Methodological aspect of the logistics technologies formation in reforming processes on the railways

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Abstract

Reforming processes of a railway transport based on those positive tendencies, which were recently observed in the transport market. They are caused by competitive rising of all railways in CIS countries and Baltic States. Experience of the countries with developed economy shows us, that reforming processes should be lead with receiving possibility system-wide effect from the individual interconnected subsystems functioning (units of rail transport) like unified system.

Systematic approach to the justification the process of reform and development of the railway sector provides the formation of a dynamic model of the individual transport units, consisting of a single organizational – technological structure. This enables the system to be generally aimed at achieving the objectives of its functioning. So, such structure can be considered a major transport system for which is characterized by new properties and characteristics and all separate rail divisions acquire the status of system elements.

In order to improve the quality characteristics of the transport process and the efficiency of cargo service, solving management task and logistic system rationalization of the goods delivery can be carried out the basis of multi-criteria methods, taking into account conservation approach. General industry logistic system should consist of the railways, their units, some large railway stations in conjunction with the relevant subsystems cargo. In process of the logistic system centers formation appears a question of managing their organizational structure. In our opinion one of the main factors which must be taken into account in shaping the organizational structure of logistics centers is an opportunity to achieve a high service level with taking in account availability of internal and external constraints.

Modern conditions needs to formalize the functioning of large dynamic rail system from the system approach position, which is directed on system-wide optimization (synergistic) effect and takes into account the complex of all participants interests in the

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transportation process. One of the main limits for this system is a providing of the resources cost reduction (rolling stock, amount of cargo on the route to the consumer, staff etc.) for an assimilation given traffic volumes. From the logistics view point customers needs main services connected with transportation, storage, loading and unloading, warehousing, order processing, inventory management, herewith, services are seen as interrelated and interactive. On the other hand, in this complex are especially important logistics service indicators (service quality, compliance is ”just in time”, etc.). Herewith logistic system should take on additional functions, which are accompany transportation, such as packaging, labeling, sorting goods, transportation design, determining the optimal transportation options, control over the movement of goods in transit. To do this, you first need to ensure the absolute safety of cargo; offer the full range of transport services; simplification of goods carriage and tariff system; reducing the delivery time; creation of a powerful and modern information network; clear interaction organization with a motor companies or obtaining of own one for delivery ensuring.

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1. **Introduction**

One of the main directions of improving the organization of railway transport process is ensuring Ukraine’s competitiveness and profitability in terms of the transport market, transport sector reformation and the integration into the European community. The solution to this problem is possible to carry out research through implementation of logistics principles in all parts of the transportation process. The formation of logistics technologies of Ukraine railways transport process must be integrated and contribute to the reform process to take into account the interests of all participants of the transportation process, and also be directed at saving technologies using limited resources (rolling stock, cargo mechanisms, etc.) to improve quantitative and qualitative indicators of operational work.

2. **Formulation of the problem**

In terms of fluctuations in traffic volumes in the presence of competition with other modes of transport and with increasing customer demands for the quality of transport services it is especially urgent to solve the scientific problem of creation of the methodological bases for the formation of logistic chains, which involves the creation of highly efficient technologies of redistribution and use of transport, the determination of rational routes of freight trains movement, forming adaptive interaction system of railway and other modes of transport in transport nodes with the creation of a modern decision support systems (DSS).

Development of the corresponding mathematical models are a means to solve the scientific challenges which will allow to determine a rational technology of Ukrainian Railways transport process organization, reduce operational costs and create a hierarchical system of logistics centers for Ukrainian Railways.

3. **Analysis of research and publications**

Reforming of Railway Transport passes towards targeting on the needs of cargo owners based on modern logistics technologies by Lomotko and Pankratov (2015). There can also be operating subsystems inside the logistical system of railways: transport or production individual units, associations or other business systems that work on common economic results by Gadzhinskiy (2005). In these conditions the carrier logistics system must be synchronized with the production processes in enterprises – shippers and consignees by Levkivskiy (2008). This can be achieved by ordering and distribution of resources from the manufacturer to the final consumer, taking into account profitability, productivity and efficiency of the whole system, by But’ko and Prokhorchenko (2013) or Lalinská et al. (2015). Implementation of logistics approaches based on the use of modern corporate information systems SCM (Supply Chain Management). SCM system reduces logistical and purchase expenses of enterprises for 1… 2% by Nikolashin et al. (2004).
The above analysis shows that for the coordination of all transport modes is necessary to create the intermodal logistics system based on logistics centers of Ukrainian railways by But’ko and Lomotko (2007), which must organize the interaction of all participants of the transportation process to organize of freight at the lowest cost and the best profit for all participants in the transport process, taking into account their share of system-wide (synergistic) effect.

4. Methodological aspect of the logistics technologies formation in reforming processes on the railways

The analysis of tendencies in transport technology development process proved the necessity of reforming railway transport in Ukraine to increase its competitiveness and profitability in the face of rising traffic volumes and reduction of rolling stock capacity. Analysis of the performance of the railways of Ukraine showed the presence of significant fluctuations in the volume of traffic. It found that existing delivering technology is not adaptive and not oriented towards customer of transport services. In these circumstances, the most effective way of organizing the transport process for railways of Ukraine should be based on the use of logistic principles, whose application is aimed at obtaining the effect of the integration of the rail industry as a holistic system. This system in Ukraine has certain features that are: geopolitical position in Europe, the availability of developed transport network with a large number of ports, limited technological time for delivery of cargo and others. Similar processes were considered by the authors Karimi et al. (2015), but the effect is based on the theory of large systems is almost considered.

Experience of domestic and foreign railways showed that along with the improvement of technology, sufficient attention to the process automation based on the DSS, which integrated into the automated workplace of operating personnel were not given, as well as not considered formation of a unified information environment within production and transport logistics chains (PTLC) based on common standards for data exchange. The use of complex optimization methods considering the fuzzy nature of the factors affecting the transport technology will surely affect the timely delivery of cargo in a positive way.

It was established that the scientific problem of organizing the transport process of Ukrainian railways is a part of the global problem of forming PTLC to move cargoes from producer to consumer with regard to interaction with other modes of transport. Therefore, improving the technology of transportation process during the carriage of goods should be based on the requirements and needs of the cargo owner considering shortage of rolling stock and other technological limitations. This can be implemented through the creation of a system of logistics centers on Ukrainian Railway, which does not exist in Ukraine to this day.

The methodological approach that improves the process of operation of Railway Transport as a great dynamic transportation system should be based on the principle of maximizing the synergistic effect. It was established that for the development of Ukrainian Railways transport process we must create a system of logistics centers of railways with formalization of process of their functioning on the basis of methods of system analysis.

Under the system of railway logistics centers we mean the set of elements (logistics service centers, PTLC with ports, border crossings, terminals and other elements of the transport and production infrastructure, including information subsystem) that are in the functional connections between each other, have some restrictions on their own technical and technological capabilities and form a unified integrity in order to reach the synergistic effect.

Transport system $S$ and all its components characterized by condition in space and time. Condition of the transport system $C$ at time $t$ is determined by the operator

$$C(t)=\Psi^0(t; C_0; U_t; V_t; P_t; X_t)$$

(1)

where $\Psi^0$ – the operator of condition (transition operator); $t$ – time; $C_0$ – the initial condition of railway transport systems; $U_t$ – controlled input impact at time $t$, through which the targeted changes in the system are made. The elements of the vector $U_t$ is input streams, train formation plan, management decisions made by responsible staff of stations, rail traffic directorates, railways departments on the operation of the railway system and interaction with other transport systems and customers; $V_t$ – uncontrolled entry influence vector at time $t$, which describes the impact on the transport system by the environment; $P_t$ – transport system control parameters at time $t$, aimed at organizing the transport process based on logistics principles will take into account the interests of all participants of the transportation process and provide cost reduction of limited resources; $X_t$ – the vector of parameters and
characteristics that characterize the intrinsic properties of the transport system at time $t$. The number of such parameters denoted by $N$, and the region of permissible values through the plurality $\mathbf{X}$. The value of output parameters of the $Y$ system depends on the input parameters $U_t$, $V_t$, internal characteristics of $X_t$ and the condition of system at the initial time $C_0$. Thus, the transformation of inputs into outputs considering the operation of the transport system might be presented generally in the form of operator.

$$Y(t)=\Gamma^0(t; C_0; U_t; V_t; X_t, S_t)$$

where $S_t$ – changing of the structure of the transport system, which reflects process of creating logistics centers in terms of reforming branch.

The railway transport system structural changes $S_t$ taking place against the backdrop of Ukrainian railways limited resources of rolling stock, bandwidth, so the configuration of the phase space is determined on the basis of these restrictions. This, in turn, leads to the necessity of solving problem of resource saving.

Functional optimum in admissible phase trajectories of railway transport systems is usually determined by its ability to achieve goals without additional resources. In particular, the phase space $\Phi$ of rail system is limited to basic parameters $X_t$ – number of locomotives ($M_{\text{вл}}$), wagons ($M_{\text{вл}}$), capacity ($M_{\text{вл}}$), and $V_t$ – cargo traffic intensity ($Q_t$) at time $t$.

In terms of the intense wear of a traction rolling stock it has been assumed that the main limitation is the number of locomotives $M_{\text{вл}}$. Thus, the phase space $\Phi$ for railway transport system in its configuration is the most frequently convex polygon with limitations.

$$\Phi \in E^2
\begin{cases}
M_{\text{вл}} \leq f(M_{\text{вл}}(Q_t)) \\
M_{\text{вл}}^{\text{max}} \geq M_{\text{вл}} \geq M_{\text{вл}}^{\text{min}} \\
Q_t \leq Q_t^{\text{max}}
\end{cases}$$

where $E_k$ – Euclidean space of dimension $k = 2$; $Q_t^{\text{max}}$ – The maximum possible cargo flows for a given system; $M_{\text{вл}}^{\text{min}}$, $M_{\text{вл}}^{\text{max}}$ - in accordance the minimum and maximum number of locomotives that are in operation.

To evaluate the effectiveness of the implementation of logistics technologies there is suggested to use a summary assessment of key indicators of transport, their influence on the final result, the significance for cargo owners. Operational indicators reflect resource efficiency, as well as serve as a basis to justify management decisions.

The methodology of construction of the technology systems and organizational structure of logistics centers of Ukrzaliznytsia should be based on the requirements of cargo owners within the implementation of logistics technology in the transportation process.

Logistic Centers (LC) of management in railway transport combine automated transportation control centers, commercial centers or centers of service, informational – statistical centers of railways (ISC) and the Main Information and Computing Center (MICC).

Logistics centers efficiently connect structural with the railways control system, which has three levels:
- strategic (top) level LC – Shared Networking with MICC;
- tactical (middle) level LC;
- operational (bottom) level LC – nodal with ACS of railway junction, which includes linear information and control systems for sorting and cargo stations as well as for customers.
5. Conclusions

The analysis of trends in transport process technology development established that the existing delivering technology is not sufficiently adaptive and not oriented towards consumer of transport services. A methodological approach to the organization of transport process at railroads of Ukraine was suggested, that is based on logistics principles and takes into account an additional factors related to the infrastructure of railways of Ukraine: provides interaction with other transport modes and comprehensively taking into account the interests of the transport process participants. Using the proposed approaches provides an opportunity to take into account the emergence of the system in order to obtain a synergistic effect. Achieving this effect involves the formation of logistics system with the corresponding logistics control centers of Ukrzaliznytsia based on information technology.

References


