Regionalization in Global Space

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CLUSTER MODEL
OF ORGANIZING LOGISTICS IN THE REGION
(ON THE EXAMPLE OF THE ECONOMIC
DISTRICT «PODILLYA»)

Abstract

The article analyses the dynamics of development indicators of the regional transport and logistics system of the economic region «Podillya». The barriers that hinder its effective functioning are identified and conditionally divided into 10 groups: political, institutional, investment-financial, infrastructural, logistical, tariff, customs, innovation, information, and environmental ones. It is proved that to eliminate these barriers it is advisable to develop a cluster model of logis-

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tics in the economic region, which means a conceptual approach that involves the creation and development of transport and logistics cluster as a mechanism for sustainable operation of the regional transport and logistics system. The cluster model includes the following blocks: a single set of logistics processes; members of the transport and logistics cluster that organize these processes; algorithm of cluster formation and functioning; organizational and economic mechanism of creation and development of transport and logistics cluster; mechanisms for forming partnerships between cluster members; achieving sustainable development of the transport and logistics cluster on the basis of stimulating the regions. Implementation of the cluster model of organizing logistics in the economic region will contribute to the synergetic (economic, social and environmental) effect.

Key words:

regional economy; economic region; transport and logistics system; logistics; cluster approach; cluster model; barriers; features; indicators; institutional conditions; components of the effect.

JEL: L91, M31, O18, P52, R10, R58.

2 Figures, 7 Tables, 2 Formulae, 43 References.

Introduction

Problem statement. Currently, the modernization of transport infrastructure using a cluster approach is among the key priorities for regional economic development. This corresponds to the main provisions of the National Security Strategy of Ukraine (approved by the Order of the President of Ukraine No. 392/2020 of 14.09.2020), the 2021-2027 State Strategy for Regional Development and the 2030National Transport Strategy of Ukraine. This is especially true for the intensification of innovative development of economic regions of Ukraine on the basis of smart specialization.

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Literature review outlining the authors' contributions and citing sources. Problems of cluster development are actively considered by economists. M. Porter (1998) introduced into use the cluster as an economic category that reflects new trends in the formation of competitive structures in the world economy. He conducted a study of spatial competitiveness in the context of the world economy and substantiated the historical and intellectual preconditions of cluster theory.

In modern conditions, the application of the cluster approach is considered to be one of the most effective mechanisms of structural development of the economy. The characteristic features of the cluster model of the economy structure include the presence of competitive enterprises; availability of competitive advantages in the region for cluster development; geographical concentration; a wide range of participants and the presence of a «critical mass»; interaction between cluster participants (Piatinkin & Bykova, 2008).

The strategic task of implementing a cluster model of the economic structure at the meso-level is to change the psychology of entrepreneurs, their understanding of the possible mutually beneficial cooperation of all members of the cluster for the common economic benefit (Gasanov & Kanov, 2013).

At the heart of the cluster approach is the concept of «cluster», which is a network of geographically close interconnected companies (suppliers, manufacturers and buyers) and related organizations (educational institutions, government and regional authorities, infrastructure companies), which operate in a specific area and complement each other (Yasheva, 2009). Cluster as a conceptual apparatus and a market organizational and structural institution has a broader meaning, because in addition to production and technological features, it also combines social, economic, institutional and cultural-mental parameters that give this entity high potential for mobility, stability and high competitiveness. Clusters are groups of interconnected companies within a certain territory, their vertical and horizontal connections strengthen social relations, create stable integrated networks (Egorov & Chigarkiva, 2006).

According to D. Rutko (2016), the category «cluster» is considered as a group of territorially (geographically) closely located firms that interact and complement each other in the same and related industries (W. Isard, A. Markusen, G. Myrdal, M. Porter, M. Enright); group of industrial companies united on the principles of economics of «industrial localization» that form a network of closely interconnected firms, including specialized suppliers (M. Best, M. J. Gordon, M. Porter, M. Fujita, H. Schmitz, G. Allison); a network of independent industrial and / or service firms with a high level of cooperation (usually through supply chains), technology and know-how creators (universities, research institutes, engineering companies), market institutes (brokers, consultants) and consumers that cooperate within a single value chain (D. Bartner, M. Best, D. Gibson, P. Krugman, F. Cook, F. Lissoni, T. Roland, A. Saxenian, M. Storper, Ch. Freeman).

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Clustering is interpreted as a way to overcome the «closing» effects characteristic of both market (working capital deficit, information asymmetry, market entry barriers) and state coordination (lack of coordination, information exchange, expansion of state control) of economic activity (Devlin & Bleackley, 1988; Swann & Preveser, 1996; Feser, 1998; Feldman & Audretsch, 1999; Dussauge et al., 2000).

Clustering is a process that ensures the consolidation of disparate elements of the social system at the local level and reveals the internal regional potential for vertical and horizontal integration. Thus, the regional cluster is recognized as the spatial economic form that emerges from the informal association of several organizations and achieves the necessary concentration of production, management, and information infrastructure in order to ensure a high level of competitiveness of the regional product (Prokopenko, 2016). The cluster model of national economic development is a conceptual approach that involves the use of clusters as system-forming elements of a modern market economy, enabling realization of the country's competitive advantages within the international economic space (Pankova & Potapenko, 2018).

A significant contribution to the development of the clustering system in Ukraine was made by M. Voynarenko (2011), who considered the cluster approach from the standpoint of institutionalism. L. Ryneyskaya (2016) studied the role of clusters in the development of national and regional economies (e.g. EU economy), which are components of the modern global economic space. M. Gridnev (2017) proposed conceptual principles for harmonization of regional economic interests of cluster formation in Ukraine. Some scholars believe (Ilchuk et al., 2013) that for a cluster to be formed there must be a coordination centre that manages the enterprises that make up the core and other participants. The core of a cluster is usually a powerful enterprise or a set of leading enterprises that are connected by vertical or horizontal connections and interact with other members of the cluster.

Theoretical and methodological provisions and practical recommendations for the formation of transport and logistics clusters are investigateded in the work of scientists, in particular Zrobek (2011), Szuster (2012), Kruczek and Zebrucki (2014), Frankowska (2015), Dmuchowski (2019), Hrytsenko (2019), Sharai et al. (2019). For instance, M. Kruczek and Z. Zebrucki (2014) consider logistics clusters as a form of partnership, which is focused primarily on logistics operators who use cooperation to develop and improve new or existing logistics services. M. Frankowska (2015) notes that logistics clusters are part of global supply chains, so they are especially important in the process of their globalization through the implementation of interacting functions.

It is a proven fact that the combination of a cluster project with logistics activities is one of the ways to increase competitiveness. Some argue that logistics clusters have the potential to make greater use of solutions developed by individual companies that form the cluster, as well as solutions developed by com-

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panies in other sectors with which such companies cooperate. The emergence of logistics clusters is stimulated by the processes of internationalization and liberalization of material and capital flows, the constant search for new sources of competitive advantage, for example, by optimizing logistics processes that reduce costs and minimize disparities in EU regions (Dmuchowski, 2019).

Both Ukrainian and foreign researchers (Hryhorak, 2017; Ivanov & Kharazishvili, 2017; Nykyforuk, 2014, 2017; Ilchenko & Karpenko, 2017; Nykyforuk et al., 2019; Dzwigol, Shcherbak et al., 2019; Dzwigol, Aleinikova et al., 2019; Kwilinski, 2019; Dementyev & Kwilinski, 2020; Zaloznova & Trushkina, 2019) have paid a lot of attention to development of theoretical, methodological and applied principles of creating a system for managing balanced development of the logistics services market as a component of the national logistics system; identifying areas for improving the efficiency of transport and logistics and key tasks and priorities for the development of the transport sector in Ukraine; evaluation of indicators of innovative development of the transport system of Ukraine to substantiate strategic guidelines; identification of global trends in digitalization, which include the use of big data and cloud technologies, the Internet of Things, blockchain, artificial intelligence, the development of robotics; development of a functional scheme of digital transformation of the transport sector.

At the same time, the versatility, multifaceted and debatable nature of certain issues on the chosen topic necessitate further research. Finding the solution to this problem is especially relevant in modern conditions of transformation of regional transport and logistic systems in the context of sustainable development.

The aim of the research is to substantiate and develop a cluster model of logistics on the example of the economic region «Podillya». To achieve this goal, methods of analysis and synthesis, systematic approach, statistical analysis, comparisons and observations, classification, structural and logical generalization were used.

Research Results

The economic region «Podillya» includes Vinnytsia, Ternopil, Khmelnytskyi oblasts (Fig. 1).

This area has several prerequisites for the creation of a transport and logistics cluster as an institution of regional development. First, it has advantageous geographical and logistical location with available transport links for freight with different countries. Second, the network of roads, strategic highways, transnational transport highways is well developed. Third, there is an extensive railway network (production units of Zhmerynka, Koziatyn Directorate of Railway Transportation of the «South-Western Railway» regional branch; Ternopil Direc-

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torate of Railway Transportation of the «Lviv Railway» regional branch of Ukrzal-iznytsia JSC). Fourth, operation of aviation infrastructure facilities (international airports «Vinnytsia», «Khmelnytskyi», «Ternopil»). Fifth, development of river transport (branches of Mohyliv-Podilskyi Pier and Vinnytsia Pier of PJSC Kyiv River Port; cargo navigation on the Dniester River from the town of Zalishchyky), etc.

Figure 1

Geographical location of «Podillya» economic region
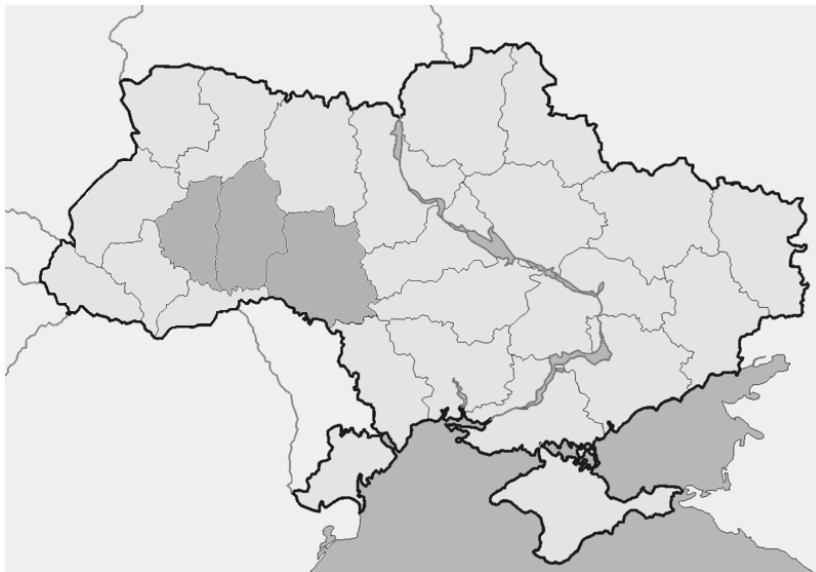
According to the State Statistics Service of Ukraine, the volume of cargo shipments by the South-Western Railway increased by 33.3% in 2010-2019, and freight by Lviv Railway rose by 13.1%. The share of freight traffic by the South-Western Railway in the total volume of shipments by public rail transport in Ukraine increased by 6.8 percentage points (from 8.1 to 14.9%); the same indicator for Lviv Railway rose by 3.1 percentage points (from 5.8 to 8.9%).

During this period, the freight turnover of the South-Western Railway decreased by 1.7%, but that of Lviv Railway, on the contrary, increased by 3.8%. The share of freight turnover of the South-Western Railway in the total freight

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turnover of public railway transport increased by 3.5 percentage points (from 19.4 to 22.9%), while the growth of Lviv Railway was 2.1 percentage points (from 8.5 to 10.6%) (Table 1).

Table 1

Freight volumes and freight turnover of public railway transport in 2010–2019

Year	South-Western Railway		Lviv Railway	
	freight volumes, million tons	freight turnover, billion tkm	freight volumes, million tons	freight turnover, billion tkm
2010	29,1	42,4	20,6	18,6
2013	37,7	46,7	22,5	19,2
2014	38,5	46,7	22,8	20,0
2015	37,1	42,2	24,3	21,0
2016	36,9	38,4	23,6	21,1
2017	40,8	42,8	27,0	22,2
2018	38,5	41,4	26,4	21,9
2019	38,8	41,7	23,3	19,3

Note: created by the authors using data of State Statistics Service of Ukraine (2019; 2020).

According to the Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions, the volume of goods shipped by railway in the economic region «Podillya» increased by 2.2 times in 2010–2019. This is due to the growth of volumes in Ternopil region by 3.7 times and Vinnytsia region by 1.6 times. The share of freight traffic by rail in Vinnytsia region decreased by 19.3 percentage points or from 73.9 to 54.6% of the total volume in the region. This indicator for the Ternopil region increased by 19.3 percentage points, or from 26.1 to 45.4%. It has been determined that freight by railway is not used in the Khmelnytsky region (Table 2).

During the studied period, the volume of road transport freight in the area increased by 25% due to an increase in the volume of Ternopil (by 67.9%) and Khmelnytskyi regions (by 41.6%), and despite the decrease in Vinnytsia region (by 0.5%). The share of volumes of road transport freight in Ternopil region increased by 5.4 percentage points (from 15.8 to 21.2%), in Khmelnytskyi – by 4.6 percentage points (from 35 to 39.6%). Meanwhile, the share of Vinnytsia region decreased by 10 percentage points or from 49.2 to 39.2% (Table 3).

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Table 2

Volumes of freight by railway in the economic region in 2010–2019, thou. tons

Year	«Podillya» economic region	Including regions of:		
		Vinnytsia	Ternopil	Khmelnytskyi
2010	5653,9	4179,0	1474,9	–
2011	6984,5	5092,0	1892,5	–
2012	8534,8	6239,0	2295,8	–
2013	8823,2	6024,0	2799,2	–
2014	9424,0	6379,0	3045,0	–
2015	10185,7	5596,0	4589,7	–
2016	10909,4	6311,0	4598,4	–
2017	11739,3	6885,0	4854,3	–
2018	11649,6	6487,0	5162,6	–
2019	12177,9	6649,0	5528,9	–

Note: created by the authors using data of Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions.

Table 3

Volumes of freight by road transport in the economic region in 2010–2019, thousand tons

Year	«Podillya» economic region	Including the regions of:		
		Vinnytsia	Ternopil	Khmelnytskyi
2010	61241,6	30147,0	9653,7	31440,9
2011	68232,0	34188,0	11568,4	22475,6
2012	73543,0	34657,0	15970,3	22915,7
2013	71930,1	33233,0	15576,2	23120,9
2014	76023,0	32814,0	17319,2	25889,8
2015	71386,1	30038,0	13766,3	27581,8
2016	73265,9	28907,0	14672,7	29686,2
2017	76663,1	27782,0	16657,9	32223,2
2018	81081,4	29195,0	18427,1	33459,3
2019	76580,6	30005,0	16209,3	30366,3

Note: created by the authors using data of Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions.

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The total freight turnover of the «Podillya» economic region decreased in 2019 compared to 2015 by 7.2% or fell from 29,820.8 to 27,659.4 million tkm. This was due to the decrease in railway freight by 7.4% and road transport freight by 6.4%. This reduction was caused by the decrease in freight turnover by railway transport in Ternopil region (13.4%) and Vinnytsia region (7.1%). In addition, there is a trend towards reduction of the turnover by road transport in Khmelnytskyi region (11.8%) and Ternopil region (3.4%). Only in Vinnytsia region, this indicator increased by 1.9% (Table 4).

Table 4

Freight turnover by types of transport in the economic region in 2015–2019, million tkm

Year	«Podillya» economic region		Including the regions of:					
			Vinnytsia		Ternopil		Khmelnytskyi	
	(1)*	(2)	(1)	(2)	(1)	(2)	(1)	(2)
2015	26283,4	3537,4	25130,9	880,5	1152,5	847,9	–	1809,0
2016	25296,3	3583,7	24187,1	945,7	1109,2	910,7	–	1727,3
2017	27620,6	3388,0	26323,9	946,6	1296,7	811,4	–	1630,0
2018	25014,7	3211,6	23146,0	894,0	1868,7	777,4	–	1540,2
2019	24347,0	3312,4	23349,1	897,4	997,9	819,4	–	1595,6

Note*: Railway transport (1); road transport (2).
Note: created by the authors using data of Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions.

In 2010–2019, Vinnytsia region's share of capital investments in the development of land and pipeline transport decreased by 7.2 percentage points or from 36 to 28.8% of the total investment in the economic region, in Ternopil the decrease amounted to 13.8 percentage points (from 32.8 to 19%). However, in Khmelnytskyi region, the share of these capital investments increased by 21 percentage points or from 31.2 to 52.2% (Table 5).

In 2010–2019, Khmelnytskyi region's share of capital investments in warehousing and ancillary activities in the field of transport increased by 5.2 percentage points (from 17.7 to 22.9%) of the total volume of such investments in the economic region, and in Ternopil the increase amounted to 5.1 percentage points (from 8.9 to 14%). In Vinnytsia region, the share of these capital investments decreased by 10.3 percentage points or went from 73.4 to 63.1% (Table 6).

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Table 5

Capital investments into the development of land and pipeline transport in the economic region in 2010–2019, thousand UAH

Year	«Podillya» economic region	Including the regions of:		
		Vinnytsia	Ternopil	Khmelnytskyi
2010	53993	19418	17684	16891
2011	116373	37770	43011	35592
2012	131389	45066	47133	39190
2013	121976	41658	34948	45370
2014	215450	40733	131056	43661
2015	172374	48979	36027	87368
2016	326569	114383	62350	149836
2017	699353	233156	249164	217033
2018	753792	211997	342649	199146
2019	556131	160240	105809	290082

Note: created by the authors using data of Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions.

Table 6

Capital investments in warehousing and ancillary activities in the field of transport in the economic region in 2010–2019, thousand UAH

Year	«Podillya» economic region	Including the regions of:		
		Vinnytsia	Ternopil	Khmelnytskyi
2010	83080	61007	7348	14725
2011	295548	229386	48535	17627
2012	460119	232866	144675	82578
2014	401164	33976	301355	65833
2015	371282	280667	46506	44109
2016	190502	67964	37733	84805
2017	317157	137675	32100	147382
2018	312000	225773	86227	–
2019	540670	341240	75521	123909

Note: created by the authors using data of Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions.

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During the studied period, the volume of direct investment into the development of transport and warehousing in the area increased by 10.8% due to increased investment in Ternopil (13.7%), Khmelnitskyi (12.4%), and Vinnytsia regions (3.1%) (Table 7).

Table 7

Direct investments in the field of transport and warehousing in the economic region in 2010–2019, thousand USD

Year	«Podillya» economic region	Including the regions of:		
		Vinnytsia	Ternopil	Khmelnytskyi
2010	14150,8	3518,9	7763,4	2868,5
2011	13320,2	3451,5	7305,1	2563,6
2012	15296,0	4481,9	9168,0	1646,1
2014	18047,0	4835,0	11724,1	1487,9
2015	16595,8	3897,3	9995,0	2703,5
2016	16347,2	3955,5	9728,8	2662,9
2017	17040,3	4430,5	9489,6	3120,2
2018	19800,2	5968,3	10031,0	3800,9
2019	15675,4	3628,4	8824,2	3222,8

Note: created by the authors using data of Main Departments of Statistics in Vinnytsia, Ternopil, Khmelnytskyi regions.

Thus, the research has shown (Ivanov et al., 2019) that effective development of the regional transport and logistics system of the economic region is constrained by many barriers, which can be divided into 10 groups:

$$B = \begin{cases} b_1(b_{11}); \\ b_2(b_{21}, b_{22}); \\ b_3(b_{31}); \\ b_4(b_{41}, b_{42}, b_{43}); \\ b_5(b_{51}, b_{52}, b_{53}, b_{54}, b_{55}); \\ b_6(b_{61}, b_{62}); \\ b_7(b_{71}); \\ b_8(b_{81}); \\ b_9(b_{91}); \\ b_{10}(b_{101}) \end{cases} \qquad (1)$$

where:

political (b_1): unstable political situation in the country (b_{11});

institutional (b_2): imperfect legislative and regulatory framework (b_{21}); lack of a regional program and strategy for the development of the transport and logistics cluster (b_{22});

innovative (b_3): insufficiently effective implementation of innovations and application of innovative *technologies* in the transport sector (b_{31});

investment-financial (b_4): *insufficient* funding for the transport sector (primarily in aviation and water systems) (b_{41});ineffective implementation of the public-private partnership mechanism (b_{42});limited tools for private investment in transport and logistics infrastructure (b_{43});

logistical (b_5): *insufficiently* efficient organization of logistics (b_{51}); uncoordinated work of the «South-Western Railway» and «Lviv Railway» regional branches of PJSC Ukrzaliznytsia, international airports, river transport facilities (b_{52}); worsening maintenance and quality of transport and logistics services (b_{53}); decreasing volume of freight traffic by various modes of transport (b_{54}); complexity and unpredictability in tariffs and delivery times (b_{55});

infrastructure (b_6): significant violations of existing logistics infrastructure facilities (b_{61}); limited infrastructure capacity (especially in river and air transport) (b_{62});

customs (b_7): considerable time for filing documents and terms of passing customs procedures (b_{71});

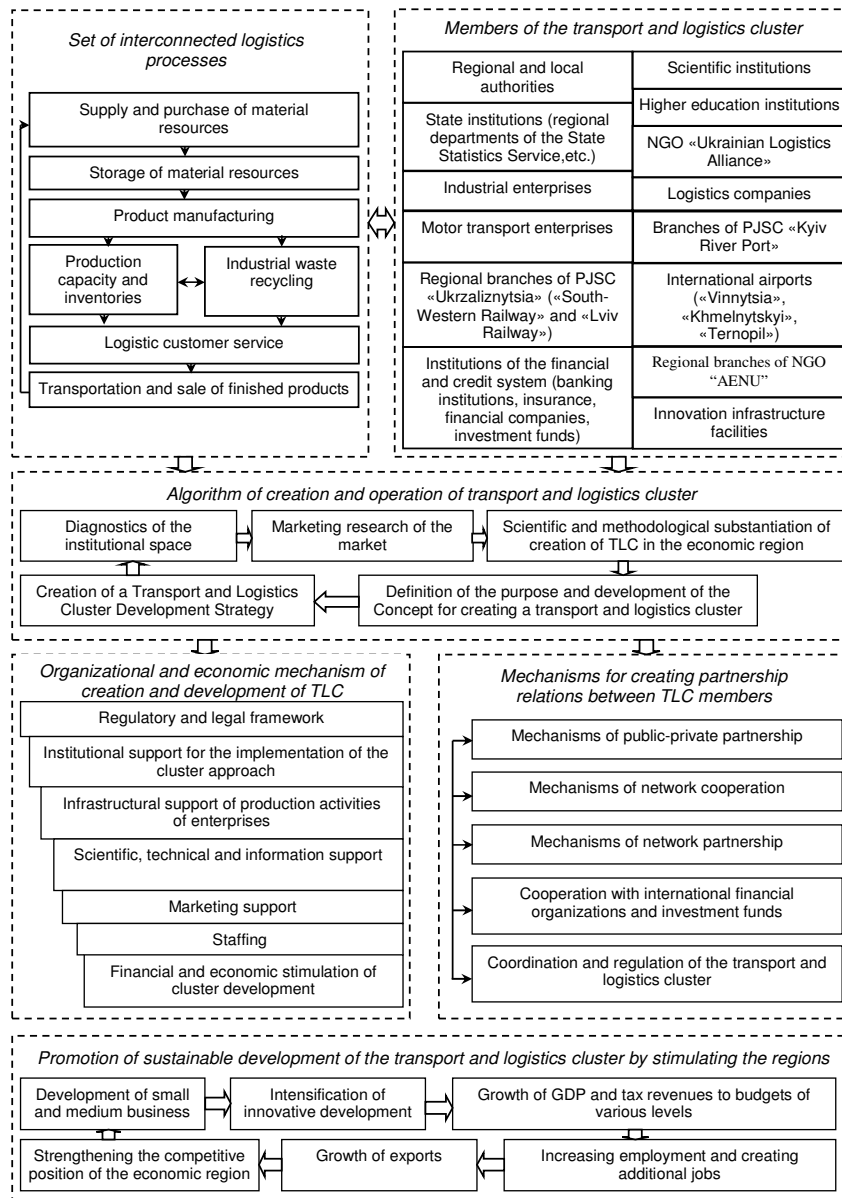*tariff (b_8)*: high level of tariffs and costs for the organization of logistics (b_{81});

information (b_9): insufficient use of information and communication technologies and digital logistics tools (b_{91});

environmental (b_{10}): insufficient application of the «green» logistics concept in the transport sector (b_{101}).

It is advisable to develop and implement a cluster model of logistics in the «Podillya» economic region to eliminate the above barriers. This is a conceptual approach that involves the creation and development of transport and logistics cluster (TLC) as a mechanism for sustainable operation of the regional transport and logistics system (*2*).

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Figure 2

Cluster model of organizing logistics in the economic region

Note: created by the authors based on Ganushchak-Yefimenko (2015), Mazniev (2015), Mykoliuk (2017), Pankova & Potapenko (2018).

Implementation of the cluster model of logistics in the economic region will facilitate the synergistic effect (E):

$$E = \sum \begin{cases} X_1(x_{11}, x_{12}, x_{13}, x_{14}, x_{15}, x_{16}, x_{17}) \\ X_2(x_{21}, x_{22}) \\ X_3(x_{31}, x_{32}) \end{cases} \rightarrow \max \qquad (2)$$

where

economic effect (X_1): increased level of investment attractiveness of territories (x_{11}); increased revenues to budgets (regional, local) as a result of qualitatively new model of regional economy, strengthening of regional competitive advantages and increase of economic capacity of territorial communities in the conditions of decentralization (x_{12}); increased level of transit potential (x_{13}); increase in freight traffic and freight turnover of various modes of transport (x_{14}); reduction of costs for the organization of logistics as a result of reduced the transport component in the cost of services and reduced time to perform customs procedures for clearance of goods (x_{15}); ensuring favourable institutional conditions for the functioning of the logistics services market (x_{16}); improvement of transportation technology using modern information and communication technologies and digital logistics tools (x_{17});

social effect (X_2): job creation and employment growth (x_{21}); improving the working conditions of those employed in the field of transport and warehousing (x_{22});

environmental effect (X_3): reduction of greenhouse gas emissions from transport as a result of optimized traffic flows (x_{31}); increased level of environmental safety (x_{32}).

Conclusions

The conducted research has established that the «Podillya» economic region there is a significant logistical and transit potential for the development of the regional transport and logistics system. However, this requires the creation of appropriate institutional conditions. First, the regulations and legislation for the development of the transport sector and the organization of logistics should be improved, taking into account the regional component. Second, the Strategy for integrated development of the regional transport and logistics system should be

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developed based on the modernization of transport infrastructure and the creation of a transport and logistics cluster. Third, an organizational and economic mechanism for managing the development of the transport and logistics system of the economic region should be developed and implemented using the tools of «green» logistics and digital technologies. Finally, the mechanism of financial support for the management of the transport and logistics system should be improved. This should be done through the use of such financial instruments as venture capital, crowdfunding, factoring, international-private-public partnership based on attracting private investment, funds of credit institutions, foreign investment resources, grants from international financial organizations.

Creation and development of transport and logistics cluster in the «Podillya» economic region can lead to annual growth in:

volumes of freight traffic by railway by 5% and freight turnover of the South-Western Railway by 2% and Lviv Railway by 2%;

volumes of freight traffic by road transport by 6% and freight turnover by road transport by 12%;

level of logistics service for service consumers by 3-5%;

share of direct investment in the transport sector and warehousing in the total direct investment in all types of economic activity of the region by 2-3%;

share of capital investment in the transport sector and warehousing in the total volume of capital investments by all types of economic activity of the region by 3-5%;

average number of employees in the field of transport and warehousing by 3%, including in the field of land and pipeline, water, air transport – by 1%;

It can also lead to annual reduction in costs for the organization of logistics activities by 12-15% due to the reduction of the transport component in the cost of services by 7-10%; average idle time of cars under one freight operation of the South-Western and Lviv railways (hours) by 25-30%.

Prospects for further research are to summarize the international experience of creating transport and logistics clusters and substantiate the conceptual provisions for the creation and development of transport and logistics systems in the economic regions of Ukraine, taking into account their regional specifics.

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