ФОРМУВАННЯ ЕКОНОМІЧНОЇ РАЦІОНАЛЬНОСТІ ВЗАЄМОДІЇ ЕЛЕМЕНТІВ СИСТЕМИ ДЕРЖАВНОГО УПРАВЛІННЯ ВОДНИМ ТРАНСПОРТОМ В НОВИХ УМОВАХ.

Актуальність. Значна зміна геополітичних умов в Чорноморському регіоні, зокрема, і світі в цілому призводить до кардинального перерозподілу товарних потоків, ринків збуту. Цей процес обумовлює зміни на ринку транспортних послуг. Наявні тенденції зміни співвідношення показників конкурентоспроможності портів Чорноморського регіону. Вказані зміни та супутні їм динамічні процеси відбуваються в реальному часі. Для того щоб економіка України відповідно реагувала на настільки динамічні зміни є нагальна потреба у встановленні чітких орієнтирів, однозначних критеріїв та формуванні пропозицій забезпечення високого ступеня адаптабельності системи державного управління до швидкої зміни зовнішніх і внутрішніх умов за умови забезпечення раціональності взаємодії елементів системи державного управління.

Мета та завдання. Метою роботи є наукове обґрунтування та розробка методичних основ взаємодії елементів системи державного управління водним транспортом в нових умовах, пропонування рекомендацій організаційного характеру щодо збільшення адаптабельності процесу управління при забезпеченні раціональності взаємодії всіх елементів системи управління. Дослідження мети дослідження зумовлює необхідність постановки і вирішення наступних завдань: запропонувати числові критерії економічної ефективності та раціональності управлінських заходів для конкретної його сфери діяльності за проведення оцінювання рівнів ефективності та раціональності управлінських заходів.

Результати. У роботі узагальнено підходи формування системи державного управління водним транспортом з належним ступенем адаптабельності до швидкої зміни зовнішніх і внутрішніх умов; запропонована тактику критеріїв економічної ефективності та раціональності управління водним транспортом та обґрунтована їх вибір, проведене ретроспективний аналіз значимості впровадження у часі системних заходів держави в сфері інтермодального та мультимодального перевезення, для збільшення ефективності взаємодії сучасних видів транспорту. Висновки. Встановлено, що інтермодальне та мультимодальне перевезення вантажів є за сучасних умов необхідною та перспективною напрямом модернізації транспортної інфраструктури, інструментом здійснення ефективного управління водним транспортом України.

Висновки. Встановлено, що інтермодальні та мультимодальні перевезення є за сучасних умов необхідною та перспективною напрямом модернізації транспортної інфраструктури, інструментом здійснення ефективного управління водним транспортом України.

Проведенням дослідження встановлено критерії валідного рівня ефективності і раціональності управлінських умов у сфері водного транспорту. Встановлено, що критерії для більшої об'єктивності повинні мати числовий а не якісний характер. Критерії економічної ефективності та раціональності конкретизовані для сфері ІМПВ. Запропонована тактика державного управління ІМПВ за належного і релевантного оцінювання рівнів ефективності та раціональності управлінських заходів. Отримані результати дослідження.
дозволяють досягти необхідних рівнів економічної раціональності взаємодії елементів системи державного управління водним транспортом в нових умовах.

Ключові слова: водний транспорт, теорія графів, градієнтна модель, критерії економічної раціональності, алгоритм державного управління.

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FORMATION OF ECONOMIC RATIONALITY OF INTERACTION OF ELEMENTS OF THE SYSTEM OF PUBLIC GOVERNANCE OF WATER TRANSPORT IN NEW CONDITIONS

Topicality. Significant changes in geopolitical conditions in the Black Sea region, in particular, and the world as a whole leads to a radical redistribution of trade flows, markets. This process causes changes in the market of transport services. There are trends in the ratio of competitiveness of the Black Sea ports. These changes and the accompanying dynamic processes occur in real time. In order for Ukraine's economy to respond appropriately to such dynamic changes, there is an urgent need to establish clear guidelines, unambiguous criteria and formulate proposals to ensure a high degree of adaptability of the public administration system to rapid changes in external and internal conditions.

Aim and tasks. The aim of the work is scientific substantiation and development of methodical bases of interaction of elements of system of state management of water transport in new conditions, offer of recommendations of organizational character on increase of adaptability of management process at maintenance of rationality of interaction of all elements of management system. Achieving the goal of the study necessitated the formulation and solution of the following tasks: to propose numerical criteria for the economic rationality of the interaction of the management system; develop a model; to substantiate the algorithm of state management of water transport for its specific field of activity for assessing the levels of efficiency and rationality of management measures.

Research results. The paper summarizes the approaches to the formation of the state water transport management system with the appropriate degree of adaptability to rapid changes in external and internal conditions, offers criteria for economic efficiency and rationality of water transport management and justifies their choice, applied analysis of the need for management measures cargo and to increase the efficiency of interaction of adjacent modes of transport.

Conclusion. It established that intermodal and multimodal cargo transportation (IMCT) is the most promising area of modernization of transport infrastructure, a tool for operational testing of new routes, a means to enter promising markets for transport services, and a mechanism for creating a new level of competitiveness of water transport in Ukraine.

The study established the criteria for the appropriate level of efficiency and rationality of management efforts in the field of water transport. It stated that these criteria should be numerical rather than qualitative for greater objectivity. Criteria of economic efficiency and rationality specified for the field of IMCT. The algorithm of public management of IMCT with proper and relevant assessment of the levels of efficiency and rationality of management measures is offered. The obtained results of the research allow achieving the necessary levels of economic rationality of the interaction of the elements of the system of state management of water transport in the new conditions.

Key words: water transport, graph theory, gradient model, criteria of economic rationality, algorithm of public administration.
Problem statement and its connection with important scientific and practical tasks. Due to the sharp change in geopolitical conditions in the Black Sea region, in particular, and the world as a whole, the inevitable redistribution of trade flows, markets, which will intensify changes in transport services markets. These trends will lead to a change in the ratio of competitiveness of the Black Sea ports. Moreover, these changes and the accompanying dynamic processes will take place in real time. In order for Ukraine's economy to respond appropriately to change, there is a obvious need to establish clear guidelines, unambiguous criteria and to form a system of public administration with a high degree of adaptability to rapid changes in external and internal conditions.

As is known from systems theory, the greatest degree of adaptability is provided by the network structure of the entire system. Obviously, for public administration, which is strictly responsible for the hierarchical structure, which was strengthened in the circumstances of the military confrontation, this will require some structural adjustment.

In our opinion, the main principle of such settlement should be the economic rationality of the interaction of elements of the system. At the stage of military action, the strengthening of centralized management of certain subsystems of the transport sector, primarily rail and inland waterway transport, aimed at defense tasks, evacuation needs, livelihoods of cities and towns should be transformed to increase the efficiency of transport subsystems.

As the transport, infrastructure, rolling stock and human capital of the transport sector have been hit hardest by the fighting, increasing autonomy in the management of modes of transport and relatively autonomous units with proper monitoring of abuses and threats to "economic feudalism" should ensure their economic efficiency.


Problems of increasing the efficiency of public administration of the competitiveness of the transport complex by formalizing economic approaches to the realization of the transit potential of the country and the introduction of mathematization of economic estimates devoted to the work of many domestic scientists and practitioners, including V. Hryshchenko, I. Hryshchenko [1], S. Kotenko, V. Kasionova, L. Dondych [2], N. Maslii, Yu.Zhdanova [3], M. Demianchuk [4], S. Ilchenko, N. Khumarova [5] etc.

In recent years, leading modern specialists have been working on improving the institutional and institutionalizational mechanisms for managing the transport sector, in particular water transport: B. Burkynskyi, V. Vasylychev, O. Barilovych, A. Vorkut, E. Zaitsev, V. Sharaf etc.

Allocation of previously unsolved parts of the general problem. Despite the significant amount of work on the theoretical foundations of public water transport management with the rapid change of external and internal factors, it became necessary to establish clear guidelines, form a system of unambiguous criteria and form a public administration system with a high degree of adaptability to rapid changes in external and internal conditions.

Formulation of research objectives (problem statement) The purpose of the work is the scientific substantiation and development of methodical bases of formation of economic rationality of interaction of elements of system of the state management of water transport in new conditions.

Achieving the goal of the study necessitated the formulation and solution of the following tasks: - to generalize the approaches to the formation of the system of state management of water transport with the appropriate degree of adaptability to rapid changes in external and internal conditions; - propose criteria for economic efficiency and rationality of water transport management, justify their choice; - to carry out the applied analysis of necessity of adjustment in one of elements of system of the state management of water transport - in the field of intermodal and multimodal transportation of freights.

An outline of the main results and their justification. Under the new geopolitical
conditions and post-war restructuring of the structure of public administration, in particular the transport sector will need some restructuring.

Since in such circumstances, the economic rationality of the interaction of elements of public administration is a prerequisite for economic efficiency of public policy in general, and this should be the main criterion for the transformation processes of the governance structure.

Criteria for the appropriate level of rationalization of decision-making mechanisms and economic policy formation are, in our opinion, the achievement of appropriate levels of economic efficiency of individual elements of government, and, according to the principle of emergence, public water management system as a whole.

Using systems theory techniques, water transport should be considered as part of the overall transport system. Improper interaction of parts of the system, increasing the level of inefficiency in one of the subsystems will affect the efficiency of management of other parts. Public administration from a systemic point of view should be considered as a supersystem for a set of transport management systems.

The mathematical apparatus that is able to formalize the problem of effective economic rationality of interaction of elements of the system of state water transport management in the new conditions is the theory of graphs, the use of which for water transport management problems is given in scientific papers [3, 6]. In this case, the controls that are modeled by graph nodes are structured by subsystems [4]. Management actions are formalized as communication incidents [4].

Obviously, the principles of the hierarchical system - the transmission of control signal (or action) from the control center through indirect layers of the management hierarchy should be replaced by the formation of signal (or action) relatively autonomous subsystems networked.

The control action (or signal) will have a gradient character and should change (increase or decrease) when transmitting along the routes of strings (see equation 1). The amplifier of multicollinear action of signals should be the criteria of economic rationality of each control signal.

\[
Q = \begin{bmatrix}
grady_{11} & grady_{1j} \\
grady_{2j} & grady_{2j} \\
grady_{ij} & grady_{ij}
\end{bmatrix}
\]

(1)

where \( Q \) - matrix of incidental connections of a graph of dimension \( |n \times m| \), \( y \) – signal (action), \( i,j \) – indices, \( i = 1 \ldots n, j = 1 \ldots m, n \) – number of subsystems, \( m \) – the maximum number of subsystem elements.

A clear example is the impact of the level of efficiency of public administration of related modes of transport on the efficiency of water transport management in the implementation of transport flows under stable pre-war conditions.

As the analysis shows, under such conditions most problems with the joint use of modes of transport arise with those types of which the level of monopolization is high, and the level of privatization - low. For water transport in general and, to a large extent, maritime transport, a higher level of problems arose when interacting with JSC «Ukrzaliznytsia».

The analysis indicates that the lack of cars at port stations in pre-war conditions - up to 74% of the required volume (see Table 1), delayed supply of wagons (measured by days), outdated fleet of wagons, wear of tracks, etc. create additional risks for efficient and rhythmic operation of seaports.

<table>
<thead>
<tr>
<th>№/№</th>
<th>Name of the port station</th>
<th>Parameter</th>
<th>In fact (design), cars per day</th>
<th>Required cars per day</th>
<th>The share of relative shortages of cars</th>
<th>Relative shortage of cars, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mykolaiv - freight</td>
<td></td>
<td>1197</td>
<td>1322</td>
<td>0,094554</td>
<td>9,46</td>
</tr>
<tr>
<td>2</td>
<td>Berehova (port «Pivdennyi » and Odesa port plant)</td>
<td>602</td>
<td>1192</td>
<td>0,494966</td>
<td>49,496</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Izmail</td>
<td></td>
<td>803</td>
<td>924</td>
<td>0,130952</td>
<td>13,09</td>
</tr>
<tr>
<td>4</td>
<td>Chornomorsk - port</td>
<td></td>
<td>1539</td>
<td>1891</td>
<td>0,186145</td>
<td>18,61</td>
</tr>
<tr>
<td>5</td>
<td>Odesa - port</td>
<td></td>
<td>1173</td>
<td>1398</td>
<td>0,160944</td>
<td>16,09</td>
</tr>
<tr>
<td>6</td>
<td>Kherson - port</td>
<td></td>
<td>324</td>
<td>521</td>
<td>0,378119</td>
<td>37,81</td>
</tr>
<tr>
<td>7</td>
<td>Zhovtneva (Mykolaiv)</td>
<td></td>
<td>480</td>
<td>1864</td>
<td>0,742489</td>
<td>74,25</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>6118</td>
<td>7248</td>
<td>0,155905</td>
<td>15,59</td>
</tr>
</tbody>
</table>

Source: own development according to the data [7, 8].
To avoid these risks, carriers began to form transport routes where inland water transport was used instead of rail, in particular, barges and «river-sea» vessels. On some routes, this led to an increase in the cost of transporting tons of cargo by ~ 4-6%, but this was offset by reducing the risks of transportation, ensuring uniformity of traffic flows.

Another example of an area that requires increased attention from public management is the need to increase the cost-effectiveness of policies in the field of intermodal and multimodal freight transport (IMT). Exactly IMT is under modern conditions the most promising direction of modernization of transport infrastructure, a tool for operational testing of new routes, a means to enter promising markets for transport services, and a mechanism for forming a new level of competitiveness of water transport in Ukraine.

The study established the criteria for the appropriate level of efficiency in this direction:
- increase in the share of IMT in the total volume of freight traffic;
- growth of IMT cargo flow in absolute terms;
- reduction of the cost of transportation of a unit of cargo for use IMT;
- reduction of downtime of IMT cargo at customs and border checkpoints;
- reduction of time for reloading and unloading processes;
- reduction of total energy consumption for reloading and unloading works per unit of cargo IMT;
- increasing the share of end-to-end documents in the total number of support documents IMT;
- increasing the level of use of information and communication technologies in processes IMT.

All these criteria have a numerical dimension, which increases the level of relevance of the assessment of economic efficiency of policy. Increasing the level of relevance is also provided by the stratification of these criteria by groups (see Fig. 1).

The economic efficiency of the transport sector is determined by the system of public administration for all institutional, institutionalizmal factors.

The impact of these factors on the transport sector is multifaceted: from the regulatory component, the effectiveness of interstate relations with neighboring countries, the organization and quality of governance at all levels to the formation of interaction of political, economic, social subsystems into a single, effectively coordinated management system of the economy and transport industry its individual components.

The importance of ensuring all the signs of

![Fig.1. Criteria of economic efficiency and rationality in the field IMT](source)

*Source: own development.*
an effective system in accordance with the theory of systems: integrity, emergence, inertia, this impact of public administration on the transport sector has in periods of socio-economic transformation and a significant level of external threats, political and economic instability.

A significant problem from this point of view is the need for a significant level of coherence in the dynamic processes of transformation of the socio-economic structure of the country and the transport sector, as the efficiency of the economy as a whole and the transport sector are interdependent. This forms the systemic basis for the need for economic rationality of the interaction of elements of the system of public administration of intermodal and multimodal transportation.

Factors that should ensure the efficiency of the transport system as a whole and its public administration system, in the first place are: compliance of the system of public administration with existing external factors, challenges and threats, the realities of the conditions of commercial and economic activities with available and accessible resources, the level of efficiency of the management system.

The system of public administration may consist of certain types of subsystems. These subsystems can be classified according to the direction of their activity (see Fig. 2): economic, in particular, banking, monetary, investment, innovation, credit, tax, insurance activities in the field of public administration, etc.; regulatory activities, in particular administrative; organizational activities; legal, in particular, subsystems of formation and observance of the accepted normative-legal maintenance.

The difficulty in achieving the required level of rationality is that to ensure their proper strategic planning, implementation, monitoring of the achievement of certain stages in a timely manner is impossible with a significant degree of uncertainty and insufficiency of all types of resources: human capital, the appropriate level of professionalism of public management, time, etc. and a high degree of uncertainty in all major factors of influence.

This degree of uncertainty in all major factors of influence, in turn, leads to low relevance of forecasts, i.e. the inability to properly prepare for the neutralization of the consequences of the challenges and the economy as a whole, the transport industry in particular. This reinforces the need for advanced use of modern information and communication technologies in all aspects from management to technical upgrades of industryinfrastructure.

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**Fig. 2.** The algorithm of public administration of IMT for carrying out an estimation of levels of efficiency and rationality of administrative actions is offered.

*Source: own development.*
Conclusions and perspectives of further research. The results of scientific research allow us to draw the following conclusions and provide the following recommendations:

1. Using a systematic approach and based on modeling public administration as a single system, it is proposed to replace the administrative nature of institutional institutionalizmal pressure on economic entities and economic subsystems in the field of water transport with economic rationality of interaction of system elements. Self-regulation of such systems allows providing a proper degree of adaptability to rapid changes in external and internal conditions.

2. The directions which need the increased attention of the state management are resulted. This is an increase in the efficiency of interaction of related modes of transport and, the direction associated with this - intermodal and multimodal freight. According to the analysis, even under stable pre-war conditions, the greatest problems with the joint use of modes of transport arise with those modes whose level of monopolization is high and the level of privatization is low. Cooperation with the JSC «Ukrzaliznytsia» is the most problematic for water transport.

3. The analysis indicates that the lack of cars at port stations in pre-war conditions - up to 74% of the required volume, delayed supply of cars, outdated car fleet, track wear, etc. create additional risks for efficient and rhythmic operation of seaports. To avoid these risks, carriers began to form transport routes where inland water transport was used instead of rail, in particular, barges and «river-sea» vessels. This led to an increase in transportation costs but was offset by reduced transport risks and ensured uniformity of traffic flows.

4. It is established that intermodal and multimodal cargo transportation is the most promising area of modernization of transport infrastructure, a tool for operational testing of new routes, a means to enter promising markets for transport services, and a mechanism for forming a new level of competitiveness of water transport in Ukraine.

5. The study established the criteria for the appropriate level of efficiency and rationality of management efforts in the field of water transport.

6. It is stated that these criteria should be numerical rather than qualitative for greater objectivity. Criteria of economic efficiency and rationality are specified for the field of IMT.

7. The algorithm of public administration of IMT with proper and relevant assessment of levels of efficiency and rationality of administrative measures is offered.

The results of the study allow achieving the necessary levels of economic rationality of the interaction of the elements of the system of public water transport management in the new conditions.

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