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ANALYSIS OF LOGISTICS CHAINS, SERVICED BY RAILWAY TRANSPORT AND APPROACHES FOR TECHNOLOGICAL DESIGN OF PROCESSES

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Abstract *– The diversity of logistics chains that provide the transfer (transit) of material resources from one logistics system to another one requires a different approach to their description and design. Industrial railway branches (industrial railway terminals) are points providing logistical operations between railway undertakings or shunting operators and the industrial systems of the various sectors of the national economy. They are the main unit of the logistics chains that use the railway transport, connecting the national railway network with the transport systems of specific production facilities, ports, intermodal transport terminals, etc., providing direct transport service between consignor - consignee without additional operations and unnecessary costs of time and resources. The presented analysis describes the approaches in technological design of the processes of the most common cases related to different logistics activities. The purpose is to define the problem, to formulate the tasks for solving it and choose the approach in determining the resource and organization of the transport service. Various variants of solutions related to port complexes, industrial objects of energy, metallurgical and chemical industries are analyzed, as well as such servicing logistic centers, manufacturing enterprises and sites with inconsistent and small wagon flow.*

Keywords – logistics, railway transportation, optimization, technology.

1. INTRODUCTION

The diversity of logistics chains ensuring the transition of freight from one logistics system to another requires a different approach to their description and design in order to synchronize the activities of different modes of transport (transport operators, carriers, freight forwarders and companies). The organization of transport processes in the choice of mode of transport can use different options influenced by the characteristics of transport flows and their purpose. The criteria of the users of the transport service, such as minimum transportation costs, also have an impact; delivery time; maximum reliability and safety; access to a certain type of transport and others. Depending on the characteristics and areas of effective application of different modes of transport, it is possible to build different transport systems, taking into account the specifics of transport and making the most of the advantages of a particular mode of transport for a particular logistics chain. The spheres of effective application of railway transport (mass loads over medium and long distances, dangerous goods and those that originate and extinguish directly in industrial railway terminals) make it indispensable in serving certain industries [1].

Industrial railway branches (IRB) are points providing logistics operations between railway undertakings or shunting operators and the industrial systems of the various branches of the national economy. They are the main unit of the logistics chains using railway transport, connecting the national railway network with the transport systems of specific industries, ports, terminals for intermodal transport and others. In the national railway network most of the (main) freight is loaded and repaid in IRB. Their main advantage is that they provide direct transport services between producer and consumer (shipper - consignee) without additional operations and unnecessary costs of time and money at the points of transhipment or interaction between modes of transport. This has led to the development and diversity of the IRB network, which in most cases are subsystems of powerful logistics chains.

The objective of the present analysis are logistics chains served by railway transport. The methods for

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their sizing (determination of the technological parameters and the resource for customer service) depending on the characteristics and limitations of deterministic and stochastic processes.

2. MAIN PARAMETERS AND RELATIONS OF THE PROCESSES IN THE LOGISTICS CHAIN

Optimizing the technology of work in different systems requires typification and classification of the main objects involved in the process and differentiation of the approach in their design. The solution to this problem is performed in the following sequence:

• Determining the type, characteristics, participants and functional scheme of the processes with the respective time parameters and dependencies between National Railway Infrastructure Company (in Bulgaria) (NRIC) and the railway carrier (operator).

• Selection of a methodology for determining the technological parameters and development of Unified Transport Technology (UTT). The process is unified for the different participants in it (NRIC, railway carrier, industrial transport operator, port operator, etc.), as it subordinates the activities in the different subsystems to a single (synchronized) mode of operation.

• The third step includes regulation of the activities in the logistics chain related to the railway transport and preparation of a contract for operation of IRB and customer service.

3. VARIANTS OF SOLUTIONS DEPENDING ON THE TYPE OF LOGISTIC ACTIVITY AND APPROACHES FOR SIZING THE LOGISTICS CHAIN

The classification of logistics chains served by rail can be structured on several principles, the main ones being the type of industry it serves, the volume of freight flows and their unevenness in annual terms, the possibility of competitive traffic services from other modes of transport and the number of industrial carriers. areas and logistics centers. The most common are:

A) Port complexes and specialized quays of various industries

They are characterized by powerful and diverse freight flows, as well as a rich nomenclature of freight rolling stock. The sequence in developing the organization of work is reduced to:

Determining the maneuvering areas for the work of the brigades by specifying their activity in accordance with the normative documents. Description of the shunting operations for servicing a specific pier, speed in the area; providing braking mass of the shunting train and order for feeding / removing the groups of wagons in accordance with the technological map for operation of the quay. The places for commercial and technical inspection of the wagons, their enrollment and other operations for cleaning, disinfection, measurement are regulated. The number of shunting brigades working in shifts and the order of passage in the zones of enemy movements (routes) are determined. In the functional analysis the specialization of the shunting brigades by port areas is made in order to improve the railway service in accordance with the specifics of the served cargo flow (quay) [2]. The industrial railway branches serving the energy sector - provide mainly transportation of energy and raw materials accompanying the processes (coal, fuel oil, various fractions of limestone, etc.).

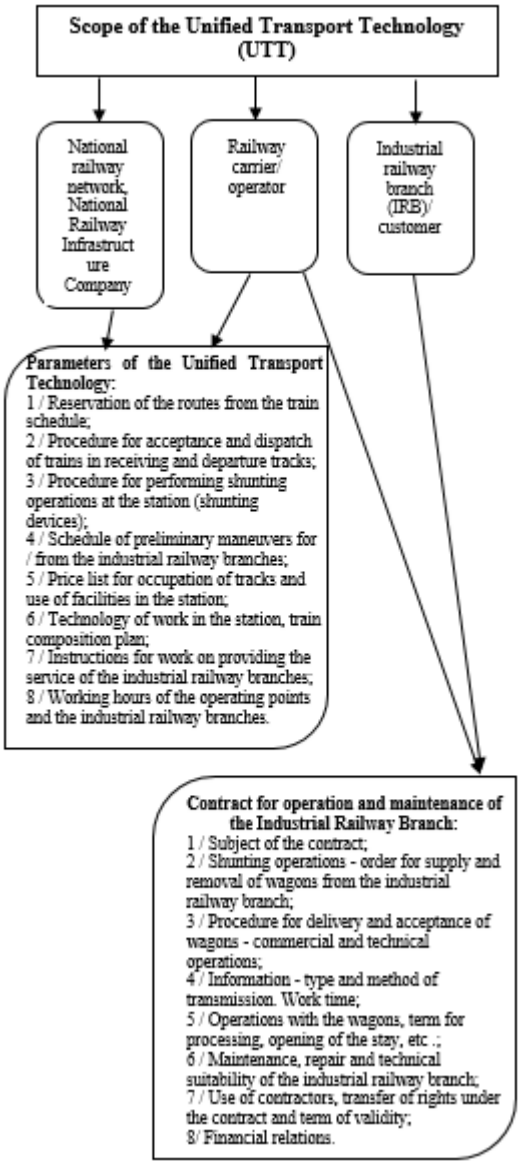

Fig. 1 Main parameters and links of the processes in the logistics chain

Due to the continuous character of the production processes and the high degree of reliability in the management of supply chains, the transport process in

the industrial zone can be defined as determined, and railway transport can be designed depending on the constraints of the logistics chain and the phases through which the freight flow passes. [3]. This requires research and analysis of unmanageable parameters influencing the processes related to the study of input flow intensity, irregularities in the interval and volume of entry, duration of processing of groups of wagons and others, which allows for an accurate description of the process. It can be presented as a queuing system or by simulation modeling to determine the resources for its provision.

B) Industrial railway branches and industrial stations of the metallurgical industry

They are characterized by active incoming and outgoing freight flows, (raw materials and finished products) [4].

The technological description of the activities and their synchronization along the supply chain requires the different time and resource parameters to be determined in the different states that the system can occupy. These conditions examine the unevenness of the IHC inlet for the period of maximum load. On this basis, a general concept for the operation of the system is developed by providing the necessary reserve of capacity and resources for different service options. The problem-solving model is presented as a queuing system (QS), implemented through a developed simulation model based on the GPSS language (General Purpose Simulation System) [5].

The specific model allows the reproduction of various technological solutions, such as the export of the main stocks of raw materials in the port complex and regular supply to the network of the main railway transport. The large capacity of the docks in the bulk cargo terminal in the port creates prerequisites for a smooth process in the transportation of raw materials and work on a fixed schedule in the highway transport. This, in turn, improves the conditions of entry into the industrial units of the transport system and ensures the necessary reliability, with significantly lower resource provision.

C) Logistics chains of the oil refining and chemical industry

They are characterized by increased requirements for security and safety of transport.

Several railway service systems can be considered here. The first are related to the service of oil derivatives, gas and chemicals from terminal to terminal, without being part of a chain for distribution and sale of material resources on the market. They apply the conventional methods of technological design, as in all IRB with the corresponding irregularities and delays of the processes within certain limits regulated in the service contracts between the railways. carrier and customer (owner of the railway branch). In another case, logistics management covers all activities in a corporate supply chain for the delivery and distribution of petroleum products, which are owned by the port terminal, the regional distribution base, a chain of petrol stations, rail transport and specialized road transport [6]. This means that the subject of research and optimization are parameters external to the chain that we cannot influence with management decisions. Such are the deliveries and operation of the maritime transport at the entrance of the logistics chain, as well as the railway carrier as a connecting link between the port and the distribution terminal (Fig. 2).

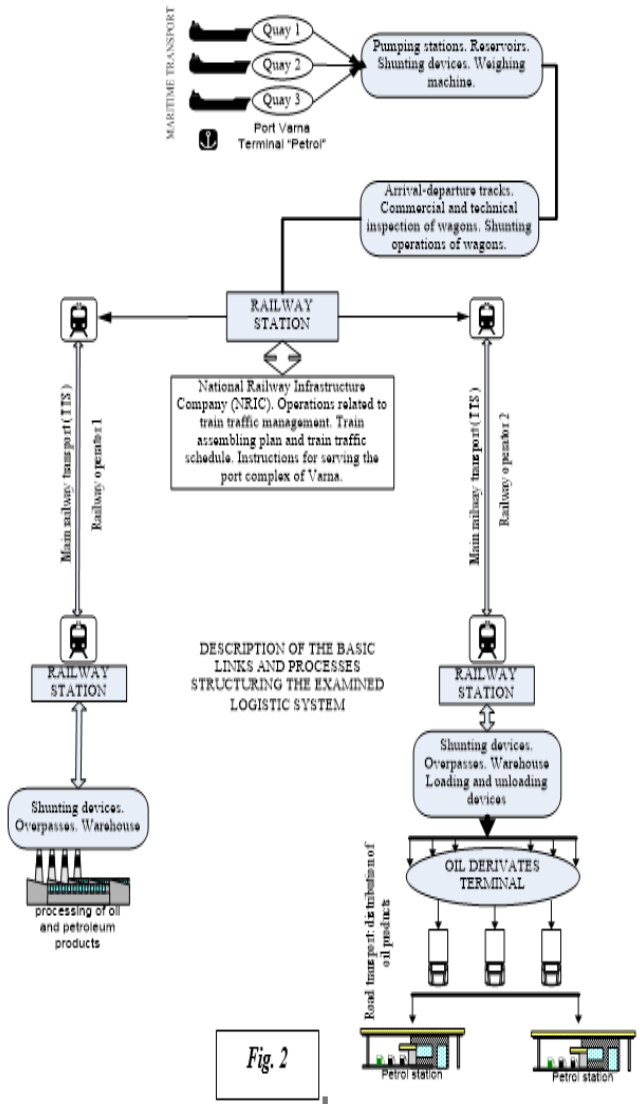

Fig. 2. The basic links and processes

In this case, the railway transport and the options for operation in various process irregularities are studied in detail and described in [7]. The narrow place in the logistics chain is the rate of realization of oil derivatives, their unevenness, the rhythm (frequency) of refueling at gas stations and

determining the necessary stocks of products in the regional terminal. The goal is not to refuse customer service due to lack of derivative at optimal costs. This optimization process requires detailed market research by regions in which the corporate chain operates.

Algorithm for achieving the goals:

• ***Step 1.*** Research, analysis and structure of the logistics chain. Description of the process.

• ***Step 2***. Analysis of the random parameters influencing the operation of the entrance of the logistics chain - maritime transport (intensity of the incoming flow, irregularities in interval and volume of arrival, duration of processing of ships).

• ***Step 3*** Implementation of the process for technological design of the transport system port - rail transport - terminal of oil derivatives (delivery time, schedule for operation in the terminals (industrial railway branches), train schedule, number of trains, gross mass of trains trains, number of locomotives, wagon fleet, etc.).

D) Industrial railway branches serving retail chains, distribution centers, manufacturing plants and sites with intermittent and low wagon traffic

In this type of industrial systems, the technology and organization of railway transport is described in the instructions for servicing the specific industrial railway branch in accordance with the technology of operation in the interacting station, and the actual process is managed operationally through round-the-clock and shift operational plans. Emphasis is placed on the procedure for servicing industrial railway branches by carriers in case there are more than two. [8]

The logistics systems described above are the most common actively served by railway transport and form more than 80% of the tonne-kilometer work in the national railway network.

4. CONCLUSION

The presented analysis describes the approaches in technological design of the processes of the most common cases related to different logistics activities. The purpose is to define the problem, to formulate the tasks for solving it and choose the approach in determining the resource and organization of the transport service. Various variants of solutions related to port complexes, industrial objects of energy, metallurgical and chemical industries are analyzed, as well as such servicing logistic centers, manufacturing enterprises and sites with inconsistent and small wagon flow.

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