# TOPICAL TASKS OF THE DEVELOPMENT OF TRANSPORT AND LOGISTICS SYSTEMS

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## ABSTRACT

Modern models of emerging transport and logistics systems (TLS) imply the integration of infrastructure and transport components into a single management system. An integral part of TLS is recognized as a transport and warehouse complex that is as a converter of the material flow of goods on the way from producers of raw and other materials to final consumers of finished products. The development of methods for managing the delivery and transit of goods in cooperation with elements of the transport infrastructure has now become one of the most demanded tasks of transport and logistics services. Optimization of processes in transport systems should be based on obtaining rational decisions, the use of dynamic models and digital technologies.

*Keywords:* *road transport, transport and logistics system, freight transportation, transport and warehouse complex, dynamic programming, digital technologies.*

**Background.** *A distinctive feature of transportation systems (complexes) in road transport is the ability to choose the direction of activity, responsibility for which can be distributed among the components of the system based on management of its functions: preparing cargo for transportation, loading, transportation, etc. [1].*

*Components of each transportation system are separate components with certain properties. Expressed in the form of indicators, these properties often have a contradictory effect on functioning of the road transport system, its speed, reliability and carrying capacity. In this case, most often contradictions can have a negative impact in the event of inconsistency in the quality of management of structural changes caused by an objective progressive development of the external environment.*

*Naturally, effectiveness of the system to one degree or another may depend on any of its elements, that is, on choice of options from among the many possible. A systematic approach to organization of freight transportation in road transport requires unification of individual parts of a disconnected process to achieve the orderliness of the latter, taking into account the ongoing structural changes. Characteristic changes in the transportation complex are primarily associated with development of transport and logistics systems (TLS) and their integral elements – transport and warehouse complexes (TWC).*

*Analysis of statistics on the growth of TWC capacity in the transport system of individual regions shows an unbalanced local dynamics of commissioning warehouse premises, while the general state of the system has a steady tendency to maintain the current dynamics. Changes in the structure of the transportation complex affect not only the production capacity, but also their geographical distribution [2, 9, 10]. It can be stated that modern road freight transportation is a more complex multi-level and multi-component formation than the previous transportation system. Therefore, causal relationships in a TLS with a developed TWC infrastructure should be formalized with the help of an adequate mathematical description, but development of optimal logistics chains for delivery and transit of goods, development of rational approaches within a single complex become an acute problem of road transportation.*

**Objective.** *The objective of the authors is to consider vital tasks at the present stage of development of transport and logistics systems, particularly in the Russian Federation.*

**Methods.** *The author uses general scientific methods, comparative analysis, evaluation approach, scientific description, system analysis.*

**Results.** *Taking into account the proposed theoretical grounds, there are two main ways to solve the problem.*

*The first concept (extensive) implies accelerated construction of TLS network. The main disadvantage of this concept is the need for large capital investments, the lengthy implementation of the program and the lack of guarantee that the new territorial location of TLS facilities will be 100 % consistent with the structure of the dynamically changing structure of cargo flows. Of course, it is impossible to completely abandon this concept, it should be progressively implemented, since the rate of increase in the capacity of cargo flows dictates the need to increase the capacity of the TLS.*

*The second concept (intensive) is based on the global practices of TLS. Many foreign large megacities have already passed a stage similar to our development of road transport systems, and the expert community has come to an unequivocal conclusion: the free market mechanisms are poorly applicable for large agglomeration TLS [3]. In this case, each interested element of the transport system (carriers, TWC owners, municipal authorities, etc.) optimizes its «own» logistics and economy, which leads to such a logistical situation when the road transport system does not satisfy everyone.*

*An alternative to this approach is the use of synchronous (integrated) optimization of the parameters of freight road transportation (FRT) and transport and warehouse logistics, which allows reducing the total mileage of vehicles, making more efficient use of TWC power, differentiating cargo flows in time and space, and partially redistributing cargo to other modes of transport.*

*An important circumstance emerging thanks to technical progress and influencing the structure of the transport process cycle in TLS, should be considered an intensive technological development of TWC. Road TLS is a complex system of transport elements FRT and TWC, designed to move goods from shippers to the consignees. Therefore, obtaining effective solutions in these conditions is possible only if we consider TLS in the context of mutually influencing (integrated) parameters of TWC and FRT. The main features of TWC as an integral component of the transportation process and as an element of the transport cycle in TLS can be considered as follow:*

*1) TWC does not function in isolation, but as an element of a TLS, and this means that the efficiency of TLS functioning as a whole depends on its effectiveness.*

*2) The established interactions and relationships of TWC with a group of clients are taken into account both at the level of the entire TLS and in a separate cycle of the transport process.*

*3) Technological development in TWC is based on the needs and economic feasibility dictated by the conditions of operation (medium) of TLS.*

*4) The complex is characterized by automated information management systems aimed not only at increasing the level of technical equipment of TWC itself, but also at facilitating its interaction with other participants in the transportation process.*

*5) Uniform types of workflow are created for all participants in the process of moving goods to TLS.*

*It is necessary to single out not the only, but the specific function of TWC in TLS, which increases the efficiency of the transport process. This function is to reduce the uneven intensity of movement of material flows, depending on the demand of consumers. This reduction implies that TWC acts not just as a buffer between shippers and final consignees, but also flexibly responds to a possible change in demand for a particular type of cargo by increasing or decreasing the corresponding shipment.*

*The solution of any task arising from some changes in the system, technology and organization of the transportation process requires an integrated scientific and methodological approach.*

*If there are local tasks (uneven arrival of cars to TWC, underloading or overloading of receiver), the transport process cycle is usually considered as a discrete type of the multiphase queuing system with a finite set of states, in which the transition from one state to another occurs abruptly at the moment of some event [1]. But TLS with a developed TWC structure is a separate type of transport systems [6]. In this case, the cycle of the transport process, in contrast to the traditional one, is characterized by a higher degree of dynamism. There is a continuous change in the state of the process with possible changes in the composition of the elements.*

*Cycles of individual stages during the transportation of goods, of course, vary over time. However, as noted, then TWC acts as a damping element that responds flexibly to changes in the traffic environment. Therefore, the cycle of the road transport process in a TLS with a developed infrastructure of TWC differs from the traditional one in micro, especially small, small road transport systems by:*

*1) high degree of dynamism;*

*2) continuous change of the process state;*

*3) possible changes in the composition of the elements;*

*4) changes in the cycles of individual processes for transportation of goods in time, depending on the environmental conditions of operation.*

*The cycle of the transport process in TLS should not be viewed as a discrete type multi-phase queuing system with a finite set of states, but as a discrete dynamic system operating in conditions of insufficient information or an indefinite state of the environment that requires multi-criteria dynamic programming to evaluate its effectiveness. The solution of any task arising as a result of certain changes in planning, organization and management of the transportation process in TLS requires optimization of cargo transportation in technologically and geographically expanding systems.*

**Conclusions.** *Summing up, it can be stated that the processes in road TLS and other types of transport systems are united by a fundamental generality, defined by:*

*1) changing environmental conditions;*

*2) dynamic development of processes in the system itself;*

*3) lack of a sufficient degree of certainty of the information state in solving problems of increasing the efficiency of the system.*

*Integration into the single elementary unit of the transport cycle of elements of FRT and TWC will optimize the process of interaction of TWC logistics infrastructure and create strategic prospects for reducing costs in development of material cargo flows. Therefore, TLS and their elements (TWC) can reasonably be created and modernized by applying and combining models of dynamic systems and multicriteria optimization methods in integrated dynamic systems.*

*At the same time, TLS as a set of objects of FRT and TWC is characterized by the presence of a number of parameters (indicators) that must be taken into account in the form of specific criteria when optimizing the operation of the system. The solution of such a task determines the process of transition from traditional methods of organization and management in transport systems to object-oriented and, accordingly, to object-oriented programming of the studied processes, that is, to automation of management processes based on digital technologies.*

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