

Sustainability of Logistic Infrastructure of Import Substituted Supply Chain under EAEU Digitalization Conditions

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Abstract—The study aims to identify the impact of digitalization on the sustainability of the logistics infrastructure of import-substituting supply chains in the EAEU. The purpose of the article is to determine the general economic and specific factors of the formation and placement of logistics infrastructure facilities on the example of the EAEU industry. As the basis of the strategy for the formation of supply chain stability in the EAEU, a decision-making model for managing a sustainable supply chain has been selected, in which the stages of developing a logistics strategy aimed at sustainability are sequentially identified. In the framework of the study, for the production and logistics clusters, included in the forestry complex, general economic and specific factors for the formation and placement of logistics infrastructure objects were determined using the example of the timber industry complex. It is concluded that it is necessary to create multimodal transport and logistics centers based on the core network of terminal complexes in the EAEU. The authors propose a model for the formation of a regional transport and logistics cluster that performs the functions of an integrated RTLS.

Keywords—*digitalization; logistics infrastructure; supply chains; sustainability; EAEU*

I. INTRODUCTION

The formation of a balanced structure of the EAEU's social production provides for the efficiency of the enterprises of industry, agriculture, construction and the service sector at the supranational level of the economic system. The key elements of the commodity market infrastructure and the basis of the logistics infrastructure are wholesale intermediary organizations (OPO) and freight forwarding companies (FEC), which ensure the functioning of the procurement, supply, storage, delivery systems of the product to the customer.

The logistics infrastructure management system contains general management issues: fleet of rolling stock of its own transport; equipment in operation and repair; the condition of access roads of the warehouse facilities, warehouse buildings (premises), warehouse, industrial and communication equipment; own fleet of rolling stock.

The digital transformation of import-substituting supply chains formed in the EAEU will allow enterprises to transition to a flexible state, ensuring quality, safety and operational efficiency. Digitalization will allow, on the basis of online dialogs between CPU counterparties, to achieve greater

customer engagement to improve business processes along the entire value chain.

II. LOGISTIC INFRASTRUCTURE

A. Logistic infrastructure in the form of a network of transport and logistics centers

The conditions for the formation of the economy of import substitution determine the logistics infrastructure in the form of a network of transport and logistics centers that accumulate financial, labor, material resources in extensive network structures.

Transport and logistics centers (hereinafter – TLC) represent a complex of terminal/warehouse areas for various purposes, container platforms, information and computer centers, engineering networks of facilities that consolidate cargo flows and transfer them to public transport. TLCs provide information, financial and other transportation services, organization and distribution of cargo delivery to consignees. In the development of wholesale and intermediary organizations, there is a tendency of specialization and concentration of commercial activities, as a result – the development of logistics outsourcing of various profiles. Logistic costs in Russia are almost 1.5 times higher than the average for all countries of the world.

The competitive advantage of the company is influenced by the choice of the best location of the infrastructure network. In practice, the logistic approach to the formation of transport and storage support for goods distribution is relevant for the organization of business processes, including infrastructure. Logistics efficiency depends on infrastructure.

Transport companies in the process of forming logistics systems exempt freight owners from sales and distribution functions.

Cargo distribution centers play an important role in the development of logistics infrastructure and allow to:

- consolidate and integrate freight flows;
- reduce the number of flights, intensifying the process of cargo delivery, at a high level ensuring the quality of service;
- optimize vehicle loading.

The main elements of the company's logistics infrastructure build vertical and horizontal ties with other business entities at the national and international levels.

Interacting and interconnected elements of it exist relatively independently and steadily, develop and improve depending on environmental changes. All this characterizes the logistics infrastructure as a self-sufficient structure. The relationship of the logistics infrastructure with other elements of logistics systems, knowledge of its structural features reveals the main characteristics of the systems:

- autonomy – the property of a system to function, develop independently of the environment within certain wide limits;
- integrity reflects the relationship with a single purposeful activity of the internal parts of the system.

Elements of the logistics infrastructure can accompany as interstate trade, industrial relations, yet have state, regional significance [23]. The specifics of the logistics infrastructure formulates tasks for management bodies to solve according to the internal hierarchy of the components of the logistics systems for servicing production needs in a more efficient way. The need for horizontal and vertical integration in the industry, ensuring the efficient use of information and data, makes development a continuous process based on digital technologies and mobile inter-machine communication (M2M communications). The Russian M2M market is growing: in 2016 – 17.9 million devices, by 2021 the total number of M2M connections is planned – 79.5 million, the potential of the Russian market as a whole is 0.5 billion devices. [26]. So, for a long time in the segment of freight transportation and electronic payments GLONASS / GPC systems were the drivers of the M2M market.

B. Supply Chain Sustainability

Logistic infrastructure is the basis for the formation of sustainable supply chains that represent the system: with an unlimited number of interconnected structures with a set of flows (i) organizing cooperative, coordination processes of participants in the value chain; cooperation in financial and other types of flows from the source of raw materials to the final consumer of a group of manufacturers, wholesalers and retailers, (ii) 4PL, 3PL providers, forwarders, warehouses, distributors.

The effect of the supply chain management process (hereinafter referred to as the CPU) is achieved by: forecasting demand and, as a result, increasing income from product sales; the reduction of overhead and transaction costs in procurement, warehousing and marketing, for the maintenance of stocks; a better use of production and logistics facilities in order to improve the level of service and accuracy of supply.

The tendency to achieve CPU efficiency is designing the CPU in such a way as to maintain the required level of stability along with the target performance indicators.

In Russian practice, the logistics chain is also often understood as the transport-terminal infrastructure of the supply chains, which is adequate to the understanding of the logistics infrastructure.

The theoretical aspects of a broad interpretation of CPU stability determine its complex property, which characterizes

the ability of a CPU to realize (maintain, restore) its target capabilities under the conditions of targeted / non-targeted exposure to disturbing factors.

A narrow interpretation of the stability of the CPU is the state of the CPU when it is stable in the planned mode of operation, which means relatively imperceptible changes in the output caused by a fixed control action of limited perturbing influences.

Comprehensive accounting of the simultaneous nature of receipt and dispatch of material flows, the main logistic characteristics of the logistics infrastructure will reduce the degree of risk and the effect of stochastic phenomena on the parameters.

There are many reasons that encourage companies to work towards sustainability of the CPU (Fig. 1).

The main one is to retain old and attract new customers. Among other important reasons: risk management, the ability to manage reputation issues and ensure compliance with laws and regulations, along with compliance with and support for international principles of sustainable business.

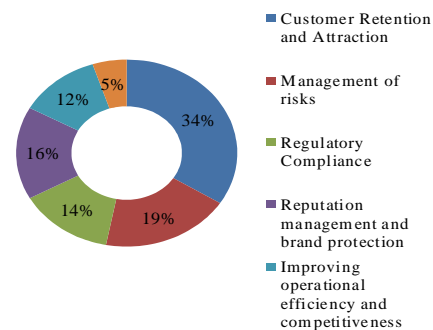


Fig. 1. Motivation of companies directing efforts to create a sustainable supply chain.

By managing and striving to improve environmental, social and economic efficiency, companies act in their own interests, the interests of their stakeholders and the interests of society as a whole, as well as the need to protect the business from possible risks by providing timely and flexible response to various changes in the external environment.

The priority task of the intensive development of macro- and microstructures of the national economy within the framework of the import substitution program can be solved by creating a stable CPU structure in the EAEU, aimed at long-term social, economic, environmental values for its participants (partner companies, society, state). For joint value creation, sustainability criteria are not only internal business processes, but their coordination with company partners [4]. Unfortunately, the majority of companies investing in digital technologies are aimed at obtaining efficient processes and reducing costs, and only a small part feels the need for investment in the formation of new sales channels and the development of new products and services based on customer-centric marketing, which allows companies-buyers to take the best solutions. Operational management in the context of digitalization is becoming a routine and lends itself to

algorithmization. The introduction of digitalization in the economic space of the EAEU will only allow leadership in import-substituting supply chains when choosing a development vector based on sustainable supply chains and generating the best result for the client of these CPUs.

C. Material flow efficiency

For high-quality delivery and stream optimization in the EAEU, it is necessary to take into account the relations between government and business; calculating its effectiveness in practice, which depends on flow coefficients reflecting deviations from contracts and market requirements (assortment mismatch; reduced quality and requirements for the preparation of accompanying documents, violation of the delivery time).

For the design of flows, it is advisable to calculate the efficiency coefficient.

The efficiency of the material flow as a result of the financial and economic activity of the CPU is calculated to determine the dependence of the supply efficiency coefficient within the chain on the organization of logistics flows in the timber industry, that is, the degree of deviation of the movement of material flows in the CPU from the planned criteria should be evaluated – (K_{efp}) [13, c.132] (1):

$$K_{efp} = \sqrt{K_{ksp} * K_{ekp}}, \quad (1)$$

where K_{efp} – coefficient reflecting flow efficiency;

K_{ekp} – coefficient determining the efficiency of the flow;

K_{ksp} – coefficient characterizing the quality of the stream.

The coefficient determining the efficiency of the flow (2):

$$K_{ekp} = \frac{C_y^p}{C_y^f}, \quad (2)$$

where C_y^p, C_y^f – monetary / in-kind amount of planned and actual costs per unit of resource that meets the requirements of the supply of the consumer.

If the value K_{ksp} low then K_{ekp} may increase at planned costs above actual. To reduce actual costs due to poor quality, an allowable deviation limit of X_0 is necessary, with growth of which the planned and actual costs are compared if the first is less than the second (3):

$$K_{ksp} < (1 - X_0), \text{ then } C_y^p \geq C_y^f \quad (3)$$

Payment K_{ksp} as a cost indicator for comparison X_0 and the amount of costs to determine the optimal value is carried out taking into account the consequences of deviations from the planned values of the material flow.

The coefficient characterizing the quality of the stream (4):

$$K_{ksp} = \frac{\sum_i^m l_i^j A_0^j - (\sum_i^m \sum_j^n \sum_p^i v_{0ijp} (dk+dh) + \sum_i^m \sum_j^n \sum_p^i v_{1ijp} r + \sum_k^i s_k^j * z_k)}{\sum_i^m l_i^j * A_0^j} \quad (4)$$

Where Z_k – losses from non-compliance with the k-th delivery parameters, rubles / actual deviation from the terms

of the supply agreement, S_k – the amount of non-compliance with the k-th agreed terms of delivery under the contract, r – specific losses incurred in the supply of excess volumes of resources (sale, storage, excess stock), $(dk+dh)$ – specific value of losses from uncompensated and compensated deficit for the i -th object of the j -th nomenclature of the p -th delivery period, rubles / rub. re-allocated resource volume, v_{1ijp} – the amount of excess resources for the i -th object j -th item of the p -th delivery period, rub., v_{0ijp} – the magnitude of shortages of products on the i -th object of the j -th nomenclature p -th delivery time, rub., (k, t) - other conditions for discussion with counterparties (accompanying documents, requirements for product quality, etc.), (p, l) – the number of intermediate supply periods stipulated by the contract, in accordance with which certain volumes of supplies are established, (j, n) – assortment items of the form products consumed in the CPU, (i, m) – forestry supply chain, V – the average selling price of the supplied resource, rubles / natural units, O – the average selling price of the supplied resource, rubles / natural units,

The delivery itself does not guarantee high-level service according to the current parameters of the customer.

Consider, for example, the timber industry of Russia. Integrated solutions in the timber industry based on regional, technological, tax and tariff policies, transport and communications policies, the banking sector, and the social sphere will create conditions for the development of deep wood processing. The choice of an algorithm for assessing the quality of the material flow and its efficiency will determine the efficiency of the CPU LPK. An important feature of the timber industry is the large-scale used outsourcing potential, in terms of both resources and operations, which are most applicable from the point of view of logistics [9].

The planning stage describes an integrated logistics system – the production and logistics cluster (PLC), which will enable the national business entities of the timber industry to participate in the international relations of the EAEU, which will affect the stabilization of market prices, their guaranteed income (futures contracts) and strengthen Russia's position in the world market [2]. Advantages of PLCs for deep processing of raw materials: the presence of wood reserves, waste from existing forestry industries and their domestic consumption, proximity to markets. To optimize forest management, the organization and digitalization of PLC flows is required, which requires the availability of modern information systems and technologies.

III. PRODUCTION AND LOGISTIC CLUSTERS

A lot of economic literature has been devoted to improving the mechanism of state support for small and medium-sized enterprises in Russia and abroad [5,6,10,15,21].

Monitoring of state support will determine its feasibility at the stage of organizing cooperation on the principles of partnership between business and government agencies. Studies of cluster policy lead to the conclusion that the conditions for the functioning and creation of clusters can also be conditions for investing in any projects based on cluster mechanisms at the same time [8]. Clusters are a component of the territorial complex and their functioning occurs within the framework of territorial-administrative borders. It is worth paying attention to the fact that going beyond these borders is

possible only when there are certain advantages in the territory near the borders [7]. An integrated logistics paradigm is a concept where elements of business systems are combined within a single system, managing flows from the source of supply to the final consumer. Flows, acting as an integrator of business processes, in accordance with logistic integration lead to a change in the organization of management from vertical to horizontal [19], which takes the form of a process-oriented management. The prospect of achieving the effect of integration in the new EAEU economy is characterized not only by lower costs and improved quality of customer service [16]. The B2B concept in the new economy should be replaced by the B2C2C concept, that is, all value chains should be formed on the basis of involving not only customer companies, but also their customers, and the goal of the business should be the goal of a more successful customer. Knowledge of the structure, composition of financial flows of production and logistics clusters allows the management apparatus of the Eurasian Economic Commission to plan and evaluate the total costs of production and distribution systems. The main and associated flows, including services, of the logistics subsystem of companies in organizing the logistics network are connected by the structural / functional divisions of the company responsible for the logistics of intermediaries, suppliers and consumers [12]. The key subject is mesostructures – business associations of enterprises of various types of economic activity for choosing a strategy in the management of technological chains (raw materials and its extraction – development of new products – production – wholesale or retail trade) based on extrapolation principles [1]. A feature of such structures is the possibility of transforming relations between participants on an organizational and planned basis, rather than spontaneous market [18]. Sectoral development and the creation of technological conditions in the formation of the institutional structure of the economy is one of the functions of the state [3].

The definition of goals, objectives, methods and principles of sustainability management allows us to analyze socio-economic systems with the identification of groups, types, classes, which defines the "stability of the system" as a multifaceted phenomenon [2].

The implementation of the coordination function in the PLC involves the administration of the implementation of the action plan:

- 1) Representation of members of the timber industry complex as part of the formed working group under state authorities.
- 2) Creating a PLC: controlling based on modeling, foresight tools, coordination, monitoring, control; sales based on tax optimization, export preferences, transit; financial regulator and optimization of obligations for participation in state support programs; development of infrastructure projects.
- 3) Formation of contractual relations among PLC participants.
- 4) PLC operation.
- 5) PLC Logistic Administration.

The motivation for the implementation of PLCs in the EAEU is the commercialization of business processes, their socialization, greening.

Logistic administration will remove the problem of assessing the reliability of PLC business ties based on controlling that streamlines transaction costs and helps maintain CPU stability in the EAEU digitalization.

IV. MULTIMODAL TRANSPORT AND LOGISTICS CENTERS

Stable and efficient functioning of transport as part of the infrastructure of Russia, an instrument of its geostrategic policy, and the factor of formation of competitive advantages of the economic system is a condition for the inclusion of the EAEU in the global economy. Thus, the high rates of economic development, the integrity of the EAEU countries and their national security are aimed at improving the quality of life of the population.

Consider the Omsk Region in Russia, whose proximity to the developing countries of the Asia-Pacific region allows us to consider it as a strategic subject of Russia for realizing the country's transit potential in the system of Euro-Asian international transport corridors (hereinafter referred to as MTK) [17].

The geopolitical position is also favorable – it is on the path of movement of goods flows between Europe and Asia (on the Trans-Siberian Railway), is a subject adjacent to Kazakhstan. At the stage of virtual development of highly developed information technologies in the branch of Russian Railways, it is proposed to consider the West Siberian territorial center of company transport services (ZS TC FTO) as a transport and logistics center, there is no physical logistics infrastructure here.

Multimodal transport and logistics centers (hereinafter referred to as MTLC) will be organized on the basis of the core network of terminal complexes in the Omsk Region and will increase foreign trade turnover and use the transit potential of the Trans-Siberian Railway for economic development. Objective prerequisites (the railway freight station "Vhodnaya" is located near the Omsk International Airport, the motorway and is located on the Trans-Siberian Railway) for the formation of a large logistics center, according to market research of logistics services, will provide logistics services: coordination and interaction of transport, cargo handling [13; 22].

Coordination of business goals with the areas of socio-economic promotion of the subject of the Russian Federation will become an integrator of MTLC participants / partners, and not just the coordination of financial and other flows.

It is planned to place the operational center of the interstate integrated logistics complex (hereinafter MILK) of the EAEU in the MTLC transport hub formed in Omsk of international rank for the implementation of the MILK project – the formation of interstate integrated logistics complexes in the member states of the Eurasian Economic Union.

Russia is interested in foreign economic relations with the countries of Central Asia (Kyrgyzstan, Uzbekistan, Turkmenistan, Tajikistan), the Republic of Kazakhstan, Iran and the People's Republic of China. Omsk MILK will fulfill the role of communication of transport systems of Russia and

Kazakhstan. Therefore, it is planned to organize 5 MTLC of international rank according to the Transport Strategy of Kazakhstan. The organization of the Almaty – Omsk – Northern Sea Route route as a meridional transport corridor will open access to waterways to the ports of St. Petersburg, Helsinki and Hamburg [24].

An alternative to delivering goods via the Suez Canal along the southern route will be the construction of MILK with a total area of 115 hectares in the Omsk Region to implement the shortest northern route with an estimated cargo handling capacity of Omsk MILK – 3.4 million tons per year.

The cluster model will ensure the implementation of the principles of internal corporate interaction to unite the economic interests of the participants/partners of the logistics center, where, as a system integrator (status of 4PL provider), the Coordination logistics center of the transport hub (hereinafter referred to as KLC TU) is organized as a subsidiary of the TS TC FTO JSC Russian Railways.

The strategic planning of the core network of MTLC involves the following steps:

- 1) Having determined the development vector of national and ITCs, we conduct a study of the state and trends of the transport and logistics services market of the EAEU participants in order to identify the prerequisites for the development of the ITLC network.
- 2) Mission selection; MTLC functions; strategic goals, tasks in accordance with the strategy of socio-economic development of the EAEU participants for the organizational structure of the ITLC formed in the form of a cluster model; the choice of areas of activity, types of services. The correctness of contractual, contractual, subcontractual relations based on the key competencies of MTLC participants/partners is important.
- 3) On the platform of territorial centers of company transport services (hereinafter referred to as the FT Trade Center) of JSC Russian Railways, as well as similar structures in the EAEU countries, a model of inter-organizational logistics coordination and integration of the ITLC based on the CLC TU is formed; strategies and principles of internal corporate interaction of participants and partners of the ITLC are selected. Information technologies of Russian Railways: SIRIUS, ETRAN, Freight Express, ACS local work management centers will allow organizing a single information space.
- 4) On the basis of PPP, the EEC cooperates with branches/branches of Russian Railways and similar structures in the EAEU countries, bodies of all levels of government, logistics and investment companies for innovative development to attract investments for the implementation of projects to create a core network of MTLC (its business plan development): site selection for the pilot MTLC; assessment of the need for investments and sources of financing, payback periods, possible risks and expected effect.
- 5) Development of a conceptual scheme for the development, deployment of MTLC core network in

transport hubs and cargo centers in the territory of the EAEU. A strategy is being developed to integrate the core network of MTLC and terminal complexes (hereinafter TC) into the regional transport and logistics system (hereinafter RTLS) with the creation of a unified information, organizational, economic, scientific, technical, personnel and legal support for integration into the EAEU logistics system.

- 6) Ensuring market viability of the development strategy of the core network of MTLC and TC based on integrated RTLS. It is required to develop financial schemes for investing in the implementation of EAEU projects on the formation of a core network of MTLC and TC and the development of transport and logistics infrastructure, which can be implemented on the basis of the PPP mechanism. The Institute of Logistic Intermediaries (organizers of the cargo and goods distribution system in the EAEU) that carry out the transportation of goods in direct mixed (intermodal) traffic through the Euro-Asian MTK system will form a regional macro-logistics system together with MTLC, TK.

Innovative development of the economy involves not only the use of new production technologies, but also new methods of decision-making and the rapid implementation of all management operations [20]. An effective innovation-oriented form of intensive development of the market of transport and logistics services in the EAEU, the integration of its participants in transport and logistics clusters (hereinafter TLC) on the basis of objective organizational and economic prerequisites for their formation in the EAEU, which, on the basis of innovation, coordinate the economic interests of all chain partners, provide a synergistic effect.

The need to develop transport infrastructure for cluster formation is confirmed by the predicted research results [25]. According to the results of a study of analogous projects, about \$ 1.5 billion of investments are needed for the formation of transport and logistics clusters (TLC), of which \$ 1.2 billion is for the development of transport and logistics infrastructure; return on investment of 7.5–8 years. This will ensure an integrated economic effect estimated at \$ 4.5 billion over a 10-year period of operation and create additional 25–30 thousand new jobs in the region.

V. CONCLUSION

As the basis of the strategy for the formation of sustainability of the CPU, a decision-making model for managing a sustainable CPU is chosen, in which the stages of developing a logistics strategy aimed at sustainability are sequentially identified.

This model is best used in consulting work on the requirements of sustainability for new partners, as it does not take into account the methods used to increase the stability of the companies' supply chain. The steady growth of the industrial product market is followed by the process of formation and streamlining of the logistics infrastructure for the efficient use of natural resources as a factor of integration into the world economy through the export of Russian raw materials.

In the framework of the PLC study, included in the forestry complex, general economic and specific factors for the formation and placement of logistics infrastructure were determined.

The growth points of the regional economy of the EAEU, located in zones of gravity towards international transport corridors, the core network of MTLIC, will be regional transport and logistics clusters. This will allow increasing business/commercial activity, directing investments to the development of additional freight flows and infrastructure, creating jobs, ensuring an influx of labor resources from different subjects of the EAEU. All this will increase the volume of gross regional product (hereinafter GRP) and the country's GDP, the integration of Russian transport in the Euro-Asian and world transport systems, the realization of the country's transit potential in the global MTK system.

Within the framework of the regional transport and logistics clusters of the EAEU, digitalization will make international supply chains more flexible and competitive in the emerging "digital world". International supply chains with digital technologies can use the convergence capabilities of all types of flows to make more informed decisions, implement transformations for "quick implementation" in terms of flexibility, quality, security, operational efficiency, and the formation of a synergistic effect of new business opportunities. The essence of modern business: not to sell manufactured goods by any means, but to help consumers make the best decisions. In the future, international supply chains that focus on digitalization should focus on greater involvement of customer companies in this process, as the leaders in the competition will be those CPUs that are aimed at a successful consumer of their services, thereby improving business processes based on digital transformation.

The project of digital transformation of international supply chains should be supplemented with the use of the "digital maturity" model to determine the current state and the desired one from the point of view of the main areas – this is the key for the formation of sustainable supply chains in the global economy.

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