SYNCHROMODAL, CO-MODAL, A-MODAL AND TRIMODAL POLY TRANSPORT LOGISTICS

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Abstract: *The article is devoted to the concepts of "synchrome and co-modal transportation", "a-modal booking", "trimodal terminal", as well as the conditions for their implementation and the experience of creating trimodal cargo distribution centers. It was noted that one of the most important problems of the socio-economic development of Russia is the underdevelopment of the transport and logistics system of the country, the weak integration of various types of transport among themselves. It is revealed that the development of synchrome transportation, in order to transform such business processes as document management and identification of parties, invoicing and supply chain management, can significantly contribute to the introduction of blockchain technology. The conditions necessary for the implementation of syn-chromodal, co-modal and a-modal transportation in the Russian Federation.*

Key words: *Synchromodality, co-modality, a-modal booking, multimodal transportation, intermodal transportation, trimodal terminals, logistics technologies, blockchain, transport flows.*

I. INTRODUCTION

One of the important tasks defined by the Transport Strategy of the Russian Federation for the period up to 2030 (ed. 05/12/2018) is "working out and introducing highly efficient integrated transport and logistics technologies ensuring the integration of all types of transport, cargo owners, consignees and other participants in the transport process. This is necessary in order to integrate into a single techno-logically compatible system, intelligent management of transport and logistics processes in the supply chains of goods, as well as reducing the processing time of batches in a terminal logistics network [4]."

To solve this problem, it is particularly important to use new approaches and technologies in transport and logistics activities to reduce the cost of freight logistics and make it more flexible.

In addition, one of the most important problems of the socio-economic development of Russia is the underdevelopment of the transport and logistics system of the country, poor integration of various types of transport among themselves. Without the necessary integration, the lag behind foreign transport and logistics companies will only deepen.

As experts of «EVENTUS Consulting» rightly point out, the increase in demand for

logistic services will further exacerbate the gap between the leading logistics operators and the narrowly functional logistics companies lagging behind in technology. A company capable of managing freight flows in the supply chain using modern information technologies [7, p. 9] can only offer the whole range of logistics services.

One of the new models for the Russian market is co-modal transportation ("co-modal transportation"), when parallel transport flows of various types of transport are organized between the initial and final intermodal terminals [15]. Moreover, these types of transport are used to efficiently use various types of transport in order to achieve the optimal and sustainable use of transport resources [18].

However, another step forward, even in comparison with intermodal and co-modal transportation, is the transition to organizing transportation on the principles of "synchromodalism", that is, organizing the integrated integration of freight and transport flows to make the best use of freight opportunities while reducing environmental costs and pressures.

II. MAIN CONTENS

The term "synchromodalism" itself was introduced in 2010 by the organization Strategist Platform Logitech (SPL), which, in its analytical report for the government of the Kingdom of the Netherlands, identified synchromodal transportation as a way of organizing delivery, in which the choice of the "default" mode of transport is absent, i.e. transportation parameters are determined on-line [14].

The generally accepted definition of synchromodal transport in the scientific literature has not yet developed. In the scientific literature, there are different definitions that highlight the most important, from the point of view of their authors, aspects of this concept:

- "in synchromodal transport, a logistics company can operate different modes of transport in real time and change them if the need arises (based on current information about the available traffic and the availability of transport)" [11];

- "optimally flexible and sustainable deployment of different modes of transport in the network under the guidance of a logistics service provider, in which the customer (consignor or freight forwarder) is offered a comprehensive transport solution" [30].

- "synchromodal networks are transport networks consisting of at least two (different) modes of transport and supporting real-time switching between them based on optimized mode selection decisions" [17];

- "synchromodal transport is a combination of intermodal planning with real-time switching".

The transition to synchromodal transport is a step forward in comparison with intermodal transport and can be implemented through the concept of booking and allowing flexible choice and its-time switching between several available types of transport at any time during the transport of goods.

In turn, operational decisions on the choice of terms, volumes, schedules of transport, mode

of transport can be made on the basis of current information on the demand for the appropriate mode of transport, its traffic condition, existing transport and logistics chains, etc.

From the point of view of shippers, the most basic change in the organization of transport is the so-called "a-modal booking" (a-modal booking), when the mode of transport is not fixed when booking a transport service. Instead, shippers will only define the main requirements to the transport service, such as difficult-you, the preferred time of transport, etc. A-modal booking is a key requirement, which allows to optimize and to unify the transport of all clients [8].

The main difference between synchromodal and intermodal transport is that the synchromodal transport network controlled as a whole and this control allows you to perform individual configuration for each stage of transportation.

Figure 1, published [3], shows the hierarchical relationship between the different types of freight schemes described above.

Synchromodality, co-modality and a-modality can be compared with in-game sports:

- The goalkeeper of one of the teams is the shipper. He introduces the ball into the game, giving the ball (cargo) to players of different roles-defender, midfielder or striker (sends the goods to one of the modes of transport);

- Protection-for example, vehicle defenders-different carriers;

- Midfield-for example, railway transport, and Midfielders-different owners of cars and operators;

- Attack-for example, sea or river transport, and forwards-different shipowners or shipping companies;

- The goalkeeper of the opposing team is the consignee, and the gates protected by him are the warehouse or terminal, terminal complex, or terminal and warehouse complex (TSC), or transport and logistics complex (TLC), or transport and logistics terminal (TLT);

- Cargo owner-the player who owns the ball;

- The team captain is the dominant mode of transport or a multimodal transport operator.

- Coach-intermodal transport operator or logistics center.

Players of the team play various combinations, passing the ball (cargo) to each other, as well as from one line to another (from one mode of transport to another), acting in concert (synchronously) and interacting with each other (co-modality).

They are led by the team captain (the carrier of the dominant mode of transport or the operator of mixed transportation) and the coach (the operator of synchromodal transportation or Logistics center).

The output of the ball out of bounds - the premises of the consignment at the intermediate terminals, warehouses, etc.

Gates rivals-terminals at points of departure and destination.

When the goalkeeper enters the ball into the game, he does not know (a-modality) on what trajectory, in what way (dribbling, short, long, grassroots or hinged gears, fast or slow running, and sometimes step, etc.) and with the participation of the players of what role (what types of TRANS-port) the ball will move across the field (the goods will be delivered to the destination).

Although there are simulated in training and successfully mastered in previous games combinations (delivery routes).

But so interesting and game sports that, with rare exceptions, the development of a game situation is unpredictable.

In any case, to achieve the game goal - hitting the opponent's goal (delivering cargo to the recipient's warehouse), coherence and coordination of all team players (co-modality) of all modes of transport (players of various roles) under the leadership of the captain (carrier of the dominant mode of transport or operator transportations) and a trainer (operator of a synchrome transportation or logistic center).

The judging panel plays the role of state regulatory authorities: the State Sanitary and Epidemiological Surveillance Center (SSESC); Center for Standardization, Metrology and Certification (CSM); Border Service (control of the ball out of the field), etc.

However, in game situations, in contrast to transportation, there is no paper and electronic document circulation. Oral commands and exchange of cues take place instead.

In order for synchrome transportation to be carried out efficiently, it is necessary to fulfill a number of conditions, some of them are described in the works of Kolik A.V. [15], Pfoser S., Treiblmaier H., Schauer O. [2], and others. Consider how far they are achievable now.

1. The existence of a transparent information system that makes it possible to synchronize the methods of ordering / booking transport of various types of transport in real time and operational management of transport networks [5]. There should be a sufficient number of services of various types of transport, providing communication between intermodal terminals. In addition to creating the necessary number of alternatives for choosing a route, a carrier, and a particular service, a large number of services reduce the delay in trans-shipment.

It should be noted that the introduction of blockchain technology can significantly contribute to the development of synchrome transportation. The potential of this technology is that it will transform business processes such as document management and identification of parties, billing and supply chain management. Sensors installed on freight cars, cars, containers will be able to monitor in real time the use of the capacity of transport units, transfer this data to the system built on the basis of the blockchain, for giving accurate bills taking into account the physical volume occupied by the shipment.

Currently, the Blockchain in Transport Alliance (BiTA) organization has joined forces with a number of US logistics companies to develop common principles and standards, based on which its members can create transport information applications [10]. The BiTA Alliance includes more than 230 companies and organizations. In early 2018, the alliance joined by the largest manufacturer of diesel locomotives, GE Transportation, which already has a number of

IT solutions for optimizing the activities of small iron ports (RailConnect) and ports (Port Optimizer) [10].

In Russia, since the beginning of 2017, «Russian Railways», together with IntelLex, launched the Freight Transportation electronic trading platform. By the middle of August 2018, about 2.85 thousand users registered on the resource, and about 144 thousand rail carriages transported. When integrating this site with road and river transport, it can become a prototype of a synchromodal operating system.

2. The operator has a synchrome transportation authority for operational management of the flow of goods in the supply chain. The implementation of proposals for equalization of responsibility for violation of the terms of delivery of goods for all modes of transport will contribute to this [9].

3. The presence of a large volume of traffic (preferably - the same type of goods). Abroad, the main examples of synchrome transportation are mainly related to container transportation [7]. In the Russian Federation, the growth of transit container traffic is projected: in 2017, the volume of transported containers amounted to 414 thousand TEU, which is 60% higher than in 2016. For 7 months of 2018, the volume of transit container traffic grew by another 25%.

4. The presence of a deep planning horizon. The deeper it is, the greater the efficiency of optimization of the processes of transportation and delivery of goods to consumers. Work is also being conducted here: JSC Russian Railways, within the framework of the General Scheme for the development of the railway network for the period up to 2025 and up to 2030, regularly sends inquiries to consignors about the alleged correspondence of the transportation of goods until 2030.

5. The presence of a sufficiently developed multimodal infrastructure (a network of terminals in the direction of delivery of products, a reserve of storage space, etc.). The Transport Strategy of the Russian Federation for the period up to 2030 provides for the development of the infrastructure of multimodal logistics centers for container traffic (including for small and medium businesses) and the transport and logistics infrastructure of international transport corridors [13].

6. Punctuality of observance of the announced schedules of regular transportations by various types of transport. This will be facilitated by the implementation of proposals for equalization of responsibility for violation of the terms of cargo delivery on all types of transport.

7. Willingness of all participants in the delivery process to flexible operational interaction. Here, the situation is changing with the development of the logistics services market and increasing competition in it.

8. The existence of a tariff system that would ensure a fair distribution of costs and revenues among participants in the transportation process. The item on the development of appropriate mechanisms for regulating interspecific competition is included in the action plan (“road map”) for the development of competition in the sectors of the economy of the Russian Federation and the transition of certain areas of natural monopolies from a state of natural

monopoly to a competitive market for 2018–2020 [1].

Synchromodalism is all the more easier to grasp that this approach is in line with the problems of integrating transport systems, which have long been actively discussed in Russian science. Back in 1993, Doctor of Technical Sciences A.A. Avetikyan wrote that it is necessary to form transport infrastructures for the ongoing convergence of various types of transport [6]. The issue of the formation of a unified transport system has recently attracted the increasing attention of researchers [16], and the term "synchromodal transportation" is increasingly penetrating the scientific literature [8].

A model study conducted by M. Zhang and A.J. Pel on the introduction of synchrome container shipments in the interior of the port of Rotterdam showed that compared to intermodal transport, synchrome transport provides generally lower transportation costs and higher processing costs, which leads to comparable total system costs.

Despite the lack of direct economic benefits, employment on service lines is increasing (by 8%), and delivery times are shrinking (by 12%). Also, synchrome services provide a higher quality of services compared to traditional intermodal transport in terms of delivery time. Synchromodal transportations have clear advantages from a social and ecological point of view, since they facilitate the transition from road transport, providing a reduction in CO2 emissions (by 31%).

Synchrome services also expand the range of competitive distances for the delivery of services not related to direct road transport, which further contributes to the transition to sustainable modes of transport. The consequence of this modal shift is a higher throughput at the internal terminals of destination and, consequently, the concentration of automobile traffic in the immediate vicinity of these terminals (15 km) [17].

The most active scientific research in the field of synchrome transportation is currently being carried out in the Netherlands, with the problems of planning synchrome transportation of goods being explored using models of intermodal freight transport, models of container flow management, etc.

Also very promising is the study of coordinated planning of synchrome freight traffic between several transport operators in various but interrelated service areas. As a goal of planning coordination, it is often proposed to minimize the total delivery costs for serving a given transport demand [2].

One of the elements of the infrastructure of integrated transport and logistics services for the development of synchrome transportation, are trimodal distribution centers, connecting the network of rail, road and inland water transport, as well as providing all other related services related to domestic and foreign trade activities [11].

The Strategy for the development of inland water transport of the Russian Federation for the period up to 2030, approved by order of the Government of the Russian Federation of February 29, 2016 No. 327-p [2], states that the creation of trimodal logistic centers is a necessary condition for optimizing the distribution freight traffic between land-based modes of transport and inland navigation. They also contribute to the development of multimodal

transport, the formation of new logistics chains for the delivery of goods with the participation of river transport. The Strategy establishes the need for state support for projects to create and develop trimodal terminals using public-private partnerships and the creation of mechanisms for its development.

According to the Strategy of the development of inland water transport of the Russian Federation for the period up to 2030, the number of trimodal terminals should increase to 6 in 2024 and to 9 in 2030 [2].

In Russia, at present, trimodal terminals are usually created with the participation of regional or municipal authorities controlling river ports and inland waterways [11]. Thus, in the Strategy of Social and Economic Development of the North-West Federal District for the period until 2020, approved by the decree of the Government of the Russian Federation of November 18, 2011 No. 2074-p (as amended on December 26, 2014), in order to ensure the demand for services of the North - The western federal district for the population and sectors of the economy provides for the creation of river trimodal container terminals [3].

The construction of the company “Logoprom” by the trimodal logistics complex in the city of Kstovo also planned the Investment Strategy of the Nizhny Novgorod Region until 2025 [5]. Representatives of the river port of Duisburger Hafen AG (Duisburg, Germany) [12] acted as consultants for the construction of this complex. Currently, the Trimodal Logistics Complex (TLC) Kstovo provides clients with a full range of logistic and stevedoring services [18]:

- acceptance of goods from water, rail and road transport;
- transshipment of goods from one type of transport to another;
- provision of open space for storage of cargo;
- the accumulation of goods to the size of ship parties;
- transport and forwarding services;
- registration of the whole range of shipping documents for receiving and sending ships.

In addition, the creation of trimodal centers is planned in the Perm Territory (based on the port of Perm), in the Republic of Bashkartostan (Ufa) and in the regions of Samara (Syzran), Volgograd (Volgograd), Nizhny Novgorod (Nizhny Novgorod) and Saratov (Saratov).

As an example of the development of trimodal logistics complexes, one can use the European, primarily German, experience.

Trimodal terminals appeared in Europe for a long time. Shortly before the First World War, trimodal terminals were created for transportation between Paris and London in Calais and Dover. In 1933, the International Container Bureau was created to develop intermodal transport, including trimodal terminals.

Of the recently built complexes, one can mention a trimodal terminal for transshipment of heavy cargo in Wesel, in the port of Rhine-Lippe (part of the Deltaport Group). This is a room with a total area of 45 thousand square meters for temporary storage of heavy goods such as cable drums or parts of cranes. For loading / unloading of cargo, four cranes with a lifting capacity of 25 tons and two special cranes with a capacity of up to 200 tons will be involved. At

the terminal, the company will be able to load and unload three river vessels simultaneously. This will allow for the transport of inland waterways of heavy and project cargoes to / from the port of Rotterdam [1].

Metrans (Germany) in Hungary is building a trimodal container terminal with a total area of 165,000 sq. M. m and an annual productivity of 250 thousand standard containers (TEU). The construction of eight railway lines is foreseen, six of which will be of a useful length of 650 m. It is planned to process 250 container trains monthly [2].

Ports Duisburg and Wilhelmshaven (Germany) in 2017 concluded an agreement on further partnership with the aim of developing trimodal logistics and transport links with the rear part of the country. Since the beginning of 2017, more than 4 million standard containers (TEU) have been recycled in the port of Duisburg. A further increase in the volume of work with containers is expected [3].

Swissterminal AG and shipping companies Ultra-Brag and Danser Switzerland (all - Switzerland) in 2015 began building a new trimodal container terminal with an annual capacity of 100 thousand standard containers (TEU) in the port on the river. Rhine in Vejle [6].

Over the past 5 years, trimodal terminals began operating in Antwerp and Brussels (Belgium), Andernach, Deggerdorf, Duisburg, Minden, Nuremberg and Emelsume (Germany), Calasette (Italy, served by the French operator Lohr).

Obviously, the creation of the development of synchrome, co-modal and a-modal transportations, as well as the creation of trimodal terminals, is a Europe-wide trend, from which Russia should not lag behind.

III. CONCLUSION

Summing up, we note that in Russia there are prerequisites for the development of synchrome transportation.

Synchrome transportation will allow getting the effect of both specific cargo owners and the transport system of the Russian Federation as a whole.

For the cargo owner, the main effects will be a reduction in the time of cargo delivery, the emergence of the ability to quickly meet the sudden change in demand for the goods supplied by them, reduction of warehouse stocks, increasing the reliability of cargo delivery, expanding the list of goods transported and distances to which these goods are competitive.

For the transport system as a whole, the effect will be expressed in the growth of freight traffic, ensuring more efficient use of the country's transport system and its capacity, switching cargo flows from the most loaded sections to the least loaded and more environmentally friendly modes of transport, which will lead to a reduction in harmful emissions.

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