MULTIMODAL NETWORK OF KAZAKHSTAN: DESIGN OF A STAGED DEVELOPMENT

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ABSTRACT

Relevance of interaction problems between rail and sea transport is primarily connected with market environment of the economy, competition, tariff policy, investment resources. In Kazakhstan, due to the presence of sea port Aktau and two international transport corridors passing through the country principles of multimodality acquire a special meaning and are implemented using logistic resources and development of design methods of integrated staged development of multimodal network, including effective alternatives providing for the situation when the shape and capacity of the current system are changing. The authors substantiate three stages, which are of strategic importance for national and regional economics.

ENGLISH SUMMARY

Background. *Improvement and development of transport infrastructure of any country should be conducted in close relationship with the key areas of international freight transportation. Under present conditions market entities inevitably need integrated approach while selecting an optimal technical plan of delivery of goods with participation of different modes of transport.*

Objective. *The objective of the authors is to investigate different aspects of a staged development of a multimodal transport network in Kazakhstan.*

Methods. *The authors used analysis, comparative method and descriptive method.*

Results. *The Caspian port of Aktau has become an important link in the supply chain of goods of two international transport corridors – «North-South» and «TRACECA» in the Republic of Kazakhstan. Aktau has a favorable geopolitical position, is the only one competitive trading port of the country and functions basing on the international management standards that meet the requirements of maritime safety and marine service. It remains the only one point of interchange between the sea and the mainline railway transport (Pic. 1). Here are the prerequisites for the need to create a transport-logistics center at the port of Aktau, which can include administrative, transportation, financial, legal and information structures.*

In this regard, the role of designing of integrated and staged development of a multimodal transport network (hereinafter-MTN) in the Republic of Kazakhstan grows. Practices show that significant losses of time and money in places of interchange of several modes of transport are caused by the lack of technological and informational interaction between them.

Freight flows forecasting at the approaches to ports is of great importance. There is a need for reasonably accurate assessment methods for different time depth that allow implementing the principles of flexible forecasting and ways of its improvement. Attention to this aspect of the matter is evident. Imperfection of forecasting methods causes unnecessary downtime of cars and ships. Different systems of standards lead to an excessive amount of paper documents, lengthy procedures of freight handling, resulting in reduction of competitiveness, both of rail and sea transport. Capacity and the level of equipment of marine cargo terminals, which are limited by project scope, also also have their impact. As well as there is also a direct relationship with the efficiency of railways, their mobility and willingness to cooperate.

With account for the indicated factors the choice of methods of engineering of the optimal scheme of a staged development of a multimodal transport system (hereinafter – MTS) seems a methodologically difficult task. MTS classification as an integrity of international transport corridors (hereinafter called ITC) of all hierarchic levels and objectives, proposed in [2, 3], Pic. 2, confirms economical practicability and strategic goals of designing in that sphere.

Comprehensive analysis of strategy materials of regional, social and economic growth [4] and research results in the papers [5,6] have shown that simultaneous staged development of communications for all modes of transport should be considered in the context of multimodality ideas, allowing to consider regional specifics and peculiarities of their economic impact.

ITC is the sequence of multimodal transport links (hereinafter – MTL) of different modes of transport, ensuring delivery of goods of any range from suppliers to customers, which is interlinked in space by multimodal transport hubs (hereinafter – MTH or MTJ).

MTH is a complex technical and economic system consisting of elements of different modes of transport and ensuring their effective interaction.

MTL is a technical and economic system presented by elements of one of transport modes participating in ITC functioning.

Given the specifics of the changes in projected traffic volumes under the market economy conditions and features of the development of elements of a consolidated transport and logistics operator in Kazakhstan, the authors offer to represent its decomposition hierarchically, corresponding to the diagram (Pic. 2):

1) international multimodal transport corridors (IMTC) and hubs serving them (IMTH) – followed by the organization of container traffic from the Asia-Pacific region to Europe via Kazakhstan;

2) interregional multimodal transport corridors (IRMTC) and junctions (IRMTJ) – they carry out cargo and passenger transportation in the country;

3) regional multimodal transport corridors (RMTC) and junctions (RMTJ) – their task is to provide transportation of goods and passengers between regions of the country.

To create a methodology to solve the problem of effective alternatives (strategies) of staged development of MTN for a close and long-term perspective there should be created:

1) Concept of designing of an integrated staged development of MTN and its elements;

2) Information support system for designing a staged development of MTN with account for changes in the shape and capacity of its elements;

3) Methodology and analytical decision-making block to change shape and capacity of MTN in environment of risks and uncertainty;

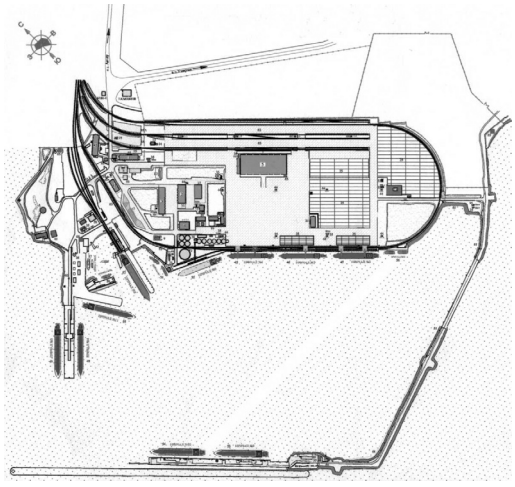
4) Method of generating of the field of effective alternatives (FEA) and changing the shape and capacity of MTN subject to uncertainty in the predictions of required volumes of traffic.

The change in the structural-parametric representation of IMTH, associated with the elements of IMTC and multimodal transport network, is multivariate and multicriteria task. To solve it at the current stage of economic development of the Republic of Kazakhstan science-based planning and allocation of limited investment resources are required. There is a need for methodology based on advanced information technologies, modeling techniques and modern principles of designing alternatives (options) of investment projects. There are many studies, in particular, those of O. V. Belyi, N. V. Pravdin, V. I. Galakhov, V. Ya. Negrei, V. N. Livshits, etc., which emphasize and clearly demonstrate the extreme complexity of the problems of this type, and offer appropriate approaches, methods and techniques for solving with sufficient precision these set tasks for different modes of transport.

However, they do not fully touch on issues of modeling of coherent and balanced development of several modes of transport in multimodal junctions that must be considered when changing their structure and capacity in the current economic environment.

It is necessary to develop a concept for the development of MTN, representing a strategy for managing a design of effective alternatives, which implies economic feasibility of changes that are being prepared, engineering preparation of production (EPP), along with monitoring of traffic volumes and technical and economic indicators (TEI) of the system, technical condition (TC) of its elements (Pic. 3).

Monitoring technology should include shaping of a common information space for decision-making support for changing the shape and capacity of MTN. Electronic passports of all system elements are formed in real-time mode. Experience of their introduction is accumulated by rail transport of the Russian Federation [5,6] and can be used for any transport systems and their objects.

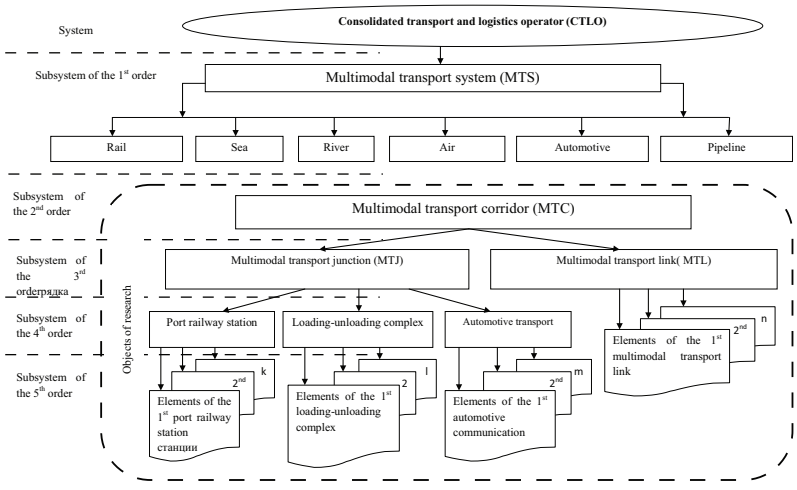


Pic. 1. Modern multipurpose terminal RSE «AISCP» (Republican State Enterprise «Aktau International Sea Commercial Port")

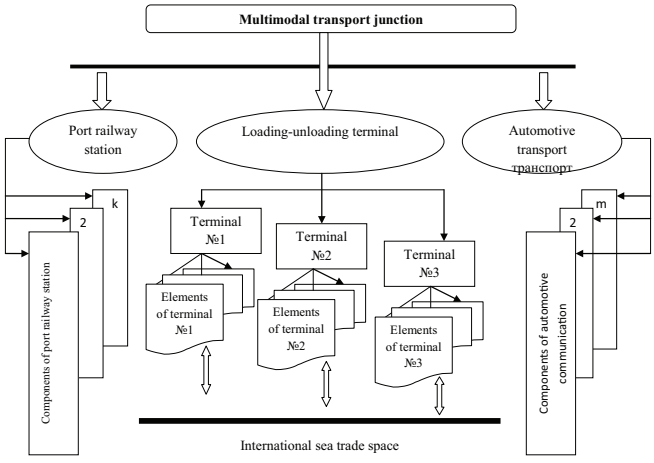
One of the results of engineering preparation is obtaining of an initial set of alternatives of changing the shape and capacity of MTN and allocation of their effective area from this set (Pic. 4).

An alternative (option) of changing the shape and capacity of MTN should be considered as an aggregate of system elements and parameters with regard to their technical state at the time of decision-making, activities to eliminate identified «narrow» places in the system components, technologies used, ways and means of their interaction, enabling to implement a certain traffic volume for target date [7].

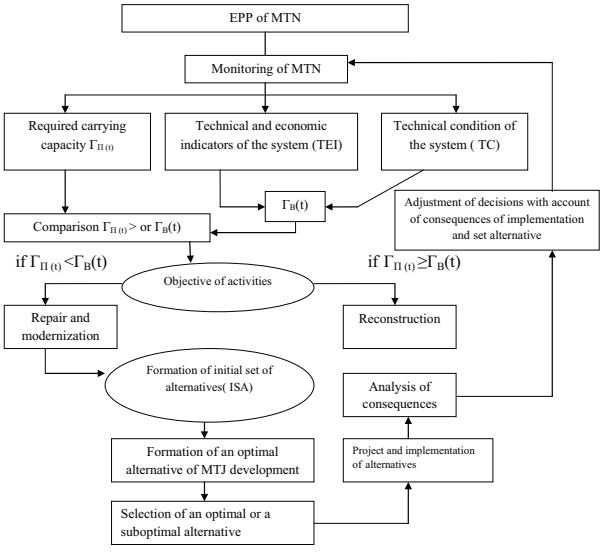
Generation of the original set and the field of effective alternatives is complicated due to the need to consider these sets for different strategies and scenarios of economic development of regions and the country as a whole. In addition, each considered scenario relies on evaluation of current and projected traffic volumes. Required carrying (estimated) capacity of MTN (ITC, MTJ, MTH) – Гп(t), determined for scenario purposes for year-wise periods, determines the considered case. Within its limits its own set of alternatives (basic framework) is fixed to make decisions on changing the shape and capacity of MTN.



Pic. 2. Micro representation of MTN.



Pic.3. Micro system representation of MTJ.



Pic. 4. Flow-chart of engineering preparation of production for creation of initial base of FEA formation of staged MTN development.

Thus, depending on the number of considered strategies and scenarios we obtain a plurality of considered cases, within each of which a desired FEA may be developed. Accordingly, we build a concept of the field of effective alternatives with respect to the development prospects of MTN (ITC, MTJ), but in fact we are building an action strategy of a decision maker. The concept refers to three essential stages.

The first stage *includes monitoring of:*

– The amount of work of a considered technical-economic system or its elements taking into account a forecast of their changes for the near future within transit or local area adjacent to a projected object (the result will be construction of dependence of required carrying capacity Гп(t) for considered cases);

– Technical and economic indicators of the existing MTN performance and its elements, as well as factors that influence failures and the capacity level of a multimodal system;

– Technical condition of elements of the system with the establishment of «narrow» places, affecting the implementation of the parameters' capacity of MTN (ITC, MTJ, MTL).

On the basis of monitoring it is possible to determine the capacity level of the existing MTN and its elements, which is expressed through the possible carrying capacity of the system Гв(t), at the same time traffic capacity must be defined for all elements and the whole system.

The first stage of the concept enables to obtain an initial information base for future action.

The second stage aims at realizing a comparative analysis of Гп(t) and Гв(t), with establishment of the terms of a technical resource exhaustion of MTN and its elements, setting possible actions that support the operation of the system. If Гп(t) < Гв(t) it is possible to improve its technical and economic indicators through modernization, repairs, requiring minimal investment. And if Гп(t) >Гв(t) it is possible to enhance stage-by-stage the capacity of MTN.

Solution of such a problem supposes appropriate tools that would enable to generate optimal alternative (schemes, strategies) of staged changing of the shape and capacity of MTN.

Time stable forecast of required carrying capacity Гп(t) defines a considered case, within which an optimal alternative to the results expected at the stage is found.

Decision-makers at this stage of the task analyze optimal and possible suboptimal alternatives and select a more appropriate one for the effective implementation of the project. At that stage they use discounted total construction and operation costs as a criterion of a search for best alternative. At the stage of substantiation of variants of funding of investment

project criterion fuction is replaced by comprehensive «integral effect» .

The final stage *is development of a project within the adopted alternative, its implementation using the impact analysis and correction of further decisions taken within the calculation horizon.*

Conclusion.

On the basis of MTN systemic representation, developed concept, adopted calculation scheme of the process of changing the shape and capacity of MTJ as a component of MTN, the authors formulated a meaningful and mathematical set of a problem of generating alternatives during changing the shape and capacity of MTN, as well as selected one of the possible methods and methodology of constructing an optimal alternative (strategy) of a staged changing if the shape and capacity for elements of MTN – ITC, MTL, MTJ and the system as a whole.

Based on the analysis of the obtained optimal and suboptimal schemes an opportunity was revealed for a fairly simple comparison with the performance results of elements and system as a whole, and this in turn made it possible to develop a technique of forming FEA as a basic framework for decision-making support at the stage of development of MTN investment project concept development. The universality of a method and developed techniques should be noted, since they enable to perform the following tasks:

1. To form an optimal scheme of a staged change of the shape and capacity of individual elements of MTN and of whole system within a fixed considered case based on criterion of «total discounted construction and operational costs».

2. To choose an optimal technology of MTN elements functioning, taking their conditions as a set of possible technological options.

3. To generate a field of effective alternatives to support decision- making on the criterion of «integral effect». The technique enables to perform this procedure for a variety of options of forecasts of required carrying capacity volumes and on this basis to choose a suboptimal scheme that is resistant to change growth forecasts Гп(t).

4. The developed technique of FEA development makes it possible to decide on increase in economic attractiveness of MTN investment project for carriers by varying monetary indicators.

5. If it is necessary, it is possible to decide on rational distribution of traffic volumes between modes of transport and MTN elements setting a different ratio of volumes by modes of transport and/or their elements as technical conditions.

The authors made systematization of factors causing uncertainty in the formation of alternatives of a staged development of modes of transport of ITC and MTJ technical systems, on the following grounds: area of occurrence; source of occurrence; time of occurrence; probability of occurrence; nature of uncertainty on the possibility of obtaining additional information in the course of management.

Keywords: multimodal transport system, railway, seaport, transport and logistics center, economy, competition, technical and economic parameters, field of effective alternatives, staged development.

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