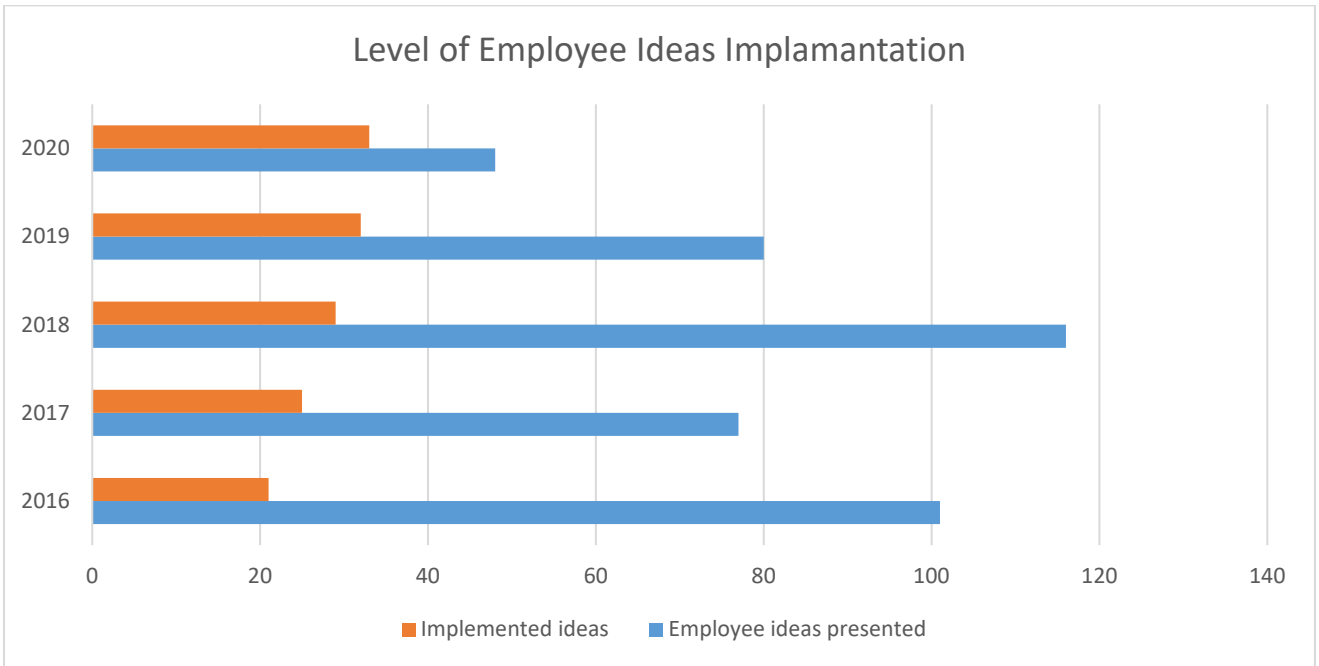

Figure 1 – Level of employee ideas implementation at Lithuanian Airports

According to the provided data, the level of implementation to the company's operation activity ideas, generated by its own employees increased significantly from

approximately 21% in 2016 to 69% in 2020. Emirates Group publishes an annual sustainability report that highlights its performance in areas such as carbon emissions, fuel efficiency, employee engagement, and community outreach programs [8].

British Airways has a dedicated page on its website called "Our Approach to Sustainability" where it provides information on its sustainability policies, initiatives, and performance [18].

Air France-KLM publishes a sustainability report that covers topics such as carbon emissions, fuel efficiency, biodiversity, and employee well-being [14].

Delta Air Lines has a sustainability page on its website where it provides information on its environmental, social, and governance initiatives, including its commitment to reducing carbon emissions (Fig.2).

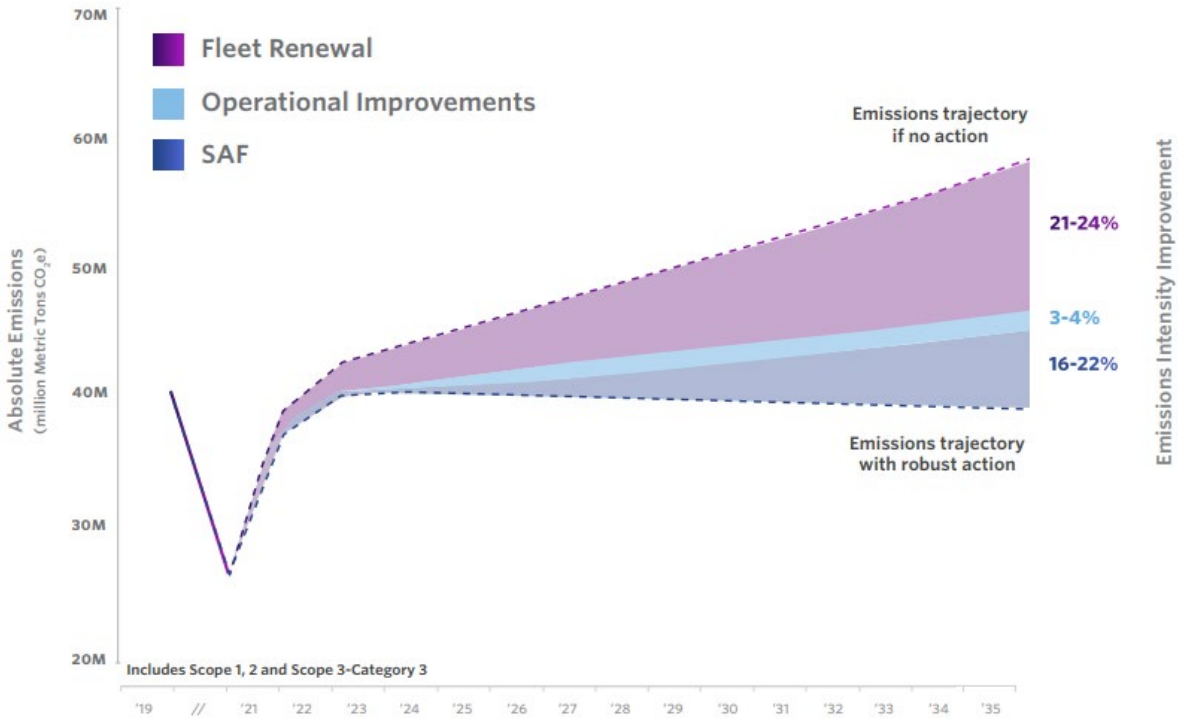

Figure 2 – Path to reduce absolute emissions and improve emissions intensity [7]

The airline has formulated a decarbonization strategy to promote climate objectives. The diagram portrays a conceivable route and its likely effects on emissions intensity and absolute emissions until 2035. Despite significant enhancements in fuel efficiency, the diagram indicates that there will be a surge in absolute emissions in the foreseeable future due to projected growth in capacity. The goal is to realize a decline in absolute emissions in the medium- to long-run, as the company transitions towards 2050 and as more economically feasible low-carbon technologies become accessible.

Ryanair has a dedicated page on its website called "Responsible Business" where it provides information on its sustainability policies and initiatives, including its efforts to reduce carbon emissions and increase fuel efficiency (Fig.3). [18].

As shown on the fig.3, the focus of the company is on operational safety and security, cyber security, training and development, emissions and occupational health and safety. The company paid attention to each of element of CSR (economic, social and environment).

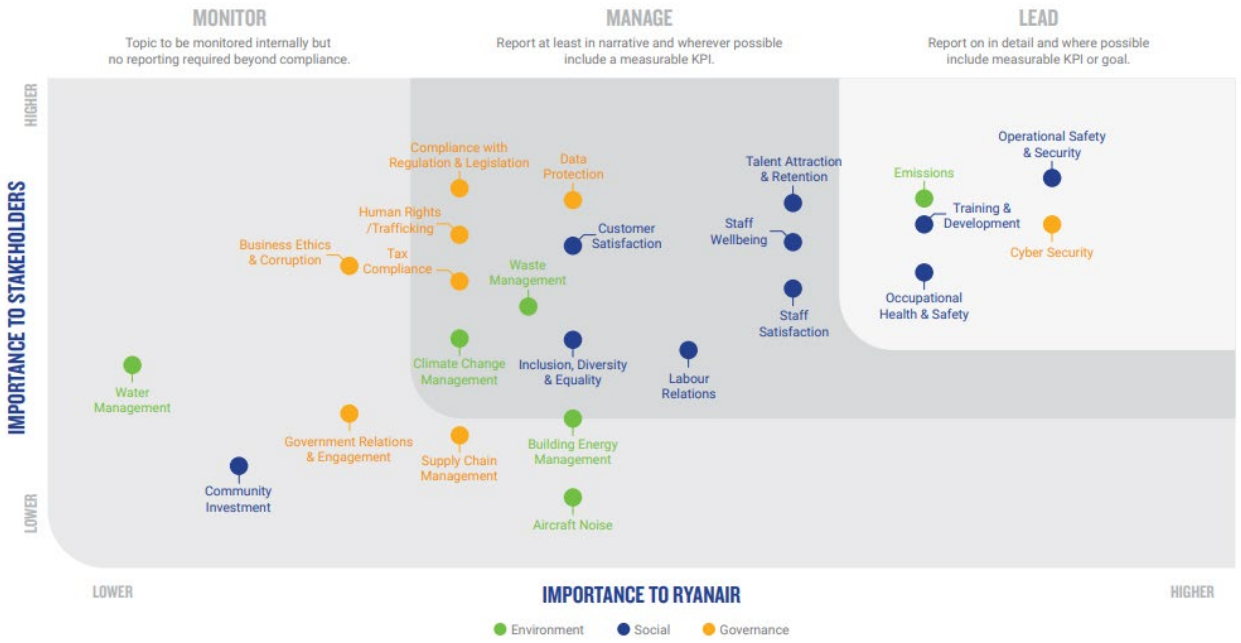

Figure 3 – Ryanair conducted a materiality assessment [18]

Propaganda of reduction of waste emissions, contamination and greenhouse gases ideas. It is a set of actions aimed at promoting the importance of reducing emissions and promoting environmentally friendly behavior to reduce the negative impact of human activity on the environment. This type of propaganda is used to raise awareness among individuals and organizations about the harmful effects of pollution and greenhouse gases on the environment and to encourage them to take action to reduce their carbon footprint.

In the aviation industry, propaganda of reduction of waste emissions, contamination, and greenhouse gases can take various forms, such as the promotion of sustainable aviation fuels, the adoption of new technologies and practices to reduce emissions, and the implementation of carbon offset programs. Airlines can also engage in public awareness campaigns to educate passengers about the importance of reducing their carbon footprint when traveling. Overall, the propaganda of reduction of waste emissions, contamination, and greenhouse gases is an important tool for promoting environmental sustainability and reducing the negative impact of human activity on the planet.

Boeing, one of the world's largest aerospace companies, has committed to reducing greenhouse gas emissions from aviation by developing and promoting sustainable aviation fuels. In 2020, Boeing launched a plan to deliver 1 billion gallons of sustainable aviation fuel by 2030. This initiative aims to reduce aviation-related greenhouse gas emissions by up to 80% [19].

Airbus, another major player in the aviation industry, has set a goal of developing a zero-emission commercial aircraft by 2035. The ZEROe initiative includes three concept designs for a hydrogen-powered aircraft, which could potentially reduce aviation emissions significantly [20].

Delta Air Lines has set a goal of becoming carbon neutral by 2030. To achieve this goal, the company has implemented a carbon reduction program that includes investing in sustainable aviation fuel, increasing energy efficiency, and purchasing carbon offsets [7].

United Airlines' Eco-Skies program is aimed at reducing the airline's environmental impact by investing in sustainable aviation fuel, reducing waste and emissions, and promoting sustainable practices throughout its operations. The program also includes partnerships with organizations focused on

sustainability, such as the Environmental Defense Fund [13].

Qantas, the flag carrier of Australia, offers a Fly Carbon Neutral program that allows passengers to offset the carbon emissions associated with their flights. The airline also invests in sustainable aviation fuel and has set a goal of reducing its net emissions to zero by 2050 [10].

Socially responsible events refer to events that are designed, planned, and executed with the goal of promoting social and environmental responsibility. Such events take into account the impact that they have on the community and the environment, and aim to minimize negative impacts while maximizing positive ones. Socially responsible events often involve the following practices: sustainable event planning (using environmentally friendly materials, minimizing waste, and reducing energy consumption), socially conscious event design (designing events with the intention of promoting social responsibility, such as using local vendors and supporting minority-owned businesses) and others.

Delta Air Lines organized a Sustainable Biofuels Summit in 2018 to discuss the use of sustainable aviation fuel in the aviation industry. The event brought together stakeholders from across the industry to discuss the benefits of using SAF, and to develop a roadmap for its future use [7].

JetBlue arranged a "One Thing That's Green" campaign in 2019 to encourage its employees and customers to adopt sustainable practices. The campaign involved a series of events, such as beach cleanups, and provided information on ways to reduce environmental impact [11].

Emirates Airlines organized a "Clean Up Dubai" campaign in 2018 to clean up beaches and promote environmental sustainability. The event was part of the airline's broader efforts to reduce waste and promote sustainable practices [8].

Etihad Airways held a "Beat Plastic Pollution" campaign in 2018 to raise awareness about the impact of plastic on the environment. The campaign involved a beach cleanup and educational events for employees and customers [9].

These events demonstrate how aviation companies are increasingly taking social and environmental responsibility seriously, and are working to promote sustainable practices within their industry and beyond.

Cross-industry cooperation is also a powerful tool for companies to achieve their CSR goals. CSR refers to the responsibility that companies have to create positive social and environmental impact, in addition to generating profits. By collaborating with other companies and organizations from different sectors, companies can leverage their collective resources and expertise to address social and environmental issues. Cross-industry cooperation can help companies achieve their CSR goals in several ways:

- Addressing complex social and environmental issues. Many of the social and environmental issues that companies are expected to address, such as climate change, require a coordinated effort across multiple sectors. Cross-industry cooperation can bring together the resources and expertise needed to tackle these complex issues.
- Sharing knowledge and expertise. Companies can learn from each other's experiences and expertise, and apply this knowledge to improve their CSR strategies. For example, a company may partner with an NGO or government agency to gain a better understanding of the social and environmental issues that are most relevant to their business.
- Enhancing brand reputation. Companies that engage in cross-industry cooperation to address social and environmental issues can improve their brand reputation by demonstrating a commitment to social responsibility. This can help to build trust with stakeholders, including customers, employees, and investors.
- Creating new business opportunities. Cross-industry cooperation can create new business opportunities for companies by

leveraging the strengths of different sectors. For example, a technology company may partner with a healthcare organization to develop new medical technologies that can be commercialized.

Overall, cross-industry cooperation can be an effective instrument for companies to achieve their CSR goals by leveraging the collective resources and expertise of different sectors. By working together, companies can address complex social and environmental issues, share knowledge and expertise, enhance their brand reputation, and create new business opportunities.

Thus, in 2019, Boeing and BMW announced a partnership to collaborate on research into carbon fiber recycling and investigate ways to reduce carbon emissions in aviation [19]. In 2016, Airbus and Siemens announced a partnership to develop electric aircraft for use in commercial air transportation. The two companies worked together to develop hybrid-electric propulsion systems that can reduce emissions and noise levels [20]. Delta Air Lines partnered with the Georgia Institute of Technology to develop a new system for air traffic control. The system uses machine learning and artificial intelligence to optimize air traffic flow and reduce delays, which can help to reduce fuel consumption and emissions [7]. In 2019, United Airlines announced a partnership with Fulcrum BioEnergy to develop a sustainable aviation fuel (SAF) production facility. The facility will convert waste into low-carbon aviation fuel, which can help to reduce emissions [13].

These examples demonstrate how cross-industry cooperation can bring together different sectors to develop innovative solutions that address environmental and social issues in the aviation industry. By collaborating with partners from other industries, aviation companies can leverage their collective resources and expertise to create a more sustainable and efficient aviation system.

Charity and sponsorship are commonly used by companies as instruments of CSR. These activities involve supporting social, environmental, or humanitarian causes through financial donations, in-kind contributions, or sponsorships of events or activities. Charity and sponsorship can be effective instruments of CSR for several reasons:

- Positive brand association. By supporting a cause that is aligned with the company's values and mission, companies can create a positive association with their brand in the minds of consumers, employees, and other stakeholders.
- Improved brand reputation. Supporting charitable causes and events can improve a company's reputation and build trust with stakeholders. This can help to attract and retain customers, employees, and investors.
- Increased social impact. Donations and sponsorships can have a direct impact on the communities and causes that they support. This can help to address social and environmental issues and contribute to the overall well-being of society.
- Employee engagement and motivation. Supporting charitable causes can help to engage and motivate employees by giving them a sense of purpose and meaning beyond their day-to-day work.

The Emirates Airline Foundation is a charity organization established by Emirates Airline in 2003 to support disadvantaged children around the world. The foundation partners with local organizations to provide education, healthcare, and other essential services to children in need [8]. Delta Air Lines has been a sponsor of the Breast Cancer Research Foundation since 2005. The airline donates a portion of the proceeds from its "pink plane" flights to support breast cancer research [7].

United Airlines is a global sponsor of the Special Olympics, providing financial support and volunteers for events around the world. The airline also supports the organization's Unified Champion Schools program, which promotes inclusive education for students with and without intellectual disabilities.

Boeing supports various charitable organizations and causes through its Global Engagement program. The program focuses on education, environment, health, and human services, and supports organizations around the world [19].

These examples demonstrate how aviation companies can use charity and sponsorship activities as instruments of CSR to support social and environmental causes, engage employees, and build a positive brand reputation. By partnering with organizations that align with their values and mission, aviation companies can make a positive impact on society and contribute to a more sustainable and equitable world.

Public relations (PR) is the practice of managing the communication between an organization and its stakeholders, including the media, customers, employees, and the general public. As an instrument of CSR, PR can be used to communicate a company's commitment to social and environmental issues, and to build trust and credibility with stakeholders. It could be applied be aviation companies in the following ways:

• Transparency and accountability. By communicating openly and transparently about their social and environmental impact, companies can build trust and credibility with stakeholders. This can include reporting on sustainability metrics, disclosing information about supply chain practices, and sharing progress on social and environmental initiatives.

• Crisis management. When a company faces a crisis related to social or environmental issues, effective PR can help to mitigate the damage and rebuild trust with stakeholders. This can include communicating openly and transparently about the situation, taking responsibility for any harm caused, and outlining steps to prevent similar incidents in the future.

• Stakeholder engagement. Effective PR can help companies engage with stakeholders on social and environmental issues, and build support for their initiatives. This can include using social media, events, and other channels to communicate with stakeholders, and soliciting feedback and input on sustainability initiatives.

• Thought leadership. By positioning themselves as thought leaders on social and environmental issues, companies can build credibility and influence in their industry and beyond. This can include publishing thought leadership articles, speaking at conferences, and engaging with experts and stakeholders on social and environmental issues.

Overall, PR can be an effective instrument of CSR for companies looking to build trust and credibility with stakeholders, engage with them on social and environmental issues, and position themselves as leaders in their industry. By communicating openly and transparently about their sustainability practices and initiatives, companies can demonstrate their commitment to social responsibility and contribute to a more sustainable and equitable world.

Southwest Airlines has a long-standing commitment to supporting the communities it serves through its "Heart of the Community" program. The program partners with local artists and cultural organizations to create public art installations and events that celebrate the unique culture of each community [21].

Emirates Airline's "Hello Tomorrow" campaign emphasizes the airline's commitment to innovation and customer service. The campaign includes advertisements featuring the airline's luxury amenities and world-class service, as well as partnerships with sports and cultural events around the world [8].

These examples demonstrate how aviation companies can use public relations as an instrument of CSR to build a positive brand reputation, engage with stakeholders, and communicate their commitment to social and environmental issues. By showcasing their values and initiatives through effective communication strategies, aviation companies can demonstrate their commitment to social responsibility and

contribute to a more sustainable and equitable world.

Conclusions. The growing importance of CSR is changing the way businesses operate, as they are increasingly expected to contribute to social and environmental goals, beyond generating profits for their shareholders. CSR allows companies to build trust with their stakeholders, enhance their reputation, and attract and retain talent. It also enables them to address pressing global challenges such as climate change, poverty, and inequality, which require collective action from all sectors of society. As such, CSR should be seen as a strategic opportunity for businesses to align their interests with those of society, and to create long-term value for all stakeholders. Ultimately, companies that embrace CSR and embed it into their core business practices are more likely to succeed in the long term, as they are better able to navigate risks, seize opportunities, and contribute to a sustainable and equitable future.

Thus, CSR is an essential concept for companies operating in the aviation industry to consider. It involves implementing instruments or tools that allow companies to act in a way that benefits society, the environment, and the economy, while also demonstrating their commitment to sustainability and social responsibility. Aviation companies have a responsibility to support the communities in which they operate, ensure the safety and well-being of their passengers and employees, and adhere to ethical business practices. CSR instruments that can be applied in the aviation industry include social campaigns, socially responsible marketing strategies, corporate ethics programs, social reporting, and propaganda of reduction of waste emissions, contamination, and greenhouse gases ideas. By implementing these instruments, aviation companies can have a positive impact on the environment and local communities, while also improving their reputation and relationship with their stakeholders.

First, CSR instruments help aviation companies address social and environmental issues, which have become increasingly important to stakeholders such as customers, investors, and employees. By adopting CSR practices, aviation companies can show their commitment to sustainability, human rights, and ethical business practices.

Secondly, CSR can have economic benefits for aviation companies. For example, reducing energy consumption and emissions can lead to cost savings and improve the efficiency of operations. Additionally, CSR initiatives can improve the company's reputation and brand image, which can attract more customers and increase customer loyalty.

However, there are also challenges associated with the implementation of CSR in the aviation industry. The industry is heavily regulated and faces complex operational and technical challenges. Moreover, the implementation of CSR can require significant financial investments and resources, which can be difficult for companies to justify in the short-term.

Despite these challenges, the use of CSR instruments in the aviation industry is becoming more widespread. Many companies are voluntarily adopting CSR practices, and governments are implementing regulations that require companies to address social and environmental issues. Overall, the implementation of CSR in the aviation industry can bring benefits not only to companies themselves but also to society as a whole.

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REVIEW

for a scientific monograph Doctor of Sciences (Economics) Yurii Kharazishvili, Doctor of Sciences (Economics) Dmytro Bugayko, Doctor of Sciences (Economics) Viachyslav Lyashenko

"SUSTAINABLE DEVELOPMENT OF AIR TRANSPORT OF UKRAINE: STRATEGIC SCENARIOS AND INSTITUTIONAL SUPPORT",

prepared at the Institute of Industrial Economics of the National Academy of Sciences of Ukraine

The monograph is dedicated to the study of three challenges - sustainable development, strategic management of air transport security and the shadow economy. The authors meaningfully consider them in connection and interconnection and reveal and justify the expediency of introducing the principles of sustainable development into the air transport system with an emphasis on the implementation of safety requirements and the minimization of the shadow economy.

The monograph consists of 5 chapters.

The first chapter is devoted to the disclosure of the theoretical and conceptual foundations of the strategic management of the safety of the aviation industry. Its relevance and practical importance for the sustainable development of not only a separate industry, but also the national, regional, international and global economy have been proven. It was determined that the safety management system is a basic component of aviation transport. The authors have developed an organizational and economic mechanism for the consistency of the strategic management of the safety of the development of aviation transport with the Sustainable Development Goals, of which the 17 Sustainable Development Goals of the UN Agenda for 2030 can be used as guidelines for creating proper conditions for the safe functioning of the aviation sector in the UN member states. At the same time, the reliability of the hypothesis was proven, according to which the national air transport safety management system is an open integrated system that has management, functional and informational connections with subsystems of sustainable development and safety at different hierarchical levels.

In the third section of the monograph, the authors identified the threat based on the concept of "risk" of air transport, the theoretical justification of the list and the importance of the impact of the threat of air transport using the method of imbalances. At the same time, an effective mechanism of anticipatory risk management in hierarchical systems is the degree of their

vulnerability using the "Swiss cheese" model of Professor J. Reason and structural analysis of deficiencies (GAP Analisys) at the levels of active and passive subsystems of the protection of aviation transport systems, namely: equipment and technologies, norms and rules of regulation, processes of personnel training/retraining. The integration of risks is created in the following directions: economic, ecological, social, technological, flight safety, aviation security and protection against terrorism, foreign policy, logistics interaction and related sectors of the economy. The author’s paid special attention to "shadow" indicators, without achieving which the level of sustainable development is impossible not only for air transport, but also for Ukraine as a whole.

In the fourth chapter, the authors propose connecting foresight to assess the long-term prospects of science, technology, economy and society, strategic directions of research and new technologies, with methodological identification and strategizing based on the classical principle of "future determined by the trajectory into the future", that is, the creation of a scientific and strategic foresight tool. The authors demonstrate a good awareness of the decisions on the deshadowing of the labour market, which have been made by other scholars, and propose their own measures in this area. The fourth chapter also developed institutional measures to neutralize threats and risks in the field of air transport. At the level of state bodies regulating the air transport market and the development of air transport, suggested implementing the following state programs: aviation safety; counteracting the negative impact of COVID-19 on air transport; aviation personnel training.

In the fifth chapter, forecast scenarios of decline and strategic scenarios of the post-war development of Ukraine's economy during the full-scale military aggression against Ukraine are investigated. For further calculations, the authors chose the worst forecast of a drop in the real GDP of Ukraine - 45% and built the desired exponential growth trajectories until 2030 according to three scenarios: 1. Achieving the level of the real GDP of Ukraine in 2015, which grows by 6.3% annually, 2. Achieving the level of Ukraine's real GDP in 2021, which grows by 7.8% annually, 3. Achieving the level of Ukraine's real GDP in 2008, which assumes an annual growth of 9.5%. 4. Achieving the level of real GDP of Ukraine in 2021 in 2048, which assumes an annual growth of 2.3%. To develop strategic scenarios for post-war recovery, a forecast of macro indicators and corresponding indicators of air transport for 2022 was made based on the assumed fall in Ukraine's GDP (-45%). As strategic goals until 2030, taking into account the current value of the integral index of sustainable development of aviation transport with the vector of limit values, the following were defined: 1. Realistic scenario - achievement of the lower threshold value. 2. Optimistic scenario – reaching the average value between the lower optimal and lower threshold values of the integral index. 3. The scenario of entering the zone of optimal sustainable development – reaching the lower optimal value of the integral index. The next stage after entering the optimal zone of the limit values is the achievement of the integral indicator of the sustainable development of air transport of the average optimal value both for all components and for all indicators - balanced sustainable development. Also, the monographs identify the threats and challenges of aviation transport of Ukraine during the full-scale military aggression against Ukraine in the areas of airline activity, the system of airports and airfields, the air traffic

control system, the aviation industry system, and the aviation education and science system of Ukraine. In response to the threats and challenges of wartime, a set of institutional measures was developed to ensure a realistic and optimistic scenario, as well as a scenario of entering the optimal security zone for the development of the post-war recovery of air transport of Ukraine. Institutional input measures to ensure the scenario of implementation in the optimal security development zone after including recovery: updating the provisions of the State Program on Flight Safety (Decree of the Cabinet of Ministers of Ukraine No. 656 dated 16.06.2021), the State Target Program for the Development of Airports for the Period Up to in 2023. (Decision of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016), the Concept of the State Targeted Scientific and Technical Program for the Development of the Aviation Industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412 of November 11, 2020) regarding post-war conditions. recovery and sustainable development; the development of mechanisms for the support of domestic air transport during the war period by the state in a harmonious combination with institutional measures regarding the broad involvement of investors of non-state ownership and foreign investors; cessation of destruction of aviation equipment and infrastructure, gradual return to the level of productivity of air transport of Ukraine in the second year after the war.

The overall impression of the content of the monograph is good. The innovative achievements of the authors are:

- development of an organizational and economic mechanism for the consistency of strategic management of the safety of the development of aviation transport with the Sustainable Development Goals, of which 17 Sustainable Development Goals are on the UN agenda for 2030;
- simultaneous application of the system of threshold values of economic, social, and environmental safety of air transport activities with the detailing of identifiers for each component as a reflection of the systemic approach;
- integration of aviation transport risks in the following areas: economic, environmental, social, technological, flight safety, aviation security and protection against terrorism, foreign policy, logistical interaction and related sectors of the economy;
- use of the method of social justice when identifying the shadow component of air transport activity;
- development of strategic scenarios for sustainable development and institutional support of air transport from a security perspective, including in the context of crisis phenomena, the global pandemic of COVID-19 and full-scale military aggression.

60-62
v.17 (2023)
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Reviewer

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REVIEW

for a scientific monograph Doctor of Sciences (Economics) Yurii Kharazishvili, Doctor of Sciences (Economics) Dmytro Bugayko, Doctor of Sciences (Economics) Viachyslav Lyashenko

"SUSTAINABLE DEVELOPMENT OF AIR TRANSPORT OF UKRAINE: STRATEGIC SCENARIOS AND INSTITUTIONAL SUPPORT",

prepared at the Institute of Industrial Economics of the National Academy of Sciences of Ukraine

Ukraine is an aviation state in which the full cycle of development, serial production, operation, technical support of aviation equipment, aircraft engines, avionics and training/retraining of aviation specialists is ensured. At the same time, a key aspect of the activity is ensuring a high level of security, since not only the preservation of life and health of people, property, but also the provision of economic stability, social standards and environmental safety depends on this decision. Therefore, the safe development of aviation transport is a priority on the way to sustainable development of the national economy. The latter necessitated the development of a new paradigm of socio-economic development of air transport.

The authors of the monograph highlight the main principles of the concept of sustainable development, which indicate the need for the interconnection of three components: economic, social and environmental on the way to overcoming global problems. In this context, technologies can contribute to the achievement of goals in all three dimensions of sustainable development, the balance of which occupies one of the leading places among the problems of sustainable development not only of individual countries or regions, but also of the world as a whole.

The authors considered the theoretical foundations and determined the economic significance of the strategic management of air transport safety and its role in promoting the sustainable development of the national economy. On the basis of the mentioned conceptual approaches, an organizational and economic mechanism of consistency of the strategic management of the safety of the development of air transport with the Sustainable Development Goals has been developed, of which the 17 Sustainable Development Goals of the UN Agenda for

2030 can be used as guidelines for creating proper conditions for the safe functioning of the aviation sector in countries - UN members.

In the course of the study, it was proved that the basis of achieving the goals of the sustainable development of aviation transport is the strategic management of safety, as an integral characteristic of the state of the economic system of the industry. The level of social and environmental components, as well as the level of the security and defense sector, depends on its level in a certain way.

The methodological principles of identifying the level of sustainable development of aviation transport in terms of safety are given and we propose the concept of sustainable development as a management structure containing a general systemic idea of the ways of transition from the current position of the management object to the desired one. The authors offer a structure and system of indicators. Out of 29 indicators, 18 (62%) are in the critical threat zone, 6 are in the crisis zone, and only 5 indicators are in the optimal zone. Modeling of the dynamics of the integral indicators of the components of the air transport of Ukraine in comparison with the integral threshold values was also carried out.

The opinion of the authors is correct that the development of the concept of sustainable development of air transport requires the interaction of various experts: aviation, security, economic cybernetics, macroeconomists, sociologists, ecologists and politicians.

The authors considered the issue of identifying threats according to the concept of "risk" of air transport, theoretical justification of the list and weight of the impact of air transport threats using the method of imbalances, theoretical approaches to measuring the level of safety - the test of the coefficient of the sequence of probabilities and the fractal-statistical analysis of the air transport safety management system. It was determined that in the system of risk management, the threat has the maximum potential energy, capable of directly harming the air transport sector in particular and indirectly causing negative consequences for the course of sustainable development of the national economy in general. To determine the list of threats according to the "imbalance method", two criteria were used: according to the distance from the point of sustainable development - the average value of the "homeostatic plateau" (the list and importance of the threats will be determined) and according to the severity of the impact by calculating the elasticity coefficients (the degree of influence of the threats will be determined). At the same time, the authors pointed out the insufficient attention of scientists to the definition of the dynamics of the integral index of air transport and its comparison with the integral threshold values, first of all, to the complete disregard of shadow indicators. The latter significantly affect the final indicator, because, according to experts, more than a third of GDP is the shadow sector. It was found that the biggest threats to the sustainable development of air transport are "shadow" indicators, without improving which achieving the level of sustainable development is impossible not only for air transport, but also for Ukraine as a whole.

Based on the obtained results, strategic scenarios for the sustainable development of air transport of Ukraine were determined based on selected indicators for each of the listed components. The result of the implementation of the concept of sustainable development to solve the tasks of strategic management of air transport safety was the definition of strategic scenarios for the sustainable development of air transport of Ukraine in terms of safety for the period up to 2030 in three scenarios: realistic, which ensures a 3.8% annual increase in air traffic, optimistic - 7 .0% increase in VAT; of balanced sustainable development – 11.6% of GVA growth. For each of these options, scientifically based quantitative values of indicators and strategic benchmarks of key macro-indicators of air transport are determined, monitoring of which allows objectively establishing the effectiveness of the relevant government policy. At the same time, based on the results of the calculations, the authors conclude that the greatest effect of sustainable development can be achieved by applying the scenario of full balance - equidistant integral indices of development components from their average optimal values.

The authors provided institutional support for the strategic management of air transport safety at the level of state regulation, at the level of interaction between the state and airlines of Ukraine, and at the level of interaction between the state, airports and the entire aviation logistics ecosystem of Ukraine.

The monographic work is a complete and complete study of the extremely urgent problem of ensuring the sustainable development of air transport in Ukraine in today's crisis conditions. The strategic scenarios of sustainable development of the industry outlined by the authors, based on in-depth analytical research, will be accepted by the scientific community, heads of aviation regulatory bodies and aviation enterprises, scientists and specialists in related fields.

Scientific publication

INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

The electronic scientifically and practical journal

Electronic scientifically and practical journal “Intellectualization of logistics and Supply Chain Management” included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): **Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)**

Field of science: Economic.

Specialties: 051 – Economics; 073 – Management

ISSN 2708-3195

DOI: https://doi.org/10.46783/smart-scm/2023-17

The electronic magazine is included in the international scientometric databases:
Index Copernicus, Google Scholar

№ 17 (2023)
February 2023

ISSN 2708-3195
DOI: https://doi.org/10.46783/smart-scm/2023-17