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Module Jean Monet "EU transport policy"

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PROBLEMS AND PRIORITIES OF THE ECONOMIC TRANSPORT SYSTEMS INTEGRATION OF UKRAINE AND THE EU

Collective monograph

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Проблеми та пріоритети економічної інтеграції транспортних систем України та ЄС: колективна монографія/укладачі: Кириленко О., Зарубінська І., Гращенко І., Литвиненко Л., Савченко Л., Семірягіна М., Овсак О., Садловська І, Бугайко Д, Новак В., Разумова К., Коваленко Ю. - під заг. редакцією д.е.н., проф. **Паливоди О. М.-** К.: Кондор, 2023. 259 с.

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The monograph examines theoretical and practical aspects of transport development in Ukraine in the context of European integration. Based on the study and generalization of the standards, values and experience of the EU countries in the development of transport and logistics, the authors have developed scientific approaches to their implementation in Ukrainian practice. Proposals aimed at developing the institutional environment, improving management mechanisms, and removing barriers to the economic integration of the transport systems of Ukraine and the EU are presented. The monograph will be useful for scientists, entrepreneurs, specialists in public management and administration, teachers, students of economic specialties and other interested persons.

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Content

FOREWORD

One of the important priorities for the development of domestic transport is orientation towards European integration. The implementation of the Association Agreement between Ukraine and the EU means that significant efforts in the development of the transport sector are aimed at bringing Ukrainian standards and policies closer to EU policies; expansion of the Trans-European Transport Network TEM-T; implementation of European values and priorities, in particular, the liberalization of the transportation market; improvement of transport networks and modernization of infrastructure, etc.

An important task for scientists and practitioners involved in the transport and logistics sector is the transformation of Ukraine into an international transport hub between Europe and Asia through the formation of a safe, reliable and efficient transport system that meets the needs of the industry and citizens of Ukraine.

The relevance of this task increased even more during the period of large-scale military operations that unfolded on the territory of Ukraine as a result of Russian aggression. Effective resistance to the occupiers depends on the ability of domestic transport to timely transport goods in the necessary volumes to meet the needs of the Armed Forces of Ukraine, the national economy and the civilian population. The main part of both military and humanitarian aid goes through European countries, which proves the urgent need for rapprochement and close cooperation of the transport systems of Ukraine and the EU in the conditions of martial law.

An important place in the formation of a sustainable and safe transport system is occupied by scientific research aimed at studying the standards, values and experience of the EU countries in building an effective transport and logistics system and the development of technologies and mechanisms for their adaptation to Ukrainian practice. The efforts of the team of

authors of the presented monograph "Problems and priorities of the economic transport systems integration of Ukraine and the EU" were aimed at solving these problems.

Scientific works of such domestic researchers as Amosha O.I., Bonyar S.V., Gryshina, L.O., Grechan A.P., Danilova E.I., Dymchenko V.V. , Dykan V.L., S, Karpenko O.M., Krykhtina, Yu.O., Ostroverkh G.E., Smerichevska S.V., Zhalilo Ya.A. and others. At the center of the studies of the mentioned scientists are the problems of developing directions for the transformation of the state transport policy, assessing the current state of the transport and logistics complex of Ukraine and determining the ways of its development to ensure the sustainable development of the country on the path of European integration, outlining the prospects of the transport sector in the European integration processes and strengthening the competitiveness of enterprises as national and international markets.

Based on the specified scientific work, the authors of the presented monograph in the first chapter investigated the state and trends of the economic development of the transport industry of Ukraine and the EU countries, considered and highlighted the key trends that affect the functioning of modern transport and logistics companies and their ability to ensure sustainable growth

The second chapter of the monograph is devoted to the problems of the development of the aviation industry of Ukraine in the context of strategic management of aviation safety, as well as the integration of Ukraine into the Single European Aviation Space. The authors studied in particular detail and summarized the current state of implementation of the provisions of the concluded Agreement with regard to legislative and regulatory acts of Ukraine. The monograph presents an analysis of the main aspects of the activity and development of air transport in Ukraine, examines the state of incorporation of Directives and Resolutions valid in the European Community into legislative and regulatory acts of Ukraine, and also defines the main

directions of the State Aviation Service, which contribute to the implementation of the European vector of integration.

The third chapter of the monograph presents an analysis of the EU cluster policy from the point of view of opportunities for the development of transport and logistics clusters in Ukraine. The experience of various European countries in the formation of transport and logistics clusters is summarized, the institutional conditions for establishing effective cluster management are investigated.

The authors of the monograph present proposals regarding directions and instruments of state support for the development of enterprise clusters in the economy of Ukraine in general and in the transport industry, in particular. The proposals are aimed at the development of the institutional environment, financial support mechanisms, cluster infrastructure and contribute to the formation of cross-industry cluster relations between companies, which are the basis for the generation of breakthrough innovations and the formation of innovative value chains in the national economy.

The monograph was developed as part of the implementation of the Module "EU Transport Policy" directed by Jean Monet under the Erasmus+ program No. 619652-EPP-1-2020-1-UA-EPPJMO-MODULE.

The monograph will be useful to scientists, managers in the field of transport and logistics, civil servants, teachers, students of economic specialties, as well as anyone interested in the development of the transport industry in the context of European integration.

Chapter 1
THE TRANSPORT SYSTEM OF UKRAINE AND THE EU: PROBLEMS OF COOPERATION AND WAYS OF OVERCOMING LIMITATIONS

1.1. Development of the Ukrainian transport system: priorities, problems, prospects

In the current military conditions of the national economic system, the ratio of macro- and microeconomic priorities has changed significantly, which has resulted in changes in the vectors of development of business entities. The importance of the transport industry lies in the fact that it provides connections between industries, foreign countries, regions of the country, enterprises, and meets the needs of production and people. Without transport, modern production and the development of society in general are impossible, as the transport system provides the necessary connections, timely delivery of raw materials and products, and labor supply. In the context of competition, transport enterprises are moving to innovative development principles, the main directions of which are innovations, i.e. new equipment and technologies, etc. The state of development of the transport industry in the absence of transformational influences, crises and military threats is usually influenced by the following factors [1]:

- territorial, i.e. geographical location in relation to the main international cargo and passenger flows;
- own cargo and passenger capacity of the state or region, which is an integral part of the socio-economic potential;
- the state's sectoral policy on the development and operation of transport systems.

However, in the current situation of military operations, the macroeconomic performance of the national transportation system is dramatically affected by transformational and crisis factors. Ukraine has a fairly favorable geographical location on the Eurasian continent, which contributed to the formation of a

strong transport hub in the regions, through which important trade and transportation routes passed. Under such conditions, the transport system of the regions had the basis for development and becoming a leader among other sectors of the state's economic system [2]. Since Ukraine is located at the intersection of communication routes between Western European and Eastern Asian countries, before the war, the country's transport and road complex had significant development potential and an extensive network of transport routes and developed modern rolling stock of all types of transport. Currently, Ukraine's transport system has many problems, the main ones being the destruction caused by Russian aggression, the unsatisfactory level of transportation safety, and the following areas can be identified

- inconsistency of the technological and technical level of domestic transport with European requirements,
- lagging behind in the development of transport services technology, low level of service,
- significant environmental impact of transport on the environment, etc.

Since the outbreak of the war between Russia and Ukraine, the value of Ukraine's foreign trade has declined. The rate of decline in exports of goods exceeds the rate of decline in imports, resulting in an increase in the negative foreign trade balance. The EU accounts for more than half of Ukraine's trade turnover, and has significantly increased its importance for Ukraine's foreign trade. Ukraine's ability to export its goods faced logistical difficulties due to the blocking of Ukrainian seaports and limited land transportation capacity, which was partially offset by the implementation of the Black Sea Grain Initiative, which helped reduce the negative balance in monthly trade [7]. The outbreak of full-scale hostilities in Ukraine on February 24, 2022, has pointed to the risk of Ukraine losing its presence in foreign markets. As Ukraine faced problems in its foreign economic activity, one of which was the restriction of logistics trade routes, as the Republic of Belarus and Russia blocked the northern and

eastern directions. In addition, Ukrainian ports in the south were blocked, making it impossible to use sea transportation. Thus, the western direction became the only one for Ukraine's foreign trade. All of this affects the competitiveness of transport in the transportation market (Table 1.1).

Table 1.1.

Cargo transportation volumes (mln tons) [3]

Year	Railway	Automobile	Water	Pipeline	Air	Total
1990	974,3	4896,3	119,0	295,9	0,2	6404,6
1991	850,7	4803,8	104,2	270,2	0,1	6133,2
1992	749,2	3703,5	74,7	264,3	0,1	4866,5
1993	534,9	2810,9	54,3	250,5	0,0	3704,8
1994	407,7	1868,9	45,5	244,1	0,0	2611,8
1995	360,2	1816,4	33,6	245,5	0,0	2489,5
1996	296,1	1254,5	22,0	245,7	0,0	1840,2
1997	293,5	1249,9	19,0	236,7	0,0	1818,1
1998	286,3	1081,3	17,8	241,0	0,0	1644,3
1999	284,2	955,3	14,6	235,1	0,0	1503,8
2000	295,9	938,9	14,7	218,2	0,0	1482,4
2001	313,1	977,3	15,2	216,4	0,0	1537,2
2002	330,2	947,3	16,4	201,3	0,1	1511,6
2003	363,4	973,3	18,8	216,7	0,1	1591,1
2004	388,3	1027,4	20,7	220,9	0,1	1678,0
2005	378,9	1120,7	21,4	212,6	0,1	1755,2
2006	398,1	1167,2	23,0	203,7	0,1	1815,1
2007	415,9	1255,2	24,2	196,0	0,1	1915,7
2008	399,7	1266,6	19,5	186,8	0,1	1892,2
2009	322,2	1068,9	9,8	154,6	0,1	1565,4
2010	358,0	1168,2	11,1	153,4	0,1	1701,8
2011	388,7	1252,4	9,9	155,0	0,1	1815,9
2012	378,1	1259,7	7,8	128,4	0,1	1781,9
2013	377,3	1260,8	6,3	125,9	0,1	1776,7
2014	325,2	1131,3	6,0	99,7	0,1	1568,1
2015	294,3	1020,6	6,4	97,2	0,1	1425,1
2016	292,1	1085,7	6,7	106,7	0,1	1497,9
2017	277,3	1121,7	5,9	114,8	0,1	1525,6
2018	267,6	1205,5	5,6	109,4	0,1	1593,9
2019	262,6	1147,0	6,1	112,7	0,1	1534,7
2020	261,3	1232,4	5,6	97,5	0,1	1602,4
2021	313,4	244,0	5,3	77,6	0,1	640,4
2022 (January)	26,2	13,9	0,3	6,0	0,01	242,7

As can be seen from the above data, the dynamics of indicators in the transport industry of Ukraine is due to the impact of internal and external macroeconomic crises [1]. The economic crisis caused by the collapse of the USSR and the cessation of traditional Soviet cargo flows lasted from 1991 to 2000. Only in 2001 did the industry begin a slow recovery, which lasted until 2008.

The global economic crisis that hit Ukraine in 2009 caused a sharp decline in cargo flows. Later, in 2011-2012, a period of some stabilization began. The political and economic systemic crisis in late 2013 and early 2014 further deepened the crisis in the domestic transportation industry. As a result, important transport corridors (North of Ukraine - Crimea, West and Center - Donbas) were virtually shut down, and many carriers were forced to leave the market because they could not support leasing and lost all liquidity (due to the crisis of non-payment of standard receivables under annual contracts for 2013-2014 and multiple increases in short-term operating overdraft rates in 2014) [1].

The data for 2017-2020 reveal contradictory trends that in no way indicate the end of the crisis in the industry.

Despite the above-mentioned systemic obstacles that have a significant and permanent impact on management activities in the field of transport in stable conditions, the analysis and diagnostics of the domestic transport industry for 2012-2013 (the period before the acute phase of the current crisis) showed [4] that the lack of a holistic formalized and adapted model for managing business processes in the transport industry was still a systemic problem for the management of transport enterprises.

The volume of cargo transported by type in January-September 2022 amounted to 242.7 million tons, which is 53.4% compared to the corresponding period of 2021. At the same time, cargo turnover in January-September was 129591.1 million tons/km, which was 60.6% compared to the corresponding period of 2021.

In 2021, cargo transportation by road amounted to 180.02 million tons, including 9.17 million tons in international traffic. The volume of cargo transportation by road in January 2022 amounted to 13.9 million tons, which is 110.1% compared to the corresponding period of 2021.

Water transportation volumes increased, amounting to 0.3 million tons in January 2022, which is 121.7% compared to the same period in 2021.

Pipeline transportation volumes in January 2022 amounted to 6 million tons, which is 77.3% compared to the corresponding period of 2021.

The volume of air transportation in January 2022 amounted to 0.01 million tons, which is 3.1% more than in the corresponding period of 2021, but the general trend of the aviation industry is not encouraging due to military aggression.

For Ukraine's international trade, the most important means of transportation have always been sea and rail. However, the full-scale war with Russia and the blockade of Ukraine's seaports have affected both the overall volume of trade and its distribution by type of transportation. Thus, while in January 2022, 80% of exports were transported by sea, in April this share dropped to 13%. Rail transport came out on top.

Thus, rail transport is currently the most popular carrier of goods through Ukraine. Analyzing 2022, it should be noted that the volume of cargo transportation by rail in January 2022 amounted to 26.2 million tons, which is 118.4% compared to the corresponding period in 2021.

It should be emphasized that in 2022, rail transport played the main function of transportation of all goods. Therefore, let's look at the trend in terms of two functions: shipment of goods and their transportation (Table 1.2).

Ukrainian rail transport is a leading industry in the country's road transport complex, providing almost 82% of freight and 36% of passenger transportation by all modes of transport. In 2018, 51.6% of the total volume of transportation by all modes of transport was carried by rail.

Table 1.2.

Volume of freight transported and shipped by rail [3], (mln tons)

Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
transportation	360,2	296,1	293,5	286,3	284,2	295,9	313,1
shipment	-	342,6	341,4	335,1	334,6	357,4	370,2
Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
transportation	330,2	363,4	388,3	378,9	398,1	415,9	399,7
shipment	392,6	445,5	462,4	450,3	478,7	514,2	498,5
Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
transportation	322,2	358	388,7	378,1	377,3	325,2	294,3
shipment	391,5	432,9	469,3	457,5	443,6	386,3	350
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022 (January)**
transportation	292,1	277,3	267,6	262,6	261,3	-	-
shipment	343,4	339,6	322,3	312,9	305,5	313,4	26,2

The importance of rail transport in Ukraine's transport communications system is further enhanced by the fact that major trans-European transport corridors run through the country: East-West, Baltic-Black Sea.

The Ukrainian railways directly border and interact with the railways of Russia, Belarus, Moldova, Poland, Romania, Slovakia, and Hungary, and operate forty international railroad crossings, as well as serve 18 Ukrainian seaports in the Black Sea-Azov basin [5].

If we analyze the range of goods transported by rail, this again points to Ukraine's favorable geographical location in the EU and underdeveloped transport infrastructure. After a sharp drop in the transportation of iron ore, ferrous metals, and construction materials in March 2022, the Ukrainian railroad has not recovered to the levels of transportation that it had before 2022. In addition to the war and the destruction of metallurgical facilities in Mariupol, the reason for this was low prices on world markets for metal and a 70% increase in tariffs for transportation by JSC “Ukrainian Railways” since July this year.

In 2022, JSC “Ukrainian Railways” reached the peak of its capacity to transport grain across the western border of Ukraine due to the military operations in Ukraine (Figures 1.1-1.2).

In September 2022, 5.5 million tons of cargo were exported by sea, accounting for 57% of total exports of goods. The full-scale war with Russia and the blockade of Ukraine's seaports affected both the total volume of trade and its distribution by type of transportation.

Thus, while in January 2022, 80% of exports were transported by sea, in April this share dropped to 13%. Water transportation volumes in 2022 partially recovered as a result of the signing of the Grain Initiative, so let's analyze the dynamics in more detail.

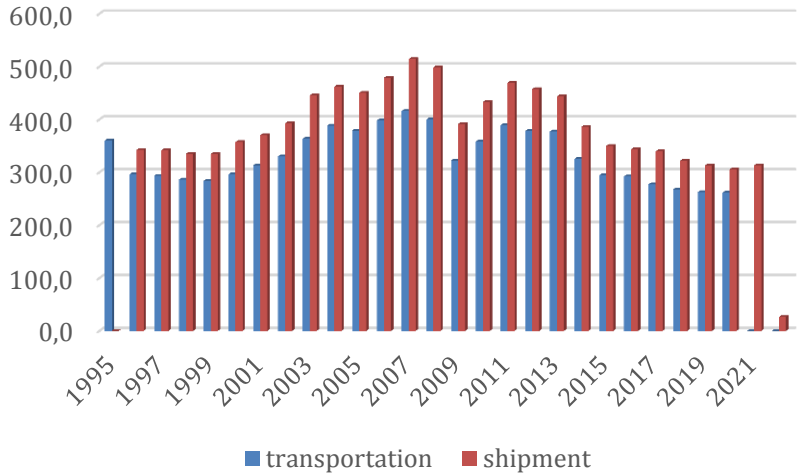

Fig. 1.1. Dynamics of freight transported and shipped by rail1, million tons (based on [3])

Interaction between maritime transport and other modes of transport takes place in ports. The increase in cargo turnover in ports leads to an increase in the turnover of rail and road transport, which delivers cargo from the port to the consignee and to the port from the shipper. The Black Sea Grain Initiative

does not include imports. Before the war, the largest volumes of imports were transported by rail. In January 2022, the railroad delivered 2.8 tons of cargo, or 49% of total imports of goods.

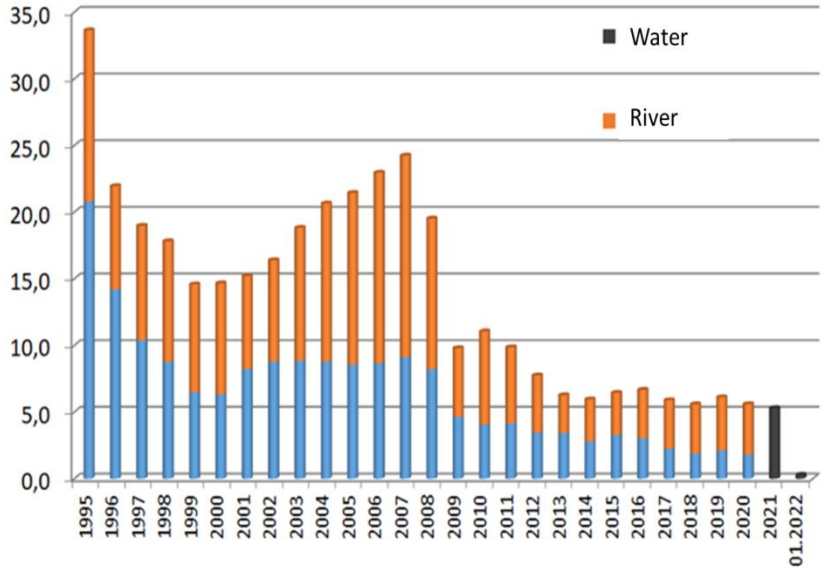

Fig. 1.2. Dynamics of freight transported by water transport, million tons (based on [3])

Sanctions against Russia and Belarus halted imports from these countries, which were mainly delivered by rail. Road transport gained the most weight in imports of goods. In September, 1 million tons of goods were delivered to Ukraine by road, accounting for 54% of total imports of goods [6].

In January-February 2022, Ukrainian exports showed a positive trend, with an increase in exports of 34% compared to the same period in 2021. In March, there was a significant decline, with a 50% reduction in exports. A slight slow recovery in exports began in May 2022, and a more significant increase in exports began when Russian aggressors unblocked Ukrainian ports (Figures 1.3-1.4).

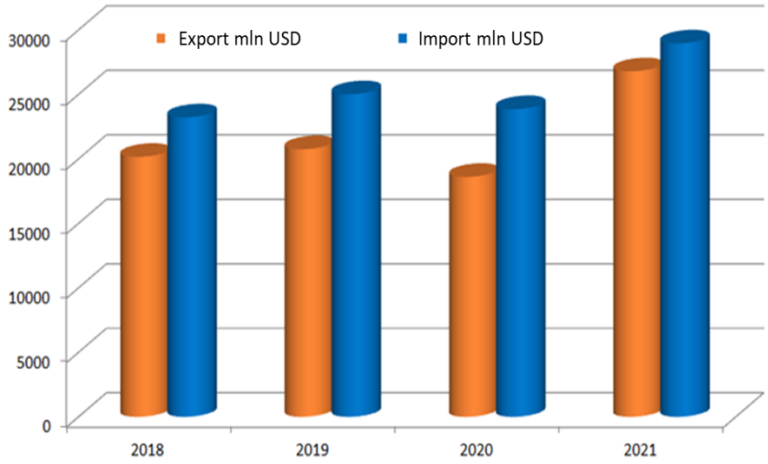

Fig. 1.3. Ukraine's foreign trade with the EU countries (based on [3])

Since the beginning of August 2022, the Black Sea Grain Initiative has been implemented, enabling Ukraine to export grain from three Black Sea ports.

In the second half of 2022, as a result of international financial assistance and the resumption of exports, in particular due to the launch of the Black Sea Grain Corridor, the situation began to change. However, the insufficient export coverage of imports remains a problem.

The negative balance of Ukraine's foreign trade in goods in January-October 2022 increased 2.6 times compared to the same period in 2021 - to $7.05 billion from $2.69 billion [7]. In January-November 2022, imports of goods exceeded exports by $8.52 billion. In 2021, the negative balance of trade in goods improved by $416.8 million compared to 2020 (in 2020, the negative balance was $5,144.3 million) (Figures 1.5-1.6.)

Figure 1.4. Foreign trade balance in 2022 (based on [3])

The negative balance of Ukraine's foreign trade in goods in January-November 2022 increased 2.3 times compared to the same period in 2021 - to $8.524 billion from $3.635 billion. In 2022, the negative balance of foreign trade in goods deteriorated by $6.4 billion to $11.1 billion [7].

The seasonally adjusted foreign trade balance in October 2022 was negative $1.129 billion, and in November 2022, the figure was also negative and amounted to $1.319 billion. The export-import coverage ratio in January-November 2022 was 0.83 (in January-November 2021 - 0.94). [3] In 2022, the negative balance of trade in goods worsened by $6,353.9 million compared to 2021 (in 2021, the negative balance was $4,770.8 million).

Imports of goods in 2022 amounted to $55,273.5 million, down 24.1%. In 2022, imports of goods exceeded exports by $11,124.7 million. In 2021, imports of goods exceeded exports by $4,727.5 million [3].

Exports of goods in 2022 amounted to $44,148.8 million, while it decreased by 35.1% compared to 2021. It should be

noted that in 2022, foreign trade operations were carried out with partners from 230 countries.

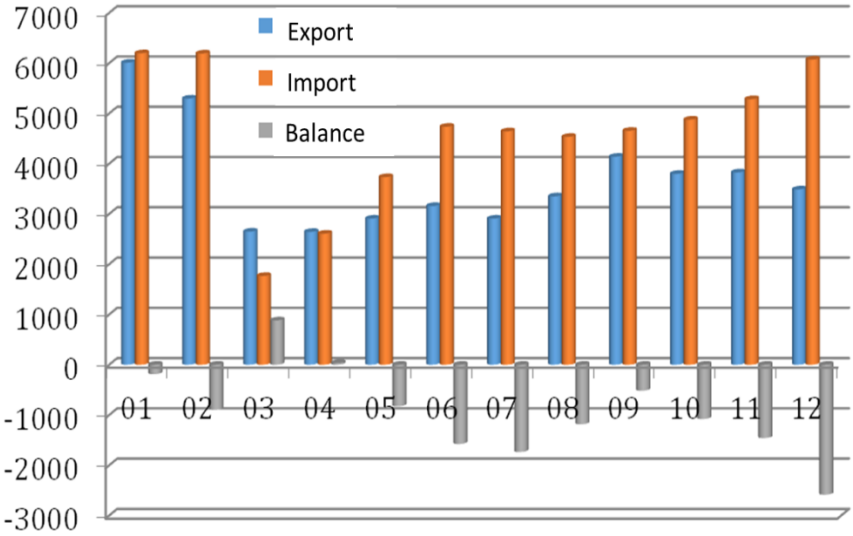

Fig. 1.5. Dynamics of foreign trade indicators by months of 2022, mln. (based on [3])

The war has led to a significant deterioration in the balance of payments, causing a 7-month deficit of $8.4 billion (in 2021, the surplus was $0.8 billion). The data shows a negative balance in imports and exports, which is undoubtedly due to Russia's military actions in Ukraine.

Table 1.3 shows positive trends in March and April and a gradual increase in imports during 2022 as a whole. In the first half of 2021, the trade turnover amounted to $61 billion, and its physical volume was 106.4 million tons.

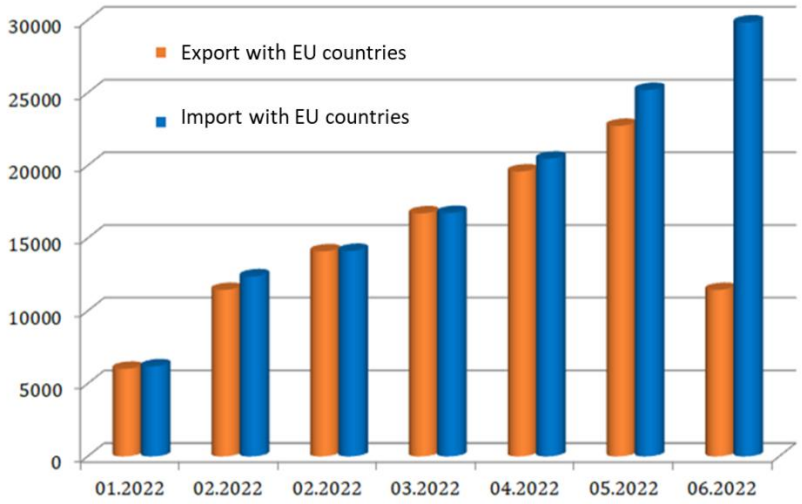

Fig. 1.6. Dynamics of exports and imports from the EU in 2022, mln. (based on [3])

In 2022, while the value of trade turnover decreased by 21.3%, its physical volume decreased by almost 36%, which is indicative of rising world prices for Ukraine's leading foreign trade goods. In the first six months of 2022, the trade turnover amounted to 48 billion dollars, and its physical volume was 68.2 million tons. [3]. Transport is of great importance for improving the living standards of the population. Currently, transport employs about 10% of those working in the country's production complex.

To ensure the production activities of enterprises and the livelihoods of people in modern society, passenger transportation and the complex of interconnected infrastructure play an important role.

Table 1.3.

Dynamics of Foreign Trade Indicators by Months of 2022, USD million (compiled by the author based on data from) [3]

Month 2022p.	Export		Import		Balance	
	Seasonally adjusted data	Factual data	Seasonally adjusted data	Factual data	Seasonally adjusted data	Factual data
01	6580,7	6008,2	7363,8	6194,6	-783,1	-186,4
02	6057,5	5293,8	7003,6	6190,1	-946,1	-896,3
03	2641,9	2646,3	1697,9	1765,6	944	880,7
04	2800,3	2640,9	2805,5	2606,2	-5,2	34,7
05	2920,2	2905,3	3884,7	3731,2	-964,5	-825,9
06	3327,2	3156,5	4951,3	4732,6	-1624,1	-1576,1
07	3146,6	2905,9	4582,4	4641,3	-1435,8	-1735,4
08	3144,7	3348,7	4262,1	4532,1	-1117,4	-1183,4
09	3700,3	4135,6	4446,2	4651,8	-745,9	-516,2
10	3560,5	3796,3	4764,9	4875	-1204,4	-1078,7
11	3460,2	3824,8	4868,9	5282,2	-1408,7	-1457,4
12	3376,3	3486,5	5347	6070,8	-1970,7	-2584,3

Modern passenger transportation is characterized by a wide variety of approaches and technologies that have their own specific production features. [8] The development of passenger transportation by sea in Ukraine is facilitated by a large number of resorts and tourist centers on the coasts of the Black, Azov, and Mediterranean Seas. According to average freight transportation distances (about 600 km), maritime transport ranks first among other modes of transportation. However, in terms of passenger transportation distance, it is significantly inferior to rail and especially road transport. An analysis of the main indicators of passenger transportation performance shows that transport companies carried 1157.4 billion passengers in 2020, which is less than in 2019 (Table 1.4).

Table 1.4.

The number of passengers transported by types of transport, million people (*for January) [3]

Year	Rail	Sea	River	Automobile	Aviation
1995	577,4	7,8	3,6	3483,2	1,9
1996	538,6	5,0	2,7	3304,6	1,7
1997	500,8	4,3	2,4	2512,1	1,5
1998	501,4	3,8	2,4	2403,4	1,2
1999	486,8	3,1	2,3	2501,7	1,1
2000	498,7	3,8	2,2	2557,5	1,2
2001	467,8	5,3	2,0	2722,0	1,3
2002	464,8	5,4	2,2	3069,1	1,8
2003	476,7	6,9	2,2	3297,5	2,4
2004	452,2	9,7	2,1	3720,3	3,2
2005	445,6	11,3	2,2	3836,5	3,8
2006	448,4	10,9	2,0	3988,0	4,4
2007	447,1	7,7	1,9	4173,0	4,9
2008	445,5	7,4	1,6	4369,1	6,2
2009	426,0	6,2	1,5	4014,0	5,1
2010	427,2	6,6	1,0	3726,3	6,1
2011	429,8	7,1	1,0	3611,8	7,5
2012	429,1	5,9	0,7	3450,2	8,1
2013	425,2	6,6	0,6	3343,7	8,1
2014	389,3	0,0	0,6	2913,3	6,5
2015	389,8	0,0	0,6	2250,3	6,3
2016	389,1	0,0	0,4	2024,9	8,3
2017	164,9	0,0	0,6	2019,3	10,6
2018	158,0	0,1	0,6	1906,9	12,5
2019	154,8	0,1	0,6	1804,9	13,7
2020	68,3	0,1	0,3	1083,9	4,8
2021	81,3	0,5		1089,3	9,3
2022*	6,3	0,0		86,8	0,5

Passenger turnover of transport companies also decreased in 2020 due to COVID-19. Air transport reduced passenger traffic by 65%.

In January 2022, the number of passengers transported by rail amounted to 6.3 million people (115.6% compared to

January 2021), while passenger traffic in January 2022 amounted to 1391.8 million passenger-km, The number of passengers transported by road in January 2022 amounted to 86.8 million people (107.7% compared to January 2021), while passenger traffic amounted to 1485.8 million passenger-km, which is 107.5% compared to the corresponding period of 2021.

Since the beginning of the full-scale war, JSC "Ukrainian Railways" has transported 1.4 million passengers to the EU, which is almost 10 times more than in 2021 and 1.5 times more than in 2019. In January-September 2022, the number of passengers transported amounted to 1168.4 million passengers, which is 59.0% compared to the corresponding period of 2021. At the same time, passenger traffic amounted to 23132.7 million passenger-kilometers (48.6% compared to the corresponding period of 2021).

Global road passenger transport operators report that global passenger traffic more than doubled in the second and third quarters of 2022, which means that Ukraine has become a leader in the global trend of passenger growth. The growth of global passenger traffic more than doubled by 130% compared to the same period last year [13].

It is noted that in the second and third quarters of 2022, a total of 34 million passengers were transported by Flix alone worldwide. Among all the countries in which FlixBus is represented, Ukraine showed the largest increase in passenger traffic this year - by 550%. [13] Bus transportation will continue to be an important means of transportation for millions of Ukrainians who have been forced to migrate to safe countries. [13] The dynamics indicate a significant decline in air passengers during the COVID-19 period.

The number of passengers transported by air in January 2022 totaled 0.5 million, which is 81.1% more than in January 2021. Air transport also showed positive trends - 181.1% by January 2021, passenger turnover amounted to 175.6% by January 2021, which is equal to 1485.8 million passenger-km (Fig. 1.7).

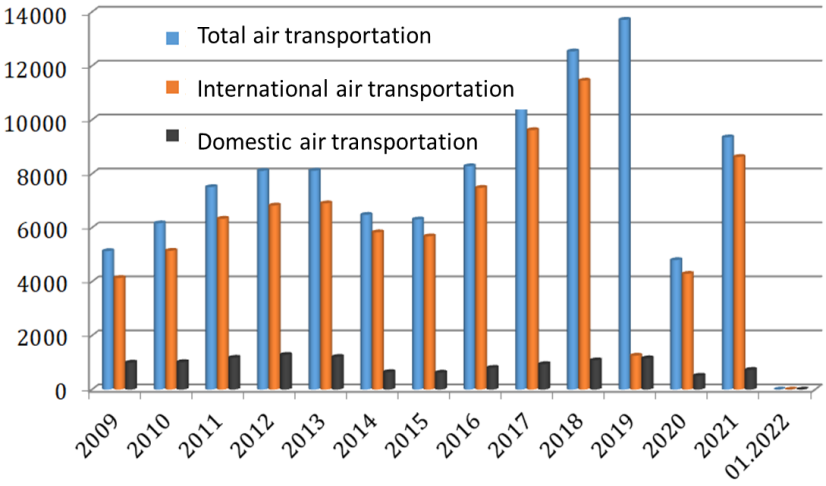

Fig. 1.7. Dynamics of air passenger transportation indicators, million people (based on [3])

Rail transport, as one of the largest carriers of Ukraine and the country's socio-economic complexes in the context of the European vector of transformation, plays a key role in organizing cross-border cooperation, improving the country's logistics efficiency and population mobility, increasing transit potential, and, as a result, strengthening the competitiveness of national producers.

The analysis of the railway transport activity confirmed the unresolved problems that impede the processes of integration into the European railway transport system, namely: insufficient state support for innovative development of the industry and, as a result, high level of physical and moral depreciation of fixed assets, rolling stock needs immediate renewal; technical inconsistency of the domestic and European transport networks and, as a result, difficulties in moving goods across the state and customs borders of Ukraine; low level of transport services, organization of the transportation process and informatization of the transportation process in general.

Taking into account the requirements of European railway legislation regarding the necessary changes in the railway networks of the EU and candidate countries, the development of domestic railway transport should take place in the following areas: improving services, ensuring interoperability of railway networks, infrastructure development and ensuring transportation safety.

Accordingly, they proposed a set of measures to be implemented at the state, sectoral and railway transport enterprise levels. However, at present, their implementation is limited, which allowed us to consider the problem of integration of railway transport into the European transport system in terms of its components: financial, organizational, managerial, investment and innovation, etc.

The analysis of the innovative activities of transport enterprises revealed the existence of significant problems at different levels, which requires finding ways to solve them in the context of the development of the industry as a whole and increasing the competitiveness of transport enterprises in local and global markets for the provision of transport services.

Studying the innovation processes at transport enterprises, it can be noted that they effectively influence and help modernize the transport system, increase the degree of transport safety, and ensure rapid, practical and economical movement [19] (Table 1.5).

Based on the above, Ukraine has a well-developed rail and water transport infrastructure. Ukraine ranks second in Europe in terms of the length of its railroad network (21.7 thousand kilometers); there are 18 seaports in the Black Sea, Azov and Danube basins; the length of inland waterways on the largest European rivers, the Danube and Dnipro, is 2.2 thousand kilometers. Ukraine's transportation system is represented by various types of transport: rail, road, sea, air, etc. The share of the transport sector in Ukraine's gross domestic product was 9.3% in 2009, 6.4% in 2014, and 6.26% in 2020.

Table 1.5.

Indicators of innovation activity in the transport industry [3]

Indicators of innovation activity	*2018*	*2020*
Total innovation expenditures, mln USD	**903,9**	**933,2**
Transportation, warehousing, postal and courier activities, mln USD.	119,4	94,6
Land and pipeline transportation, mln USD.	37,7	15,0
Warehousing and auxiliary activities in the field of transportation, mln USD.	21,0	17,6
R&D performed in-house, mln USD	**283,8**	**264,3**
Transportation, warehousing, postal and courier activities, mln USD.	45,2	50,3
R&D performed by other companies, mln.	**77,3**	**69,4**
Transportation, warehousing, postal and courier activities, mln USD.	10,7	6,8
Land and pipeline transportation, mln USD.	c/s	0,1
Warehousing and auxiliary activities in the field of transportation, mln USD.	0,2	c/s
Other innovation costs, mln USD.	**542,8**	**599,5**
Transportation, warehousing, postal and courier activities, mln USD.	63,4	37,5
Land and pipeline transportation, mln USD.	36,7	14,6
Warehousing and auxiliary activities in the field of transport, mln USD.	20,8	16,8
Number of innovatively active enterprises, units	**8173**	**2281**
Transportation, warehousing, postal and courier activities, units	568	133
Land and pipeline transportation, units	294	66
Water transport, units	5	–
Air transportation, units	10	3
Warehousing and auxiliary activities in the field of transport, units	243	60
The volume of innovative products (goods and services) sold, million USD.	**1412,9**	**2380,4**
Transportation, warehousing, postal and courier	47,5	64,1

Indicators of innovation activity	*2018*	*2020*
activities, mln USD.		
Land and pipeline transportation, mln USD.	4,1	20,5
Warehousing and auxiliary activities in the field of transport, mln USD.	15,8	34,9
Of the total volume of innovative products (goods, services) sold, new to the market, million USD	**579,9**	**430,8**
Transportation, warehousing, postal and courier activities, mln USD.	36,3	3,5
Land and pipeline transportation, mln USD.	c/s	0,4
Warehousing and auxiliary activities in the field of transportation, mln USD.	8,8	c/s
The volume of innovative products (goods, services) sold that are new only to the company, mln USD.	**833,0**	**1949,5**
Transportation, warehousing, postal and courier activities, mln USD.	11,2	60,6
Land and pipeline transportation, mln USD.	c/s	20,0
Warehousing and auxiliary activities in the field of transportation, mln USD.	7,0	c/s

An overall analysis of the dynamics of the capacity of the Ukrainian transport industry in GDP shows a decrease in transportation volumes, which include a drop in the volume of finished industrial products in Ukraine and a decrease in domestic demand due to a decrease in purchasing power, as evidenced by the dynamics of the domestic transport industry.

The destruction of part of the transport infrastructure, deterioration in the quality and congestion of some transport routes, impossibility of transporting the vast majority of goods by sea, loss of segments related to the markets of Russia and Belarus, and consequent disruption of supply and distribution chains were signs of military risks in 2022. At the same time, foreign trade was reoriented to European markets and new logistics routes. The decision of the EU and a number of other trading partners of Ukraine to improve the transportation of Ukrainian goods through the EU and general liberalization ensured the restart of the export credit agency. [9] One of the

aggressor's goals was to try to destroy the transport infrastructure, which was supposed to complicate the implementation of important and urgent humanitarian and economic tasks. The developed transport infrastructure of Ukraine, significant diversification of the transport system and a decentralized system of private passenger and freight carriers and the centralized system of Ukrzaliznytsia preserved the country's connectivity, ensured economic turnover, mitigated the humanitarian crisis, and supported the flexibility of the economy, although logistics, in particular for export deliveries, became more complicated and expensive. [9]

It should be emphasized that despite the major negative challenges that the Ukrainian transportation system faced in 2022, it was able to ensure the transportation of essential goods to and from Ukraine. Now we need to consolidate and build on this success, find alternative ways to deliver goods, and work with our neighbors to increase the capacity of our common border to handle cargo. The connections and projects that Ukraine develops now will also be needed in the future when it joins the EU.

Since Ukraine's independence and before Russia's full-scale military aggression, Ukraine's transportation sector has faced many challenges, but since the beginning of the war, these problems have been exacerbated and reached a new level due to the destruction of transportation infrastructure in eastern Ukraine.

The financial and economic crisis in Ukraine, which led to a decrease in the output of industrial and construction products, has led to a decrease in demand for freight transportation by all modes of transport. In the course of integration of the transport sector of Ukraine and the EU, and in order to obtain a synergistic effect from this process, it is necessary to solve a number of existing problems in a timely manner [11]:

1. Integration processes in the transport sector require an organizational and regulatory framework. At the global level, it is necessary to develop and enforce transport policy norms at the

national and international levels and to interact the transport potentials of member countries with the subsequent modernization of transport infrastructure. The work of customs needs to be optimized by eliminating inaccuracies in the legislative framework and reducing the number of customs officers and, as a result, delays at customs control points [10]. Underutilization of the transport sector's potential and, as a result, inadequate capacity of domestic roads and poor road surface quality.

The existing legislation of Ukraine creates adequate, but not perfect, legal conditions for the operation of a transport company and international activities. The inconsistency between the current legislation on regulating the activities of transport carriers that ensure the safety of passenger and cargo transportation and the system of state control over compliance with the law by transport sector personnel is an urgent problem that needs to be addressed quickly.

Therefore, in order to adapt Ukraine's legislation to that of the European Union in the field of transport, it is necessary to improve the legislative and regulatory framework for the functioning of the transport industry, namely: rules for access to infrastructure, new procedures for market access - licensing, safety certification, etc. However, the regulatory framework is not actually functioning due to high corruption in the area of permitting and customs clearance. Therefore, there is a need to improve the legislative regulation of the transport market in Ukraine, to meet the needs of society and the economy in terms of transportation safety, efficient resource consumption, and reduction of the technogenic impact of vehicles by adapting the norms of Ukrainian legislation to the norms of EU acts.

Another important aspect that should be improved at the legislative level is the provision of socially important services and compensation of costs from the regulated tariff at the expense of budgetary funds in the process of providing passenger transportation Insufficient funding for these services

leads to a failure to ensure the social component of sustainable development.

2. The level of development of the domestic transport sector differs significantly from most EU countries, which hinders the rapid implementation of integration measures. The insufficient level of innovation and digitalization of the Ukrainian transport sector also hinders its European integration.

Statistical information indicates insufficient innovation activity of transport enterprises. The total number of innovatively active enterprises in Ukraine in 2018 amounted to 8173 units, in 2020 the figure decreased significantly to 2281 units (Fig. 1.8).

Indicators show that during the COVID-19 period, all areas of the transportation industry experienced a decline and therefore little attention was paid to innovation and innovation.

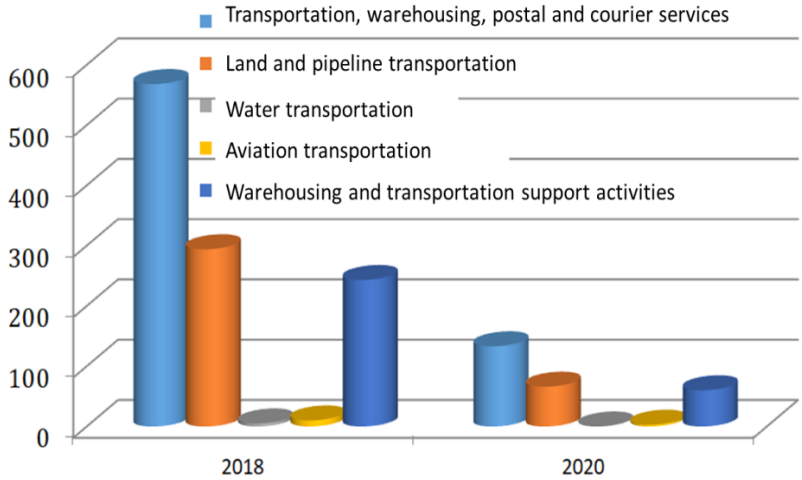

Fig. 1.8. The number of innovation-active enterprises (built by the author on the basis of [3])

In 2018, the share of innovation-active enterprises was 15.5, in 2020 it was only 3.6. While the share of water transport enterprises that implemented innovations in 2018 was 20%, in 2020, no innovations were implemented at all.

The volume of sold innovative products (goods, services) amounted to USD 1412.9 million in 2018 and USD 2380.4 million in 2020. As the graph shows, the trend remained positive despite the COVID-19 crisis (Fig. 1.9). Transport, warehousing, postal and courier activities sold innovative products (goods, services) worth USD 47.5 million in 2018 and USD 64.1 million in 2020 (Fig. 1.9).

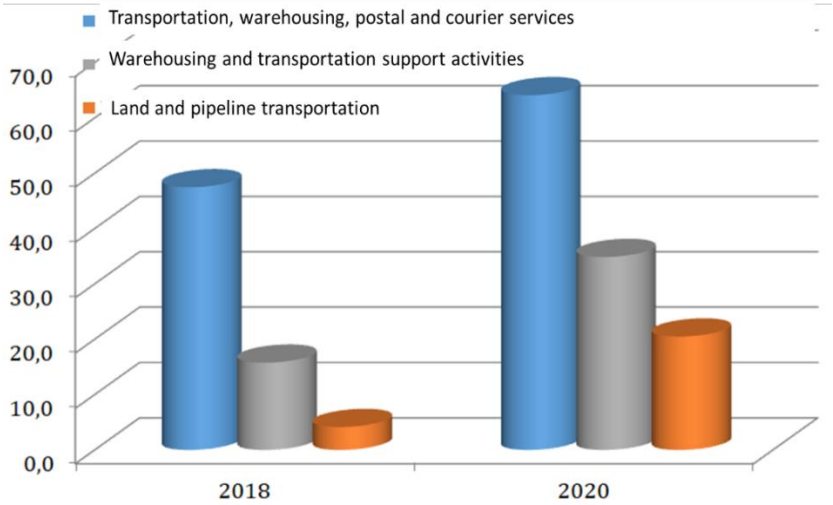

Fig. 1.9. Volume of innovative products (goods, services) sold, mln. (based on [3])

The introduction of digital technologies in transport, logistics, freight management, and public administration will help solve a significant part of transport problems and increase transportation efficiency. Once public and other services related to transportation are converted to electronic format, the process of generating legally binding electronic supporting documents becomes automated, in particular, through the introduction of smart paperless contracts [14]. Fruitful and effective cooperation with the General Inspectorate of Road Transport of the Republic of Poland to adopt the experience of implementing European transport safety standards is one of the important steps to overcome the problem of insufficient innovation and

digitalization of Ukraine's transport system. Promoting the creation of a free trade zone and the formation of transport corridors between the member states of the Organization for Democracy and Economic Development (GUAM) and launching a project to create an electronic TIR Carnet and install Smart generation digital tachographs on vehicles will ensure overcoming acute problems in this area [15].

3. The EU's legislative requirements for the fleet in terms of environmental friendliness indicate that Ukrainian carriers are not competitive. To overcome this problem, it is advisable to take into account the need for periodic renewal of rolling stock and the creation of a special financial reserve during the strategic planning of the enterprise's activities [10]. Such measures will solve the problem of high level of depreciation of rolling stock and low level of transportation safety. Such steps will partially solve the problem of the lack of a systematic approach to ensuring the functioning of transport, creating a competitive environment, equal conditions in the transport services market and low efficiency of Ukraine's international trade cooperation, which is significantly inferior to the indicators of the European Union.

4. The corruption of the permit issuance process is an extremely difficult problem. Developing the most effective method of allocating scarce permits at the level of the Ministry of Infrastructure, followed by strict control over local implementation, and introducing an effective and balanced permit quota system. In particular, to ensure a 5% reserve of the number of permits to account for new business entities or expansion of activities by existing ones, to test and eliminate deficiencies in the operation of the transport portal of electronic services in general and the system of electronic booking of permits in particular, to reduce the number of officials and replace them with new and qualified officials involved in the process of distributing permits to enterprises.

5. Inadequate level of qualification of transport sector employees. The transformation of the system of professional

training and education of management personnel in the transport sector of Ukraine should take into account the need for ideological education based on cultural and moral ideology. It is important to ensure that the process of electing officials is based on passing qualification tests to deepen understanding of the existing problems of the transport sector and improve the efficiency of decision-making regarding the regulation of its activities with constant monitoring of the qualification level of managers and employees, which in turn is a tool for implementing anti-corruption measures in the system of managing the economic potential of the transport sector. Determining the scope of necessary changes in rail, road, aviation and water transport, their provision and implementation is determined by the professionalism, competence, flexibility and morality of management personnel. Improving the skills of employees, namely drivers, logisticians, and managers, can be solved by conducting professional trainings, taking professional and personal development courses, and providing moral and material incentives for personal development. Conducting seminars and training for employees, including drivers, logisticians, and managers, in crisis management, which will ensure quick decision-making in force majeure circumstances and a high-quality response to environmental challenges in the implementation of transportation services, which is extremely important for Ukraine.

Given the EU's experience in the development of transport systems and Germany's declared course towards Industry 4.0, a concept of industrial development that provides for the widespread introduction of Cyber Physical Systems (CPS), including in transport, we can conclude that the European community has already begun the process of transition to the operation of smart vehicles. The Fourth Industrial Revolution, which is gaining momentum in the European Union, involves the sustainability of transport systems through digitalization and the

creation of innovative environmentally friendly technologies [12].

To date, we can identify the following innovative contours of transformation of EU transport systems, the implementation of which in the Ukrainian transport sector will solve many pressing problems.

1. Digitalization of transport. Based on the use of electronic vision and BigData technologies, today it is possible to control each vehicle and significantly relieve traffic flows, as well as increase traffic safety [17]. Modern electric cars already adapt to the owner's habits, for example, by warming up the seat or interior in advance and suggesting the most likely routes. The car also notifies the owner in time when a part needs to be replaced or when it is time for maintenance. Another advantage of digitalization is the simplification of communication between people and the transportation system. Today, passengers already have the opportunity to use devices to receive data on the number of available seats in the nearest vehicle, and carriers have the opportunity to receive information on the number of passengers in real-time and send additional flights where they are needed. The digitalization of transport is closely related to logistics IT systems [17]. Using modern cloud-based logistics IT systems, it is possible not only to quickly find a customer, and calculate the most economically advantageous route, but also to pick up a passing cargo for the return trip. Today, the task is to implement hybrid systems using 10 alternative logistics to ensure that delivery is carried out in accordance with the customer's wishes. Proactive logistics based on Big Data analysis is also gaining popularity.

2. Development of intelligent transportation systems and vehicles. Intelligent transportation systems are in the center of attention of both the European and global automotive markets. Many companies are working in this area, striving to bring the "autonomy" of their models to perfection. Today, smart highways are already being created where traffic detectors can be used to flexibly regulate the density of traffic flows. For example, Kyiv

has implemented the Road Zipper flexible reversal system, which has a payback period of less than one year [18].

Another innovative tool for improving the EU's transportation systems is the use of drones, which is particularly effective in areas such as agriculture, energy, transportation and logistics, oil and gas, the military, and others. Delivery of goods, monitoring, disaster relief (delivery of medicines and essentials, assistance in search and rescue operations), crime fighting, and protection of national borders are just some of the possible functions of drones.

The ways out of a crisis are determined by the reasons that provoked the crisis. At the same time, the speed of overcoming the crisis is determined by the quality of management decisions aimed at overcoming it [12]. The creation of a promising program should be based not only on measures to overcome and overcome the crisis, with the least losses in the shortest possible time, but also on measures aimed at preventing the occurrence of crisis situations in the transport sector as a whole.

The analysis shows that the transport complex of Ukraine, under favorable conditions, can apply a number of different types of development strategies based on the use of external opportunities that minimize the weakness of the domestic transport complex and ensure the use of strengths to realize external opportunities and reduce threats. That is, today, despite the war, Ukraine has the prerequisites for building a transport and logistics system similar to the European one, both through establishing effective cooperation with the EU in the transport sector. Therefore, given the current state of the domestic transport system, the macroeconomic and sectoral crisis, the problem of forming an optimal program for the development of the transport industry, taking into account national, sectoral and corporate specifics, and the post-war state of the dilapidated transport infrastructure, we believe that the main European integration process of the transport sector of Ukraine should be the comprehensive integration of various modes of transport to

achieve the common goal of creating a single European Transport Area [10].

European integration is Ukraine's main and unchanging foreign economic priority, the implementation of which in the transport sector will increase the volume of traffic along international transport corridors located in Ukraine, improve the conditions for exporting Ukrainian goods, involve national carriers in the transportation of transit goods between Europe and Asia, improve traffic safety, etc.

Thus, we can state that European integration for Ukraine is a multifaceted process that primarily involves changes and adaptation of the transport sector to European standards within the country. A comprehensive approach to European integration processes in the transport sector of Ukraine will contribute to the formation and development of the global transport market, increase the competitiveness of enterprises, safety, environmental friendliness, quality and accessibility of transport services.

In the context of European integration, it is necessary to increase the competitiveness of the transport industry in foreign markets, improve the legal mechanism of public-private partnership, and strengthen cooperation between the public and private sectors, public authorities, and local governments.

The ineffectiveness of state regulation and support for the development of the domestic transport sector over the decades has been the basis for the decline in its competitiveness. Therefore, the principles of state policy regarding the problems and prospects of transport in general need to be revised. Public policy should be based on the following principles:

– First and foremost, the protection of national interests;

– complexity and multi-vector regulation of the transport sector and the optimal degree of state intervention;

– compliance and complementarity of state industrial, transport, investment and innovation, social, and other policies with the overall goal and mandatory fulfillment of obligations set

out in state programs and strategies for the development of the transport sector;

– adaptive measures of state regulation aimed at increasing the investment attractiveness of the transport industry, its renewal and modernization, which will ensure its competitiveness.

The level of development of the economic potential of the transport industry is determined by the internal capabilities of rail, road, water and air transport to participate in the formation of a common European space, which is formed with the participation of all transport industry entities.

It is important to find ways to adapt to the needs and conditions of the internal and external environment of the transport industry of Ukraine, which will ensure the formation of adaptive management of its economic potential at the state, sectoral and transport enterprise levels.

Taking advantage of the experience of developing transport complexes in advanced European countries, it can be noted that at this stage, the strategy of creating transport clusters can bring significant benefits to domestic transport enterprises. Transport clustering can be an effective tool for the development of the domestic transport system.

1.2. Investigation of European transport system strategies

The transport sector is one of the most important in the EU economy as a vital component. The study of the state and key prospects of modern economic development and integration processes in the EU allows to draw certain conclusions about the implementation of successful practices within the framework of the common transport policy.

At the moment, the EU is the most developed integration grouping of states in the world in terms of the depth of integration. The EU was established due to the need to create a

common space with intertwined economic systems to ensure mutually beneficial joint development. Having overcome a number of stages of evolution, from the creation of a free trade area to the formation of a full-fledged economic union, the EU has become a complete, highly effective integration union. A powerful common market has been created, which has provided all the necessary conditions for perspective development.

The introduction of the four freedoms in the EU has resulted in increased competition and economies of scale, deeper specialization, and more efficient allocation of resources in terms of space and time (Fig. 1.10). This is also facilitated by the continuous improvement of economic relations with other countries in the European region, including the reformatting of relations with the United Kingdom, which left the EU in 2020.

Improvement of the EU transport system is to create a crisis-resistant and reliable transport system by ensuring the development of the Trans-European Transport Network (TEN-T). Each EU member state has its own peculiarities and results of the phased implementation of the transport network development strategy in the context of TEN-T [20; 21]. In particular, Germany, Denmark, the Netherlands, Poland, and Sweden have a better fit with the TEN-T approach than other countries, which creates greater opportunities for successful adaptation and elimination of fragmentation problems that could hinder the sustainability of the Trans-European Transport Network.

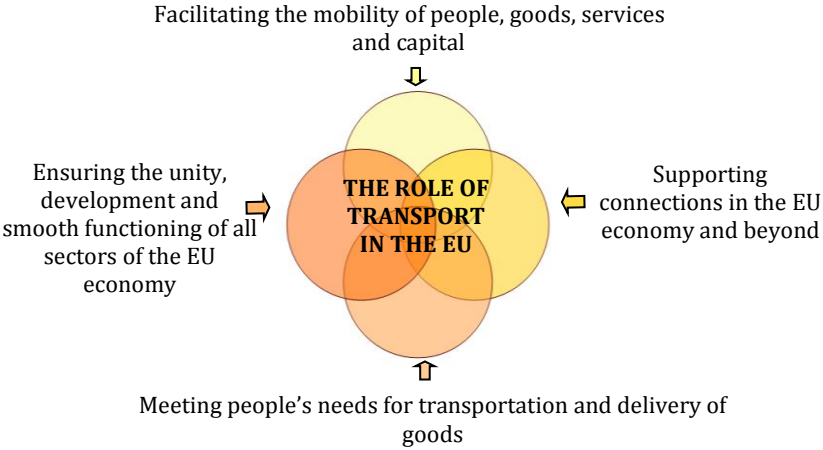

Fig. 1.10. The importance of transport for the functioning and development of the EU, which determines the priorities of the common transport policy and strategy

The EU aims to build a modern, integrated transport system that will strengthen the global competitiveness of the Union and will be able to respond to the challenges of sustainable, smart and inclusive growth. The starting point is to ensure a well-functioning infrastructure capable of providing effective, safe and sustainable transportation of people and goods.

It is reasonable to study the strategies of the European transport system in the context of sea, air, rail, road and inland waterways.

The EU transport policy is focused on the integration of national road, waterway, railroad and airport systems into a fully connected and smoothly operating network – the Single European Transport Area [22; 23]. For this purpose, the formation of the TEN-T core network should be completed by 2030, and the integrated network - by 2050.

The barriers in the transport sector that hinder the creation of a single transport market are as follows:

- excessive bureaucracy and administration;

- technical incompatibility;
- differences in technical and administrative standards;
- the presence of bottlenecks and missing links [24; 25].

A single, highly effective transport system ensures coordinated domestic and international transportation, support for trade operations, and integration into the international transport market.

The dominance of certain areas of development in the EU transport sector is due to a number of factors. Given the specific conditions of the environment, the priorities for the development of the EU transport sector are as follows:

- holistic approach;
- high quality transport that is safe and reliable;
- a well-maintained and fully integrated network;
- more environmentally sustainable transport;
- maintaining the EU's dominant position in transport services and technologies;
- protection of transport workers and their rights, while ensuring human capital development to increase the performance and competitiveness of the EU economy;
- better pricing to increase economic viability by creating economic incentives (e.g., for off-peak road use or the use of more environmentally friendly modes of transport);
- conditions for the development of accessible mobility.

Priority problems have determined the orientation of implementing strategies for the European transport system development.

The EU transport strategy is focused on creating a sustainable transport system that meets the economic, social and environmental needs of society and contributes to the creation of a fully integrated and highly competitive EU in the long term [26; 27]. It is necessary to create an optimal combination of regulatory and market forces in order to mitigate the aggravation of economic and social contradictions in the transport services market, as well as to ensure the progressive

development of the industry. The key aspect in this matter is the building up of the optimal transport infrastructure (Fig. 1.11).

The EU's long-term transport strategy is to create a sustainable EU transport network by 2050 [28]. The Trans-European Transport Network (TEN-T) is a core aspect of the EU's transport strategy.

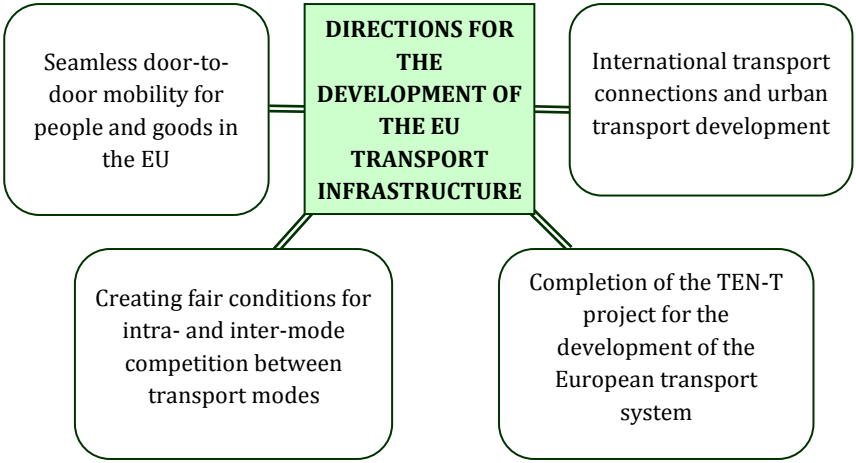

Fig. 1.11. Directions of the EU transport infrastructure development

The comprehensive goals of TEN-T are as follows:

- ensuring sustainable mobility of people and goods throughout the EU;
- creating a high-quality infrastructure;
- effectively covering the entire EU territory by connecting island, peripheral and landlocked regions with central regions, as well as connecting major agglomerations and EU regions;
- ensuring interoperability and intermodality within and between different modes of transport;
- optimal use of existing capacities;
- creating conditions for the economic viability of the network;

- connecting the network with the member states of the European Free Trade Association (EFTA), Central and Eastern Europe, and the Mediterranean countries [21].

There are key threats that will affect the development of EU transport in the strategic perspective (Fig. 1.12). They are related to the phased implementation of the sustainable development strategy.

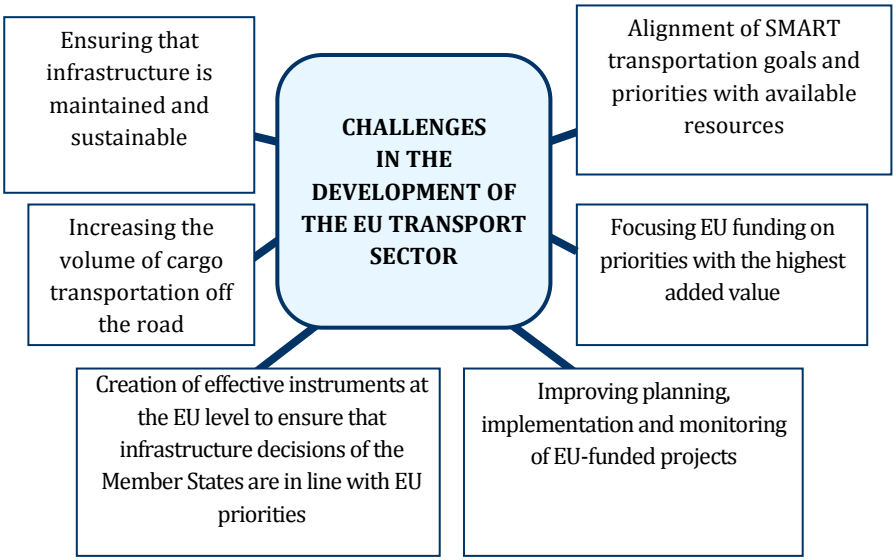

Fig. 1.12. Key problems of the EU transport sector development related to the gradual implementation of the sustainable development strategy

Individual strategies have been developed for each component of the EU's transport sector.

The aim of the EU Road Transport Strategy is to promote mobility that is efficient, safe, reliable and environmentally friendly [28].

Within the framework of this single strategy, projects are being implemented to make EU road transport socially just and competitive, creating appropriate conditions for workers, new

opportunities for companies, ensuring the functioning of the road transport market for better connectivity and the use of smart mobility services, and promoting environmentally friendly and sustainable mobility.

Common EU rules and regulations in the field of road transport services are as follows:

- rules of access to the profession and the market;
- minimum standards for working hours, driving time and rest (including for commercial road transport);
- minimum annual taxes on vehicles;
- general rules on tolls and user fees for heavy vehicles.
- harmonization of the maximum weight and dimensional parameters of motor vehicles.

According to the Rail Transport Strategy, the following key areas are essential for the development of a strong and competitive industry and a well-functioning Single European Railway Area:

- opening the rail transportation market to competition;
- improving the interoperability and security of national networks;
- development of railway transport infrastructure [29].

For this purpose, the 4th Railway Package was implemented, which included the implementation of technical and market components. The technical component provided for the comprehensive implementation of measures (Fig. 1.13).

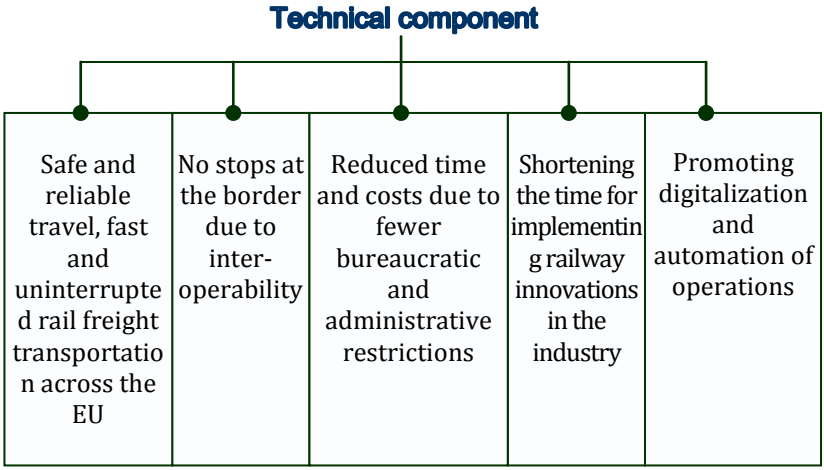

Fig. 1.13. Elements of the technical component of the 4th EU Railway Package [30]

The market component of the 4th EU Rail Package aims to complete the process of gradual market opening. It ensures the general right of railway companies established in one Member State to carry out all types of passenger transportation throughout the EU, and implements rules aimed at increasing impartiality in the management of railway infrastructure and preventing discrimination. It also introduced the principle of mandatory tendering for contracts for the provision of public services in the field of rail transportation.

The European shipping sector offers high-quality cargo transportation services in Europe and around the world. The long-term priorities for the development of EU maritime transport are determined by the relevant strategy and are reflected in certain areas of improvement (Fig. 1.14).

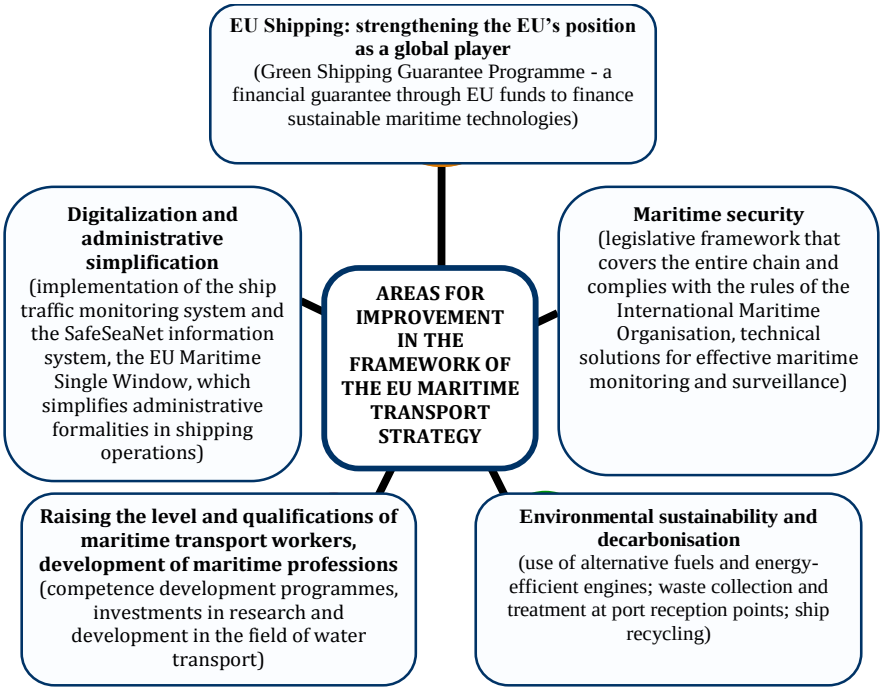

Fig. 1.14. Areas of improvement under the EU Maritime Transport Strategy [31]

In order to achieve the desired results of the EU maritime transport development, the following problems need to be addressed:

- implementation of measures to counteract instability in the maritime transport market;
- preventing/minimising the negative effects of crisis phenomena and risks in this area;
- resolving the issue of vessel demurrage and improving the effectiveness of measures to protect the marine environment;
- responding to changes in the development of the energy market and updating the fleet of tankers for the transportation of natural gas, which will guarantee the stability of supplies to the EU countries.

The Aviation Strategy for Europe aims to create a single aviation area based on the principles of safety and sustainability.

The priorities of the EU aviation sector development strategy are interdependent and complementary:

1) Positioning the EU as a leading player in the air transport market. The EU aviation sector should find opportunities to enter new expanding markets. This can be achieved through new external aviation agreements with key countries and regions of the world. This will not only improve market access conditions, but also create new business opportunities for European companies and guarantee fair and transparent market conditions based on a clear regulatory framework [31]. Such agreements will also increase the number of connections and reduce prices for passengers, contributing to the overall development of trade relations, economic growth and job creation.

2) Removing constraints to aviation development by overcoming capacity constraints, increasing effectiveness and improving connectivity. Planning for future demand for air travel and avoiding airspace congestion is of utmost importance to the EU. For this reason, the Strategy emphasises the importance of the successful implementation of the Single European Sky project, the optimal use of the busiest airports, and the monitoring of connectivity within and outside the EU to identify existing problems and address them.

3) Ensuring high EU safety standards through a shift to risk and performance management. In order to meet the needs of European citizens and businesses, it is crucial to maintain high EU standards in the areas of safety, security, environmental protection, social issues and passenger rights. The Strategy envisages taking important steps in this direction, including updating EU safety rules to maintain high safety standards in the face of the constant growth in air traffic. An enabling and responsive regulatory framework will provide greater flexibility for the industry to develop successfully and remain globally competitive. This requires the use of advanced technologies and

risk-based approaches. Measures are also being taken to strengthen social dialogue and improve employment conditions in aviation, as well as to implement strong pan-European measures to achieve carbon-neutral growth from 2020.

4) Introduction of innovations and digital technologies. Innovations and digitalisation can be a prerequisite for the development of the aviation sector and enhancing its role as a stimulant of economic growth. In particular, the EU needs to make full use of the potential of unmanned aerial vehicles. The Strategy sets out the legal framework to ensure their safe use, legal certainty for industry, and addresses issues related to privacy and data protection, security and the environment. Appropriate investments in technology and innovation will ensure the EU's leading role in international aviation. The EU has invested €430 million annually until 2020 in the Single European Sky Air Navigation Research (SESAR) project. The timely implementation of SESAR solutions can potentially create more than 300,000 new jobs. The use and optimisation of information and communication technologies are also particularly important for improving airport capacity, productivity and service quality [32; 33].

One of the priorities of the EU Sustainable and Smart Mobility Strategy is the development of urban mobility.

With the deepening of globalisation, the introduction of advanced technologies and communication solutions, digitalisation and growing urbanisation, traffic flows are changing, congestion and environmental pollution are increasing, and thus creating additional pressure on urban ecosystems [34-37]. The pandemic has also affected these problems by intensifying e-commerce, as well as the latest trends in greening the economy and sustainable development in general. Failure to address these issues or inadequate response to them can lead to significant problems with maintaining economic stability and hinder the creation of favourable conditions for the development of society. This necessitates the development of urban mobility and the improvement of urban

logistics. This is an urgent problem that needs to be addressed, in particular for cities in EU member states that are striving for a more integrated economy, removing bottlenecks and reducing fragmentation of transport networks for better interaction within the common market and beyond.

More than 70% of the EU population lives in cities, which account for more than 85% of EU GDP. Moreover, urban transport infrastructure is embedded in international transport networks. The distribution and delivery of goods in a city can be a first or last mile delivery – the first or last stage in the supply chain, respectively. Therefore, urban logistics must be prepared to meet the growing needs of the population, as well as to prevent or mitigate possible risks. Traditional solutions may no longer be effective, so it is worth shifting to smart practices that are being successfully introduced in the EU market.

Each city accumulates a variety of freight and passenger flows, the organisation and operation of which is accompanied by a number of challenges and difficulties. The growing number of private cars on the roads not only overloads the city's transport networks, but also causes environmental damage. EU countries are trying to solve this problem, in particular, by using green mobility practices. In addition, rational urban planning is essential to avoid crowding, numerous intersections, congestion and increased pollution in the city centre or other parts of the city. Adequate smart solutions can address the relevant urban logistics challenges, supporting sustainable development (Fig. 1.15).

Among other smart solutions, a special place in improving urban logistics for sustainable development is the creation of transport and logistics centres (clusters) to resolve the issue of optimising cargo flows in the city, which can ensure coordination and consolidation of logistics providers serving the city and delivering goods from and to its territory. Overall, this will help reduce congestion in the city, cut costs, speed up delivery, and integrate the centre into the EU transport and logistics system.

Also, reverse logistics can help solve the problem of urban waste (the problem of used containers and packaging, production waste, low-quality and illiquid products, other materials and products that can be reused in the production process or that need to be disposed of).

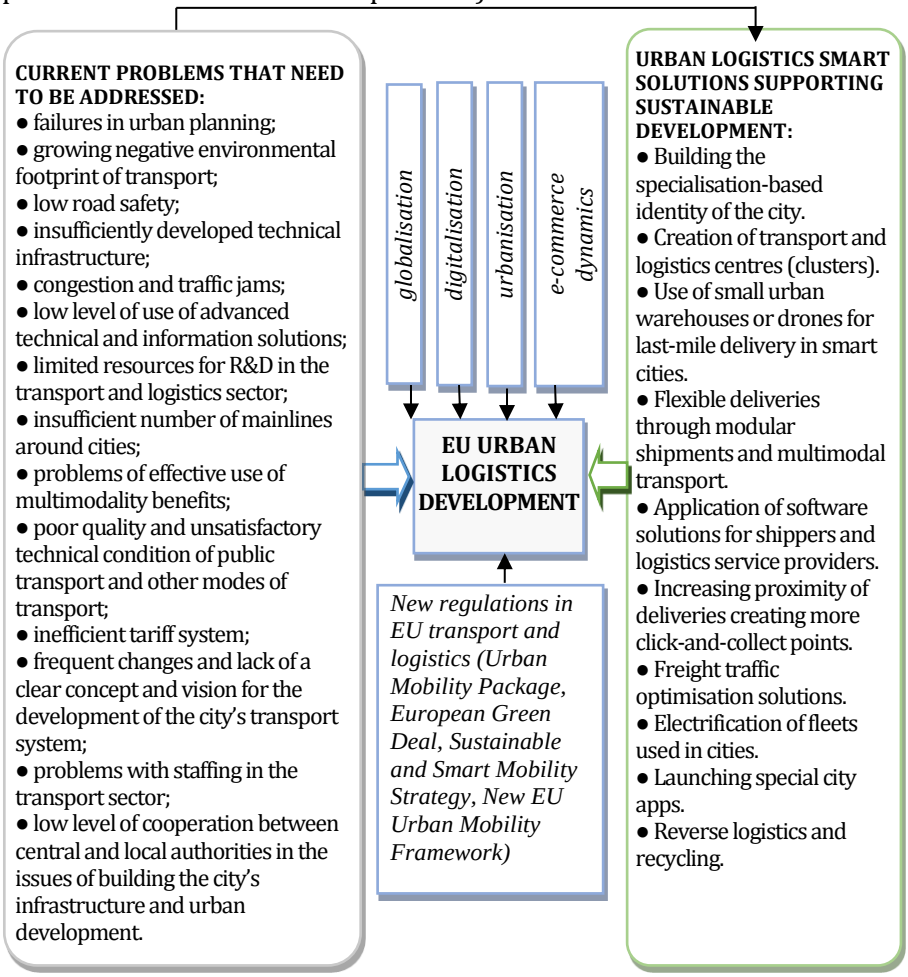

Fig. 1.15. Factors influencing the development of urban logistics and the use of adequate smart solutions to overcome them in the EU

One of the challenges of applying EU smart practices in urban logistics for sustainable development is the environmental and economic contradiction, as logistics is aimed at minimising costs, while compliance with environmental principles and the introduction of green technologies in logistics processes requires additional costs. To address this issue, the EU has a number of support programmes, including government support through subsidies and grants, and the introduction of preferential lending and taxation systems for environmentally friendly companies, which also encourages them to consider modern practices as profitable.

Today's dynamic market conditions contribute to the emergence of new requirements and needs of city residents and visitors, which leads to significant structural and functional changes. Therefore, it is important to implement adequate smart solutions for the development of urban logistics to improve the quality of life and sustainable development, which is in line with the strategic priorities of the European transport system.

1.3 . European green deal and urban traffic restriction zones

The European Green Deal (EGD) is a set of political initiatives put forward by the European Commission with the general goal of making the European continent climate neutral by 2050. The EGD was presented by the President of the European Commission, Ursula von der Leyen, on December 11, 2019. She stated that the plan would make Europe the first climate-neutral continent. The EGD also relies on Horizon Europe and supports scientific research and innovation in transport technologies.

The Ukraine-EU Association Agreement opens opportunities for Ukraine to participate in the European Green Deal by:

- implementation of the principles of sustainable development,
- reduction of greenhouse gas emissions,

- increasing the use of alternative energy sources,
- preservation of natural ecosystems,
- protecting the health and well-being of citizens from the consequences of climate change,
- reduction of production and consumption of energy-intensive products,
- ensuring the competitiveness of Ukrainian manufacturers and enterprises.

In 2020, an interdepartmental working group on coordination of climate change mitigation was established in Ukraine as part of the European Green Deal initiative of the European Commission under the leadership of Dmytro Kuleba, Deputy Prime Minister for European and Euro-Atlantic Integration of Ukraine.

Unfortunately, Russia's unprovoked attack on Ukraine in February 2022 significantly complicates the pursuit of the European Green Deal, not only in Ukraine, but throughout the European continent.

The paper [38] about influence the war in Ukraine to EGD was written in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Leibniz Institute of Agricultural Development in Transition Economies (IAMO) and the Stockholm Environment Institute (SEI). According to the authors' point of view, to cope with the effects of the war, some EU politicians have even proposed rolling back the European Green Deal (EGD). Such a step, however, would be a severe blow to the EU's aim of achieving climate neutrality by 2050 and mitigating climate-related disruptions.

Additionally, the European Green Deal is instrumental in addressing some of the implications of the war in Ukraine. It can facilitate an integrated response that considers the global concerns raised by the concurrent geopolitical, health and socio-environmental crises, in both the short term and the long term. The war's effects on food security, energy security, industrial supply chains and environmental protection should be addressed with due attention to immediate threats, and with a

view to speeding up the nascent sustainability transformation in order to avoid exacerbating future disruptions.

Global supply chains, particularly industrial supply chains, have been disrupted by the war and related sanctions. The energy price spike and inaccessible transportation routes have further exacerbated the disruptions.

One of the recommendations for the EU is to make big investments in decarbonizing industry, heating and transport (for example, green hydrogen usage)[39-40].

Thus, the war in Ukraine has a huge impact on maintaining and following the initiatives of the European Green Deal, not only in Ukraine itself, but also in all European countries. And only joint efforts aimed at following the green course will make it possible to achieve its goals by 2030 and get the declared positive environmental effect.

At the same time, one of the significant areas that should be paid attention to when implementing the principles of the EGD in life is the supply chains [41-42]. The purpose of this work is to study the relevance, feasibility and ways to implementation of environmental indicators into last-mile logistics.

Last-mile logistics is considered on the one hand the most important part of the supply chain, on the other hand the most difficult. However, it can also be the most expensive part. All this makes it necessary to pay great attention to planning, organizing, analyzing and searching for opportunities to reduce the price of this section of the supply chain, while maintaining a high level of customer satisfaction who ordered such a service.

It should be noted that traditionally and justifiably, the last-mile logistics in most cases is carried out by road. This is primarily due to its mobility, the high density of motor roads and the convenience of access to this type of transport for both consignors and consignees.

The transportation of goods by road transport in Ukraine is regulated by the Rules for the transportation of goods by road transport in Ukraine [43]. These Rules were registered in the Ministry of Justice of Ukraine on February 20, 1998 under No.

128/2568. Further, numerous changes and additions were made to the Rules, namely:

- by orders of the Ministry of Transport of Ukraine dated March 23, 1998 N 90, dated November 5, 2001 No. 763, April 25, 2006;

- by order of the Ministry of Transport and Communications of Ukraine dated May 22, 2006 No. 493;

- by orders of the Ministry of Infrastructure of Ukraine dated December 5, 2013 No. 983, dated January 27, 2016 No. 26, dated August 10, 2018 N 368, dated June 3, 2019 No. 413;

- by the decision of the State Committee of Ukraine on Regulatory Policy and Entrepreneurship dated February 24, 2006 No. 27.

Last-mile logistics in this document exists in the form of urban (ot city) transportation, that is, transportation that is carried out within a certain city.

Many cities and towns struggle with the balance of congestion, 'liveability', air pollution, noise levels, accessibility, damage to historic buildings and other pressures of urban life.

Air pollution is responsible for 310 000 premature deaths in Europe each year [44]. This is more deaths than caused by road accidents. The human health damage from air pollution is estimated to cost the European economy between €427 and €790 billion per year [44].

Congestion also has a significant impact on the economy, costing nearly €100 billion, or 1% of the EU's GDP, annually [45]. The different types of Urban Access Regulations can reduce traffic and congestion in a city, and ensure that delivery will be done in time.

In 2020, there were 19 102 road fatalities, equivalent to 43 road fatalities per million inhabitants in the EU, and no less than 935 555 injuries on EU's roads (excluding Ireland) [46]. Less traffic and well-planned streets in urban areas can lead to fewer accidents [47].

Tourists visiting and bringing money into the cities do not want to see traffic jams. In Italian cities, for example, there are

lots of Zona a Traffico Limitato (ZTL) to attract tourists and increase their satisfaction from the country [48].

There is another type of pollution, noise, which is equally devastating and lethal. In fact, 12 thousand premature deaths in one year are caused by excessive exposure to sounds and high intensity noises, with 48 thousand new cases of ischemic heart disease [49]. Almost 90% of the health impact caused by noise exposure is associated with road traffic noise.

For urban delivery, proximity to the consumer is key to reducing delivery times. But locating within densely populated urban areas means that operators face more stringent regulations in terms of traffic movements, operating hours and vehicle emissions. Some cities and towns have regulations or restrictions for vehicles going into all or part of their area to improve issues such as air quality, congestion or how people experience the city. This can be by for example:

- charging for access to road space (urban road tolls);
- not allowing dirty vehicles to go into the city (low emission zones);
- or by other entry restrictions or access regulations [50-51]. These other types of regulation we call other entry restrictions, or key Access Regulation Schemes (key-ARS).

The world's first LEZs for vehicles were introduced in Gothenburg, Stockholm (Fig.1.16), Malmo and Lund in Sweden back in the mid 1990s. The restrictions put in place were targeted at the most polluting diesel trucks and buses in the city centre (vehicles over 3.5 tonnes). Private cars were not included in the restrictions then.

One of the most curious things in Sweden in 1996 was the demand from trucking companies to make LEZs bigger.

The big delivery companies who invested in new vehicles realized they could make more money from having a good environmental profile, so they wanted the zone made bigger.

There are two low emission zones in Stockholm:

1) Stockholm has a low emission zone in place in Hornsgatan (street) covering passenger cars, mini buses and

vans since 15 January 2020. From the 15th of January 2020 minimum standard is Euro 5, from the 1st of July 2022 minimum standard is Euro 6;

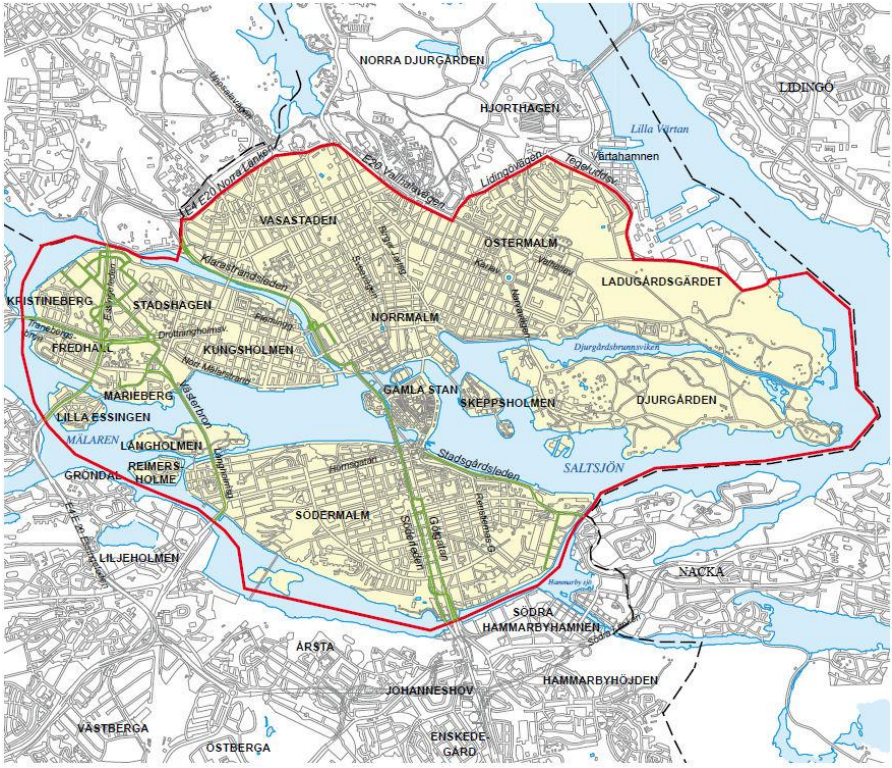

Fig. 1.16. Restrictions in Stockholm: national LEZ affecting lorries and buses [52]

2) the existing central city area lorry and bus low emission zone allows lorries and buses that are Euro 6.

For example, the UK government is pushing hard to achieve zero-emission status by 2030 followith EGD and UK cities have set ambitious plans to decrease their carbon

emissions over the next years. In city centre locations, vehicles are increasingly facing emissions charges, traffic congestion and parking restrictions. Several cities across the UK have introduced charges for vehicles that do not meet certain emissions criteria. The roll-out of these Ultra Low Emission Zones (ULEZs), Clean Air Zones (CAZs), Zero Emission Zone (ZEZ) and other pollution-reducing schemes in cities across the UK is accelerating. Urban logistics operators are therefore exploring cleaner, alternative methods of transportation such as Electric Vehicles and bicycle couriers [53].

The Ultra Low Emission Zone (ULEZ) operates 24 hours a day, 7 days a week, every day of the year, except Christmas Day (25 December). The zone currently covers all areas within the North and South Circular Roads. The North Circular (A406) and South Circular (A205) roads are not in the zone.

If your vehicle doesn't meet the ULEZ emission standards and isn't exempt, you need to pay a £12.50 daily charge to drive inside the zone. This applies to cars, motorcycles, vans and specialist vehicles (up to and including 3.5 tonnes) and minibuses (up to and including 5 tonnes).

Lorries, vans or specialist heavy vehicles (over 3.5 tonnes) and buses, minibuses and coaches (over 5 tonnes) do not need to pay the ULEZ charge. They will need to pay the LEZ charge if they do not meet the LEZ emissions standard.

The ULEZ is expanding from 29 August 2023 across all London boroughs [54].

In 2019, London became the first city in the world to introduce an ultra-low emission zone, or ULEZ, designed to encourage people to drive less polluting cars or use other methods of transport in order to improve air quality (Fig. 1.17). When introduced, the ULEZ covered the same area as the London Congestion Charge zone.

From 25th October 2021, the ULEZ is expanded to incorporate all areas between the north and south circular ring roads. An area is 18 times larger than the original 2019 ULEZ [55].

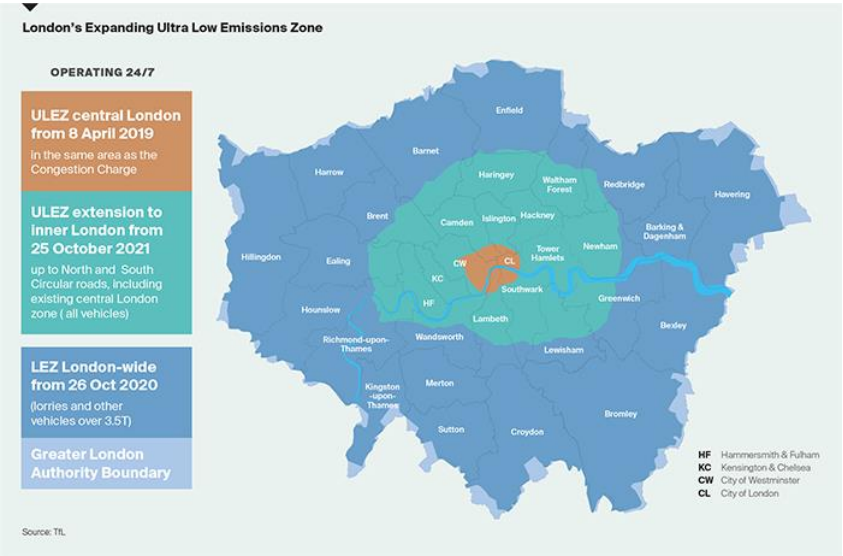

Fig. 1.17. Emission Zones of London

Except London, there are lots urban traffic restrictions in the UK. There are 23 areas with Low Emission Zones, London has three of them. Other access regulations are in London (Coaches Access Regulation, Lorry Control, Safer Lorry Scheme), Newcastle (Limited Traffic Zone), Oxford (Coaches) and Reading (Access Regulation). Charging Schemes are in Dartford, Durham and London and Tunnel Toll is in Mersey River Crossings. You can four observe Zero Emission Zones - three in London and one in Oxford [56].

In London, the Mayor's transport strategy is to try to achieve 80% of trips across London in walking, cycling and mass transport by 2040; the ULEZ is feeding into a long-term vision of the city by 2040. This news comes just weeks before the Ultra Low Emission Zone (ULEZ) comes into force in London, where drivers of older, more polluting vehicles (up to Euro 4 for petrol and Euro 6 for diesel) are now being charged to enter the congestion zone area at any time.

Italy has many different low emission zones with differing standards and timeperiods, mainly in northern Italy, but also in mid Italy and Sicily, combined LEZ and urban road tolling schemes in Milan and Palermo (Fig. 1.18). There are also over 200 camera enforced Access Regulations all over Italy. We also provide information on Italy's motorway tolls here.

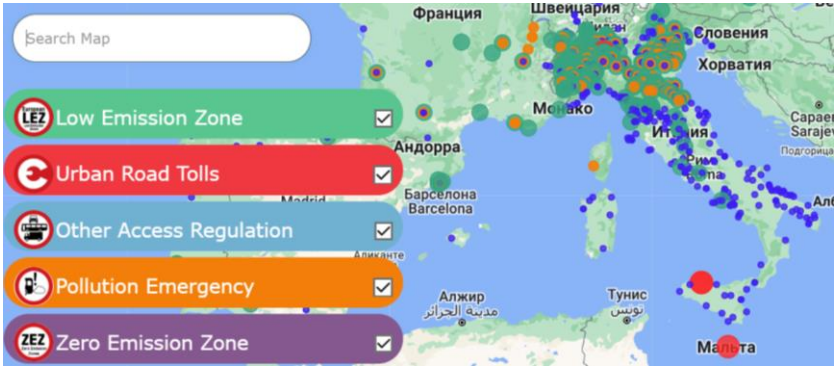

Fig. 1.18. Lots of traffic restrictions in Italian cities [57]

There are restrictions on where you can drive in Rome, Milan, Turin, Florence, Bologna and many more cities.

In most cases, you can't drive into cities during the day on weekdays, although in some, cars are barred on Sundays too. Penalties for entering at a restricted time range from €70 (about £60) to a very steep €450 – circa £400.

In an attempt to combat congestion and air pollution, Milan has limited city access further for petrol and diesel vehicles (Fig. 1.19). With an area covering approximately 72% of the entire municipal territory, "Area B" is now Italy's largest low emission zone.

"Area B" is a region of 97.6% of the city's resident population (almost 1.4 million inhabitants). It impacts all those who enter the city by motor vehicle every day, steadily and progressively restricting the most polluting ones in a bid to enhance air quality.

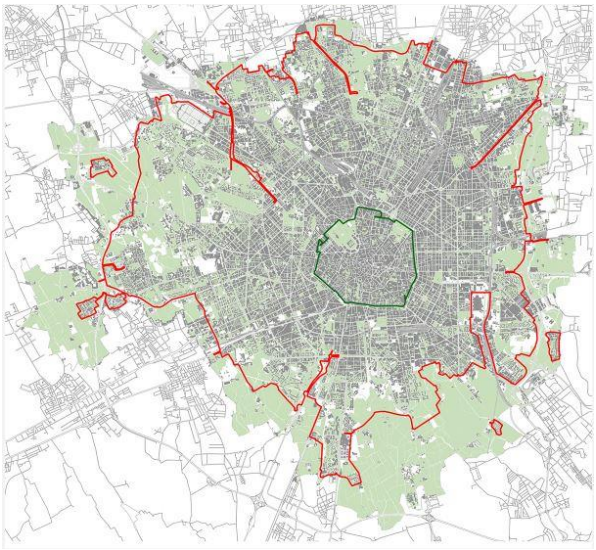

Fig. 1.19. Restrictions in Milan: red line is the boundary of the Area B, green line is the boundary of the Area C (strictly pedestrian zone) [58]

Euro 0 petrol vehicles and Euro 0, 1, 2 and 3 diesel vehicles are now banned within this area from Monday to Friday between 7:30 and 19:30 (excluding holidays). On 1st October 2019, Euro 4 diesel vehicles will also be banned (these have been banned from the central "Area C" since 2017). Gradual bans for other classes of passenger and freight vehicles will follow until 2030, the point which all diesel vehicles will be banned in Milan.

The introduction of "Area B" has been described by the municipality as "part of a definite, progressive and gradual set of rules to reduce particulate matter and improve urban quality in Milan". They predict air pollution to decrease dramatically in the next few years: it is expected that atmospheric traffic emissions will reduce by roughly 25 tonnes of PM10 and between 900-1,500 tonnes of NOx by 2026.

Among the countries of the former USSR, Latvia is the only country that currently has restrictions on road traffic in cities (Fig. 1.20).

Fig. 1.20. Restrictions in Latvia: red line is the boundary of the Area B, green line is the boundary of the Area C (strictly pedestrian zone) [59]

Riga has a large pedestrian area in its city centre. Only vehicles performing property management work or serving trade or other companies are allowed in the pedestrian area at certain times.

The following vehicles can enter and park in the Old Town pedestrian and bicycle area:

- town vehicles;
- vehicles providing goods and services in the Old Town area.

They can enter the area only on weekdays between 06:00 - 12:00 and on weekends and holidays between 06:00 – 14:00, provided that there is no other route available, pedestrians have priority, the gross vehicle weight over five tonnes and the vehicle is parked for no longer than one hour in the places marked with blue on the map above.

Loading and unloading can be done Monday to Friday from 04:00 - 12:00.

And Saturday and Sundays from 06:00 - 14:00.

The second and the last city in Latvia where there are any traffic is Jurmala. The restriction is from 1 April to 30 September a fee applies for entering Jurmala.

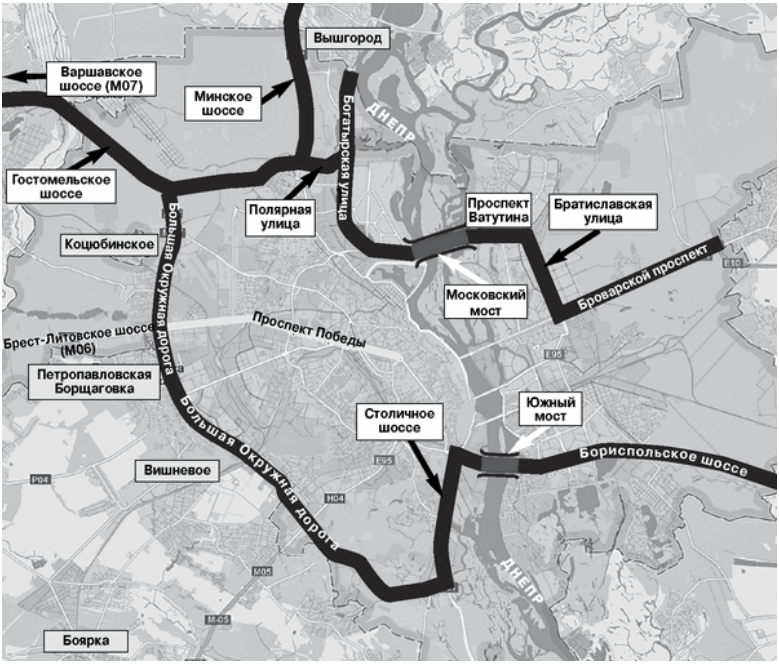

Fig. 1.21. Scheme of passage of cars over 4.5 tons in Kyiv [62]

The entrance fee for Jurmala city center is 2€ / day.

If you want to pay for all period 01.04-30.09, it cost 107 for all cars up to 3.5 t and 213 € for all cars over 3.5 t.

The following are exempted from the fee:

- residents;
- owners of real estate in the zone;
- vehicles of disabled people;

- electric vehicles;
- operational vehicles;
- specialized vehicles;
- vehicles of foreign diplomatic corps;
- police, national armed forces, fire fighters ets.;
- vehicles of the Jurmala City Municipal Authorities [60].

Deputies of the Kyiv City Council supported the decision of the Kyiv City State Administration to restrict the entry of trucks with a maximum permissible weight of more than 4.5 tons into the capital from 7:00 a.m. to 8:00 p.m. [61].

At the same time, it is possible to enter cars that transport goods in international traffic from 10:00 a.m. to 5:00 p.m., but only if the drivers have an international road waybill "CMR" or a book of international road transport (TIR) and road train equipment with the "TIR" sign.

It is worth noting that such measures in the Ukrainian capital are insufficient, since Kyiv has been among the dozen cities with the highest level of traffic jams for several years in a row.

Looking at the congestion rates in Kyiv since 2018, we can clearly see that the situation is getting worse every year. If in 2018 Kyiv was in 13th place in the world in terms of traffic congestion, then by 2021 the situation has worsened to a critical third place. At the same time, the time in congestion increased from 42% in 2018 to 56% in 2021 (Fig. 1.22).

Of course, the war has made its own adjustments. A huge number of people left the capital, which reduced the load on the transport infrastructure. For the same reason, the movement of freight transport has decreased its intensity - fewer people consume fewer goods, produce fewer reverse flows, waste, etc. However, now it makes sense to talk about the post-war state of affairs, when the country will revive, logistics flows will increase, and the transport network will remain the same.

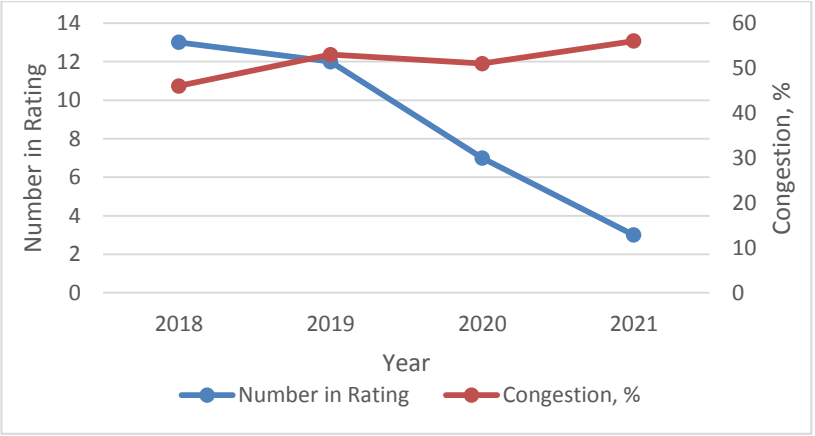

Fig. 1.22. Congestion indicators of Kyiv 2018-2021 [63]

Pedestrian zones in Kyiv are scanty in comparison with other European capitals. As for zones with reduced or zero emissions, there are none at all. There is a need to adapt the experience of large European cities with past congestion and air quality problems that have achieved positive results after the implementation of certain bans or restrictions on traffic in parts of the city.

We should not forget about the economic component of such restrictions. Yes, Kyiv and several other cities in Ukraine now have different parking rates in different parts of the city, motivating residents and tourists not to use private vehicles when traveling to the city center. However, such measures are not sufficient. In addition to the cost of car parking, the experience of paying when entering a touristic, densely populated area of the city, as well as an area with a lack of traffic capacity should be considered.

The result of such restrictions are positive changes for the environment of the city. Such positive shifts can be divided into two parts: for passenger and freight transport (Fig. 1.23).

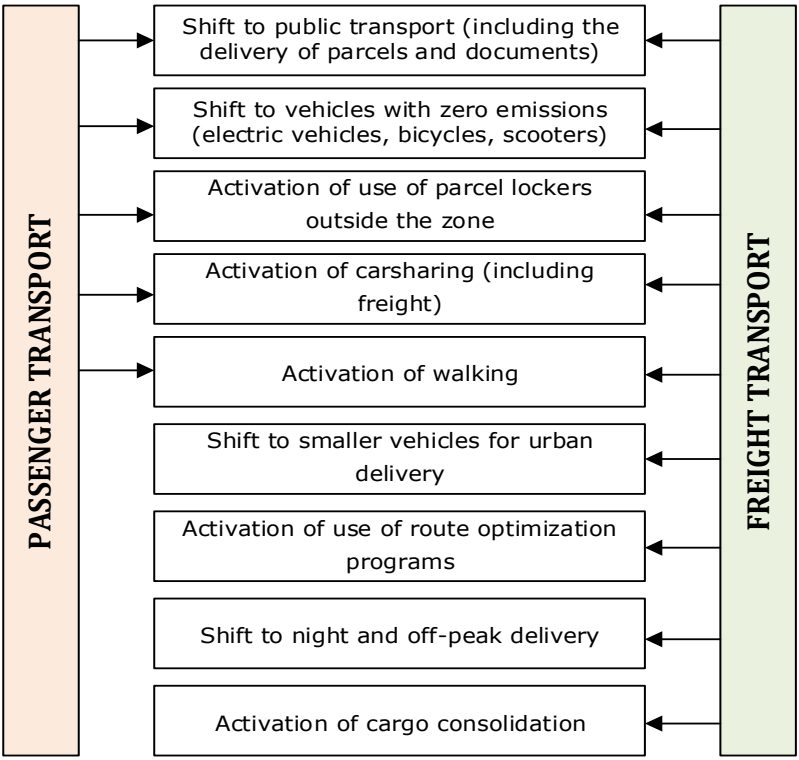

Fig. 1.23. First-level consequences of traffic restrictions in Kyiv

Positive effect caused by implementation of traffic restriction for the environment and social life:

- more time walking;
- less diseases caused by poor air quality;
- less accidents;
- less travel time due to reduced congestion levels;
- city budget revenues from the zone fee;
- reducing investments in own transport;
- reducing the number of cars in the city (Fig. 1.24).

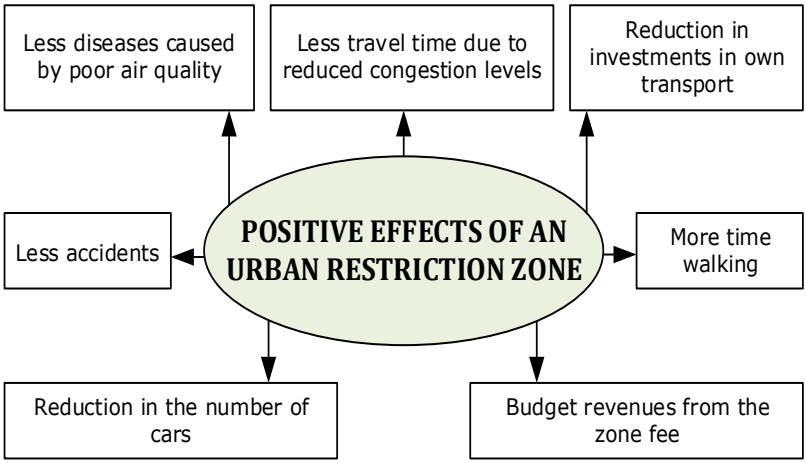

Fig. 1.24. Second-level consequences of traffic restrictions in Kyiv

However, like any initiative, the introduction of traffic restrictions in Kyiv will require some investments, namely:

- the cost of the system for collecting funds for entering the zone;
- the cost of building parking lots that allow leaving a vehicle near a restricted or expensive zone;
- the cost of the monitoring and control system, which allows tracking violations;
- cost of construction of consolidation centers [64];
- expansion of auxiliary infrastructure - charging for electric vehicles, parking for bicycles and scooters;
- creation of a network of bicycles, scooters that can be rented;
- reconfiguration of the delivery vehicle fleet - introduction of light vehicles as well as specific environmentally friendly vehicles such as cargo bikes [65];
- renovation of public transport to meet the increased passenger flow (mainly due to electric transport) (Fig. 1.25).

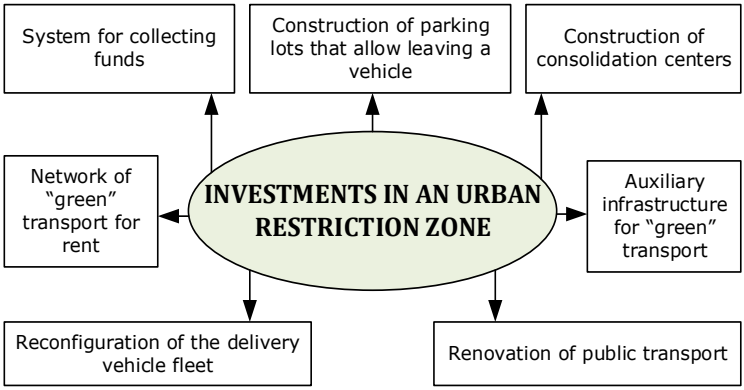

Fig. 1.25. The cost of investment in traffic restrictions in Kyiv

The experience of developed European countries shows the feasibility of introducing transport restrictions zones within the big cities. There can be such incentives for transport restrictions zones implementation:

- reducing the congestion level;
- improvement of air quality;
- solution of environmental problems;
- reduction of accident rate;
- reduction of noise level;
- increasing attractiveness for tourists, etc.

The positive effects of the introduction of zones of restrictions can be divided into those for passenger and freight transport. These effects make it possible to improve the ecological and social climate of the city, make it safer and more attractive for tourists.

However, the introduction of zones of restrictions implies not only positive effects, but also investments. Some of them are quite significant and force local authorities to revise development programs not only for the city, but also for suburban areas. On the one hand, such measures add a lot of jobs, on the other hand, they take away a place to live.

Thus, like any major project, the introduction of zones of traffic restrictions in Kyiv requires a thorough analysis of the advantages and disadvantages, costs and benefits. The only indispensable condition in carrying out such an analysis is to take into account not only direct costs, but also indirect (external) costs associated with the environmental and social problems of the city. Usually it is these indirect components that make it possible to make a choice in favor of the implementation of a project to restrict urban traffic.

1.4. Peculiarities of implementing the EU Sustainable and Smart Mobility Strategy in terms of end-of-life vehicle management

To ensure the successful implementation of the European Green Deal, Circular Economy Action Plan and Sustainable and Smart Mobility Strategy, it is particularly important to intensify the development of the EU automotive industry, in particular in terms of end-of-life vehicle management, which poses a serious threat to the environment and can be considered an essential reserve of secondary resources.

The EU automotive industry covers a wide range of different companies and organisations involved in the design, development, production, marketing and sale of passenger cars, light trucks, commercial vehicles, buses, trailers, motorcycles, mopeds, special and military vehicles, spare parts and components.

In modern conditions, the automotive industry is one of the most valuable industries with a high level of influence of leading companies, which are powerful giants with great resource potential and innovative leaders in their field. The automotive industry is the final link in the production pyramid and determines the level of technological progress in the EU [37]. At the same time, building a strong and well-developed automotive industry requires a balanced state policy and a coherent common policy of the integration union member states.

The main factors affecting the EU automotive industry and its value chain include technology, market conditions, customers and business environment factors, which are a source of limited materials and proper infrastructure required for production.

The EU is one of the world's largest car manufacturers. Important impacts that demonstrate the significant influence of the EU automotive industry on overall development include:

- the turnover generated by the automotive industry accounts for almost 8% of EU's GDP;
- vehicles provide €374.6 billion in tax revenues to the budgets of European countries;
- the automotive industry contributes to the EU trade surplus of €79.5 billion;
- the automotive industry has an important multiplier effect in the EU economy, especially for the steel, chemical and textile industries and manufacturing sectors;
- investing €58.8 billion per year in research and development, the automotive industry is the largest private investor in innovation in Europe (approximately 32% of total EU investment);
- the automotive sector in the EU employs about 13 million people, which is 7% of all jobs; with production (direct and indirect) accounting for 3.4 million jobs, sales and service for 4.5 million, and transport for 5.1 million [66].

Given the key importance of the automotive industry for the EU economy, it is vital to manage supply chains in this sector (Fig. 1.26) to create positive outcomes.

The benefits of supply chain management in the EU automotive industry, in particular, using digitalisation opportunities and in line with the concept of sustainable development, include the following:

- Increased customer satisfaction by eliminating potential delays (timely delivery of goods and services that meet customer expectations in terms of quality and cost) and reliability – through the use of advanced technologies and systems, it is

possible to gain a reputation as a reliable and competent company for customers.

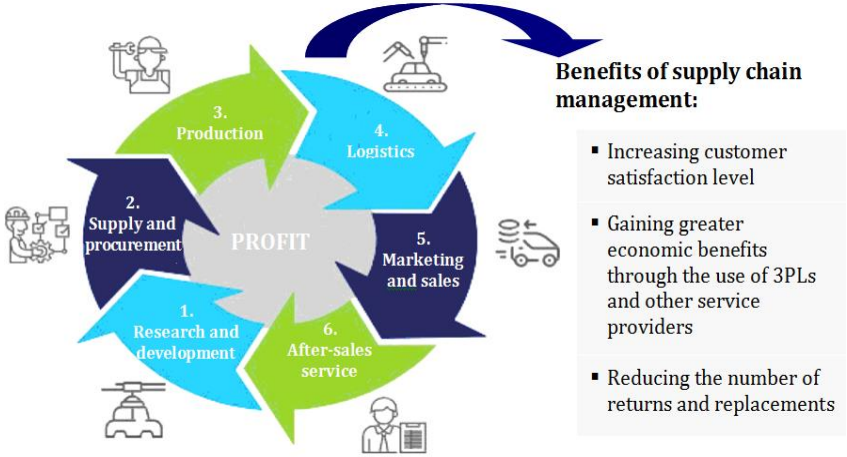

Fig. 1.26. Stages and benefits of supply chain management in the EU automotive industry
* Compiled on the basis of [37; 67]

- Increased margins through the use of 3PLs and other service providers: lower parts storage costs due to the introduction of just-in-time production and optimised pricing (supply chain management systems may include software solutions that allow companies to download real-time prices for various products, materials and parts).

- Reducing the number of returns and replacements (the implementation of supply chain management software allows companies to track each part and determine whether there are enough parts available, as well as helps identify which parts are needed for assembly, and significantly reduces the likelihood of human error) [68; 69].

Economic growth and increased purchasing power of Europeans have been the main drivers of the growth in demand for cars, which has led to investments in production capacity. Western European automakers in the EU focused on research

and development, sales, marketing and logistics. The EU countries in Eastern Europe have contributed to the success of the industry with a highly competent workforce with excellent technical skills, as well as lower labour costs.

There is a shortage of highly competent professionals in the automotive industry, so the most critical areas for developing the skills and abilities of employees in this sector include: expanding the skills portfolio; maintaining the adaptability of managers, employees and organisations in general to ensure that activities are reoriented to areas where automotive professionals can use their knowledge and skills to meet consumer needs.

The key issues that currently require significant efforts and comprehensive solutions in the EU automotive industry are smart mobility and sustainable practices, ensuring resilience, adaptability and flexibility.

Starting in 2020, the global automotive sector faced a decline in demand and production volumes caused by the COVID-19 pandemic and a shortage of essential components for production (in particular, automotive semiconductors). Global car sales began to recover, reaching 66.7 million units sold in 2021, with positive dynamics in 2022 and 2023, but this did not ensure that they would reach the level of 2019 [70].

Changes in global sales of passenger cars and trucks in 2019-2021 are shown in Fig. 1.27.

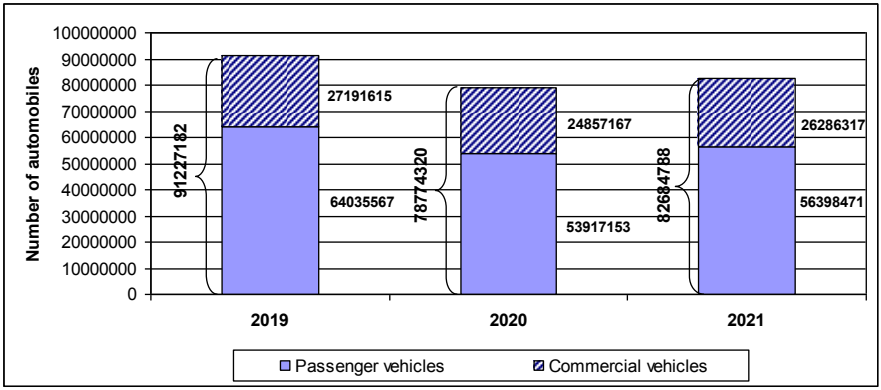

Fig. 1.27. Dynamics of global sales of passenger cars and commercial vehicles [70]

The global automotive market was worth around US$2.86 trillion in 2021. In 2022, the market grew to USD 2.95 trillion. This growth is the result of a slow recovery, but the figure remains below the size of the automotive market in 2019.

In 2021, the recovery in car production was uneven across different regions of the world compared to 2020: while North America recorded a slight increase of 0.2%, South Asia and South America saw growth (in the range of 15-25%), Japan and South Korea, and the European region, on the contrary, recorded a decrease in car production – by 3.3% and 4.8%, respectively [70]. This is primarily due to the peculiarities of the market recovery and individual components of the automotive industry in each country.

Table 1.6

Top 10 passenger car manufacturers in the EU, cars

EU countries	Years				Changes 2022/ 2021, %
	2019	2020	2021	2022	
Germany	4 493 922	3 393 960	2 946 320	3 336 116	+13.2
Spain	2 175 909	1 759 907	1 598 986	1 702 641	+6.5
Czech Republic	1 398 996	1 129 429	1 095 096	1 190 160	+8.7
Slovakia	1 072 858	943 746	976 947	964 072	-1.3
France	1 590 636	869 856	852 812	940 690	+10.3
Romania	490 412	438 107	420 755	507 269	+20.6
Italy	548 688	455 323	447 673	476 929	+6.5
Hungary	524 348	433 601	416 843	441 776	+6.0
Sweden	285 709	245 671	253 488	257 446	+1.6
Belgium	247 020	237 075	222 105	235 385	+6.0
EU: total	14 096 444	10 779 146	10 055 833	10 769 893	+7.1

Source: [71]

In recent years, the largest passenger car manufacturers in the EU have been Germany, Spain, the Czech Republic, Slovakia, and France (Table 1.6). Overall, there was a positive production trend in 2021-2022. Trade in cars generates an annual trade surplus of €79.5 billion for the EU (Table 1.7). Passenger cars account for the largest share of EU exports (90.42% in 2020 and 90.62% in 2020).

Table 1.7

Trade in cars in the EU by vehicle type, million euros

Type of transport vehicle	Indicator	2020	2021
Passenger cars	Imports	51 597	53 344
	Exports	121 144	126 854
	Trade balance	69 547	73 511
Cargo vans	Imports	4 123	5 117
	Exports	6 227	6 699
	Trade balance	2 104	1 583
Trucks and buses	Imports	2 302	2 054
	Exports	6 613	6 427
	Trade balance	4 311	4 373

Source: [70]

In 2021, exports from the EU totalled 5.1 million vehicles. Most passenger cars were exported from the EU to the UK (980362 vehicles), as well as to the USA (648127 vehicles) and China (410917 vehicles). In 2020, the EU vehicle fleet consisted of 246.3 million passenger cars and approximately 35.6 million commercial vehicles and buses (Fig. 1.28).

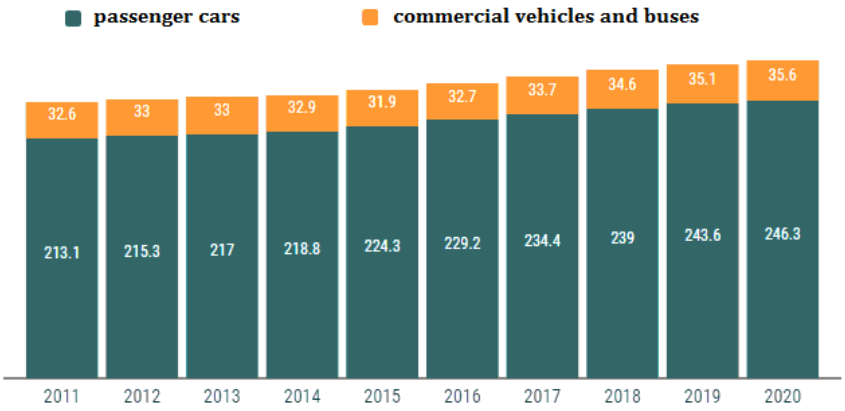

Fig. 1.28. Size and structure of the EU vehicle fleet, million vehicles [72]

The EU passenger car fleet grew by 1.2% in 2020 compared to 2019, with a total of 246.3 million vehicles on the road. The largest growth was observed in Romania (+5.4%) and Slovakia (+5.1%), while the French fleet slightly decreased - (0.3%).

Across the EU, there are almost 29 million vans in use, half of which are in three countries: France (5.9 million vans), Italy (4.3 million) and Spain (3.9 million). In 2020, there were more than 6.2 million medium and heavy commercial vehicles on EU roads, up 1.7% from 2019. Poland has the largest truck fleet with about 1.2 million units. There were also 684,285 buses in operation in the EU, almost half of which are concentrated in Poland (124,526 vehicles), Italy (99,883 vehicles) and France (93,506 vehicles).

Currently, the average age of vehicles in the EU is 11.8 years (Fig. 1.29).

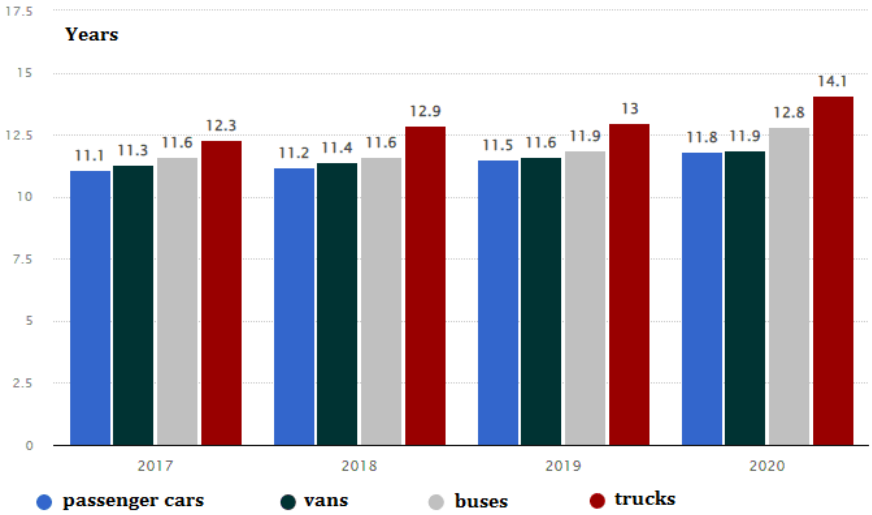

Fig. 1.29. Average age of the EU vehicle fleet by vehicle type in 2017-2020
Source: [66]

The average age of light commercial vehicles in the EU is 11.9 years. Of the four main EU markets, Italy has the oldest van fleet (13.8 years), followed by Spain (13.3 years). In the passenger car category, Lithuania and Romania have the oldest fleets, with an average age of almost 17 years. Luxembourg has the newest passenger cars (average age – 6.7 years). The average age of trucks in the EU is 13.9 years. Greece has the oldest truck fleet with an average age of 21.4 years, while Luxembourg (6.7 years) and Austria (7 years) have the newest. Buses on EU roads are 12.8 years old on average. The oldest buses in the region are those in Greece, which are over 19 years old. Overall, only six EU countries have a bus fleet that is less than 10 years old (Fig. 1.30).

Given the EU's current sustainable development priorities, the vehicle fleet of some member states needs to be updated to include more environmentally friendly models. It is also

important to take into account current trends in the automotive sector.

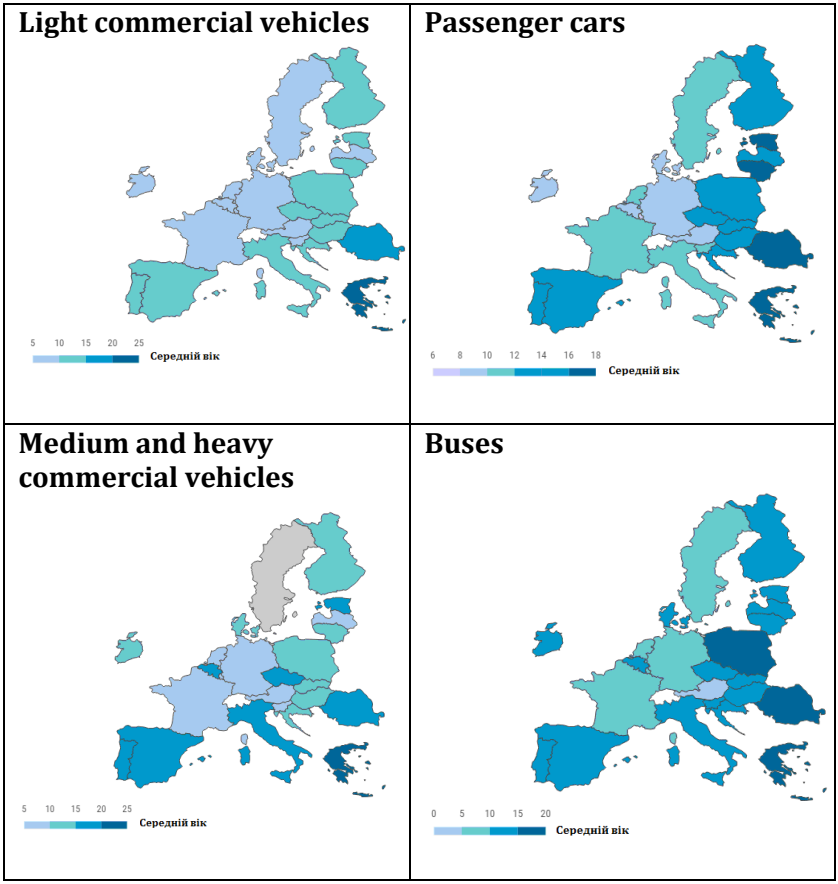

Fig. 1.30. Average age of the EU vehicle fleet by vehicle type
Source: [72]

Key trends in the automotive industry in 2023 include the following:

- focus on delivering a positive customer experience and offering a high level of quality and value;
- partnerships between automakers and technology companies (in particular, taking advantage of outsourcing – for

example, technology companies can use their resources to create customised software for cars in accordance with the requirements of automotive companies);

- increased sales of used vehicles due to affordability, personal mobility options and trust in original equipment manufacturers;

- increased green mobility – growing demand for electric vehicles: 19% of new passenger car registrations are expected to be electric – battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) – in 2023, up from 14% in 2022, as well as hydrogen-powered vehicles;

- automakers' transition from a "just-in-time" strategy to a "stockpiling" strategy to increase the supply of raw materials, despite the additional costs of storing stocks, to address possible disruptions in the supply chain (in particular, to prevent possible problems with raw materials for the production of semiconductors) [73; 74].

Startups in the automotive industry are creating better conditions for the introduction of advanced technologies in line with future trends. In particular, startups involved in the development of self-driving or autonomous vehicles that minimise the need for human drivers are changing the concept of transport. Autonomous vehicles are also expanding the scope of last-mile delivery, reducing downtime and making public transport relatively safer.

The development of vehicles with digital identification that is protected from unauthorised access, making them distinct from other vehicles in the network, is becoming more widespread. This allows for easy tracking of data about a given vehicle in terms of various aspects such as insurance, driver safety, preventive maintenance and fleet management. Altogether, this could lead to radical changes in the entire mobility ecosystem in the EU and elsewhere.

The need for a global effort to combat rising greenhouse gas emissions has led to the development of electrification solutions – the transition to the use of electric vehicles (EVs)

[75]. However, for the wider adoption of EVs, it is necessary to address such issues as high price, insufficient battery quality, underdeveloped charging infrastructure, fleet electrification and powering charging networks with renewable energy sources. This is in line with the EU's priority of ensuring smart and sustainable mobility. For example, the German startup ChargeX offers a modular solution for charging electric vehicles that turns parking spaces into charging stations. The startup's Aqueduct platform is easy to install, has 4 charging modules with a capacity of up to 22 kW and provides monthly reports. The solution recognises the energy needs of each car and automatically controls the charging speed for each vehicle, which are key benefits [73].

Artificial intelligence technologies, such as machine learning, deep learning and computer vision, are used in robotic automation in the automotive industry. They enable the management of self-driving cars and fleets, help drivers improve safety, and improve services such as vehicle inspection and insurance. Artificial intelligence is also being used in automotive production, accelerating production rates and reducing costs. Human-machine interfaces use voice or haptic feedback to control vehicles, stretching the limitations on the ways and aspects of a car that users can control. These interfaces make driving safer and more enjoyable. They also enable the use of smart virtual assistants that help drivers and passengers interact with vehicles and other service providers. In this area of future transport development, the German startup Apostera (acquired by Samsung Harman in 2022) offered an advanced driver assistance system. Its platform combines augmented reality, a smart camera, and surround view monitoring to illuminate the route around curves, bends, slopes, and complex intersections, helping drivers stay in their lane, prevent collisions, and enable autonomous driving [73; 74]. At the same time, customer-oriented solutions are offered, taking into account a particular car model.

Another promising and widespread area of development is 3D printing, which helps the automotive industry in the following ways:

- enables rapid prototyping using 3D printed models, which speeds up the design and testing stages;
- enables manufacturers to print parts according to specific requirements;
- provides production of composite materials with a focus on manufacturing lighter, stronger and more durable automotive parts.

The Italian startup Moi is a successful example of the production of high-performance parts for the automotive industry using a combination of thermosetting composites and 3D printing. It also serves other industries such as aerospace, construction, and biomedical [73].

Under current conditions, it is important to use management decision support systems to effectively forecast demand, generate scenarios and reduce uncertainty in the environment. For example, Swiss startup Unit8 uses Big Data and analytics to offer digital solutions for various industries. For the automotive sector, it develops predictive models that encourage automotive companies to improve their marketing and operations and increase their revenues. These models provide insights into product design, price, as well as after-sales service.

Taking into account the priority areas for the development of the EU automotive sector, it is important to implement a set of measures that includes:

- creating customer-centric European mobility to become the unchallenged global leader in implementing breakthrough innovations in mobility;
- leading the way in sustainable mobility solutions, with an action plan to achieve zero emissions to fulfil the industry's commitments;
- follow the EU's unique path to develop the global mobility industry of the future and keep creating higher and sustainable added value for stakeholders [76].

European regional production systems and value chains act as a channel through which large, small and medium-sized enterprises, with the support of demand-driven connectivity programmes, can better integrate into global value chains.

In this regard, electrification, smart and shared mobility, which will ensure environmental sustainability and transport effectiveness, are key opportunities for the EU automotive sector, largely enabled by digitalisation. This is clearly reflected in the evolution of EU regulation and common policies as the pace of greening and digitalisation of the automotive industry increases. Increasing the flexibility and performance of the existing network, as well as stimulating investments in renewable energy and cross-border electricity transmission to improve environmental sustainability, strengthening the EU's global leadership in sustainability-related technological development, while leveraging the presence of European automakers and top-tier suppliers in international markets, can help to deliver on the EU's aspirational plans. Complementary measures that create significant employment, investment and value-added opportunities are the development of electromobility and the use of multimodality.

When implementing measures to ensure sustainable supply chain management, taking into account all the challenges of the automotive industry, special attention should be paid to ensuring the analysis and implementation of strategic functions, as well as the adequate use of benchmarking and business restructuring. At the same time, greater flexibility is needed in economic pricing, management of intra-corporate agreements, use of intellectual property opportunities, and implementation of adaptive changes.

One of the most important areas is to reduce the negative impact of vehicles at all stages of their life cycle. According to a report by the European Environment Agency, transport accounts for about a quarter of total carbon dioxide emissions in the EU, of which 71.7% are from road transport [77]. The dynamics of carbon emissions by sector is shown in Fig. 1.31.

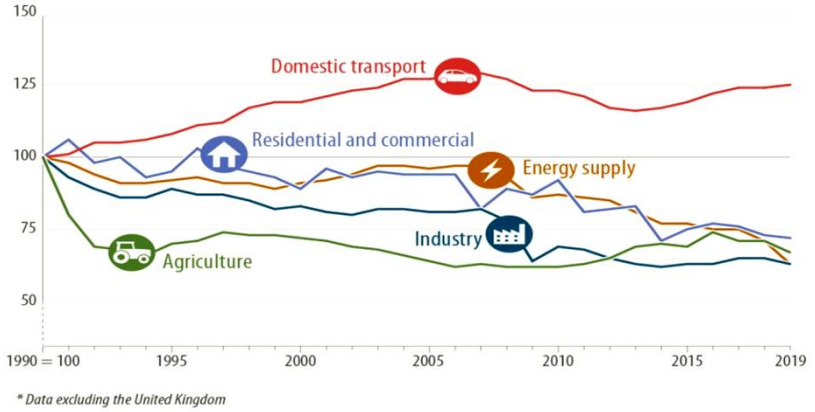

Fig. 1.31. Dynamics of carbon emissions by sector [77]

The transport sector is the only one where greenhouse gas emissions have increased over the past three decades, rising by 33.5% from 1990 to 2019.

Road transport dominates the structure of greenhouse gas emissions in the EU, with passenger cars and heavy goods vehicles accounting for the largest share of emissions (Fig. 1.32).

Significant reductions in carbon dioxide emissions from transport are problematic, given that the rate of emissions reduction has slowed in recent years. Current projections are for a reduction of only 22% in transport emissions by 2050, which falls far short of current targets. However, existing initiatives are driving positive results. Overall, road transport is responsible for approximately 20% of Europe's greenhouse gas emissions, and emissions from vehicle materials are expected to account for 60% of total life-cycle emissions by 2040.

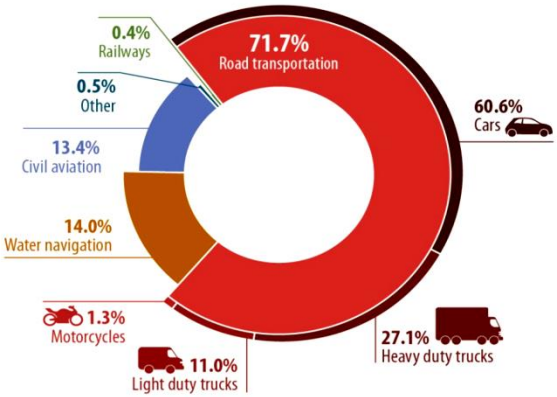

Fig. 1.32. Structure of greenhouse gas emissions in the EU [30]

The European Green Deal aims to "make transport sustainable for all" by moving towards clean mobility for clean, accessible and affordable transport [78; 79]. The European Commission also promotes the growth of the zero- and low-emission vehicle market. In particular, there is a desire to provide citizens with the infrastructure necessary to charge electric vehicles for short and long journeys (Table 1.8). Starting in 2026, road transport will be covered by emissions trading, which will put a price on pollution, encourage the use of cleaner fuels and reinvestment in clean technologies.

Table 1.8

Targets to reduce carbon dioxide emissions from new passenger cars and vans in line with the European Green Deal

№	Measures to be undertaken	Target level
1.	Reducing emissions from passenger cars by 2030	55%
2.	Reducing emissions from vans by 2030	50%
3.	Reducing emissions from new cars by 2035	0

* Compiled on the basis of [78]

In basic terms, there are two ways to reduce carbon dioxide emissions from cars: making vehicles more fuel efficient or changing the fuel they use. In 2019, the majority of road transport vehicles in Europe were powered by diesel (67%), followed by petrol (25%). Electric vehicles are becoming increasingly popular, accounting for 17.8% of all new passenger cars registered in 2021, up significantly from 10.7% in 2020. Sales of electric vehicles (battery electric vehicles and plug-in hybrid electric vehicles) have increased sharply since 2017 and tripled in 2020, when current carbon emission targets began to apply. In 2021, electric vans accounted for 3.1% of the market share of new registrations [66]. This indicates a shift towards sustainable types of vehicles that are more environmentally friendly.

In the context of implementing the European Green Deal [78], the Circular Economy Action Plan [80], the Waste Framework Directive [81] and the Sustainable and Smart Mobility Strategy [26], it is of particular importance to address the end-of-life vehicle challenge in terms of resource efficiency and decarbonisation.

Consumption of transport products and services in the EU requires approximately 1460 kg of primary raw materials per person annually. Therefore, the problem of recycling vehicles at the end of their life cycle is becoming increasingly urgent. The electrification of vehicle fleets is gaining unprecedented momentum. At the same time, there is a need to apply circular approaches to ensure decarbonisation and reduce the automotive industry's dependence on primary raw materials. However, existing market barriers prevent the rapid adoption and implementation of circularity principles. In order to create favourable conditions for the circular use of materials, products and services, measures are urgently needed to address these issues.

Improving circularity in the automotive industry should be aimed to:

1. Extend performance assessment from the conventional consideration of tailpipe emissions to include all life-cycle stages along the entire value chain to enable more rational and efficient decision-making for the mobility and manufacturing sectors in general.

2. Accelerate the use of advanced circular low-carbon materials to increase demand and improve recycling markets, with a focus on metals, plastics and battery materials. At the same time, recycled materials can be considered as high-quality raw materials for a new production cycle.

3. Reorient circularity towards value-added processes by broadening practices from recycling to extending the life of vehicles through reuse and recycling.

4. Improve vehicle utilisation and sustainable mobility by promoting fleet management and vehicle sharing [81].

Actions under the EU Circularisation Roadmap for the automotive industry envisage comprehensive improvements:

- Creating effective market incentives for the transition to a circular automotive industry (integrate life cycle perspectives into relevant decarbonisation legislation and improve data availability through digital product data sheets and single data spaces).

- Changing economic incentives (taxation systems, carbon pricing, access to investment) to ensure that circular products and services are profitable and attractive for investment. This will help to create interest and engage stakeholders in addressing sustainable mobility issues.

- Harmonise and improve existing regulation (including revision of the End-of-Life Vehicle Directive in line with stakeholder recommendations) across all life cycle stages and components.

Environmental performance should be analysed from the perspective of the vehicle life cycle, taking into account the impacts and decisions at each stage. At the same time, it is necessary to promote sustainable material management through Extended Producer Responsibility [83]. At each stage of the

vehicle life cycle, it is essential to implement the principles of the circular economy (Fig. 1.33). It all starts with the development of a vehicle with a focus on creating a sustainable product with possible weight reduction, procurement of raw materials from suppliers with priority given to environmental criteria (in particular, the use of recycled materials), production of vehicles with energy efficiency, optimisation of the production process and logistics, and prevention of unproductive waste during the whole production process.

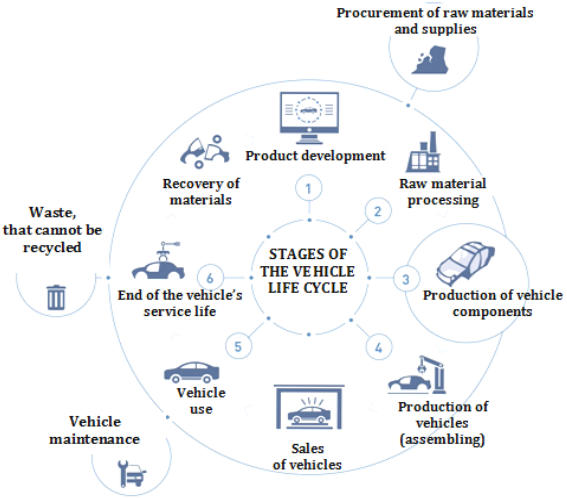

Fig. 1.33. Stages of the vehicle life cycle where circular economy principles need to be implemented [67]

In the EU, automotive engineers are actively applying Life Cycle Assessment in the development of concept vehicles to support the concept of Mobility as a Service (MaaS). Life Cycle Assessment (LCA) is a methodology that takes into account the entire life cycle of a vehicle, from raw materials and production (production phase) to its service life (use phase) and disposal or recycling at the end of its service life (disposal phase) [84]. It also covers the full life cycle of energy sources. The LCA approach helps manufacturers assess and reduce the overall environmental impact of automotive products.

Vehicle life cycle management involves comprehensive measures at certain levels:

- Prevention – based on design inputs, the right choice of materials and adequate technological solutions, which creates the preconditions for extending the life cycle of a vehicle and reducing the amount of waste at the end of its life cycle. Prevention of waste generation is the preferred option, as in the EU, sending waste to landfill can be seen as a last option.

- Reduction – is achieved at the design and development stage of the technology through the choice of materials and the priority reduction of their consumption.

- Reuse – means that vehicle components that have reached the end of their useful life are used for the same purpose for which they were intended (in their current state or after some treatment).

- Recycling – means the processing of waste in the production process for its original purpose or for other purposes, except for energy recovery.

- Energy recovery is the last level of management related to the use of energy obtained by direct combustion of materials that cannot be reused or recycled in new production, but can still be converted into heat in an economically feasible way.

- Waste is the residue that cannot be used for any of the above purposes, i.e. it is an unusable product. Since end-of-life vehicles are hazardous waste, only a small proportion of waste should reach this stage [81; 82; 85]. To achieve this, it is necessary to ensure that all operations related to the management of this process are optimised.

End-of-life vehicles are automotive products (vehicles) that have reached the end of their useful life and are classified as waste that can only be disposed of or recycled [86]. Components and materials removed from such vehicles (batteries, engine oil and other liquids and metal parts) are also considered waste.

A vehicle may be considered as having expired due to the will of the user (owner), as well as due to the condition of the vehicle.

End-of-life vehicles should be considered in two categories: natural or ordinary (those that have technically or economically exhausted their life) and premature (new vehicles withdrawn from service after an accident).

According to the Waste Transport Regulation, end-of-life vehicles cannot be exported from the EU.

End-of-life vehicles represent a waste stream with a large amount of recyclable materials, which can lead to high levels of reuse (spare parts) and recyclable components (e.g. steel and copper) [40]. The increase also leads to high environmental risks associated with recycled hazardous substances (e.g. oils, petrol) and materials requiring safety measures.

About 8-9 million tonnes of car waste are generated in the EU per year, of which 25% is hazardous. About a third of vehicles with expired service life in the EU are not deregistered (illegally exported or sold for scrap or abandoned) [88; 89].

The total weight of passenger cars, light trucks and other light goods vehicles disposed of in the EU in 2020 was 6.3 million tonnes, with 96.0% of parts and materials reused and recovered, and 90.5% reused and recycled, indicating a really high recycling rate [88].

Changes in the number of end-of-life vehicles by EU and other European countries in 2010-2020 are shown in Table 1.9 representing significant changes.

In the coming years, demand for electric vehicles is expected to increase significantly due to the implementation of

Table 1.9

Number of end-of-life vehicles by EU country

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU	*6 213 000*	*5 555 000*	5 123 000	*5 085 000*	5 043 000	4 968 000	4 823 000	5 300 000	6 105 000	6 074 000	*5 434 000*
Belgium	170 562	165 016	160 615	134 506	126 835	107 425	106 458	120 896	142 852	134 629	110 161
Bulgaria	69 287	62 937	57 532	61 673	80 862	85 946	92 706	102 442	99 835	85 670	68 635
Czechia	145 447	132 452	125 587	121 838	131 987	139 440	145 928	154 306	169 715	178 683	167 814
Denmark	100 480	93 487	106 504	125 650	104 413	98 929	89 039	117 124	117 519	119 551	95 084
Germany	500 193	466 160	476 601	500 322	512 163	473 386	412 801	506 531	560 455	461 266	406 044
Estonia	7 268	11 413	12 835	14 712	14 720	12 884	11 184	16 236	18 147	15 293	15 501
Ireland	158 237	134 960	102 073	92 467	86 950	74 910	98 213	140 788	162 521	149 445	118 867
Greece	95 162	112 454	84 456	86 205	82 863	87 050	46 573	39 761	47 141	49 533	44 759
Spain	839 637	671 927	687 824	734 776	724 820	689 760	611 446	620 055	748 306	813 768	713 404
France	1 583 283	1 515 432	1 209 477	1 115 280	1 084 766	1 016 326	1 046 083	1 138 742	1 571 776	1 623 522	1 331 185
Croatia	:	:	35 213	*32 135*	19 388	16 900	20 386	21 074	27 404	40 892	46 919
Italy	1 246 546	952 461	902 611	876 052	853 584	958 245	978 960	990 876	1 030 318	1 094 731	1 002 401
Cyprus	13 219	17 145	17 547	13 212	11 160	8 293	5 151	5 453	7 523	10 170	9 367
Latvia	10 640	9 387	10 228	9 003	9 268	8 924	8 049	11 439	11 435	11 592	11 885
Lithuania	23 351	26 619	22 885	26 482	29 982	26 546	21 306	21 066	20 629	22 001	31 147
Luxembourg	6 303	2 341	2 834	2 290	2 225	1 617	1 854	1 972	3 103	2 827	2 416
Hungary	15 907	13 043	15 357	14 897	15 283	16 788	15 141	15 573	19 280	20 743	19 526
Malta	330	2 526	2 530	1 198	2 646	4 509	5 632	7 570	7 599	6 616	8 108
Netherlands	232 448	195 052	187 143	183 451	188 487	167 777	197 488	199 506	214 013	177 404	194 982
Austria	82 144	80 004	64 809	73 993	59 904	47 926	48 077	58 462	60 272	54 424	50 944
Poland	259 576	295 152	344 809	402 416	454 737	478 202	380 529	495 805	514 210	450 066	:
Portugal	107 419	77 929	92 008	92 112	86 713	84 158	88 559	99 910	107 140	111 112	101 378
Romania	190 790	128 839	57 950	37 989	42 138	41 886	46 572	49 830	67 344	84 621	79 360
Slovenia	6 807	6 598	5 447	:	6 260	5 980	7 093	8 590	12 141	15 182	15 493
Slovakia	35 174	39 171	33 469	36 858	29 175	26 176	36 931	35 328	39 343	52 722	53 355
Finland	119 000	136 000	119 000	99 300	94 540	99 630	114 460	128 280	120 040	100 922	109 099
Sweden	170 658	184 105	185 616	189 748	186 967	188 810	186 875	192 395	204 458	186 370	175 748
Iceland	4 195	4 075	5 824	4 463	5 245	6 063	6 527	9 483	11 392	11 635	10 927
Liechtenstein	107	94	114	326	188	230	260	326	213	180	195
Norway	112 537	124 563	119 905	141 452	139 920	145 098	142 280	143 664	143 767	144 933	138 203

Source: [88]

the European Commission's Mobility Strategy, which aims to reach 30 million electric vehicles by 2030, as well as new vehicle emission standards that will effectively phase out internal combustion engines by 2035, which will likely be replaced by the vast majority of electric vehicles.

The demand for materials for vehicles ranges from steel, aluminium, plastics, rubber and glass to critical raw materials required for car batteries and integrated electronics for both electric vehicles and internal combustion engines. This creates conditions for the development of recycling practices.

The importance of managing end-of-life vehicles can be explained by looking at different aspects. Improper management of end-of-life vehicles can cause environmental problems, and the European economy will lose millions of tonnes of materials that could be reused. Therefore, due to rising material prices,

end-of-life vehicles are seen as a valuable resource for a wide range of different materials rather than waste.

A vehicle, regardless of its age and weight, is made up of approximately 75% ferrous and non-ferrous metals, with the share of non-ferrous metals increasing steadily. The remaining 25% of a vehicle's weight is made up of tyres, fluids and other combined materials [87]. Under various conditions, more than 90% of the weight of such vehicles can be reused and recycled.

To provide an environment for the management of end-of-life vehicles, relevant regulations have been developed. The regulatory framework for the management, recycling, treatment and safe disposal of end-of-life vehicles in the EU is provided by Directive 2000/53/EC of 18 September 2000 on end-of-life vehicles [92]. It is reinforced by Commission Decision 2005/293/EC, which sets out detailed rules for monitoring the reuse/recovery and reuse/recycling objectives of end-of-life vehicles.

Under Commission Decision 2001/753/EC, Member States are required to report to the EU every three years on the amount of waste collected and recycled, and under Commission Decision 2003/138/EC on the labelling of vehicle components and materials.

The importance of the above-mentioned Directive is explained by the fact that it is the key automotive regulation containing general provisions that promote the development of a circular economy, including measures for the use of recycled materials, identifying specific recovery, recycling and reuse targets, as well as rules relating to the recovery and sale of end-of-life vehicle parts.

The Directive sets out measures to prevent and limit waste from end-of-life vehicles and their components by ensuring their reuse, recycling and recovery. It also aims to improve the environmental performance of all business entities involved in the life cycle of vehicles [93; 94].

The main areas of implementation of Directive 2000/53/EC can be considered in terms of prevention, promotion and improvement (Fig. 1.34).

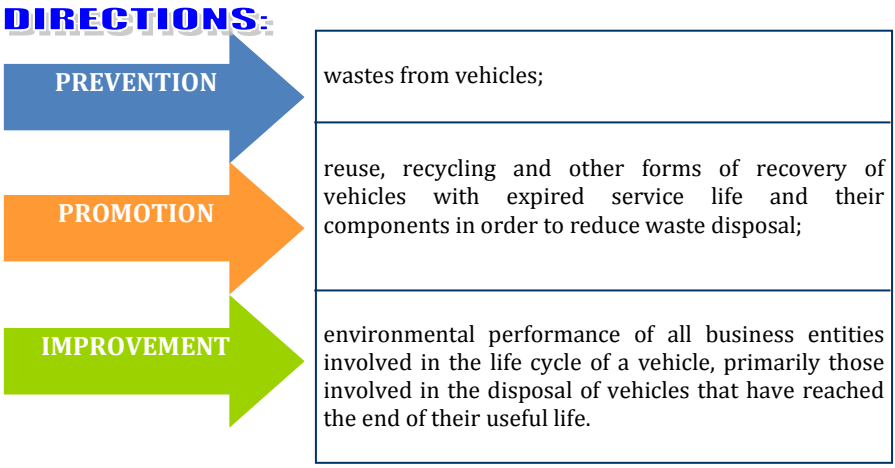

Fig. 1.34. Main areas of implementing Directive 2000/53/EC on end-of-life vehicles
* Compiled according to [92; 95]

The parties' obligations under Directive 2000/53/EC on end-of-life vehicles are as follows:

1. Manufacturers of vehicles and equipment shall take into account the disassembly, reuse and recycling of vehicles when designing and manufacturing their products. They shall ensure that new vehicles are

- at least 85% reusable and/or recyclable by weight per vehicle;
- at least 95% reusable and/or recoverable by weight per vehicle.

Also, manufacturers cannot use hazardous substances such as lead, mercury, cadmium and hexavalent chromium, except for the prescribed uses.

2. Manufacturers, importers and distributors shall provide systems for the collection of end-of-life vehicles and, where

technically feasible, used parts of repaired passenger vehicles. Owners of such vehicles handed over to official waste treatment facilities must obtain a certificate of destruction. This is necessary to remove the vehicle from the register, allowing the last owner to show that they are no longer responsible for their vehicle. Manufacturers must cover all or a significant part of the costs associated with the delivery of end-of-life vehicles to a waste treatment facility. The owner of the vehicle should not bear any costs when delivering the vehicle to an authorised waste treatment facility, except in exceptional cases where the engine is missing or the vehicle is full of waste.

3. Waste treatment facilities must apply for a permit or register with the competent authorities of the EU country where they are located. Such specialised companies issue a certificate of destruction to the owner, which is proof that the vehicle has been handed over and will be treated in accordance with the required standards before destruction [92].

In 2020, the EU's end-of-life vehicle reuse and recycling rate was 90.5%, up 1 percentage point from 2019 and 3.2 percentage points from 2018. 15 EU Member States reported reuse and recycling rates of 90% or more in 2020, with another nine Member States reporting rates in the range of 85.0%-89.9%, indicating that the target levels have been achieved. Some Member States reported a decrease in the range of 84.6% to 84.9% (Table 1.10).

There are also certain peculiarities in the reporting of EU Member States on the levels of recycling and reuse of end-of-life vehicles. For example, countries may not have reported some of the materials obtained as a result of cleaning and dismantling, which may be stored on the territory of authorised treatment facilities in anticipation of export for further processing at favourable market prices, as well as to limit transportation costs.

The annual rate of countries exceeding 100% (e.g., Poland –118.8% in 2019) is explained by the processing of stocks of waste vehicle parts at dismantling and shredding facilities that

were not processed in previous years. In general, the target level of 85% set by Directive 2000/53/EC was exceeded.

Table 1.10

Total level of recycling and reuse of end-of-life vehicles (% of the weight of M1 and N1 vehicles)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU	*83.5*	*84.4*	84.6	*85.3*	85.4	87.0	87.1	87.9	87.3	89.5	*90.5*
Belgium	89.0	88.2	88.7	88.2	89.2	91.3	92.1	93.2	93.5	92.9	93.0
Bulgaria	88.9	90.0	89.5	93.2	94.1	94.4	94.6	97.6	94.8	95.8	96.1
Czechia	80.3	80.3	80.3	80.3	80.3	90.2	90.3	91.9	95.5	93.3	97.3
Denmark	90.5	92.8	92.4	*86.6*	86.0	91.2	88.8	91.5	89.9	94.6	94.8
Germany	95.5	93.4	92.3	89.8	89.5	87.7	89.3	89.5	87.1	86.9	86.8
Estonia	77.3	76.1	80.9	77.7	87.0	86.0	85.8	85.9	87.1	87.6	87.2
Ireland	77.0	80.5	81.8	80.4	82.1	83.3	86.0	85.9	86.4	87.4	90.3
Greece	84.5	85.2	82.8	88.8	80.4	64.5	*100.0*	91.9	98.7	69.7	92.8
Spain	82.8	82.9	83.0	83.6	84.3	85.0	85.4	85.8	85.9	86.0	86.2
France	79.0	80.8	82.4	85.3	85.9	87.5	86.9	87.4	86.9	87.1	87.6
Croatia	:	:	97.2	100.0	89.5	92.8	93.9	99.3	97.4	96.3	97.2
Italy	83.2	84.8	80.8	82.2	83.4	84.6	82.5	83.2	82.6	84.2	84.9
Cyprus	81.1	84.0	84.7	84.3	87.7	89.1	90.3	89.2	89.8	88.7	91.0
Latvia	85.7	85.4	97.6	92.4	92.2	86.6	94.3	84.0	96.0	88.9	84.6
Lithuania	88.1	87.2	89.2	92.1	93.5	94.6	94.9	94.8	92.4	93.5	94.6
Luxembourg	85.0	82.9	85.0	84.0	87.0	87.0	86.0	94.3	94.1	96.7	97.2
Hungary	82.1	84.4	84.4	90.7	90.3	94.6	95.4	95.5	95.1	94.4	95.6
Malta	64.2	87.0	95.8	91.9	45.0	77.7	54.4	56.1	81.0	79.2	90.1
Netherlands	83.3	83.1	83.7	86.0	86.1	87.7	88.9	87.1	87.1	87.2	88.0
Austria	84.2	82.8	83.4	85.0	85.8	86.9	87.2	86.6	86.2	87.3	86.1
Poland	88.8	89.5	90.4	88.6	85.5	94.7	94.3	95.7	93.4	118.8	:
Portugal	82.8	82.9	82.7	82.9	83.8	84.0	83.5	85.2	86.1	88.2	87.3
Romania	80.9	82.9	84.0	83.8	84.1	85.1	85.1	85.0	85.2	85.0	85.4
Slovenia	88.6	86.1	100.0	:	85.9	90.2	91.6	102.9	97.6	89.5	110.1
Slovakia	88.4	93.1	89.9	92.5	94.8	88.4	96.1	95.7	95.1	95.5	95.6
Finland	82.5	82.5	82.5	82.5	82.8	82.8	82.8	82.8	82.8	84.7	84.7
Sweden	84.4	84.4	85.0	84.6	84.4	84.6	86.7	88.2	86.8	87.4	87.7
Iceland	95.2	82.0	100.0	99.6	97.7	98.5	96.8	97.5	97.5	97.4	92.2
Liechtenstein	76.0	80.0	77.2	78.2	78.7	80.5	75.6	75.1	74.5	75.7	69.7
Norway	83.9	73.6	75.5	75.4	82.9	85.2	85.2	86.2	87.7	85.2	87.3

Source: [88]

According to Table 1.11, the overall level of recovery and reuse of end-of-life vehicles as a percentage of the weight of M1 and N1 vehicles is mostly above the target level of 95%.

Since Directive 2000/53/EC was adopted in 2000 and since then there have been many fundamental changes in the production of vehicles, it needs to be revised. In particular, this is due to the active use of new generation technologies and components in cars (plastics, carbon fibre or electronics), which create special problems and conditions for their recovery and recycling from end-of-life vehicles [96-98]. It is also necessary to

Table 1.11

Total level of recovery and reuse of end-of-life vehicles (% of the weight of M1 and N1 vehicles)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU (*)	*87.6*	*89.2*	89.9	*90.6*	91.4	92.8	92.7	93.7	92.9	95.0	*96.0*
Belgium	91.2	90.6	93.0	93.0	94.2	96.7	96.4	97.3	97.3	97.1	97.3
Bulgaria	89.2	92.0	91.3	94.1	95.0	95.1	95.6	98.8	95.8	96.5	96.6
Czechia	86.3	86.3	86.3	86.3	86.3	95.7	95.4	95.6	99.3	97.3	101.9
Denmark	90.7	92.9	92.6	86.7	86.1	97.6	97.1	99.6	98.2	102.6	102.3
Germany	106.2	108.2	106.3	103.8	101.4	95.8	98.0	98.4	95.7	93.6	94.0
Estonia	78.4	79.0	85.1	86.4	88.4	87.0	89.8	89.9	91.2	91.9	91.3
Ireland	77.4	82.7	87.8	91.6	90.7	91.8	92.8	94.6	95.2	95.2	97.1
Greece	86.5	87.7	90.3	91.5	85.5	68.9	108.0	99.5	108.3	77.2	98.8
Spain	85.7	87.4	88.2	91.5	93.5	95.0	93.4	94.0	92.6	92.4	93.1
France	81.9	84.8	87.0	89.3	91.3	94.3	94.8	94.6	94.2	95.0	95.7
Croatia	:	:	99.9	100.0	96.2	99.5	99.5	99.7	97.7	96.7	97.5
Italy	85.4	85.3	82.3	82.8	85.1	84.7	82.6	83.2	82.6	84.2	84.9
Cyprus	86.9	86.6	86.9	86.6	90.2	90.7	93.2	91.9	96.8	95.8	97.2
Latvia	86.1	86.0	97.9	92.6	92.4	87.0	94.5	84.1	96.0	89.1	84.6
Lithuania	88.5	87.4	90.1	92.4	94.4	95.0	95.4	95.1	95.4	95.1	95.1
Luxembourg	88.0	90.9	95.0	95.0	95.0	97.0	96.0	96.2	95.9	97.8	98.0
Hungary	86.8	86.2	86.2	91.7	95.6	95.2	95.8	96.9	95.8	95.4	97.7
Malta	64.2	87.1	96.0	91.9	45.0	77.7	54.4	56.1	81.0	79.2	90.1
Netherlands	95.3	96.2	96.1	95.9	96.0	97.0	98.7	98.7	98.4	98.5	98.3
Austria	96.5	97.6	94.2	96.7	96.1	96.9	96.9	97.9	97.8	97.8	97.4
Poland	89.8	91.5	92.8	90.3	88.0	97.0	96.3	98.6	95.3	122.2	:
Portugal	86.8	87.9	87.6	90.5	92.7	92.7	92.1	93.8	94.9	96.7	98.9
Romania	85.5	86.8	86.0	87.4	88.5	90.8	92.1	92.6	92.2	92.4	91.6
Slovenia	90.6	90.3	103.0	:	91.3	95.6	96.5	109.9	103.7	95.4	117.2
Slovakia	90.2	94.6	91.2	93.7	96.0	89.4	97.4	97.5	96.8	97.1	97.1
Finland	95.0	95.0	95.0	95.0	97.3	97.3	97.3	97.3	97.3	95.2	95.2
Sweden	91.1	90.8	90.6	91.3	91.3	96.8	94.6	97.2	95.3	96.8	96.7
Iceland	95.2	82.0	100.0	99.6	97.7	98.5	96.8	97.6	97.6	97.4	92.3
Liechtenstein	92.3	92.4	92.7	89.0	90.6	90.8	85.6	84.7	85.7	87.1	80.3
Norway	94.7	93.3	93.8	94.7	97.5	96.7	97.7	97.2	97.4	96.6	97.2

Source: [88]

adapt the Directive to the provisions of the European Green Deal, the Circular Economy Action Plan and the Waste Framework Directive with a transition to more sustainable models and principles of the circular economy.

Changes in the automotive industry ecosystem have encouraged it to develop the business of recycling end-of-life vehicles, including reuse, recovery and recycling operations (Fig. 1.35).

The positive effects of the development of the end-of-life vehicle recycling business in the EU can be seen in terms of certain aspects:

1) Environmental aspect: reduction of carbon dioxide emissions into the atmosphere and contribution to the reduction of the carbon footprint over the life cycle of a vehicle.

2) Economic aspect: expanding the practice of reusing used spare parts, which cost less than new parts, facilitating the repair

of damaged vehicles and reducing fleet maintenance costs; production of materials from recycled raw materials.

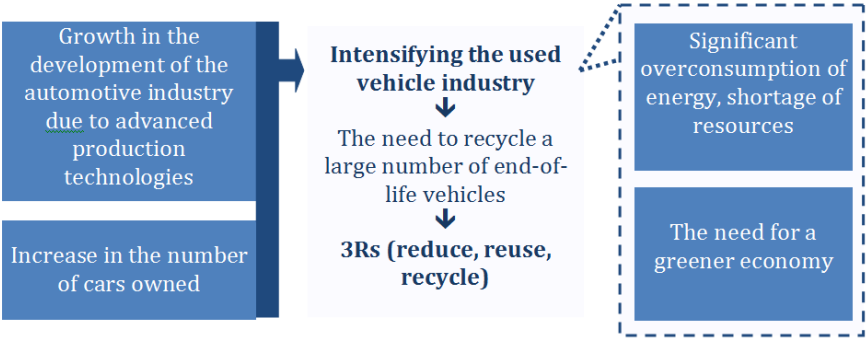

Fig. 1.35. Factors that have stimulated the development of the waste vehicle recycling business in the EU
* Compiled by the author

3) Social aspect: authorised recycling facilities provide a large number of direct and indirect jobs created through material recycling activities; used spare parts facilitate mobility.

Vehicles have one of the highest recycling rates of any product. This is facilitated at the design stage of the vehicle in accordance with the Reuse, Recycling and Recovery (RRR) Directive, which requires that any vehicle be 95% recyclable based on the composition of the materials from which it is made [98; 99].

Thus, it can be concluded that a vehicle recycling system can not only help to eliminate or prevent the formation of waste vehicle landfills, but also become a source of valuable secondary resources. To implement such a system, it is necessary to take into account the degree of recycling of vehicle materials and the development of technologies for obtaining secondary raw materials from vehicle waste. All this is fully in line with the EU's development priorities.

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Chapter 2
PROBLEMS AND PROSPECTS OF THE INTEGRATION OF UKRAINE INTO THE SINGLE EUROPEAN AVIATION SPACE

2.1. Integration of Ukraine into the Common European Aviation Area

The agreement On Common Aviation Area with European Union and its members (Agreement) was signed in October 2021 during the EU – Ukraine summit and was approved by the Legislative Body of Ukraine only in February 2022. By this date all the Ukraine - EU countries' international aviation transportation was managed according to the provisions of Air Services Agreements concluded on the bilateral basis[1]. The negotiations on the concluding the Agreement started in 2007 and in 23 of November 2013 it was initialized summit in Vilnius. But its signing had been postponed because of the dispute on the Gibraltar airport' status among Spain and UK. This question disappeared due to the UK's brexit. In addition, on June 23, 2022, at the summit of the leaders of the European Union countries, it was decided to grant Ukraine the status of a Candidate for EU membership [2], which is an important landmark event for Ukraine. However, the adoption of this decision was facilitated by a detailed analysis conducted by the European Commission of the data provided by Ukraine in the form of a questionnaire filled with answers. In general, the process of admitting a country to the EU involves the implementation of systemic large-scale reforms, and the completed questionnaire makes it possible to conduct a thorough assessment of the state of readiness of the country in various aspects, including in the sectorial context.

According to its content, the Agreement introduces a common list of norms to rule the air transport services between the Ukraine and EU. It should be noted that the "standard" version of the Agreement was taken as the basis, but later it was

expanded due to the presence of a large-scale aviation industry in Ukraine.

The results of the study of the prerequisites and consequences of the conclusion of this Agreement were published in the scientific works of such scientists as Mikhalchenko O.G., GeetsI.O., Bugayko D.O., Sadlovskaya I.P., Ovsak O.P. and others. However, today, the detail of the current state of implementation of the provisions of the concluded Agreement to the legislative and regulatory acts of Ukraine is of particular relevance, based on the fact that it is a key element in the process of Ukraine's integration into the European Common Aviation Area (ECAA).

The purpose of our research is to analyze the main aspects of the activity and development of aviation transport of Ukraine, to study the state of incorporation of Directives and Resolutions in force in the European Community, which are specified in the Agreement in the legislative and regulatory legal acts of Ukraine, as well as to determine the main activities of the State Aviation Service, which will contribute to the implementation of the European vector of integration.

In the air transportation market of Ukraine over the past four years before the spread of COVID19, there was an increase in the volume of passenger traffic carried out by both domestic and foreign airlines. However, according to the results of 2019, growth in the segments of passenger and freight traffic slowed down somewhat - 103.3 thousand commercial flights were completed in total, which is only 3% more than in 2018. They were carried out by 29 domestic airlines, while in 2018 - 34, which, according to the results of 2018, performed 7% more commercial flights than in 2017, as presented in Table 1.

It should be noted that after a period of decline in business activity caused by the global financial crisis of 2008, bankruptcy of the Ukrainian airline Aerosvit and redistribution of rights to carry out international air transportation, after a period of gradual growth from 2012 to 2014, and a decrease in air traffic in 2014-2015, when Russia's aggression against

Ukraine began, in 2016, the results of the reorientation of the directions of passenger and cargo flows of Ukrainian airlines were already noticeable [3]. The latter, combined with the deepening of the processes of gradual liberalization of bilateral intergovernmental agreements between Ukraine and other countries of the world, led to a rapid increase in passenger traffic: the total number of international passenger traffic by domestic airlines increased by 31.6% in 2016, by 28.6% in 2017-2017, and in 2018 and 2019, growth slowed down somewhat, amounted to 19.5% and 9.6%, respectively. As presented in Table 2.1, in general for 2016-2019. there was an increase in the growth rate of all volume indicators of the activities of domestic airlines, in particular, passenger turnover - increased almost 2 times, passengers were transported by 67% more, as well as regular cargo. Table 2.2 provides information on changes in the performance indicators of Ukrainian airlines in international traffic.

In general, for the period 2016-2019. there was an increase in the growth rate of all volume indicators of the activities of domestic airlines, in particular, passenger turnover in international traffic increased almost 2 times, passengers were transported 67% more, as well as cargo 38% more in regular international traffic.

According to the statistical data presented in Table 2.1, international transportation of passengers and goods by volume provide the lion's share of the volume indicators of domestic airlines, changes in their volumes in essence and determine the resulting performance indicators of Ukrainian airlines.

Table 2.1

Volume indicators of Ukrainian airlines performance

Indicators	Volume indicators						Rats of changes in indicators, %				
	2016	2017	2018	2019	2020	2021	2017 / 2016	2018 / 2017	2019 / 2018	2020 / 2019	2021 / 2020
Passengers transported, thousands of people:	8278	10556	12533	13706	4798	9348	129	119	110	34,2	195
including on regular roughts, thousands of people.	5736	6768	7868	8252	1788	3323	118	116	105	18	186
Fulfilled passenger-kilometers, billion pass.km:	16	20	26	30	10	19	131	128	117	33	185
Including on regular flights, billion pass.km:	11	13	16	17	3	6	118	125	112	17	180,6
Cargo and mail transported, thousands of ton:	74,3	82,8	99,1	92,6	88,3	79,4	111,5	119,6	93,1	95,7	89,9
Including on regular flights, thousands of ton.	14,3	19,2	21,1	19,6	5,7	6,5	134,1	110,1	93,3	28,9	114,0
Fulfilled ton-kilo-meters, million tkm:	226,4	275,3	339,7	295,6	316,2	346,3	121,7	123,4	86,9	107,1	109,5
incl. on regular flights, mln. tkm	45,3	70,5	92	93	18,4	39,9	155,8	130,5	101	19,8	216,8
Fulfilled commercial flights, thousand units:	79,5	93	100,2	103,3	45,3	74,1	115	107,6	103	40,7	163,6
including on regular flights, thousand units	55,2	63,3	67	66,6	20,4	34,4	111,9	104,8	98	22,8	168,6
Flight hours, hours	213	253	282	299	45,32	82,39	0,119	0,112	0,11	00,15	0,189
including on regular flights, hours	137	156	168	171	93	135	0,114	0,107	0,1	0,054	0,145

Table 2.2

Volume performance indicators of Ukrainian airlines in terms of international flights

Indicators	Volume indicators of international traffic by years						Rats of changes in indicators, %				
	2016	2017	2018	2019	2020	2021	2017 / 2016	2018 / 2017	2019 / 2018	2020 / 2019	2021 / 2020
Passengers transported, thousands of people:	7475	9615	11451	12547	4288	8622	129	119,1	109,6	34,2	201,1
including on regular roughts, thousands of people.	4944	5838	6796	7107	1285	2609	118	116,4	104,6	18,0	203,1
Fulfilled passenger-kilometers, billion pass.km:	15,2	19,9	25,4	29,7	9,8	18,4	131	127,6	116,9	33,0	187,8
Including on regular flights, billion pass.km:	10,3	12,1	15,1	16,9	2,9	5,2	118	124,8	111,9	17,1	179,3
Cargo and mail transported, thousands of ton:	74,1	82,6	98,8	92,0	88,0	79,4	111	119,6	93,1	95,7	90,2
Including on regular flights, thousands of ton.	14,1	18,9	20,8	19,4	5,6	6,5	134	110,1	93,3	28,9	116,1
Fulfilled ton-kilo-meters, million tkm:	226,2	275,2	339,6	295,2	316,1	346,3	122	123,4	86,9	107,1	109,6
incl. on regular flights, mln. tkm	45,2	70,4	91,9	92,9	18,4	39,9	156	130,5	101,1	19,8	216,8
Fulfilled commercial flights, thousand units:	67,9	78,1	84,0	86,7	35,3	59,9	115	107,6	103,2	40,7	169,7
including on regular flights, thousand units	44,6	49,9	52,3	51,6	11,8	21,9	112	104,8	98,7	22,8	185,6
Flight hours, hours	198	234	262	279	126	198	0,118	0,111	0,106	0,045	0,157
including on regular flights, hours	123765	139485	150384	153855	34815	65968	113	107,8	102,3	22,6	189,5

Thus, more than half of all passenger transportation of domestic airlines are international regular transportation. In 2018, according to the approved schedule, regular international flights were carried out by 10 domestic airlines to 46 countries of the world, in turn, the number of passengers using their services increased by 16.4%. In general, this year of the study, domestic and foreign air carriers performed 300 thousand flights, which is 18.5% higher than 2017 year. Simultaneously with the increase in the number of flights in many directions, the network of routes of domestic airlines developed. Thus, during 2018 and 2019, Ukrainian air carriers opened 17 new regular routes.

At the same time, there was an expansion of activities in the Ukrainian market of foreign airlines, 5 new foreign airlines began regular flights to Ukraine. 2018 was also marked by the development of a route network of foreign airlines, which launched the operation of 27 international air lines. In total, 38 foreign airlines from 37 countries of the world flew to Ukraine in 2018. 37.8% more passengers used their services than in 2017 (SAS Report 2019). By the number of passengers transported in 2018, foreign airlines transported half of the total volume of regular passenger traffic between Ukraine and the countries of the world.

As presented in Table 3, from 2016 to 2019. international regular passenger transportation in accordance with the approved timetable was carried out by 10 domestic airlines to 43 countries in 2016 and to 46 countries in 2019. The average percentage of flights loaded grew from 78% to 80%. The development of the network of routes of domestic air carriers continued, which in 2016 started operating on a regular basis only 4 new routes, while in 2017 - 10 routes, and in 2018 and 2019. - 17 new international airlines [3].

At the same time, the share of regular passenger traffic in the total volume of passenger traffic of domestic airlines gradually decreased from almost 70% in 2016 to 60% in 2019. The share of regular passenger traffic also gradually decreased during the period: from 69.4% in 2016 to 64.5% in 2019. In turn,

the share of international scheduled traffic in the total volume of passenger traffic of domestic airlines gradually decreased - from almost 60% in 2016 to 52% in 2019 [4, 5].

Table 2.3

Regular passenger transportation by Ukrainian airlines in the period before the spread of COVID19 and the introduction of restrictions on flights

Indicators	2016	2017	2018	2019
Number of airlines operating international regular services	10	10	10	10
Average% of flight load	78,2%	77,5%	78,8%	80,9%
Number of countries in the world, in regular traffic	42	43	46	46
Number of international airlines operating on a regular basis	4	10	17	17
Share of regular passenger traffic,%	69,28	64,11	62,7	60,2
Share of regular passenger flights in the number of commercial flights,%	69,4	67,7	66,86	64,47
Share of international regular transportation in the total volume of passenger and passenger transportation of domestic airlines	59,72	55,3	54,22	51,9

Source: compiled by the authors on the basis of content analysis of reports of the State Aviation Service of Ukraine

At the same time, on the market for the period 2016 - 2019. there was an expansion of the activities of foreign airlines. In 2019, 37.4% more passengers used their services than in the previous year. Table 2.4 presents the systematization of the development of regular passenger transportation by foreign airlines in the period before the spread of COVID19 and the introduction of restrictions on flights.

In total, 40 foreign airlines operated regular passenger flights to Ukraine in 2019 (including four new ones - the Austrian airline Laudamotion, the French Aigle Azur (flew until September 2019), the Israeli Israir Airlines and the Norwegian Scandinavian Airlines System) from 37 countries of the world.

During the year, 29 new routes were opened by foreign air carriers, of which 21 new routes were opened by Ryanair and Wizz Air Hungary, as presented in Table 2.4.

Table 2. 4

Regular passenger transportation by foreign airlines to Ukraine during the last period before the spread of COVID19 and the introduction of restrictions on flights

Indicators	2016	2017	2018	2019
Number of foreign airlines operating international regular services	28	29	38	40
Number of countries in the world from which regular flights were operated by foreign airlines	27	27	37	37
Share of foreign ACs in the total volume of regular passenger traffic between Ukraine and the countries of the world,%	43,8	46,1	50,2	57,0
Number of international airlines operating on a regular basis	2	10	27	29
Number of new foreign airlines in the international air transportation market of Ukraine	2	3	5	4

Source: compiled by the authors on the basis of content analysis of reports of the State Aviation Service of Ukraine

In 2016, two foreign airlines entered the Ukrainian market - SprintAir from Poland and AirSerbia from Serbia, in 2017 - Qatar Airways from Qatar, Ernest SpA from Italy and Kish Air from Iran. Over the 2019 year, 4 airlines appeared on the air transportation market in Ukraine: the Austrian airlin

Laudamotion, the French Aigle Azur, the Israeli Israir Airlines and the Norwegian Scandinavian Airlines System [4].

Table 2.5

Ukrainian airport performance for the period 2015-2017

Indecators	2016			2017		
	Total	by stages of flight		Total	by stages of flight	
		international international	domestic		international international	domestic
Sent + aircraft arrived, units	133166	104403	28763	159866	125571	34295
including regular flights, units	101485	80434	21051	121413	94999	26414
including irregular flights, units.	31681	23969	7712	38453	30572	7881
Passenger traffic, thousand people	12930	11296	1635	16499	14591	1908
including on regular flights, thousand.	10376	8776	1601	12646	10770	1876
including on irregular flights, thousand nos.	2554	2519	34,8	3853	3821	32
Cargo and mail flows, tons	42855	41846	1010	52334	51051	1284
including on scheduled flights, tons	37865	36891	975	47260	46008	1252
including on non-scheduled flights, tons	4990	4955	34,9	5074	5043	32

The number of international airlines operating on a regular basis increased: from 2 routes in 2016, 10 in 2017, 27 and 29 routes in 2018 and 2019, respectively. According to the results of 2019, out of 29 new routes of foreign airlines, 21

routes were opened by low-cost airlines Ryanair and Wizz Air Hungary. Accordingly, the share of foreign airlines in the total volume of regular passenger traffic between Ukraine and the countries of the world increased: from 43.8% in 2016 to 57% in 2019. It was in 2016 that the number of flights of foreign low-cost airlines to Ukraine began to grow [1, 2].

As of 2019, commercial flights of domestic and foreign airlines serve 19 domestic airports and airfields, as presented in Table 2.5, since 2016 there has been a positive dynamics in the number of services in them of take-offs and landings.

Table 2.5 and Table 2.6 present the dynamics of the volume indicators of the airports of Ukraine, Table 2.7 - reflects the rate of change in the volume indicators of airports, and Table 8 - shows the volume indicators for international flights for the period 2016 - 2021.

Analysis of the data in Tables 2.7 and 2.8 showed that in the airports of Ukraine for 2016-2019 there was a rapid increase in volume indicators - for 2017 by 18-29%, for 2018 - passenger traffic increased by a quarter. However, according to the results of activity in 2019, it was found that growth slowed down, despite the fact that passenger traffic in international traffic on regular flights increased the most. In turn, due to the introduction of anti-Covid restrictions, the number of international flights served at Ukrainian airports in 2020 amounted to only 42.4% of the 2019 level. International passenger traffic of domestic airports, in turn, amounted to only 34.7%, and international post-cargo traffic, respectively, 88.1% of the 2019 level, as presented in Fig. 2.1.

Table 2.6

Ukrainian airport performance for the period 2018 – 2021pp.

Indicators	2019		2020		2021	
	Total	international	Total	international	Total	international
Sent + aircraft arrived, units	201229	162669	94014	69037,0	152415	117598
including regular flights, units	153599	124865	58633	41686,0	96157,0	71709
including irregular flights, units.	47630	37804	35381	27351,0	56258,0	45889
Passenger traffic, thousand people	2433,5	21994	8664,5	7628,9	16221,0	14753,8
including on regular flights, thousand.	1883,0	16530	5643,5	4627,2	10172,7	8738,3
including on irregular flights, thousand nos.	5502	5464	3021,0	3001,7	6048,3	6015,5
Cargo and mail flows, tons	60212	58432	52244	51501,6	63228,1	62459,2
including on scheduled flights, tons	54124	52994	40771	40415,8	52545,8	51861,4
including on non-scheduled flights, tons	6088	5437	11473	11085,8	10682,3	10597,8

Table 2.7

Rates of change in the performance of airports in Ukraine

Indicators	Rats of changes in indicators, %				
	2016/ 2017	2018/ 2017	2019/ 2018	2020/ 2019	2021/ 2020
Sent and arrived aircraft, thousand units:	120,0	114,3	110,1	46,7	162,1
incl. on regular flights	119,6	115,6	109,5	38,17	164,0
Passenger traffic, thousand persons:	127,6	124,5	118,4	35,61	187,2
incl. on regular flights	121,9	125,0	119,1	29,97	180,3
Mail loads, thousand tons:	121,9	107,8	106,7	86,77	121,0
incl. on regular flights	124,8	108,5	105,5	75,33	128,3

However, as the analysis of statistical data for 2021 showed, the air transport market of Ukraine, despite the continued influence of negative factors associated with the COVID-19 pandemic, confidently restored its lost positions. During 2021, 27 domestic airlines flew on the passenger and cargo transportation market, which performed 62% more commercial flights than in 2020, while the annual growth rate of the passenger traffic attracted by them in international traffic amounted to 93%, in particular, on regular flights it grew by 88%. Post-cargo flows increased by more than 20% this year, and regular ones by more than 28%, such dynamics was inherent in international post and cargo transportation.

Table 2.8

Rate of change of performance indicators of airports of Ukraine in terms of international flights

Indicators	Rats of changes in indicators, %				
	2016/ 2017	2018/ 2017	2019/ 2018	2020/ 2019	2021/ 2020
Indicators	120,3	115,9	111,7	42,4	170,3
Including on regular flights	118,0	117,4	112,0	33,4	172,0
Sent and arrived aircraft, thousand units:	129,2	125,8	119,8	34,7	193,4
incl. on regular flights	122,7	126,8	121,0	28,0	188,8
Passenger traffic, thousand persons:	122,2	108,0	105,8	88,1	121,3
incl. on regular flights	124,7	108,9	105,8	76,3	128,3

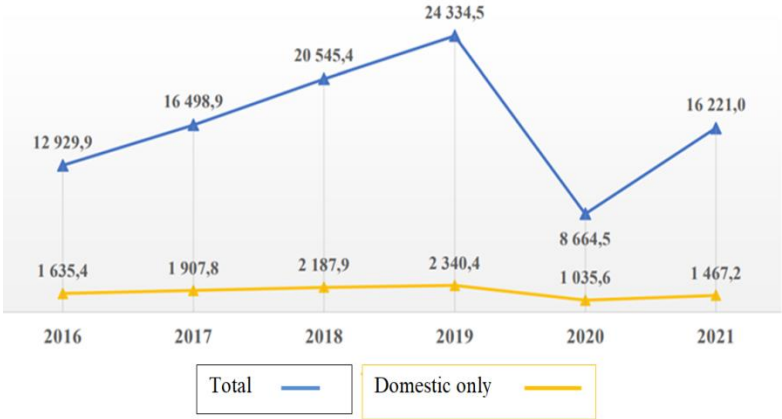

Fig. 2.1. Passenger traffic of airports in Ukraine, thousand passengers.

It is important to note that the number of flights of all airlines served at Ukrainian airports in 2021 amounted to 94% of 2019 data, which clearly illustrates the successful recovery of the aviation industry after the anti-pandemic flight restrictions.

As it was proved above, in the second chapter, thanks to the gradual liberalization of the conditions of bilateral international agreements, the market of air transport services developed rapidly from 2016 to 2019, before the implementation of restrictions on the movement of aircraft aimed at stopping the spread of the COVID19 pandemic. Such agreements, in particular, define designated air carriers that have the right to operate international scheduled flights between certain airports. According to these agreements, it is determined whether airlines can freely set tariffs (whether approval by another party is required), how many airlines can provide transport services, as well as the frequency of flights, the type of airplane for the certain route, their capacity.

In general, the liberalization of air transport services markets is a stable trend that began with the deregulation of the US aviation market and gradually spread throughout the world. It is implemented by expanding the terms of bilateral agreements between partner countries, as well as the creation of special aviation regimes called "open skies". In turn, the creation of a single EU aviation market put an end to the system of bilateral agreements on air traffic between EU member states. Many studies report that liberalization has led to significant growth in the economy and transportation through increased competition and efficiency in the air transportation industry and positive externalities for the overall economy. In liberalized markets, there is usually a significant increase in traffic due to reduced airline fares as competition increases. Liberalization has allowed more choice and more competitive prices for travelers. This creates positive externalities for the economy as a whole by stimulating economic growth and employment opportunities, boosting trade and improving transport and logistics services. But these consequences are not the same in different countries.

High competition leads to a change in the composition of airlines operating in the aviation market of countries, especially small countries whose national airlines are not leaders in terms of minimum costs. Such a situation leads to their displacement from the market and the dominance of world airlines - low-cost - leaders [6, 7]. As stated at the ICAO World Aviation Forum in 2015, a liberal environment best leads to the sustainable development of international air transport [8] boosting trade and improving transport and logistics services. But these consequences are not the same in different countries. High competition leads to a change in the composition of airlines operating in the aviation market of countries, especially small countries whose national airlines are not leaders in terms of minimum costs. Such a situation leads to their displacement from the market and the dominance of world airlines - low-cost - leaders [6, 7]. As stated at the ICAO World Aviation Forum in 2015, a liberal environment best leads to the sustainable development of international air transport [8]. boosting trade and improving transport and logistics services. But these consequences are not the same in different countries. High competition leads to a change in the composition of airlines operating in the aviation market of countries, especially small countries whose national airlines are not leaders in terms of minimum costs. This situation leads to their displacement from the market and the dominance of world airlines - low-cost - leaders [6, 7]. As stated at the ICAO World Aviation Forum in 2015, a liberal environment best leads to the sustainable development of international air transport [8]. whose national airlines are not leaders in terms of minimum costs. This situation leads to their displacement from the market and the dominance of world airlines - low-cost - leaders [6, 7]. As stated at the ICAO World Aviation Forum in 2015, a liberal environment best leads to the sustainable development of international air transport [8]. whose national airlines are not leaders in terms of minimum costs. This situation leads to their displacement from the market and the dominance of world airlines - low-cost - leaders [6, 7]. As

it was stated at the ICAO World Aviation Forum in 2015, a liberal environment best leads to the sustainable development of international air transport [8].

The European common aviation space was created by concluding a relevant agreement between the EU member states, Norway and Iceland, and the countries of the Western Balkans region [9]. This agreement ensured the spread of high standards of flight safety and aviation security, which were introduced and are constantly being improved by the European Civil Aviation Organization.

The Agreement on CAA has corresponding parts - articles regulating its functioning (the so-called "Main Agreement") and Annexes. Annex I contains a list of EU Directives and Regulations used to regulate the following components: A) Entrance to the market; B) air traffic control; C) flight safety; D) Aviation security; E) Environment, F) corresponding social components; G) Protection of consumers; H) Other corresponding legislation. Annex II stipulates country adaptations and certain procedural norms. Appendix III - Rules in conducting and providing state aid. In turn, Appendix IV is the procedure for the legislative settlement of conflicts between the parties. Annex V contains protocols that stipulate transitional provisions for each associated country [10].

In accordance with the provisions of the Agreement, the signatory countries must ensure the incorporation into national legislation of the international safety standards set forth in the Convention on International Civil Aviation regarding the rules of registration, technical condition and validity of aircraft and crew documents. The country's airports must use the aviation security standards listed in Annex I, which deal with the prevention of "unlawful interference". In order to optimize the capacity of air navigation services and airports, their compliance with safety standards and general air traffic standards in Europe should be proven, cooperation in air traffic management should be carried out, and the Single European Sky should be expanded. Rules of

competition and state aid between the parties, if they are part of concluded other agreements,

In order to administer the processes of implementation of the agreement, a Joint Committee should be established, which will include representatives of the contracting parties. Its functions include notifying other parties about changes in legislation, reviewing Annex I.

The analysis of the Agreement showed that all the Protocols of Annex V stipulate the existence of two transitional periods for most of the countries - neighbors of the EU, and the composition of the article on "transition conditions" differs in nine protocols by country specificities. However, the rights regarding the execution of flights, set forth in the article "conditions of transition", in relation to community carriers and air carriers licensed by a certain state, have an identical nature in relation to different participating countries [10].

As set out in Article 28, the provisions of this Agreement shall prevail over the provisions of bilateral intergovernmental air service agreements and/or other arrangements established between the Associated Parties, on the one hand, and the European Community, an EU Member State, Norway or Iceland, on the other hand party, as well as between associated parties. It is important that, according to Article 32, the European common air space can be expanded upon the acceptance of a country that incorporates into its national legislation the stipulated provisions of the laws of the European Community and with which close economic cooperation has been established, which must be expressed in the signing of the Agreement on Association with the EU. Accordingly, appropriate changes are made to the Agreement on "ESAP". Moreover, after such a country becomes a member of the EU, corresponding changes are made to the Agreement on "ESAP" and the air carriers of this country acquire the right of "community air carrier". In this way, the European common air space is gradually expanding.

It should be noted that the agreements on CAA were concluded by the EU with the Mediterranean and Black Sea

countries that signed the Association Agreement. In addition, the Kingdom of Morocco became the first country with which the Euro-Mediterranean Aviation Agreement in the field of aviation was signed at the end of 2006. Similar agreements were also concluded by the EU in 2012 with Georgia and Jordan, in 2013 with Israel, in 2020 with Moldova, and in 2021 with Ukraine and Armenia [11]. According to the general conditions of such an agreement, air carriers of such countries receive the right to carry out transportation within the EU, guided by the common rules of law regarding the issuance of licenses and access to the market, competition, non-discrimination, flight safety, state aid. After signing such an agreement, countries incorporate into their national legislation EU norms in the field of air transport management.

The Agreement with Ukraine was based on a standard CAA agreement, but later it was expanded due to the presence of a large-scale aviation industry in Ukraine. Prior to the conclusion of the Agreement on CAA, bilateral agreements on air traffic with all member states were in force regarding air traffic between Ukraine and EU countries. Until 2002, national airlines of the countries were designated as designated carriers on international routes in bilateral agreements. But in November 2002 the Court of Justice of the European Union found that such a designation was discriminatory and contrary to EU law, it ruled that each EU member state must grant equal market access for routes to destinations outside the EU to any carrier registered in EU. Consequently, bilateral agreements between EU member states and third countries, including Ukraine, were amended to take into account this legal requirement. Thus, low-cost airlines were granted wide access to the Ukrainian market."Air Arabia", "Pegasus Airlines", "Ernest Airlines", "Ryanair", "Wizz Air", "UP", "Vueling Airlines", "Meridiana", "FlyDubai", "EstonianAir", "AegeanAir", "GermanWings", "Air Baltic", etc. [12]. The introduction of low-cost airline flights was carried out after the citizens of Ukraine were given the opportunity to visit EU countries without visas. As the analysis of the annual reports of

the State Aviation Service of Ukraine showed, during 2018-2020, the operating conditions of air lines gradually expandedunder bilateral agreements regulating air traffic between Ukraine and other countries, in particular, changes in designated carriers and flight frequencies.

Here the issue is the Agreement on the "Common Aviation Space" between the European Union and its member states and Ukraine (hereinafter - the "SAP" Agreement with Ukraine), which was signed on October 12, 2021 at the 23rd Ukraine-EU Summit. Accordingly, on February 17, 2022, the Vysha Rada of Ukraine ratified it. Since then, the implementation of the provisions of EU Directives and Regulations into the national legislation of Ukraine in accordance with the annexes of the Agreement is not voluntary, but mandatory.

According to its content, the Agreement on SAP regulates the establishment of a single list of rules for the provision of air transport services between the EU and Ukraine, which, according to the results of the analysis, mainly concerns the following components: (a) flight safety (Article 7), (b) aviation safety (Article 8) , (c) organization of air traffic (Article 9). The specifics of the concluded agreement are determined by the existence of a large-scale aviation industry in Ukraine and the related regulation of cooperation in the field of aviation equipment production. Thus, Article 12 regulates cooperation in the production sphere. In particular, it is said that the parties aim to promote cooperation in the production sphere, in particular by: (i) developing business relations between manufacturers of aviation equipment of both Parties; (ii) promotion and development of joint projects, that will contribute to the stable development of the air transport sector, including its infrastructure; (iii) technical cooperation to comply with European Union standards; (iv) expansion of opportunities for manufacturers and developers of aviation equipment; and (v) investment promotion under this Agreement [10]

Annex II regulates the introduction of changes to the regulations regarding the commercial operation of contractual lines as follows:

1. Each Party grants air carriers of the other Party the right to provide air transportation services on the following routes:

(a) for European Union air carriers: any point in the European Union:

- intermediate points in the territories of the partners of the European Neighborhood Policy, countries of the European Economic Area Agreement - any point in Ukraine - points outside the borders;

(b) for air carriers of Ukraine: any point in Ukraine - intermediate points in the territories of partners of the European Neighbourhood Policy, countries of the ECAP Agreement - any point in the European Union.

(in) air carriers of the European Union are also allowed to carry out air transportation between points in Ukraine, regardless of whether these transportations begin or end within the EU [10, 11].

Appendix III stipulates transitional provisions between the first and second stages of the Agreement. The basis for moving to the second stage is a positive assessment based on the results of the inspection carried out by the European Commission and the Aviation Safety Agency of the European Union. In particular, the Agreement states that during the first transitional period:

a) air carriers of the European Union and air carriers that have received a Ukrainian license have the right to use unlimited commercial rights between any point in the European Union and any point in Ukraine,

b) depending on the results of the assessment of the state of implementation of the relevant requirements and standards of the European Union by Ukraine and further informing the parties, Ukraine is involved as an observer in the work of the Joint Committee, which is created in accordance with the

provisions of Regulation (EC) No. 95/93 on common rules for the allocation of slots at the airports of the European Community ; and

c) the provisions of Article 22 (Commercial opportunities), subparagraph 5(c) (Ground handling of air carriers of other parties) do not apply.

The conditions for the transition to the second transitional period provide for the following for Ukraine:

a) incorporation into national legislation and implementation of applicable requirements and standards:

b) application of air carrier licensing rules, mostly equivalent to those specified in Chapter II of Regulation (EC) No. 1008/2008 of the European Parliament and the Council of September 24, 2008 on common rules for air transportation in the European Union;

c) regarding aviation safety – implementation of Part II of Document 30 of the European Civil Aviation Commission in its latest version.

Table 2.9 below presents the results of the input analysis in a systematic manner Directives and Regulations of the EU to the normative legal acts of Ukraine for the implementation of the Agreement on CAA regarding the components of Annex I.

Table 2.9

Analysis of the status of introducing the requirements of Regulations and Directives valid in the EU into the legal system of Ukraine for the implementation of the Agreement on CAA regarding component A of Annex I

List of requirements and standards of EU acts subject to be included into the Ukrainian legal acts regarding the Agreement	List of normative legal acts of Ukraine implementing requirements and standards of EU acts
Appendix I "A. Market access and related issues"	
EP/EC Regulation No. 1008/2008 on common rules for air carriage	Including of this regulation into the Ukrainian legal acts is envisaged by making changes to the Air Code of Ukraine (ACU), the Law of Ukraine - On

	economic activities' licensing types.
European Council Regulation (ECR) No. 95/93 amended by: Regulation No. 894/2002, Regulation No. 1554/2003, Regulation No. 793/2004, Regulation No. 545 /2009, Regulation No. 2020/459 and Regulation No. 2021/250 of the European Parliament and the Council, included in Council Regulation (EEC) No. 95/93	Council Regulation (EEC) No. 95/93 is partially implemented in Ukraine. The maim principles of slot appointment in accordance with ECR No. 95/93 were set out in the ACU. Accordingly, all the procedure' issues are stipulated in the Order No. 645 dated July 16, 2004 issued by the Ministry of Transport
European Council Regulation 96/67/EC of 15 October 1996 on access to the market of ground handling services provision at EU airports	Aviation regulations of Ukraine "Access to the market of ground handling services and rules for certification of aviation entities providing ground handling services" are being developed by DAAU
EP/EC Regulation No. 785/2004 on insurance issues for airlines and airplane operators, as amended by: a) Commission Regulation No. 285/2010 of April 6, 2010 on amendments to Regulation No. 785/2004 of the European Parliament and Council of April 21, 2004 on insurance requirements for air carriers and aircraft operators; b) Commission Delegated Regulation No. 2020/1118 of April 27, 2020 on amendments to EP/EC Regulation No. 785/2004	In Ukraine, aviation insurance is carried out in accordance with the terms and conditions of the Procedure and Rules for Mandatory Aviation Insurance of Civil Aviation, approved by Resolution No. 676 of the Cabinet of Ministers of Ukraine dated 06.09.2017. This Procedure and the rules as a whole comply with Regulation (EC) No. 785/2004 of the European Parliament and of the Council of April 21, 2004 on insurance requirements for airlines and airplane operators

Source: [11]

According to the results of the systematization of the component of Appendix I "V. The organization of air traffic found that since the vast majority of EU Regulations concern the organizational and technical elements of air traffic control, ensuring the airworthiness of aircraft, components and equipment, as well as improving the Rules for the technical investigation of incidents and aviation events in civil aviation, they are subject to processing by the State Traffic Safety Administration together with State Enterprise for Air Traffic

Management of Ukraine "Ukraerorukh" and the Ministry of Defense of Ukraine,

Table 2.10

Analysis of the status of introducing the requirements of the Directives and Regulations in force in the EU into the legislative and regulatory acts of Ukraine for the implementation of the Agreement regarding components C and F of Appendix I

List of requirements and standards of EU acts subject to implementation into the legal system of Ukraine, respectively the Agreement	List of normative legal acts of Ukraine implementing requirements and standards of EU acts
C. Impact on environment	
ES/EP Directive 2002/49/EC dated June 25, 2002 on environmental noise measurement and control, as amended by: Commission Directive (EU) 2015/996 of May 19, 2015 establishing general methods of noise assessment in accordance with Directive 2002/49/EC of the European Parliament and of the Council. ES/EP Regulation No. 598/2014 of 16 April 2014 laying down rules and procedures for the introduction of noise-related operational restrictions at Union airports within the framework of the Balanced Approach and repealing Directive 2002/30/EC.	In order to lay the foundations of aviation noise control at airports, the Aviation Rules of Ukraine, namely the chapter "Requirements to the airport operator concerning zoning of the territory adjusted to the airport from the consequencience of the impact of aviation noise" (order No. 381 State Aviation Service) were adopted, which are based on the principles of the directive of the European Parliament and the Council of June 25, 2002 No. 2002/49/EC on measurement and control of processes related to environmental noise. In accordance with the requirements of Aviation Rules No. 381, the results of measurements of the characteristics of aviation noise are periodically published on the websites of the airport (aerodrome) and are considered as a basis for monitoring the implementation of measures aimed at reducing aviation noise. Aviation noise contours are an information base for summarizing statistical information on

	the characteristics of aviation noise at the airport (on the airfield) and in the area near it, informing the population, relevant state bodies and local self-government bodies about the characteristics of noise, clarifying the actual zones of influence of aviation noise in the area near the airport (airfield) to take into account the prospects for the development of settlements. For the purpose of accessibility and comprehensibility of the data on the levels and contours of the traffic noise, the use of an online system for collecting information on noise from the aviation infrastructure (with geospatial information) and visualization (using an interactive map of Ukraine) - NOMOS - is proposed. https://nomos.avia.gov.ua/
F. Issues on consumer rights protection	
Council Regulation No. 2027/ on the liability of airlines in the event of aviation accidents, as amended by Regulation No. 889/2002 of the European Parliament and of the Council of May 13, 2002 amending Council Regulation No. 2027/97. Regulation No. 261/2004 of the European Parliament and Council of February 11, 2004 on establishing general rules for compensation and assistance to passengers in the event of denied boarding and cancellation or long delay of flights, as well as repeal of Regulation (EEC) No. 295/91. Regulation No. 1107/2006 of the European Parliament and of the Council of July 5, 2006 on the rights of disabled persons and persons with physical disabilities during air travel.	Provisions of EU Regulations 261/2004, 1107/06 and 2027/97 are fully included into legal acts of Ukraine. In particular, the provisions of the above-mentioned normative acts are included in the Aviation Code of Ukraine, Articles 100, 102-107, the Aviation Rules of Ukraine.

Source: [11]

The phased opening of the market is due to the need to equalize the conditions for air carriers of both sides in the formation of passenger flows through the gradual adaptation of Ukrainian legislation to EU Directives and Regulations, the introduction of uniform flight safety standards, the modernization of Ukrainian airports, etc. This approach will ensure compliance with one of the main principles of the Chicago Convention on ensuring equal and fair opportunities for the parties [11].

In accordance with the provisions of the Agreement, in the first transition period air carriers of the EU and air carriers that have received a Ukrainian license have the right to use unlimited commercial rights between any point in the EU and any point in Ukraine (called 3rd and 4th air freedoms). World experience has shown that the opening of access to the air market usually leads to an increase in the offer of air transportation services, an increase in passenger traffic due to a decrease in tariffs. This is often accompanied by the entry of new airlines into the market, an increase in the market share of world leaders, and the expansion of their route network, which clearly contributes to the improvement of the quality of passenger service and activates business activity in the country's economy in general.

The study revealed the positive dynamics of bringing Ukraine's requirements for the flight operation of aircraft into compliance with EU aviation safety requirements, introducing appropriate procedures for Ukrainian aviation entities and objects of aviation activity by incorporating relevant EU directives and regulations into the Air Code, Aviation Rules of Ukraine and other regulatory documents. It should be noted that in connection with the full-scale military invasion of Russia on the territory of Ukraine, the introduction of the legal regime of martial law and the closure of the airspace of Ukraine, the civil aviation industry suffered extremely large losses, which is connected, in particular, with the impossibility of flights by civilian aircraft. But thanks to the high degree of implementation

of the EU regulatory regulation in the legislation of Ukraine, the civil aviation industry suffered extremely heavy losses, which is associated, in particular, with the inability to fly civilian aircraft. But due to the high degree of implementation of EU regulatory regulation in the legislation of Ukraine, Ukrainian airlines under martial law continue to play an important role for the country's economy: air carriers with a domestic certificate of aircraft operator carry out flights to transport passengers and goods, in particular in the EU countries.

The State Aviation Service is the central body of the executive power, the activities of which are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Infrastructure, which implements the state policy in the field of civil aviation and the use of airspace of Ukraine and is the authorized body for civil aviation issues.

According to the Regulation on the State Aviation Service of Ukraine, approved by the Cabinet of Ministers of Ukraine Resolution No. 520 dated October 8, 2014, the main tasks of the State Aviation Service are the implementation of state policy in the field of civil aviation and the use of Ukrainian airspace; submission of proposals to the Minister of Infrastructure to ensure the formation of state policy in the field of civil aviation and the use of Ukrainian airspace; organization of the use of the airspace of Ukraine; implementation of state control and supervision over the safety of civil aviation, supervision over the provision of air navigation services.

Since the implementation of Directives and Resolutions valid in the EU into legislative and regulatory acts of Ukraine is carried out with the direct participation of specialists of the State Aviation Service of Ukraine, the main directions of its activities for 2023 related to the implementation of the Agreement on "SAP" are systematized below.

So, among the list of issues of rule-making activity, it is advisable to highlight the following:

1) the draft Law "On Amendments to Certain Legislative Acts of Ukraine Regarding State Regulation of the Activities of Air

Carriers Related to the Transportation of Passengers, Cargo, and/or Mail by Air," which should be drafted by the end of 2023.

2) resolutions of the Cabinet of Ministers of Ukraine:

a) "On Amendments to the Licensing Conditions for Conducting Business Activities for the Transportation of Passengers, Dangerous Goods, and Hazardous Waste by Air";

b) "On the approval of the State Program for Quality Control of Aviation Safety of Civil Aviation".

3) orders of the State Aviation Service:

a) "On the approval of the Aviation Rules of Ukraine "Rules for the operation of unmanned aircraft";

b) "On the approval of the plan of cyber protection measures, countering cyber threats and ensuring cyber security for 2023";

c) "On the approval of the Aviation Rules of Ukraine "Maintaining the airworthiness of aircraft and aircraft products, components and equipment and approval of organizations and personnel involved in the performance of these tasks" (in the new version);

d) "On the approval of the Methodological recommendations for the development, approval and support of the Instructions for the execution of flights and the Instructions for the use of air space"

e) "On the approval of changes to the Aviation Rules of Ukraine "Rules for providing aeronautical information"

e) "On the approval of the APU "Technical requirements and administrative procedures for the certification of aerodrome meteorological equipment"

g) "On the approval of changes to the Aviation Rules of Ukraine "Requirements for air navigation service providers, flight procedure design service providers, aeronautical data providers and the system of certification and supervision of them" and other legal acts;

g) "On approval of the Aviation Rules of Ukraine "Organization and conduct of ground and flight inspections of

ground means of communication, navigation, surveillance and light signaling equipment of civil aviation of Ukraine"

h) "On approval of the Aviation Rules of Ukraine "Rules for issuing permits for aircraft flights in the airspace of Ukraine"

i) Draft order of the State Aviation Service of Ukraine, Ministry of Defense of Ukraine "On approval of changes to the Aviation Rules of Ukraine "General rules of flights in the airspace of Ukraine"

i) "On amendments to the Aviation Rules of Ukraine, Part 21 "Certification of aircraft, related products, components and equipment, as well as developer and manufacturer organizations" APU-21 (Part-21)"

k) "Procedure and conditions of civil aviation risk insurance"

l) "On amendments to the Aviation Rules of Ukraine "Procedure for notification of events in the field of civil aviation, consideration of received information, its analysis and taking appropriate measures", approved by order of the State Aviation Service dated 12/27/2019 No. 1817;

m) "On approval of changes to the Aviation Rules of Ukraine "Technical requirements and administrative procedures for certification of airfields";

n) "On the approval of the Aviation Rules of Ukraine "Rules for admission to operation of airfields";

o) "On Amendments to the Aviation Rules of Ukraine "Technical Requirements and Administrative Procedures for Flight Operation in Civil Aviation", approved by Order of the State Aviation Service of Ukraine dated 07/05/2018 No. 682, registered with the Ministry of Justice of Ukraine on 09/27/2018 under No. 1109/32561 " and other.

In addition to the specified activities related to the development of legislative and regulatory documents, the DAAU carries out organizational work in such areas as:

1) implementation of supervision and control over compliance by subjects of aviation activity with the requirements of regulatory and legal acts; implementation of test measures

(situational experiments) of aviation security, introduced by subjects of aviation activity (provided that the security situation improves and martial law is abolished); supervision of the financial capacity of operators and mandatory aviation insurance of civil aviation in accordance with the approved inspection plans; conducting internal audits, etc.

2) carrying out activities on certification and supervision of subjects and objects of aviation activity and conducting methodical classes with representatives of operators on issues of achieving uniformity in informing airspace users about aeronautical information, etc.

3) conducting seminars, consultations with representatives of the industry on various related issues, holding meetings, preparing draft plans, reporting information, monitoring and other work, in particular, publishing relevant materials on the official website of the State Aviation Service, which will contribute to increasing the degree of openness.

The following should be identified as priority directions for the restoration of civil aviation of Ukraine in the post-war period:

- inreconstruction and further development of the airport infrastructure of Ukraine;
- modernization of regional airports and bringing their technical condition in line with modern ICAO standards in order to serve new types of aircraft;
- inrestoration and development of air mobility of the population and the transit potential of the airspace of Ukraine, restoration of cargo air transportation;
- expansion of the network of international air connections with partner countries;
- adaptation of national aviation legislation to EU legislation within the framework of the implementation of the Agreement on "SAP";
- preservation of aviation personnel of Ukraine and their qualifications.

In the short-term perspective, the priority direction is the development of a project of a new national strategy for the development of the civil aviation industry (first of all, in the part related to the optimal market positioning of airports), which should be taken into account when preparing general plans for the recovery of regional vitality. At the same time, it is appropriate to take into account: the number of population in each region (taking into account the internally displaced); production facilities (production facilities, factories, enterprises) that were not damaged, production facilities (production facilities, factories, enterprises) that were damaged and the estimated time required for restoration; tourist and business potential of the region.

The main priorities for the recovery of civil aviation in the medium term are as follows:

- carrying out an assessment of the condition of damaged/destroyed property at the objects of the aviation infrastructure and making a decision regarding the expediency of its restoration, taking into account the general plans for the restoration of the vitality of the regions and plans for the development of transport connections by other modes of transport (high-speed rail, road, inland waterways);
- modernization of regional airports and bringing their technical condition in line with modern ICAO standards in order to serve new types of aircraft;
- restoration of functioning of Ukrainian airports;
- restoration of the provision of air navigation services in the airspace of Ukraine
- creation of conditions to stimulate the recovery and development of air traffic.

The strategic stage of the restoration of civil aviation can be defined as the stage of structural modernization and full integration into the EU, the main priorities of which should be the further modernization of regional airports in order to ensure the suitability of their infrastructure for servicing modern aircraft, based on the prospects of increasing demand for air

transportation; the development of new technologies aimed at the transition to sustainable aviation fuels (SAF), the adoption of global market measures regarding carbon (CO2) emissions within the framework of the System of compensation and reduction of CO2 emissions for international aviation (the CORSIA program).

2.2. Strategic management of aviation security of Ukraine and the EU as a tool for ensuring the sustainable development of the national economy

Strategic management of the safety of transport systems is an effective tool in the process of supporting the sustainable development of both the economy in general and the industry in particular [13]. Strategic management of aviation security is provided by three hierarchical levels of management: global, regional-international and national.

At the global level, the strategic management of air transport safety is implemented by the International Civil Aviation Organization (ICAO). ICAO develops standards and recommended practices for 193 member countries of the organization. They are set out in 19 Annexes to the Convention on International Civil Aviation (Chicago Convention of 1944) [14]. Appendix 19 "Safety Management" [15] is devoted to the development of the global aviation safety management system. ICAO's strategic goals are correlated with 15 of the 17 UN Sustainable Development Goals [16]. The organization strives to work closely with states and UN bodies to support the respective goals. ICAO carries out systematic work on the implementation of standards and recommended practices in the areas of safety, efficiency and regularity of air transport of the world air transport.

Ukraine is a full member of the UN and ICAO, fully complies with the standards and gradually implements the organization's recommended practices. On June 14, 2019, the ICAO Council approved the third edition of the Global Aviation Safety Plan for 2020-2022. This document defines global strategic directions for

the development of aviation safety and provides a basis on which regional, subregional and national action plans will be developed and implemented, which contributes to the harmonization and coordination of international civil aviation activities [17]. The Global Aviation Safety Plan (GASP) outlines a strategy for continuous improvement, which includes the following strategic goals of states: development and implementation of aviation safety control systems, implementation of state aviation safety programs, development of aviation safety control systems, including proactive risk management. Systematic studies on the development of constant monitoring of threats and anticipatory risk management of the aviation safety management system are carried out by specialists of the International Air Transport Association (IATA) [18], the Airports Council International (ACI), the Civil Aeronautics Organization (CANSO), the Council of Aerospace Industry Associations (ICCAIA), Air Transport Action Groups (ATAG) and other global organizations [19]. The leaders of the aviation industry, Boeing and Airbus, provide forecasting of the development of the industry at the global level [20].

At the regional-international European level, the strategic management of aviation safety in the context of sustainable development is implemented within the powers of leading regional organizations in the field of aviation. In Europe, the European Parliament and the Council of the EU [21], the ICAO European and North Atlantic Bureau (Paris, France), the European Aviation Safety Agency (EASA) [22], the European Conference play a primary role in ensuring an agreed level of safety and sustainable development of civil aviation of Civil Aviation (ECAC) [11], European Organization for the Safety of Air Navigation (EUROCONTROL) [23]. In order to regionally implement the ICAO Global Aviation Safety Plan, each region must prepare a regional aviation safety plan. In 2021, the third edition of the European Regional Aviation Safety Plan (EUR RASP) was published [24]. EUR RASP uses the EU security risk management process in the interests of all 55 European states. This means that identifying and assessing safety issues,

developing measures to reduce negative consequences and measuring their effectiveness provide some feedback that can then be used to reduce systemic and operational safety risks in the European aviation system. The European Aviation Security Plan 2020-2024 (EPAS) [25] is the main medium-term document that provides a holistic and transparent security management framework at the regional and national levels, supporting objectives and tasks of the Global Aviation Security Action Plan (GASP) [16]. Ukraine is a full member of ECAC and EUROCONTROL, but it is not a member of the European Aviation Safety Agency (EASA) and the EU, having the status of an associated state. In Ukraine, European norms and regulations are systematically implemented in the process of harmonization of the main aviation legislation, which creates certain restrictions at the regional level.

The national air transport security system is developing in the context of the implementation of the Law of Ukraine "On National Security of Ukraine" dated June 21, 2018 No. 2469-VIII [26]. Periodic monitoring of its activities is carried out by the State Committee of Statistics of Ukraine [27] and the State Aviation Service of Ukraine [28] and the National Bureau of Investigation [29] of aviation events and incidents involving civil aircraft.

Therefore, issues of strategizing aspects of air transport safety and its sustainable development receive considerable attention at the global, regional, and national levels. It is quite obvious that the safety of air transport directly depends on its economic and technological development, aviation infrastructure, social and environmental components. That is, the safety of aviation transport is a component of the system of sustainable development of the industry in particular and the national economy as a whole. The integration of the strategic management of aviation safety of Ukraine and the EU is a necessary condition for entering the path of sustainable development of the industry.

Background, objectives and principles of the European Regional Aviation Safety Plan (EUR RASP). The main objective of the EUR RASP is to focus common attention on regional aviation security issues as a continuation of the European work to improve aviation security and ensure full compliance with ICAO standards. This approach complements the existing system of development of safety rules, their compliance and investigation of aviation disasters and serious incidents in case of their occurrence [30].

The EUR RASP adds a proactive element to the current system by closing the security management cycle and linking security issues at the regional level to action plans and initiatives implemented to mitigate the underlying risks.

The EUR RASP sets the first level of priorities, which are further supplemented at the national level by National Aviation Security Plans (NASPs) compiled within the framework of state aviation safety programs. It creates a field of action because coordination and close collaboration are key to maintaining its relevance and effectiveness.

Since 2017, the ICAO Regional Office for the European Region and EASA have been working together to develop a Regional Aviation Security Plan (RASP) based on the European Aviation Security Plan (EPAS), thus allowing all States that are part of the European Region to benefit from this approach. The systemic approach consists in the comprehensive use of mechanisms of the European security risk management (SRM) process for the entire Euroregion.

The first edition of the EUR RASP, covering the period 2019-2021, was issued on 31 January 2019 following approval at a joint meeting of the coordination groups of the European Air Navigation Planning Group (EANPG) and the Regional Flight Safety Group - European Region (RASG-EUR) [31] ICAO. The second edition of the EUR RASP, covering the period 2020-2022, was adopted in June 2020[32]. The third edition of the EUR RASP, covering the period 2022-2024, was adopted in December 2020[33].

The EUR RASP is updated annually to maintain consistency with EPAS. Given the disruption caused by the COVID-19 pandemic and its impact on all aviation stakeholders, the focus of EPAS 2021-2025[34] and EPAS 2022-2026[35] is to adjust the rulemaking output to alleviate the additional burden on stakeholders and ensuring a safe return to operations. This also meant that no significant changes were made to the strategic priorities, so the EPAS 2021 cycle did not represent a major update to EPAS. Accordingly, the strategic priorities in this edition of the EUR RASP remain stable.

Given the impact of the COVID-19 pandemic on aviation stakeholders, no annual review of the EUR RASP was initiated in 2020. Therefore, the EUR RASP 2022-2024, being the third edition of the regional plan, considers the changes introduced both from the EPAS 2021-2025 and the final draft EPAS 2022-2026.

This publication has been prepared in coordination with the ICAO EUR Regional Safety Expert Group (RESG), a working group within the framework of the European Aviation System Planning Group (EASPG), to support the development and implementation of the EUR RASP, including safety improvement initiatives and performance in line with the objectives EASPG.

European Aviation Safety Plan (EPAS). The EUR RASP builds on the experience gained by EASA, the EU and ECAC in the development and implementation of EPAS. EPAS is a key component of the Safety Management System (SMS) at European level, which is described in the European Aviation Safety Program (EASP). The regional approach complements national approaches by offering more effective means of fulfilling the state's obligations regarding safety management in the EU aviation system. EPAS constitutes the regional security plan for EASA Member States, which sets out strategic priorities, strategic mechanisms, the main risks affecting the European aviation system and the necessary actions to mitigate these risks to further improve aviation safety. In view of the sharp reduction in traffic volumes due to the COVID-19 crisis and the new risks

caused by its consequences, EPAS 2022-2026 sets a desirable safety objective to collectively maintain a pre-pandemic high level of aviation safety during the recovery phase and to improve safety after recovery. EPAS covers a five-year period and is reviewed and updated annually.

Due to the specific difference in coverage areas for EPAS and EUR RASP and with due regard to the legal obligations arising from EPAS for EASA Member States in accordance with Regulation (EU) 2018/1139, Chapter II Aviation Safety Management [36], it was agreed to maintain both documents, while ensuring that they were consistent as far as practicable and not contradict each other.

The strategic priorities of EPAS derive from the EU Aviation Strategy. The main security risks and corresponding mitigation actions feeding the EPAS are developed through the European Security Risk Management SRM process. It includes a set of processes that are aimed at identifying safety issues that are the cause and factors that contribute to the occurrence of various consequences of disasters and ensure their mitigation. This involves analyzing data from various sources and collaborating with aviation security partners from national aviation authorities and industry through The Collaborative Analysis Groups (CAGs) and the Network of Aviation Security Analysts (NoAs).

Transport is one of the key industries of any state. It is considered as a tool for solving priority political and economic tasks, as well as a means of ensuring defense capability. The volume of transport services directly depends on the level of economic growth of the country. At the same time, transport itself stimulates an increase in the level of economic activity. An important link of the unified transport system is air transport, which occupies a significant place in connecting Ukraine with other countries and their individual regions. Its effectiveness should contribute to stabilization, structural transformations, development and implementation of foreign economic activity, improvement of the quality of life of the population, and protection of Ukraine's national interests. Under the conditions

of changing the concept of development of the industry, the existing aviation legislation, as a component of the process of national regulation of air transport, in some aspects does not fully satisfy today's needs of the aviation industry. In the legislation that regulates relations in the field of civil aviation security, there are certain areas of uncertainty, the consequence of which is the inability to fully regulate the aviation industry in modern economic conditions [37].

It should be taken into account that the development of the market of own international air transportation takes place under the influence of the worldwide processes of globalization and liberalization, which affects the development of the entire world air transport. Right now, Ukraine faces the task of reorienting its legislation to modern standards of international and European air connections. Prospects for improving the legal regulation of air transport are constantly being studied by the world's leading organizations in the field of civil aviation, the International Civil Aviation Organization (ICAO) [38] and a number of European institutions and organizations. Strategic management of the safety of transport systems is an effective tool in the process of ensuring the sustainable development of both the economy as a whole and the industry in particular.

Generally accepted in world practice, taking into account the peculiarities of each state, the national (state) regulation of air transport includes three main processes:

1) legislative (development of laws, rules, regulations);

2) licensing (issuance of permits, application of restrictions, refusal to issue or revocation of permits for air transportation on a permanent or long-term basis);

3) special permit (certification) [39].

The legislative process of state regulation includes, as a rule, three components: development of laws; development of state policy; creating rules and regulations.

The United States believes that unrestricted international market access for air transport service providers is a key component in enabling the air transport sector to maximize its

contribution to the global economy. Liberalization agreements, including Open Skies agreements, that ICAO member states have concluded on a bilateral, regional and multilateral basis over the past ten years are evidence of an international consensus on the benefits of liberalization.

The ICAO International Civil Aviation Organization also advocates the acceleration of liberalization processes, as stated in the documents recently adopted by it. In the context of reforming relations in the international aviation system, ICAO pays special attention to legal regulation. In order to implement its conceptual vision for the stable development of civil aviation, the ICAO defines in the "Strategic Goals of the ICAO" a list of strategic goals, one of which is legal regulation, namely the strengthening of legal norms regulating the activities of international civil aviation. ICAO notes that the main issues that are of global importance, require regulation and attention of states and form the basis of this organization's activities are: trade in services; negotiations on air communication with the participation of groups of states; ownership of airlines and control over their activities; aspects of liberalization related to flight safety and aviation security; participation and fair competition; consumer interests; taxation.

The Council of the EU started the first stage of liberalization of the processes of legal regulation by adopting such normative and legal acts as directives, and subsequently, regulations began to be adopted by the Council of Europe to solve the relevant tasks. According to Art. 249 of the 1957 Treaty establishing the European Community, the directive is binding on each member state to which it is addressed, as far as the expected result is concerned, leaving the right to choose forms and means. The Regulation is a general act that is subject to direct use by all EU member states. Thus, the "soft style" of regulation applied at the beginning, which provided for greater freedom of EU member states to implement the requirements of regulatory acts, was gradually replaced by more specific norms that regulate the

activities of air transport entities in detail. Today, international air traffic within the European Union is fully regulated by its law.

The most developed legislation in the field of civil aviation can be considered the aviation legislation of the USA. The main federal law is called the Federal Aviation Act of 1958 [40]. This law of 1958 is a voluminous document that regulates in detail all matters of aviation activity. Basically, its norms are norms of direct effect, which makes this law an effective regulator of the vast majority of aviation relations. The Aviation Law of 1958 is constantly updated. Substantial changes were made to it by the US Congress in 1975, 1978, 1990, 1992 and 1994. Aviation issues are also regulated by other normative legal acts of US legislation.

The state regulation of civil aviation activities of Ukraine is based on the Constitution of Ukraine [41], the Air Code of Ukraine dated 19.05.2011 No. 3393-VI [42], other legislative acts, national normative legal acts, state and industry standards, and standardization guidance documents , regulatory and legal acts of the Soviet era, which primarily concern the rules for the use of aircraft of those times and have not lost their relevance and do not contradict the Constitution and current legislation of Ukraine, valid for Ukraine, acts of international air law, documents of international organizations of which Ukraine is a member [43].

The sustainable development of aviation transport is carried out in the context of comprehensive improvement of the transport system of Ukraine. In 2018, the Decree of the Cabinet of Ministers of Ukraine No. 430 approved the National Transport Strategy of Ukraine for the period until 2030 [44]. The implementation of the National Transport Strategy consists in ensuring the sustainable development of the transport sector of the economy. The strategy includes five priority areas: the development of effective public administration in the transport sector; provision of quality transport services and integration of the transport complex of Ukraine into the international transport network; ensuring sustainable financing of the transport complex; increasing the level of safety in transport; achieving

urban mobility and regional integration in Ukraine. Aviation transport has a special place among its strategic initiatives. In order to develop passenger air transportation, it is proposed to: continue certification of compliance with safety requirements at Ukrainian airports; to ensure compliance of the airport certification procedure and airworthiness review with the provisions of EU directives; to solve the issue of lack of funding needed to support infrastructure development; continue the process of harmonization of national legislation with the EU; create conditions for promotion of new air carriers to the market, first of all, Low Cost models; systematically implement the policy of liberalization of the aviation market. In order to develop cargo air transportation, it is proposed to ensure investment and development of modern multimodal hubs, oriented to service, including cargo air flows; to develop and implement a program for the development of cargo air transportation; to provide adequate financing for the development of air cargo terminals and infrastructure.

According to the provisions of Annex 19 "Safety Management" to the ICAO Convention on International Civil Aviation, strategic aviation safety management at the national level is implemented within the framework of the State Aviation Safety Program (Safety State Program – SSP) [45]. In Ukraine, this direction is regulated by the Flight Safety Program in the field of civil aviation, which was approved at the meeting of the Aviation Safety Council of the State Aviation Service of Ukraine on March 27, 2018. The program has a structure that meets ICAO requirements. However, its main drawback is the level of signatories. Unlike most countries of the world, where this Program was approved by the legislative body (parliament), in some cases - by the Cabinet of Ministers or the National Security and Defence Council, in Ukraine it is made public at the level of the regulator. Therefore, the basis of the Program is the provision of resources for the safety of state aviation transport. Only under the condition of real state support is it possible to assert the effectiveness of the Program. In June 2021, the Decree

of the Cabinet of Ministers of Ukraine No. 656 approved the State Flight Safety Program [46]. This is undoubtedly a sure step forward on the way to the development of the national culture of air transport safety [47].

The development of airports and their infrastructure is the cornerstone of the sustainable development of air transport and aviation logistics. Considerable attention is paid to this direction by the state. Thus, on February 24, 2016, Resolution No. 126 of the Cabinet of Ministers of Ukraine approved the State target program for the development of airports for the period until 2023 [48]. The purpose of the Program is to ensure the sustainable development of aviation transport and its infrastructure, the implementation of global and regional standards in the operation of the national airport system, the development of transit and transfer transportation, and the improvement of the efficiency of state property management. Expected results of the Program: increase in air passenger traffic to the level of 24.3 million passengers by 2023; doubling the capacity of airports; reduction of time for ground maintenance of each aircraft to 35-40 minutes; double the transit potential; development of public-private partnership and non-aviation activities of airports; formation of favourable conditions for Low Cost model airlines, creation of additional jobs [49].

Ukraine is one of ten countries that have a full cycle of development, serial production, operation, maintenance of aviation equipment, as well as an extensive system of training and retraining of aviation specialists. Therefore, the development of the domestic aircraft industry is a strategic priority of the country's development. In November 2020, the Decree of the Cabinet of Ministers of Ukraine No. 1412-r "On the approval of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030" was published [50]. In fact, the government updated the provisions of the Strategy for the Revival of the Domestic Aircraft Industry until 2022, put into effect by the Decree of the Cabinet of Ministers of Ukraine No. 429-r dated

May 10, 2018 [51], and extended the terms of its implementation until 2030. The goal of the Strategy is to restore the stable development of the aircraft industry and ensure the profitability of high-tech production of aviation equipment in Ukraine. The action plan of the Strategy envisages the modernization and production of passenger and transport aircraft of the Antonov family, Mi rotorcraft, unmanned aerial vehicles, import substitution of components. The comprehensive implementation of the Strategy will contribute to the technical re-equipment of the production capacities of aircraft manufacturing enterprises, the creation of modern centres for basic maintenance, the repair of domestically produced aircraft equipment and the certification of aircraft equipment according to international standards. Among the priorities of innovative measures in the air transportation market, it is proposed to create a state regional airline and equip it with a fleet of aircraft of the Antonov family of its own production.

Therefore, it is necessary to approach the issue of harmonizing the legislation of Ukraine on air transport with the norms of international and European law in a comprehensive manner. This should be done through the further joining of the state to multilateral and bilateral agreements on the development of international air traffic, through the fulfilment of obligations arising from membership in international organizations, as well as in the process of preparing relevant regulatory acts. To date, not enough attention is paid to the joint research of scientists on law, economics and public administration in matters of harmonization of air law of Ukraine. The consequence of this is the imperfection of both the current normative legal acts and the normative legal acts that are at the stage of development and adoption. The way out of the situation can be seen in the further continuation of research in the direction of harmonization of the legal regulation of air transport of Ukraine with the joint participation of aviation specialists and scientists in the fields of air law, economics and public administration. A positive role in the process of harmonization of

legal regulation in civil aviation will be played by the further extension of work within the framework of the European Union TWINNING programs, the development of cooperation between the state aviation authority and research universities, national academies and research institutes.

The UN's global strategic document is the 2030 Agenda for Sustainable Development. It is an action plan aimed at ensuring global sustainable development in economic, social and environmental directions, which ensures that no UN member country is left behind. The 17 sustainable development goals on the 2030 agenda can be used as guidelines for the coordinated development of UN member countries (Fig. 2.11.) [52]. It was determined that the achievement of the following Global Sustainable Development Goals (SDGs) directly or indirectly depends on the results of aviation activities: 4. Quality education; 8. Decent work and economic growth; 9. Industry, innovation and infrastructure; 11. Sustainable cities and societies; 13. Climate changes. The defined list of Sustainable Development Goals, in the solution of which aviation transport participates, is not exhaustive. Every year, the number of countries that also connect aviation to a wider range of UN Sustainable Development Goals, such as 4, 8, 9, 11, 13, 14, 16 and 17, is increasing. It is substantiated that the main tasks for aviation are the development of transportation at the national, regional and global levels in order to ensure economic, social and environmental priorities, as well as maintaining an acceptable level of national aviation safety. At the same time, taking into account the specifics of the management process of sustainable development is defined as conceptually fundamental. In contrast to classic management systems, which work according to the principle of "From up to bottom", management of sustainable development needs to ensure cyclicality, that is, a combination of "From up to bottom" (from top to bottom) and "From bottom to up".

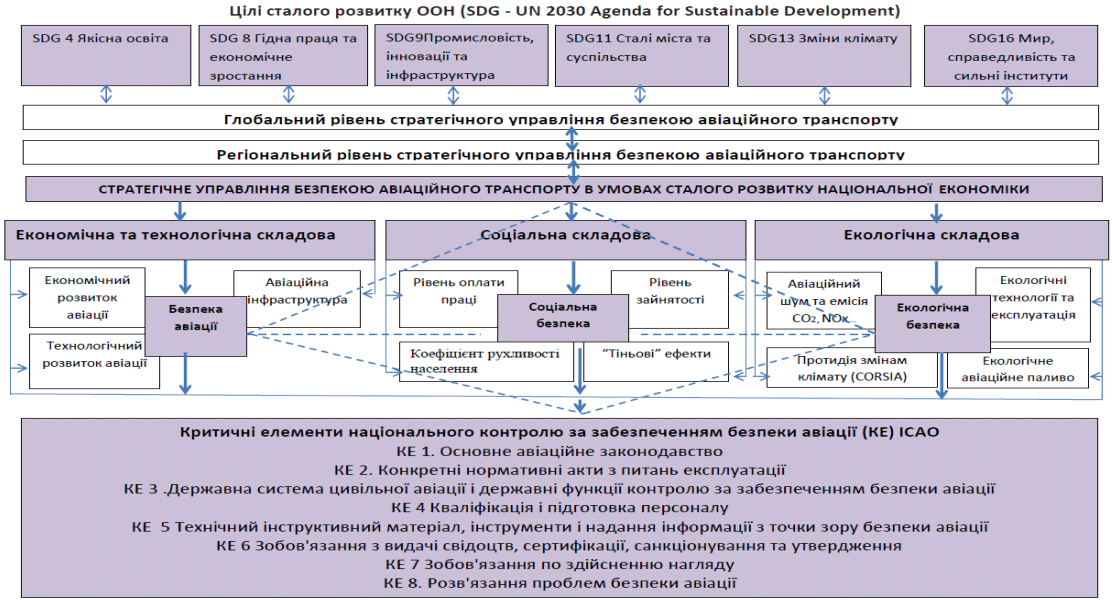

Рис. 2.11. Організаційно-економічний механізм стратегічного управління безпекою розвитку авіаційного транспорту [53].

1. It is possible to say that the strategic goals of sustainable development are the main orientations of humanity, but the strategies for their achievement need constant updating and improvement at the global, regional-international and, above all, national levels. Every year, the challenges to humanity are more and more critical. Under such conditions, only a flexible strategic management system that actively uses the tools of Change Management and an anticipatory integrated risk management system is able to prevent catastrophic consequences for human life.

2. Strategic management of the safety of the aviation industry in the conditions of sustainable development of the national economy includes three components that are integrated in order to solve the complex task of ensuring aviation safety:

3. 1) economic and technological (planning of the economic development of aviation, aviation infrastructure, economic security, aviation security);

4. 2) social (opportunities for obtaining an education, basic services, health and humanitarian assistance, improving the quality of life);

5. 3) environmental (anti-climate change (CORSIA), aviation noise and CO_2 emission, NO_x environmental technologies and operation, ecological aviation fuel).

6. Strategic management of the safety of the aviation industry in the conditions of sustainable development of the national economy consists in the application of an integrated system of anticipatory risk management in solving the tasks of ensuring aviation safety, social and environmental safety. Taking into account the specifics of economic and technological development, social and environmental components of air transport, the concept of comprehensive national security of air transport is proposed, which is the quintessence of aviation security, social security and environmental security by simultaneously achieving all components and indicators of sustainable development criteria thanks to strategic management. The hypothesis that the national air transport

safety management system is an open integrated system that has a number of management, functional and informational connections with subsystems of sustainable development and safety at different hierarchical levels has been proved. Sustainable development goals and air transport are informationally linked to three hierarchical levels of strategic air transport safety management: global, regional and national. These levels are structurally interconnected by managerial (undisputed implementation of standards by regions and countries and voluntary compliance with ICAO recommended practices), functional (interaction of global, regional aviation organizations and national regulators/stakeholders) and information links (exchange of information on aviation safety issues) [54]. At the national level, the information links of the goals of sustainable development are the basis for the development of a set of measures for the development of functional and management links aimed at the systematic achievement of the goals at the national level and ensuring the appropriate contribution of the state at the regional and global levels.

7. *Goal 4 "Quality education"* is provided within the framework of the management of the social component of air transport.

8. *Goal 8 "Decent work and economic growth"* is ensured within the framework of the management of the social component with the help of indicators "level of remuneration in the production of air transport of Ukraine" and "level of employment in air transport".

9. *Goal 9 "Industry, innovation and infrastructure"* is ensured within the management of economic and technological components in the clusters "Economic development of aviation" and "Aviation infrastructure" with the help of such indicators as the level of investment in aviation transport, the level of export services of aviation transport, the level of import services of aviation of transport, the ratio of domestic and international air transportation.

10. *Goal 11 "Sustainable cities and societies"* is ensured within the framework of the implementation of a systemic approach to determining the safety level of sustainable development of aviation transport by managing the economic and technological development, social and environmental components of aviation transport. Solving the task of sustainable development of society is the quintessence of strategic management of air transport safety in the conditions of sustainable development of the national economy.

11. *Goal 13 "Climate change"* is ensured within the framework of managing the environmental component with the help of the following indicators: the ratio of the CO_2 emission level of aviation transport of Ukraine to GDP; the level of emissions of pollutants into the atmospheric air; the level of expenses for environmental protection.

12. *Goal 16 "Peace, justice and strong institutions"* is achieved within the economic and technological components. Aviation transport of Ukraine takes an active part in UN humanitarian missions, primarily in unstable regions, and achieves significant results in the fight against famine and epidemic diseases. Domestic transport airlines play a special role in this. Among them, the undoubted leader is the "Antonov" airline, which carries out cargo transportation on the world's largest transport planes.

13. *Critical elements of national control over aviation safety IKAO*. The results of the strategic management of the safety of the aviation industry in the conditions of sustainable development of the national economy are the state's achievement of high indicators of the implementation of 8 critical elements (CE) of the system of state control over aviation safety, namely:

14. CE 1. Basic aviation legislation.

15. CE 2. Specific normative acts on exploitation.

16. CE 3. State system of civil aviation and state functions of control over aviation safety.

17. CE 4. Qualification and training of personnel.

18. CE 5. Technical instructional material, tools and provision of information from the point of view of aviation safety.

19. CE 6. Obligations for issuing certificates, certification, authorization and approval.

20. CE 7. Obligations regarding supervision.

21. *CE 8. Solving aviation safety problems* [55].

22. Compliance with the requirements of critical elements is the basis for the state's maintenance of a satisfactory level of aviation security. National strategic security management in order to develop a positive impact on the sustainable development of the national economy is implemented at the level of aviation transport enterprises. Taking into account the above, the second part of the work will be devoted to the development of the theoretical-economic and methodological foundations of the impact of strategic management of air transport safety on the sustainable development of the national economy at the level of airlines, airports in the performance of international air transportation, the interaction of aviation logistics market subjects in solving the tasks of sustainable development of the national economy and integration of remotely piloted aircraft systems into the air transport system of Ukraine [56].

23. One of the main tasks of the integration of strategic aviation safety management of Ukraine and the EU is the actualization of the role of national aviation transport in achieving the UN Strategic Goals, declared in the Sustainable Development Agenda until 2030. Taking into account the specifics of the management process of sustainable development is defined as conceptually fundamental. In contrast to classic management systems, which work according to the principle of "From up to bottom", management of sustainable development needs to ensure cyclicality, that is, a combination of "From up to bottom" and "From bottom to up". The strategic goals of sustainable development are the main orientations of humanity, but the strategies for their achievement need constant updating and improvement at the global, regional-international and, first

of all, national levels. That is, it is possible to assert the interdependence and the need for structural integration of all hierarchical levels of aviation safety management, primarily the national level of aviation of Ukraine and the regional-international level of the EU. The integration of the strategic management of aviation security of Ukraine and the EU is an effective tool for ensuring the sustainable development of the national economy and maintaining an agreed level of security in the industry.

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CHAPTER 3
DEVELOPMENT OF TRANSPORT AND LOGISTICS NETWORKS: OPPORTUNITIES FOR IMPLEMENTING THE EUROPEAN EXPERIENCE

3.1 European approaches to identifying innovative priorities for smart specialization in the field of transport

The modern innovative development of European regions is linked to the concept of smart specialization, which is an innovative approach aimed at stimulating production and job growth in the EU by enabling each region to identify and develop its own competitive advantages. Through partnerships and a bottom-up approach, smart specialization brings together local authorities, academia, business and civil society to work on long-term growth strategies. Features of smart specialization include:

- focus on the region's own strengths and comparative competitive advantages;
- focus on the priority of investment in research and innovation in the competitive area;
- focus on a common vision of regional innovation.

By 2020, more than 120 smart specialization strategies have been implemented across the EU, directing more than €40 billion in research and innovation funding (and more than €65 billion including national co-financing). Representing a local approach to innovation policy, smart specialization requires regions and Member States of the European Union to focus their investments on a limited number of well-defined research and innovation priorities, developed and implemented through continuous interaction between policy makers and stakeholders.

Thus, based on the concept of smart specialization, regions practice concentration of resources and focus on the development of distinctive and original areas of specialization [1]. Regional research and innovation strategies for smart

specialization are integrated programs of economic transformation that accomplish five important tasks:

- focus investments on key regional priorities that are based on ICT-related knowledge;
- are based on the region's strengths, competitive advantages and potential;
- support technological and practical innovation and aim to stimulate private sector investment;
- fully involve stakeholders and encourage innovation and experimentation;
- are evidence-based and include robust monitoring and evaluation systems.

Traditionally, EU strategies to support innovation development in the regions have focused on creating a general enabling environment and opportunities for innovation, such as support for universities, intellectual property rights, scientific infrastructure, ICT, competition and openness, and human capital formation. The strategy, now defined as a key component of the EU's cohesion policy, retains this emphasis on horizontal measures, but adds a smart specialization "logic" that focuses on more vertical interventions. This implies the identification and selection of desirable technologies, areas, subsystems that could be promoted through regional policy. Such a focus enhances the effects of innovation specialization and is a desirable evolution, as it helps to maximize the benefits of the size and critical mass of R&D sectors that are in close proximity to each other and creates favorable opportunities for spillovers of knowledge created by others. This innovation specialization creates opportunities for small businesses to grow by focusing on a "reasonable" number of original innovation areas. European practice shows that regions are more effective if they practice resource concentration by developing distinctive and original areas of specialization.

However, prioritizing certain technologies always entails unpredictability, as it involves predicting future developments in technology and markets. Defining the desired areas of

intervention in a vertical way - which technologies, which subsystems - is extremely complex and risky. The conventional strategies for minimizing these risks are of two types:

- "café para todos": politicians like to distribute money to all territories (regions) and do not like to make a choice between them. However, in this case, no serious prioritization can be expected.
- imitation (repetition) of the practice of other regions, in order to distribute the risk of failure among all of them in case the choice turns out to be a failure.

Smart specialization is also a regional policy goal that helps local government officials identify areas and activities for potential regional specialization. The difficult policy challenge facing smart specialization is to emphasize the vertical logic of prioritization while avoiding the failures associated with top-down and centralized bureaucratic processes of selection and technology selection. How do we prioritize and privilege some R&D activities, some subsystems, or some industries, without diminishing the power of market-based resource allocation to stimulate decentralized entrepreneurial experimentation? Prioritizing vertically is difficult, which is why smart specialization is about defining a method that helps policymakers identify the desired areas for innovation policy intervention.

This is why prioritization is a crucial element of smart specialization. Resources should be concentrated in specially selected areas related to certain types of technologies, industries, disciplines, subsystems within a sector or at the interface between different sectors.

Smart specialization is focused on identifying potential through experimentation and the discovery of technological and market opportunities, as well as providing additional information to other actors in the economy. It aims to generate economies of scale and agglomeration, as well as to identify coordination failures between certain economic activities (for example, a certain business may not develop in terms of

profitability if there is no simultaneous investment in a related industry).

In order for smart specialization to be effective in practice, a number of researchers [1-5] have formulated five basic principles:

- optimization of detailing;
- entrepreneurial discoveries;
- changing priorities;
- inclusiveness;
- experimental approach and evaluation.

The first principle is quite difficult to implement, as it involves developing priorities at the so-called middle level. At this level:

- new activities or projects involve groups of firms and research partners;
- the aim is to explore a new area of (technological and market) opportunity;
- the priority has potentially a certain weight and high significance for the regional economy (in terms of the type of structural changes it may cause).

This means that, according to the concept of smart specialization, it is not advisable to determine the priority, neither at the level of the industry, nor at the level of an individual enterprise. The priority should be defined in such a way that it covers a group of interrelated enterprises that may belong to different types of economic activity and have technological and market potential. In these cases, the authorities would not support entire sectors or individual firms, but the growth of new activities. Of course, economic activity takes place at the firm level, but the point of smart specialization - as with any new industrial policy - is not to favor one particular firm, but to support the development of collective action and expertise aimed at research, experimentation, and discovery [6]. Focusing on the development of new activities, as defined above, allows authorities to achieve two things with one policy: it indirectly improves the overall performance of the sector, while

building capacity and expanding the knowledge base in new areas.

The second principle of smart specialization concerns the identification and support of entrepreneurial discovery. According to the research of D. Forey and K. Goenag, entrepreneurial discovery is associated with the identification of a promising area of activity in terms of innovation and research. Its definition is rather risky, since it is not about a specific innovation, but about an innovative discovery that contains the potential for structural changes, i.e., can cause innovative changes in several directions simultaneously. Thus, an entrepreneurial discovery is not just the emergence of an innovation, but a variation of innovative ideas in a specialized field that generates knowledge about the future economic value of a possible direction of change.

According to the concept of smart specialization, prioritization is no longer the task of certain planning departments, but is an interactive process in which the private sector generates information about new activities, and public administration assesses their potential and then supports those entities that are more capable of realizing this potential [2].

Economic policy has traditionally been based on the use of various scientific methods for planning priority industrial development. Typically, such methods were used as modeling and simulation, scenario, matrix, expert, etc. However, all these methods have one significant drawback. They ignore entrepreneurial knowledge.

Entrepreneurs in the broadest sense (innovative firms, research leaders in higher education, independent inventors and innovators) are in the best position to identify areas of research and innovation in which a region is likely to succeed given its existing capabilities and productive resources. Entrepreneurial knowledge is most often spread within a region. Stimulating entrepreneurial discovery involves creating external linkages with universities, laboratories, suppliers, and users to integrate and structure this fragmented and dispersed knowledge.

Hence, vertical economic policy should focus on activities aimed at researching, experimenting and exploring what should be done in the future within a single sector or between different sectors in terms of research and development and innovation and generating economic and social value for a particular region.

The social value of discovery is that it informs the entire system that a particular area of research and innovation is likely to create new opportunities for the regional economy. This is not the standard model whereby the innovator excludes others from using the innovation in order to appropriate the largest share of the benefits. The discovery and the subsequent activities that emerge have the potential to provide information and experience to other actors in the regional economy. Thus, rewarding entrepreneurial discovery should maximize spillover effects such as experience sharing and innovation diffusion. An entrepreneurial discovery means the discovery of opportunities to exploit a particular technology or line of business, and the entry of others into the discovered field of activity is proof that others find the discovery significant. When an experiment and discovery is successfully diffused, it encourages others to shift their investments from old areas of activity with less growth potential to new ones. Entry is a key component of smart specialization so that agglomeration externalities can be realized: the discovery of a potential area in which a region could become a leader should very quickly lead many actors to enter new activities. This is the beginning of the clustering phase of the smart specialization process.

An important outcome of recognizing and implementing an entrepreneurial discovery is the structural changes that occur in the regional system. As a rule, they mean a certain process of diversification based on existing capabilities and industrial knowledge and stimulated by the development of research and innovation activities. There are different stages of such linked diversification:

- Transition is characterized by a new sector emerging from existing industrial assets (a set of research,

engineering and production capabilities that support innovation).

- Modernization occurs when the development of specific applications of a general-purpose technology has a significant impact on the efficiency and quality of an existing (traditional) sector.
- Diversification, in a narrow sense, is the third pattern. In such cases, discovery refers to the potential synergies (economies of scale, spillovers) that can materialize between a traditional activity and a new one. Such synergies make the move to a new activity attractive and profitable.

Practice shows that priority is given to those activities where innovative projects complement existing production assets. However, it is also possible to make an entrepreneurial discovery whose exploitation possibilities are not related to any of the existing production assets.

The combination of the first two principles of a smart specialization policy (specification and entrepreneurial discovery) leads to priorities that focus on new activities that are aimed at researching, experimenting and exploring what an industry or a particular sector of the economy needs to do in terms of innovation and R&D to improve its efficiency and competitiveness.

The third priority means changeability, meaning that any priority cannot be sustained for a long time. Experts have concluded that after four to five years, "new activities" are no longer new. Whether they have failed or have successfully reached maturity, they should no longer be a priority for a smart specialization strategy. Adherence to this priority ensures that the organization is updated in a timely manner and is set up to continuously develop and support new technological and market opportunities in the region.

The fourth priority of smart specialization is to follow an inclusive strategy. Inclusiveness means that different regional sectors and clusters should be involved in the search for entrepreneurial discoveries and the selection of priorities,

especially those that are not dynamic and productive and require structural changes. However, this does not mean that the strategy will support any project in any problematic sector. Certainly, the focus of support should be on entrepreneurial discovery. But inclusive smart specialization means giving every sector a chance to be present in the strategy through a good project. Inclusiveness means different rates of development of individual subsystems of the regional economy, since prioritizing good projects in less dynamic sectors and economic activities will be more difficult and expensive than in the most dynamic parts of the economy.

The fifth priority in implementing smart regional specialization is the experimental nature of economic policy and the need for evaluation. If the four criteria described above are met, the policy of smart regional specialization is experimental. Experimentation is closely related to the risk that not all entrepreneurial discoveries will meet expectations. In order to ensure that support for a particular entrepreneurial discovery and its capacity building is not terminated too soon and does not continue for so long that investments are wasted on unviable projects, a clear system of evaluation indicators is needed to determine the level of achievement of the set goals, successes and failures.

In implementing the criteria described above, a smart specialization policy relies on setting goals. They are defined in such a way as to promote the emergence and early development of new activities that are potentially rich in innovation and contain significant innovation spillovers; diversification of regional systems by creating new variants of them; and the creation of a critical mass of networks and clusters within a diversified system. A summary of the elements of the smart specialization strategy is presented in Fig. 3.1.

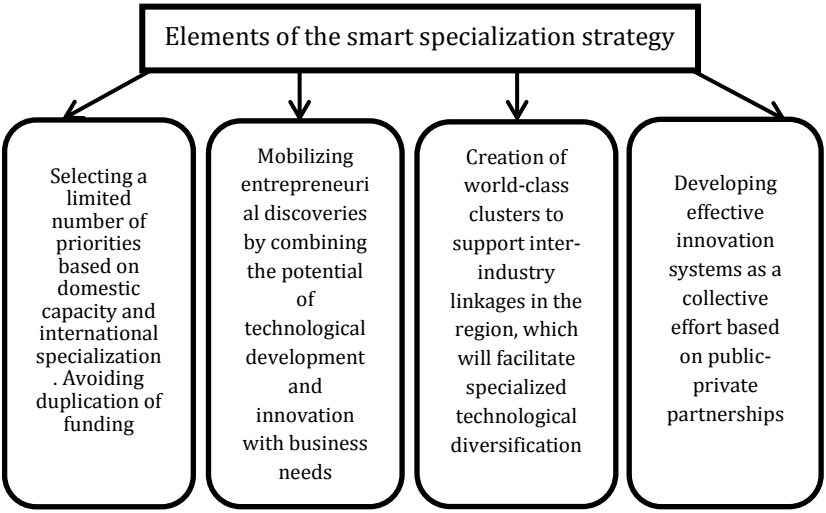


Fig. 3.1. Elements of the smart specialization of regions

It is worth noting that the strategy of smart specialization in the region is based on the simultaneous support of several areas of entrepreneurial research that are not necessarily in the field of fundamental knowledge. The objective may be to find and support productive and potentially useful activities that aim to improve existing innovations, adapt them to regional needs, or support "co-inventions" to address specific quality and productivity problems in one or more important sectors of the economy of a particular region.

The act of implementing certain innovations resulting from “co-invention” in a particular sector of the economy is not a simple task. “Co-invention” involves a large amount of research and development, design and redesign, in other words, a set of knowledge-driven activities. Therefore, smart specialization implies abandoning the principle of a deep division of labor between knowledge producers and knowledge users. All regions face challenges to improve operational efficiency and product quality in their businesses, and making these improvements is

often a matter of research and development, capacity building and innovation, which generate certain structural changes.

The strategy of smart specialization turns less developed regions into good followers, building up capabilities and knowledge in a particular application area, allowing them to learn from the leaders. But the leaders are not in the invention of general technologies, but in the joint invention of their specific applications in various economic activities.

In this way, the regions that follow and the companies that operate in them, by developing and implementing a smart specialization strategy, become part of a competitive environment in which regions with similar strategies have the opportunity to create a viable market niche that will not be quickly eroded by the entry of larger external competitors.

In addition, ongoing cooperation between regions in entrepreneurial discoveries ensures strategic diversification and builds protective mechanisms against the routinization of innovation, creative myopia, and collective inertia. There are many stories of highly successful clusters or regions that fail to reinvent themselves when new waves of technology and market opportunities arrive. Moreover, when innovation is concentrated in one large company, it has been proven that such a company and its employees suffer from creative myopia. They are not inclined to look outside and learn from others [7-8].

Each of the smart specialization goals should be measurable. Indicators for the goals should be somewhat eclectic, as the trends and evolution underlying the smart specialization goals are not captured by the standard knowledge and innovation indicator framework.

However, the need for indicators of smart specialization is crucial. Without metrics and indicators, as well as regular data collection, patterns of smart specialization strategies cannot be tracked, structural transformations cannot be assessed, and strategies cannot be compared. Therefore, there is an urgent need for further research and development in this area to create a set of accessible statistics on smart specialization.

In addition to static approaches aimed at measuring the competitive position of regions in science and technology, checking the ratio between public and private R&D, and measuring the structure of the regional economy, there is a need to measure new trends in entrepreneurial discoveries, the development of new activities, system diversification and the creation of critical clusters, in other words, to measure progress towards the various objectives of smart specialization.

When considering the possibilities of implementing a smart specialization strategy, it is also worth emphasizing the interregional nature of knowledge and entrepreneurial discoveries. It is often possible that the administrative space of a particular region is not sufficient to deploy resources for a particular innovation. Therefore, the collective research, engineering and production capabilities that support innovation are not necessarily deployed and contained within strict regional boundaries. Resources in the knowledge economy are not fixed and specific to each region. Extra-regional entrepreneurship, as well as extra-regional finance and skilled "business services" can start and carry out new activities in regions where these factors of production are lacking. At the same time, such extra-regional resources can develop and expand the potential of small regional companies created by local entrepreneurs. This raises the question of creating a broader innovation environment to which a particular regional system belongs.

As mentioned above, one of the principles of the smart specialization strategy is to ensure that the priorities chosen are changeable. Therefore, it is very important to review the portfolio of priorities on a regular basis. After a certain period of time, the "old" priorities funded under the smart specialization strategy should be removed so that new ones can be focused on. However, it should be borne in mind that it will take time to get at least initial results. Supporting new activities requires a certain continuity in R&D funding for at least 5 years. Therefore, European experts point out that the change in priorities should not mean that the "old" activities will no longer be funded.

Rather, these activities should move from a strategy of smart specialization to a general regional innovation strategy that involves other funding instruments. In this sense, according to European research, the smart specialization strategy and the regional innovation strategy need to be highly complementary.

A smart specialization strategy is a rather complex policy that tries to make two critical and somewhat contradictory requirements compatible: setting priorities according to a vertical logic (specialization) and supporting market forces that work to identify areas and spheres where priorities should be set (smart). The practical implementation of such a policy faces significant challenges.

The first of them arise at the stage of setting priorities for regional innovation development. According to Ron Boschma, a professor at Utrecht University, there are two main ways to practically identify priorities for smart regional specialization. The first is through supporting entrepreneurial discoveries, and the second is through analyzing the region's extensive databases on trade, industry, patents, etc. Both, according to the researcher, have certain drawbacks. Relying only on entrepreneurial discoveries can provide new knowledge about the potential opportunities of regions that cannot be revealed by secondary data analysis, but using this approach carries the risk of overambitious local entrepreneurs and overestimation of their own capabilities. At the same time, big data analysis makes it possible to avoid subjective errors. That is why in practice it is advisable to use both approaches in an integrated manner.

The entrepreneurial discovery process (EDP) is one of the main elements of the S3 concept. The EDP is a bottom-up process that involves interaction between the participants of the “four spiral” - private companies, government agencies, academic and research centers, and civil society. The interaction of these actors is aimed at identifying new regional technology areas and market opportunities that should be supported and developed.

The EDP encourages co-creation of actions and policies among the participants of the four-tiered spiral to promote the

development and emergence of strategic priority sectors, for example, by exploring the scope for cross-sectoral cooperation and the formation of new value chains.

At the same time, the role of regional governments is to provide focused governance and act as a platform to ensure, support and guide stakeholder participation in the policy-making process [9].

In the European Union, the smart specialization policy is supported through the Interreg Europe program (2021-2027), which is aimed at interregional cooperation and is co-financed by the European Union (program budget - 379 million euros). The goal of the program is to reduce differences in the levels of regional development and improve the quality of life in the regions of Europe.

The program aims to create an environment that enables the exchange of solutions to regional development problems. The main mechanism that the EU builds for the regions through Interreg Europe is to support the exchange of best practices and study of interregional policies in 29 countries - the EU-27, Norway and Switzerland.

To support entrepreneurial discoveries, the program provides for special projects:

- Beyond EDP,
- HIGHER,
- INNOHEIS,
- S3Chem.

The aim of Beyond EDP is to improve the design and implementation of EDPs by encouraging continuous interaction between stakeholders in the four-tiered spiral.

HIGHER aims to strengthen regional policy instruments aimed at promoting innovative projects through the cooperation of the triple helix - research centers, industry and public authorities.

INNOHEIS aims to encourage higher education institutions and their research and innovation infrastructure to participate in

the implementation of the Smart Specialization (S3) strategy and the process of starting a business.

S3Chem aims to improve the implementation of S3 in terms of identifying regional priorities in the chemical sector.

Interreg Europe projects have identified many best practices to improve the business start-up process. A common approach from Interreg Europe's best practices to improve EDP is to create thematic working groups involving participants in a four-level spiral to identify S3 priorities (Figure 3.2).

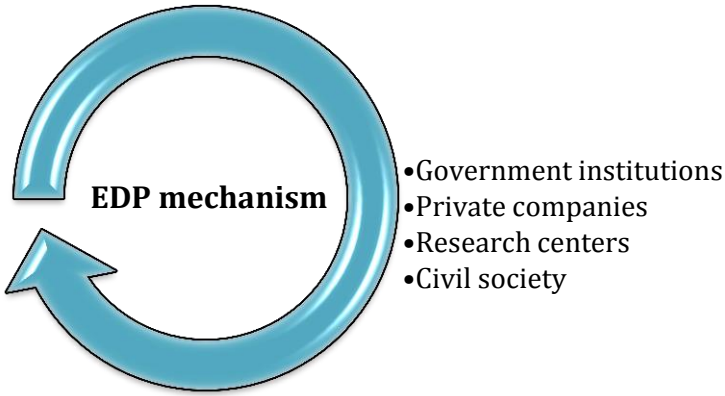


Fig. 3. 2. Formation of the EDP mechanism with the participation of four economic agents

The experience of Interreg Europe practices in developing EDPs is presented in Table 3.1.

Interreg Europe's best practices emphasize that EDP can be implemented not only at the regional level, but also at different territorial levels, such as urban and rural. It can also facilitate cross-sectoral exchanges that will contribute to the transformation of traditional industries by incorporating digital technologies or social challenges such as green growth.

The experience of European countries shows that managing smart specialization is incredibly challenging for several reasons. On the one hand, managing S3 requires in-depth stakeholder engagement as well as significant coordination at local, national, and supranational levels. On the other hand, different actors in the governance systems may not share a common understanding of the S3 and its objectives, which hinders decision-making.

Table 3.1

Characteristics of Interreg Europe projects for EDP

Project title	Results and characteristics of actions	Regional location
Beyond EDP	The RIS3 best practices in Extremadura point to the importance of motivating the four stakeholders to participate in the working groups by providing them with opportunities for joint action and policy-making. The experience of government agencies in Umbria has shown the importance of individual entrepreneurs participating in thematic working groups. Entrepreneurs act as knowledge brokers in their networks and facilitate the development and rapid dissemination of knowledge and information to other entrepreneurs through trust and shared social capital.	Spain, Italy
HIGHER	Exchanging best practices in strategic research and innovation partnerships (SRIPs). Experience shows that a thematic working group can be piloted by different institutions (clusters, universities, intermediary organizations, etc.). Use of strategic roadmaps to achieve higher competitiveness not only through technological foresight, but also by identifying bottlenecks in the regulatory framework.	Slovenia
S3CHEM	The practice of the regional program in Asturias emphasizes the importance of having a coordinator in each thematic working group to facilitate interaction and ensure regular meetings of the thematic working groups.	Spain

MARIE	The effective practice of managing the process of starting a business (EDP) in the Val-de-Loire Center shows the importance of building the capacity of regional policy makers to realize their institutional objectives.	France

Source: [10]

Such challenges are complex and long-term: caution, patience and a deep understanding of the institutional structure of each region and country are needed to make progress.

Managing S3 requires significant capacity building, and Interreg Europe's projects focused on identifying best practices and policy learning have an important role to play. However, such a favorable outcome will not happen automatically and must be consciously sought by both S3 governing bodies and Interreg Europe project consortia. It is important to build structured channels of cooperation between these two actors, ensuring a deep understanding of each other's objectives.

The Interreg Europe program also includes projects to support better governance policies. In particular, BRIDGES aims to improve the management of S3 by providing access to structural funds. The project focuses on improving sectoral competence centers (CoCs) as units for implementing smart specialization.

COHES3ION aims at aligning sub-regional innovation policies with regional S3 and thus promotes efficient multiplier governance models.

IMPROVE focuses on better management and implementation of the Structural Funds Program for the implementation of research, development and innovation policies with a focus on S3.

At the same time, RELOS3 aims to implement regional smart specialization strategies in the local context by actively engaging the triple helix actors, namely local authorities, innovation entities and companies.

The concept of smart specialization is implemented through policies that require the development of calls for

proposals and selection of projects for funding. European experts have identified 5 categories of measures to support the implementation of smart specialization:

- Launch of strategic initiatives that involve the activity of participants in the four-level spiral in the priority area of smart specialization.
- Reorientation of existing programs by adding a new criterion dedicated to "contribution to smart specialization" in competitive programs.
- Changing strategic plans by aligning them with the priorities of smart specialization strategies.
- Aligning infrastructure with the smart specialization agenda.
- Establishment of smart specialization forums by creating platforms for key stakeholders in smart specialization strategies.

The Interreg Europe program aims to engage European clusters in developing and implementing better policies to address the priorities of smart specialization strategies. The ClusterS3 project guides cluster policies towards the inclusion of SMEs in global value chains.

Interreg Europe's successful experience within the ClusterS3 project has been to support regional clusters in the Italian Piedmont by creating seven regional innovation clusters covering each thematic area of the smart specialization strategy. In 2015, the region started the process of reviewing the existing clusters by reconfiguring them in the following areas: smart products and manufacturing, green chemistry and advanced materials, energy and clean technologies, information and communication technologies, agri-food, textiles, and life sciences. The reconfiguration of the clusters was focused on aligning their activities with S3's strategic priorities.

The ClusterS3 project in the Basque Country (Spain) supports cluster organizations that manage ad hoc committees and working groups of interested organizations to prepare cooperation proposals to be submitted to Interreg Europe calls

for proposals. Cluster policy within the ClusterS3 project increases the opportunities for successful cooperation between small and medium-sized enterprises (SMEs) by co-financing activities or providing technical assistance to cluster organizations. SMEs are the true backbone of regional economies, but due to their lack of scale, they cannot face global challenges alone. Cooperation is essential for their success. Cluster initiatives aim to facilitate such cooperation, and strong clusters help to develop and agglomerate specialized knowledge and skills and attract investment. Cluster organizations provide business intelligence, create working groups, help SMEs identify common challenges in innovation, technology, R&D, and internationalization, and help SMEs define common goals and implement projects in cooperation. The multiplier effect of cluster activities can overcome the traditional sectoral approach to building new inter-cluster value chains to enter new high-growth areas in line with regional smart specialization strategies.

In the Lubelskie Voivodeship (Poland), the ClusterS3 project introduced a change in cluster policy. In practice, clusters are often key actors in the process of developing and implementing a regional smart specialization strategy, but coordination between cluster functioning and regional policy is lacking. Having studied the experience of the Basque Country, the Lubelskie Voivodeship was able to strengthen the cluster network and cluster coordination by creating direct links between regional governments and cluster managers.

An example of the implementation of a smart specialization strategy in the transport sector is the development of the Aviation Valley cluster, which is located in southeastern Poland. This is a region characterized by a high concentration of aviation companies, research centers, and advanced educational and scientific institutions, as well as the existence of cooperative ties between them.

As one of the largest aviation clusters in the world, this cluster has a long industrial tradition that began in the 1930s

with the production of aircraft engines. In the following decades, many new companies were established in the region. The growth of the industry was accompanied by diversification, driven by the production of helicopters, spare parts for passenger aircraft, and fighter jets.

Although Poland's economy was hit hard by a deep recession in the 1990s after the collapse of the socialist economic system, the aviation industry did not collapse. Close cooperation between business, academia, and government led to a regional strategy of cooperation between industry stakeholders to support and further develop the cluster. In 2003, the Aviation Valley Association of Aviation Industry Entrepreneurs was established with 18 founding members. Currently, the Association consists of 177 organizations with more than 30,000 employees in the aerospace industry and annual sales of about EUR 3 billion.

The reasons for establishing the Aviation Valley Association were primarily to develop a low-cost supply chain based on small and medium-sized businesses in the region and to create favorable conditions for aerospace business. Promoting research, technology development, and innovation is also a focus of the cluster, as it is advanced technologies that allow companies to participate in major international programs and ensure long-term competitiveness. Among other reasons for creating an aviation cluster in southeastern Poland was that 90% of Polish production in the aviation industry was geographically located there. The region also had a competitive labor force and production. The Rzeszow University of Technology, with its well-developed faculty of mechanical engineering and aviation, had cooperative ties with production. The region also had a favorable environment for investors due to the introduction of a low corporate income tax. Infrastructural reasons include the location of an international airport and the main highway connecting southeastern Poland with its southwestern part.

Today, the main goals of the Aviation Valley are: organizing and developing a cost-effective supply chain; creating favorable

conditions for the development of aviation industry enterprises in the region; developing research, skills and qualifications in the field of aviation; cooperation and development of aviation companies and universities that will promote new concepts and develop the aviation research and development sector; promoting and supporting the Polish aviation industry; influencing the economic policy of the Polish government in matters related to the development of the aviation industry.

The goals and objectives of the Aviation Valley cluster are implemented through joint projects of the cluster, in which interested organizations participate. These projects include the "Lifelong Learning Model that meets the needs of the regional labor market", the Aviation Valley Cluster Environmental Initiative project, and the HiPAir project - high-performance work practices for competitive small and medium-sized enterprises in the aviation sector.

The development of the Aviation Valley cluster within the framework of the concept of smart regional specialization, which is actively developing in the EU, demonstrates the feasibility and effectiveness of this approach for the development of the transport sector, as well as the need to study the experience and consider options for its adaptation to Ukrainian economic practice.

3.2. EU cluster policy: national and regional level

Cluster policy is a key tool for increasing the competitiveness of industries and regions, enhancing their innovation potential and development in the medium and long term in the EU. It stimulates and complements national and regional measures aimed at developing cooperation between clusters of enterprises, including international and cross-border ones.

Business clusters, or agglomeration economies, are a natural phenomenon in many regions and for many types of

economic activities. Clusters have been recognized in the management literature since the 1890s, but since the earliest days of human organized economic activity, as suppliers, customers and partners naturally clustered together.

In most parts of the world, clusters are understood as geographical clusters, often around a particular industry or sector. Media, high tech, life sciences, medical technology, space travel, maritime transportation, finance, seafood, energy; all have strong geographic clusters that have developed and matured naturally over time.

According to the Cluster Policy Guidelines approved by the European Commission, a cluster is a group of companies and related economic operators or institutions that are located close to each other and have sufficient potential to develop specialized knowledge, services, resources, suppliers and skills [11]. Enterprise clusters are ecosystems of companies and associated institutions in an industry linked by common and external factors. Compared to other ecosystems, the distinguishing feature of clusters is cooperation and partnership between different actors. They are both a concept and an economic reality whose clear effects can be measured statistically. The main features of a cluster as a group of enterprises are shown in Fig. 3.3.

The Cluster Policy White Paper (2004) contains six criteria for defining a business cluster:

- geographic concentration: this is influenced by hard factors such as history, external economies of scale, and soft factors such as social capital and learning processes;
- Specialization: focusing on an activity to which all actors are committed;
- Multiple actors: consisting of representatives of business, government, academia, and the financial sector;

Fig. 3. 3. Signs of a cluster of enterprises

- competition and cooperation;
- critical mass: necessary to achieve internal dynamics.
- cluster life cycle: not temporary short-term phenomena, but lasting with a long-term perspective;
- innovation: clusters are involved in technological, commercial and organizational change.

The main participants of the cluster are:

- enterprises specializing in specialized activities;
- enterprises that supply products or provide services to specialized enterprises;
- enterprises that serve public sectors, including transport, energy, engineering, environmental protection, and information and telecommunications infrastructure;
- market infrastructure organizations;
- research and educational organizations;
- non-profit and public organizations, associations of entrepreneurs, chambers of commerce and industry;
- organizations of innovation infrastructure and infrastructure supporting small and medium-sized enterprises: business incubators, technology parks, industrial parks, venture

capital funds, technology transfer centers, design development centers, energy saving centers, subcontracting support centers;

- Centers and agencies for entrepreneurship development, regional and municipal development, investment attraction, agencies for the support of exports of goods, state and municipal funds for entrepreneurship support, credit promotion funds, joint-stock investment funds and closed-end mutual investment funds that attract investments for small and medium-sized enterprises, etc.

The evolution of cluster systems has gradually acquired the expression of a triple helix, which reflects the peculiarities of the transformation of the world economy to the information type (Fig. 3.4).

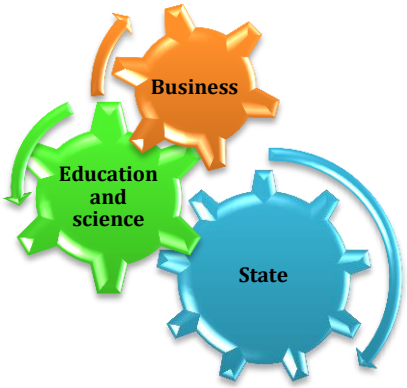


Fig. 3.4. The triple essence of the cluster development model

In the 1990s, professors Henry Etzkowitz and Loet Leidesdorf conceptualized the basis of the so-called triple helix, building on 25 years of Western innovation policy experience. The structure of the triple helix was seen as "university-business-government". Over the following years, the triple helix model was incorporated into most Western innovation policies, leading to the development of a large number of science parks,

technology transfer offices, and close relationships between businesses and universities. Eventually, the triple helix became the mainstay of many innovation cluster programs that brought research, government, and industry together in close partnership.

Over the past 10-20 years, researchers, practitioners, and emerging innovation economies have shown that the triple helix concept is not sufficient to explain and support the entrepreneurial ecosystems that are emerging around the world. Economic growth from China to Israel has demonstrated the greater importance of the "entrepreneurial economy." Today, effective clusters are being designed and built around "industries of the future" to help regions, countries, and national leaders navigate economic change and prepare for new economic growth in industries that have future growth prospects. Cluster policy researchers today propose a model of the entrepreneurial ecosystem based on five pillars. It recognizes entrepreneurship and private risk capital as equally important pillars of the cluster economy (Figure 3.5).

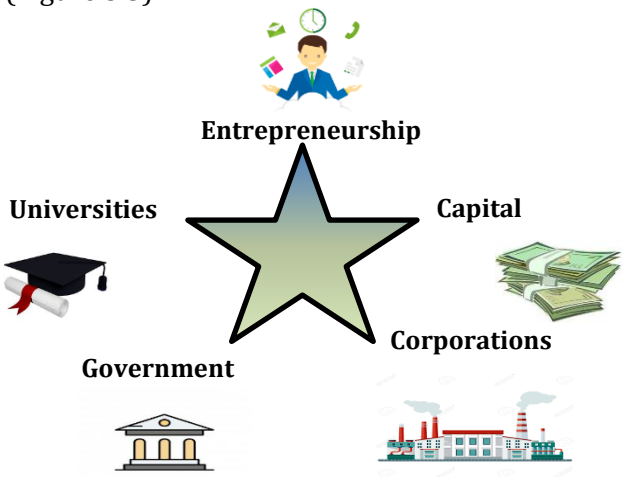


Fig. 3. 5. Structural components of innovation clusters

Modern clusters, especially those with an innovation focus, are moving from a triple helix to a pentagon. They actively recruit key members from corporate, governmental, academic and entrepreneurial structures, and then continue to build a system-level innovation mechanism for national and international impact. The successful development of clusters in the EU countries is evidenced by the statistics provided by the European Cluster Observatory, Fig. 3.6.

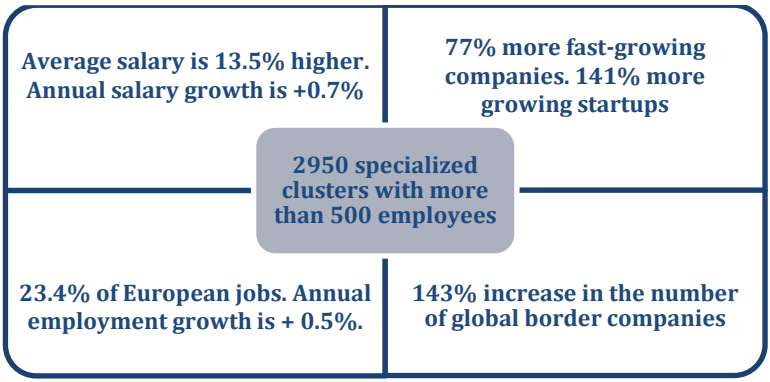


Figure 3.6. Statistical data on the development of European clusters

In addition, European clusters provide 61.8 million jobs and about 50.3% of jobs in export industries. There are 200 high-performance clusters in the EU with productivity 140% higher than the EU average [13].

In order to assess the dynamics of cluster functioning, compare different clusters, and provide more targeted support, the EU has introduced a unified classification of clusters based on the following criteria:

- size
- specialization
- productivity
- SME performance

- innovation leaders.

According to these criteria, there are highly productive clusters, medium productive clusters, basic productivity clusters, and clusters without pronounced cluster effects.

The "size" criterion reflects the overall employment figures and means that the classification takes into account the total number of employees in the industry for a given region.

The "specialization" criterion reflects the degree of specialization measured by the location quotient. The location quotient is calculated as the ratio between the share of the industry in total employment in a given region and the share of the industry in total employment in all countries considered in the analysis. Values greater than one (> 1) indicate high regional specialization.

The criterion of "productivity" is measured by the average wage per employee (in equivalent full-time equivalents) in the region. Productivity levels vary across Europe, and these differences are taken into account as components of cluster performance.

The criterion of "SME performance" is measured by the number of high-growth firms (i.e., those with an annual growth rate of 20% in turnover or employment over a 3-year period, subject to minimum employment and turnover thresholds). Research shows that entrepreneurial activity drives economic growth, and entrepreneurship policies in highly developed economies should focus on potentially high-growth new companies.

The criterion of "innovation leaders" is measured by the number of global frontier firms (i.e., the top 5% of firms in terms of productivity (on a value-added per employee basis), calculated by adding up the factor income flowing to employees (wages) and capital owners (profits) within any developing or exporting industry during the year, as the relative performance of such firms is likely to reflect their ability to innovate, rapidly diffuse and reproduce advanced ideas.

Research shows that entrepreneurial activity drives economic growth, and entrepreneurship policies in advanced economies should focus on fast-growing new companies.

On average, specialized clusters in emerging industries host 16 such high-growth companies, compared to 9 based elsewhere. This means that specialized clusters support 77% more high-growth companies than others. Most of them are located in the creative industries, digital technologies, or mobility [13].

Currently, there are 2950 specialized regional clusters in the EU, which can be divided into groups according to the classification approach described above, Fig. 3.7.

There is a positive correlation between the size of a region and the number of clusters in that region. The top 25 regions with the largest number of strong clusters include 10 EU metropolitan areas. The largest number of regions with clusters is located in Italy (7 regions), Spain (5 regions), Germany (4 regions), France and Poland (2 regions each). Belgium, Hungary, Ireland, Sweden, and the United Kingdom each have one region in the top 25 [13].

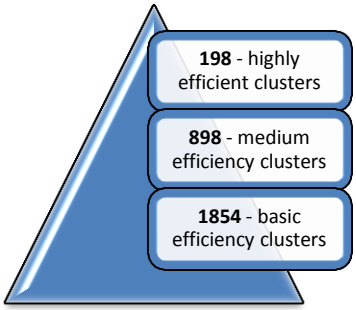


Figure 3.7. Classification of specialized regional clusters in the EU countries

Despite the peculiarities in their creation and operation, the development and support of transport and logistics clusters

is carried out within the framework of general approaches to the development of enterprise clusters in the EU.

It is worth noting that a transport and logistics cluster (TLC) is a group of geographically localized, interdependent companies specializing in the storage, escort and delivery of goods and passengers, as well as organizations servicing infrastructure facilities and other organizations that complement and reinforce each other's strengths and realize the competitive advantages of the territory where they operate.

The types of transport and logistics clusters are shown in Fig. 3.8. Port TLCs are formed on the basis of seaports. River ports, due to the general decline in the role of inland waterways and river transport, are not currently the basis for the formation of TLCs, but can be an important part of territorial TLCs. The exception is ports located on inland waterways but accessible to sea vessels (e.g., ports in the lower reaches of rivers), i.e., functionally seaports.

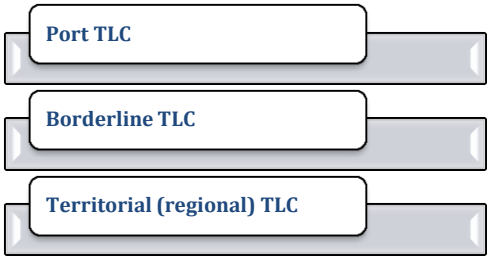


Fig. 3.8. Classification of transport and logistics clusters [14]

Seaports can be divided into categories:

- port gateways, where the predominant type of operations is transshipment from sea to land routes or vice versa;
- transhipment/interlining ports, where the predominant type of operations is transshipment from one vessel to another.

Gateway ports connect the maritime transportation network with the land transportation infrastructure. Gateway ports serving maritime transportation are analogous to railroad marshalling yards. In practice, most ports perform both types of operations in different proportions. Characteristics of some maritime clusters of the European Union are presented in Table 3.2.

Table 3.2

Characterization of maritime clusters in EU countries

Location	Characteristics
European Network of Maritime Clusters (ENMC), 2005, Paris	Exchange of experience, coordination of activities, strengthening of maritime clusters of member states and Europe as a whole; ENMC includes maritime cluster organizations from Bulgaria, Denmark, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Norway, Poland, Spain, Sweden, the UK
The Dutch Maritime Network	Eleven sectors of the maritime industry are represented, including fisheries, the Royal Netherlands Navy and the yacht building industry
Sea cluster of Norway	The entire maritime industry is united, represented by three main groups: shipping, marine services and shipbuilding
Maritime cluster Schleswig-Holstein (Germany)	Combines: fisheries, shipbuilding, cargo and passenger shipping, ship and port equipment manufacturing, construction of hydraulic coastal structures, clean energy production, information technology, marine tourism, research institutes of various profiles - biology, ecology, offshore technologies, oil and gas production technologies, oceanography, hydrography, shipbuilding technologies; educational organizations

Source: [15]

Border and regional TLCs can be combined into the category of intracontinental TLCs. Border TLCs are formed on the basis of transport hubs at the intersections of major international transport corridors with state borders and have a cargo specialization. Historically, border TLCs were formed on the basis of railway border crossings, however, at present, road

transport operations at many TLCs are comparable to or even exceed those of railways.

Regional TLCs are formed on the basis of the transport systems of medium and large cities, as well as urban agglomerations (metropolitan areas, megacities in which the city is integrated with suburbs and closely located settlements).

The main differences between TLCs and urban transportation systems are as follows:

- The TLC does not include the entire transportation system, but only those enterprises that are interconnected with each other;
- The TLC includes not only transport system enterprises, but also enterprises of other local infrastructure sectors that are integrated into the cluster (gas station chains, power supply to traction substations, vocational education institutions);
- scientific and research organizations in the field of transport and logistics, etc.

Territorial TLCs can be found at one stage or another in any large city. At the minimum level of development, territorial TLCs serve the needs of freight transportation and population mobility only within the territory of the city itself (urban agglomeration) - clusters based on urban transport. Territorial TLCs have both passenger and freight sectors. These sectors operate on the basis of general and specialized infrastructure.

According to the latest data published by the European Cluster Observatory, there are 72 clusters in the EU specializing in transport and logistics services. Among them, there is one high-performance cluster, 19 medium-performance clusters and 52 basic performance clusters [13].

The high-performance cluster is located in the United Kingdom, which is not currently a member of the EU. The medium productivity clusters in transportation and logistics are located in the following regions:

- Germany (Darmstadt),
- Ireland (South and East),

- Spain (Galicia, Pais Vasco, Madrid, Castilla y Leon, Castilla-La Mancha, Comunidad de Valencia, Andalusia, Canary Islands),
- France (Rhône-Alpes),
- Italy (Liguria, Lombardy, Lazio),
- Romania (Northwest, Center, West),
- Slovakia (Western Slovakia).

The development and support of existing regional clusters is carried out within the framework of the European Cluster Policy Concept. It has gone through several key stages in its development:

- first stage - 70s and 80s of the last century - emergence of cluster programs in a number of regions of Italy, Germany, and Austria;
- second stage - mid-90s - active spread of national cluster support programs;
- the third (modern) stage is the transition to the development of world-class clusters, stimulation of inter-cluster interaction, strengthening of interagency coordination of cluster support and implementation of the "smart specialization" strategy.

In 2003, the Green Paper on Cluster Initiatives was published, which emphasized the importance of cluster initiatives and identified a number of necessary factors for effective cluster formation.

In order to develop and implement a clear and accessible pan-European cluster policy, the European Cluster Alliance was formed in 2006, bringing together partners of 4 large-scale national cluster projects funded by the European Commission through the PRO INNO Europe initiative program.

The EU's modern cluster policy is a key tool for increasing the competitiveness of industries and regions, enhancing innovation potential and economic development in the medium and long term. The pan-European policy stimulates and complements national and regional measures aimed at

developing cooperation between clusters, including international and cross-border ones.

Support for clusters is envisaged in important EU program documents. In particular, the Europe 2020 economic development program emphasized the institutionalization of regional clusters and their further development through increased financial support within national innovation development strategies, as well as through incentive programs of the European Commission.

In the new EU long-term budget cycle (2021-2027), regional enterprise clusters are mentioned as the basis for industrial competitiveness under the EU's flagship program to stimulate research and innovation, Horizon Europe. The EU supports enterprise clusters through the European Regional Development Fund and its Regional Innovation Strategies program.

Its main directions are:

- turning innovation into one of the priorities of regional policy;
- increase the number of innovative projects implemented by companies;
- development of cooperation and collaboration between enterprises and government agencies.

In EU countries, clusters are supported through special programs. Sometimes, cluster support is part of programs aimed at developing small and medium-sized businesses (SMEs), supporting innovation policy (e.g., Lithuania), or ongoing programs of the European Structural and Investment Fund (ESIF).

In 2019, the EU invested €2.32 billion in support of clusters and business networks, primarily for the benefit of SMEs. Italy, the United Kingdom, Germany, Portugal, Poland, France, and Greece are the countries where more than €100 million was invested in cluster support in 2014-2020. Thus, financial support for clusters is considered an important element of economic policy in European countries.

Cluster programs in the EU are developed and operate at three levels:

- national,
- regional and
- interregional.

In the vast majority of countries, cluster programs exist at the national level. However, in France, for example, both the national and regional levels of intervention are important, while Germany and Poland create cluster programs at the national, regional and interregional levels. Programs that have an interregional context are often part of European Territorial Cooperation programs.

The most important objectives of national cluster programs in the EU countries are as follows:

- Strengthening cooperation structures between companies, industries and academia;
- Increasing the competitiveness of small and medium-sized enterprises (SMEs);
- support for internationalization activities;
- strengthening the importance of cluster activities;
- promotion of research, development and implementation of technologies;
- development of innovation potential;
- support for excellence of cluster members;
- strengthening innovation ecosystems in specific regions;
- promoting entrepreneurship, startups and spin-offs;
- promoting scaling;
- promoting the social economy and other solidarity-based initiatives for local development strategies.

The last three goals listed above are not currently highly ranked in cluster programs in most EU countries. However, Germany, Montenegro, Poland, and Romania have programs with similar objectives. Strengthening cooperation structures between different types of cluster members, increasing the competitiveness of SMEs, and internationalization activities are

the most important goals pursued by cluster programs in EU member states. Most cluster programs are quite broad in scope and address several objectives. Priority program areas include emerging industries, cross-sectoral cooperation, and small and medium-sized businesses.

In addition, some countries also aim to support "mature" industries that have already passed the phases of development and growth or restructuring. This emphasizes the high focus on industries that have a high level of experience and that may hold the potential for new activities in the future.

An analysis of EU cluster support programs suggests that the most important measures in cluster programs are:

- support for SME participation in clusters;
- international cluster cooperation;
- internationalization of cluster activities;
- intersectoral cooperation;
- financing of research and development projects of cluster members;
- development of cluster organizations.

The most commonly used types of support for cluster programs are grants, cluster management training, assistance in networking or partnership building, technical assistance, financial instruments such as loans or guarantees, etc. trend monitoring, specific services (export advice, training, coaching), capital investment (national co-financing), donations, and training.

As a rule, the sources of funding and implementation of national cluster programs are the national budget, EU funds, European Structural and Investment Funds, the private sector, and profits from previous cluster activities. Almost all EU countries have cluster programs: Estonia has the Cluster Development Program, Germany has the Internationalization of Advanced Clusters Program, Greece has a program to support creative industries, and Poland has a national cluster program for internationalization of cluster activities. An overview of

current cluster policies in the EU countries is presented in Table 3.3.

Quite often, regional clusters in the EU are supported as part of regional innovation strategies and Structural Funds programs in European regions. Clusters in European regions are often supported in a combined approach between different levels of government (European, national, regional).

Table 3.3

Characteristics of cluster programs in selected EU countries

Country	Cluster program
Austria	National cluster platform since 2008
Czech Republic	Clusters of cooperation
Estonia	Cluster programs have been consistently implemented in Estonia: Cluster Development Support (2008-2013), (2014-2020), Cluster Development Program (2019-2023)
Denmark	Innovation networks focused on dissemination and cooperation in academia can exist as cluster organizations as well as knowledge institutions. Regional authorities also support cluster initiatives. The Danish Executive Council for Business Development, established in late 2018, supports cluster activities and innovation networks.
Germany	Currently, there are more than 4 programs. The three current major cluster initiatives of the Federal Ministry of Education and Research (BMBF) are: a) Internationalization of Advanced Clusters, Promising Projects and Benchmarking Networks, b) Innovation Forums for SMEs, c) Advanced Cluster Competition. This competition provided 600 million euros of support to clusters. It had three rounds of selection, during which five advanced clusters were selected each time. Each of the successful cluster organizations received up to 40 million euros of funding for 5 years. There are other BMBF programs that are used to support cluster development. Clusters are supported by the Federal Ministry of Economic Affairs and Energy (BMWi) and the German regions (Länder).

France	Cluster competitiveness policy launched in the mid-2000s. In the first phase, 67 competitiveness clusters were selected for support. In the current fourth phase, 56 clusters in 13 central regions and 2 remote regions of France have been awarded the competitiveness distinction.
Lithuania	The project "Promotion and Development of Innovation Networks (INOLINK)" is aimed at integrating enterprises into clusters, increasing cluster maturity and international cooperation. The Lithuanian Innovation Development Program for 2014-2020 (LIDP) covered all issues related to the state innovation policy, including the integration of clusters into global value chains. Lithuania has a Concept for the Development of Lithuanian Clusters.
Greece	The national program "Creating Innovation Clusters - Greek Product, Single Market: Planet" was implemented in 2011-2015 (annual budget of EUR 8 million). Funding came from the national budget, EU funds and the private sector. The National Program for the Creation of Innovation Clusters has been renewed in the current period. Within the framework of the Regional Program "Attica 2014-2020", in 2018, a competition "Promoting entrepreneurship through the creation of innovation clusters in the Attica region" was held. The initiative, which has a total budget of EUR 6.6 million in public spending, supports the creation of innovation clusters in the Attica region, in sectors prioritized in the regional smart specialization strategy, including the blue economy and the creative economy. The competitiveness of the enterprises participating in the clusters is also supported through the Investment Promotion Law entitled "Synergies and Networking". Specific goals include strengthening export potential, increasing regional competitiveness, and supporting the creation of technology consortia.

Source: [16]

Objectives aimed at supporting cooperation structures within clusters, the competitiveness of small and medium-sized enterprises, and research and innovation activities are prioritized in regional cluster programs.

Regional cluster support in this respect does not differ from cluster programs at the national level. The size of the

region, the range of measures implemented through cluster programs, and the number and types of clusters supported play an important role in determining the size of the budgets of regional cluster programs.

In the period 2008-2017, EUR 45 million was spent on various programs in Germany, including international support for advanced clusters, EUR 144 million in France, and EUR 69 million in Hungary.

It is important to emphasize the high degree of interconnection between regional policy and cluster organizations: the latter are consulted in strategic planning and the formation of EU regional policy. The high level of involvement of cluster organizations in consultations with public authorities emphasizes the interconnection between the strategic and operational levels and the importance of exchange between program developers and users.

The main areas of cooperation with the government include: exchange of best practices and experiences in participating in policy development (smart specialization strategy, sectoral policies); joint monitoring and improvement of existing support programs and anticipation of possible changes; participation in regional and national institutions; meetings, seminars, conferences, etc.

Some cluster programs specifically address targeted actors - mainly cluster organizations - while others target different private or public actors, e.g. different types of private firms, research and/or academic institutions. This emphasizes the objectives of cluster programs: promoting cooperation among cluster members, R&D and innovation activities, and support for SMEs.

Most often, regional clusters are supported as part of regional innovation strategies. The main objectives of regional cluster programs are:

- strengthening cooperation structures between companies or between industries and science/research;

- increasing the competitiveness of small and medium-sized enterprises (SMEs);
- industrial modernization (e.g., through the use of advanced technologies, digitalization, introduction of new business models, innovations in the service sector)
- development of innovation potential;
- strengthening the regional innovation ecosystem;
- promotion of research and development (R&D);
- technology development and implementation.

Objectives aimed at supporting cooperation structures within clusters, the competitiveness of small and medium-sized enterprises, and research and innovation activities are of great importance in regional cluster programs. Regional cluster support in this respect does not differ from cluster programs at the national level.

Only the internationalization category is given a lower priority in regional programs compared to the national level. Support for SMEs and existing industries in the region are the main objectives of regional programs, followed by cross-sectoral cooperation. Emerging industries have a lower priority rating in regional cluster programs compared to national programs.

The European Union countries use a very wide range of mechanisms to support enterprise clusters at the regional level. These include: development of existing cluster management organizations; financing of networking events; support for international cluster cooperation (across borders; in the same sector); promotion of digitalization; support for internationalization of cluster activities; promotion of a new culture of cooperation and management of different stakeholders; support for market entry (e.g. testing, proof of concept, prototyping, demonstration projects); provision of technical assistance to cluster management organizations (consultancy, training on improvin.

Some regions clearly focus on funding cluster organizations in their programs, while others target a wider range of actors, including private business, academia and

research institutions. This shows that some cluster programs explicitly target industrial cluster members and their activities, while others rather focus on stakeholders that form the regional ecosystem and thus have an indirect impact on cluster activities.

According to the objectives and mechanisms developed, regional cluster programs are most often aimed at supporting cluster management organizations (cluster organizations).

A cluster organization *is an organization that focuses on the development of cluster initiatives, a cluster management structure whose activities are aimed at strengthening the competitiveness of clusters and cluster member companies.*

The goals of a cluster organization most often are**:**

- formation of the cluster identity;
- development of a cluster strategy;
- brand building;
- promoting innovation and research projects;
- forming a network of relationships between direct and associated cluster members.

The origin of cluster organizations and their initiation may vary. In general, the following classification criteria can be distinguished in terms of how cluster organizations are formed:

- initiated by the public and private sectors;
- by the thematic orientation of the network, which mainly responds to members from a limited geographical area (however, there are many examples of international cluster networks);
- by formality and organizational and legal form.

The structure of cluster initiatives, their roles, funding, and activities vary, but in broad and idealized terms, they are most common:

- are based on a triple helix structure with membership from the private sector, academia and the public sector;
- work to meet the needs of different members, both directly addressing current needs, but also sometimes

initiating activities with a longer-term perspective and a more radical innovative character;

- have good networks in all three of these areas, understand the culture and how these parts function, and are skilled at building relationships between them;
- initiate projects, including participants from different spheres;
- lobby and try to influence legal frameworks and standards to better meet the needs of cluster members;
- organize networking meetings;
- perform business analytics;
- they often work with internationalization, developing business opportunities and creating international R&D projects.

On average, most cluster organizations are small, with three or fewer employees, and are supported by public funding (typically 60%) and private contributions. It is important to note that the government financially supports, but does not create or manage such organizations.

To succeed in bridging innovation gaps, cluster organizations foster dense networks and regular communication among members. Typically, more than 50% of member firms are located within one hour's driving distance. This does not mean that cluster initiatives are only local. Although researchers have noted the importance of territorial proximity in the location of cluster members, today, in the context of the spread of information and communication technologies, this factor is weakening, as effective communication can occur even across considerable distances between members. The latter statement is especially important for transport and logistics clusters, whose members usually provide their services over large areas without reference to the place of registration and location of the main facilities of the enterprise.

Today, clusters have a global dimension, which is why many cluster organizations have relationships with clusters across Europe and in some cases around the world, but often

these partners are not official cluster members. In terms of membership, 75% of clusters have formal members, while 25% work in more loosely connected partnerships (Figure 3.9).

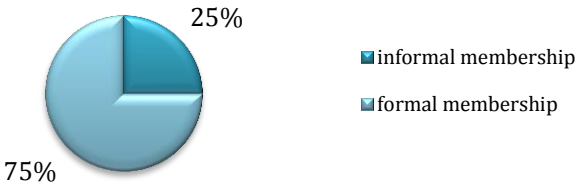


Figure 3.9. Share of cluster organizations with official membership

The number of official cluster members varies. Most cluster organizations in the EU have between 20 and 100 members. Only a few cluster organizations have restrictions on official membership.

Cluster organizations are public-private partnerships.

The status of public-private partnership is also emphasized by the fact that about 40% of the funding is on average private and 60% public. Long-established cluster organizations tend to receive somewhat more income from the sale of services (consulting) and somewhat less national public funding (Figure 3.10).

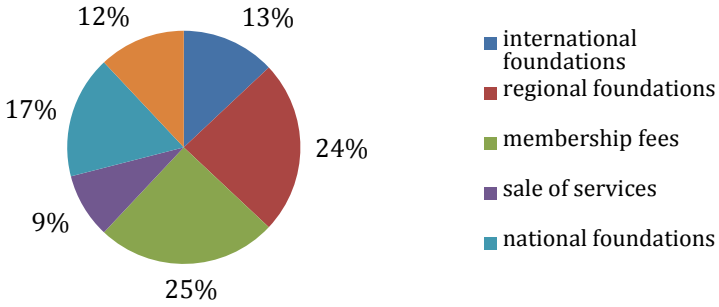


Fig. 3.10. Financing of cluster organizations in EU countries

Studies of transport and logistics clusters in EU countries show that their effectiveness directly depends on the competencies of the cluster organization. It is worth noting that although cluster organizations are usually formed according to standard rules and procedures, each cluster organization is a unique structure that has its own specifics depending on the scope of activity, the number of cluster members, the level of their social and economic interaction, etc.

A cluster organization may be established in various legal forms: as a limited liability company, association or non-profit organization, etc. The governing bodies of a cluster organization include representatives of almost all cluster members. As a rule, the supreme governing body of a cluster organization is the general meeting. However, other forms of clusters are also possible, where other decision-making tools are used.

The main activities of a cluster organization are organizational, expert, analytical and informational support of the cluster's functioning.

Another important area of work of the cluster organization is the development of programs and development strategies, and ensuring their implementation. In order for the cluster development program to be effective, the cluster organization should provide a range of consulting services on certain issues (e.g., legal support) for cluster members; conduct media campaigns to promote cluster activities; attract investment resources within the cluster program; support coordination of members' activities within the cluster program; conduct marketing research in various markets related to the promotion of cluster products and services, etc.

A study of existing programs of individual clusters suggests that each cluster development program must be coordinated in terms of goals, resources, and timing. It should also contain performance indicators for the implementation of planned activities. To maximize the effectiveness of the cluster program, it should involve a predominant number of both direct

and associated participants representing the educational, scientific and innovation infrastructure. The optimal structure of the cluster development program is shown in Fig. 3. 11.

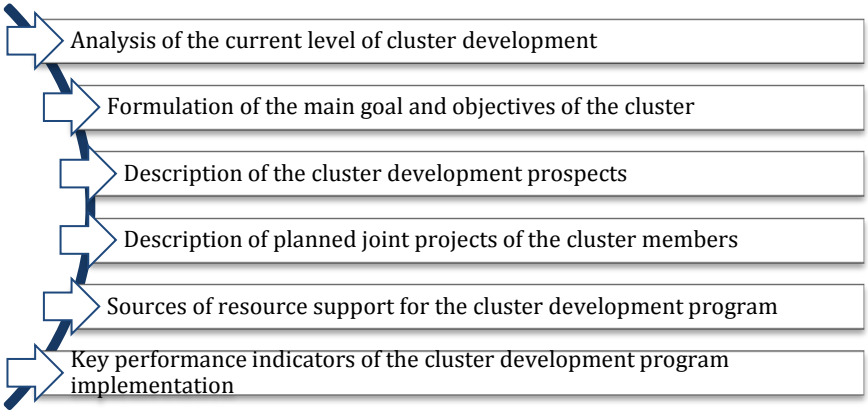


Fig. 3.11. Structure of the cluster development program[12]

A significant component of the cluster program is the development of approaches and selection of areas for joint projects of cluster members, which are the main tools for achieving synergistic cluster effects. A joint project is a set of process and technological measures to create and develop economic cooperation in a cluster. The general structure of the joint project is shown in Fig. 3.12.

Joint cluster projects may differ by types of economic activity, number of participants, sources of financing, results, etc. The essential characteristic of cluster projects is the mandatory generation of effects that can be used by all cluster participants or their vast majority.

The existence of synergistic effects from the implementation of joint projects by cluster members is the main motivating factor for enterprises to participate in them and to support the project from the EU grant programs. Based on the generalization of practical material related to the activities of

cluster organizations operating in transport and logistics clusters in Europe [17-20], six general types of joint projects in clusters can be distinguished, Fig. 3.13.

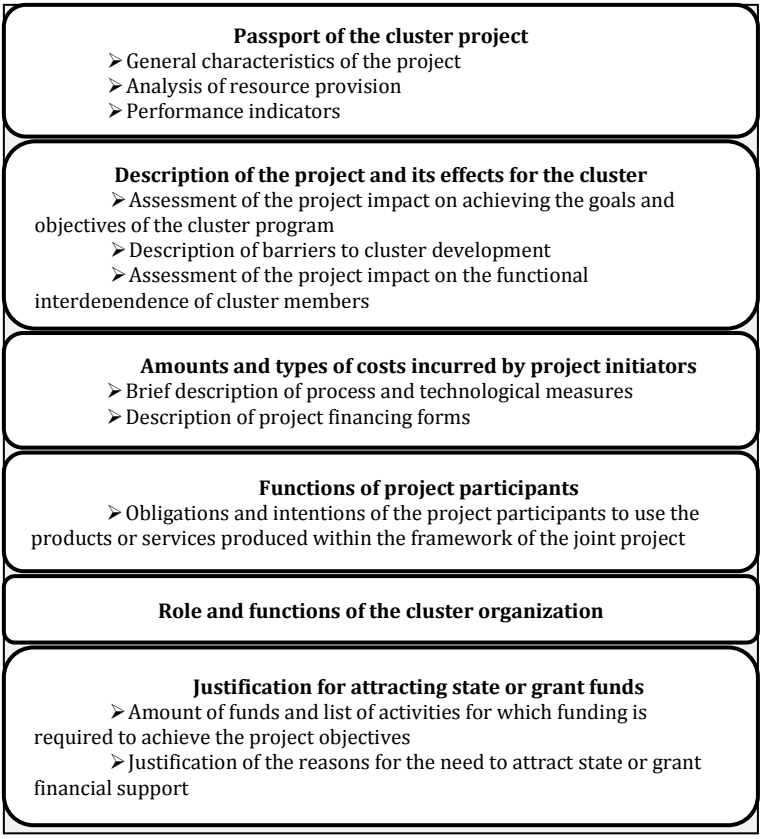


Fig. 3.12. Description of the joint project of the cluster members [12]

The central figure for a cluster organization is the manager. In the absence of a formal cluster organization, cluster managers working within enterprises, government, or industry

associations can contribute to the success of cluster initiatives. Often their titles are process manager or sector development manager.

Cluster managers who have extensive private sector experience and are respected by participants can effectively facilitate innovation and growth of cluster initiatives. They act as a conduit for facilitating the interactions that are key to spreading the knowledge and trust that cluster members need to drive innovation.

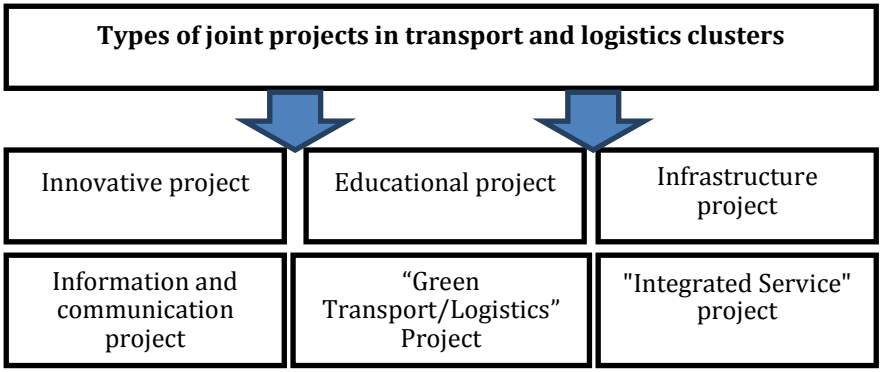


Fig. 3.13. Classification of joint projects in the transport and logistics cluster

Today, managing cluster organizations has become a profession. During the 1990s, it was still a novelty, and many cluster managers were true entrepreneurs, or as they were called in the Green Paper, "cluster entrepreneurs." Now cluster initiatives have evolved into more stable organizations. Many cluster managers have been trained in cluster schools: Clusterland in Linz (Austria), IESE in Barcelona, REG X in Kolding (The Danish Cluster Academy, since 2014 not functioning). In addition, there are cluster accreditation organizations (ESCA), a club for cluster managers, and various educational programs in the EU. Many cluster managers in the EU are new to the business, but about 20% have more than 10 years of experience.

The competencies of the manager are important for the effective operation of the cluster. A person with a strong analytical mindset may not always be an effective cluster manager and organizer. Of course, analysis is also needed in cluster management, but much more important is the ability to build relationships between companies and make the culture more open. Therefore, a cluster manager must have networking skills to bring competitors to the table and try to find common ground.

The European Union's cluster policy relies on a number of institutions that are established and function to support, coordinate, communicate and evaluate the performance of European clusters. Among these institutions are the European Cluster Observatory (ECO), the European Cluster Alliance (ECA), the European Cluster Excellence Initiative (ECEI), and the European Cluster Partnership.

In 2006, the European Commission launched the first phase of the European Cluster Observatory (ECO), which provided statistical information, analysis, and mapping of clusters and cluster policies in Europe. The subsequent second phase continued to build on these objectives by focusing on supporting inter-sectoral linkages, competitiveness and entrepreneurial opportunities. The current third phase builds heavily on the previous experience, but extends it by focusing on industrial change. This means that the new European Observatory of Clusters and Industrial Change (EOCIC) focuses on key advanced technologies, digitalization, creativity, service innovation, entrepreneurship, and resource-saving solutions as key drivers of industrial change. Thus, this organization aims to promote the development of world-class clusters and business networks in the European Union, as well as to accelerate industrial modernization and job creation through the growth of regional clusters [21].

The aim of the European Observatory of Clusters and Industrial Change (EOCIC) is to help European regions and countries develop better evidence-based cluster policies and

initiatives. The Observatory supports: industrial modernization; entrepreneurship in new industries with growth potential; SME access to clusters and internationalization; strategic interregional cooperation; and investment in smart specialization strategies.

The European Cluster Alliance (ECA) was established in 2006 as an open platform for policy dialogue between national and regional authorities.

Its objectives are:

- promoting flexible inter-cluster cooperation at the European level and activating the cluster network;
- cooperation with other networks and organizations that support clusters at the European and global levels;
- promoting the internationalization of cluster members, their better knowledge of European clusters;
- studying, promoting and protecting the collective interests of the cluster community;
- formulating joint recommendations for public administrations in cooperation with national associations.

The European Cluster Alliance brings together 18 organizations: national cluster associations, public institutions, etc., more than 800 cluster organizations, 150,000 of the most innovative enterprises and more than 11,000 universities, research centers and public institutions [22].

The European Cluster Excellence Initiative (ECEI) was launched in 2009, with the aim of developing a European methodology for benchmarking clusters to improve the management of cluster organizations and the quality of services for their members. This led to the emergence of European cluster excellence labels (gold, silver and bronze). By 2020, 1383 cluster organizations in Europe and beyond had received the European Cluster Excellence Label: 1141 bronze marks in 46 countries, 132 silver marks in 20 countries and 110 gold marks in 18 countries [23].

In 2009, under the auspices of the European Cluster Excellence Initiative (ECEI), the European Commission launched

a number of cluster-related projects and initiatives aimed at improving the quality of cluster policy in Europe and increasing the effectiveness of existing cluster management efforts. Today, the European Cluster Excellence Initiative leads the benchmarking and labeling of clusters in Europe.

In 2014, the European Commission launched the European Cluster Excellence Program under the COSME program to improve the effectiveness of cluster management. In 2019, it entered a new phase, leading to the formation of 13 new European Cluster Excellence Partnerships with 69 European partners in 2020. These cluster partnerships not only strengthen cluster management skills, strategies and joint activities through benchmarking, training and mentoring, but they also introduce a new tool to promote strategic interregional cooperation.

One such tool is the ClusterXchange program, which supports short-term cross-border exchanges to explore opportunities for growth and better connectivity of industrial ecosystems. The program targets cluster members representing cluster organizations, SMEs, as well as so-called support organizations, i.e. technology centers, research institutes, factory laboratories, (digital) innovation centers, creative centers, resource efficiency service providers, incubators and accelerators, etc. The ClusterXchange program provides participants with a lump sum to visit other clusters in Europe to promote cooperation between regional ecosystems and clusters. During 2014 and 2015, 57 cluster organizations in different EU countries took advantage of the opportunities described above. 83 cluster managers have been able to improve their cluster management approaches, benefiting nearly 11,000 SMEs.

The European Cluster Excellence Initiative recommends that cluster organizations measure the external and internal effectiveness of their work against a number of recommended indicators. In particular, the external effectiveness of the cluster initiative is recommended to be assessed over the past three years according to the following criteria:

- cluster growth (number of enterprises, employment);

- innovations (new products and services);
- international competitiveness of cluster members.

The criteria for assessing internal efficiency over the past three years are as follows:

- ability to meet deadlines;
- ability to achieve goals;
- financial stability;
- ability to attract new members and participants.

Another effective institutional tool to support cluster policy in the EU is the European Cluster Collaboration Platform (ECCP). Today, it brings together more than 1,000 cluster organizations around the world. The European Cluster Collaboration Platform provides cluster organizations with information support at the regional, national and international levels; facilitates business networking and international cooperation, allows to find potential partners for the exchange of experience and joint preparation of applications for competitions, as it has a unique database of regional, national, international and sectoral cluster networks.

Ukrainian companies have also joined the European Cluster Platform. Thanks to this cluster support tool, 71% of Ukrainian participants established contacts with foreign clusters, 12% of Ukrainian participants increased their revenue by improving their business models, and 6% attracted investment or other financing [24]. During 2017-2020, Ukrainian participants exchanged experience with clusters in Spain and Hungary, participated in such match-making events for clusters as «Cluster Excellence Denmark» (Denmark), meetings of clusters in Austria, Italy, Lithuania, Poland, and Ukraine, as well as the «EU Cluster Weeks» initiative.

The ECCP is an effective networking tool that also helps to strengthen cooperation between clusters within Ukraine. 40% of the implemented innovations also have a positive impact on the environment. 29% of the participants started to produce new/improve existing products/services thanks to ECCP. Currently, 23 Ukrainian clusters are registered in the ECCP

network. The sectoral and regional structure of Ukrainian participants in the ECCP is shown in Fig. 3. 14.-3.15.

The Ukrainian clusters participating in the ECCP mostly represent industries with high added value and a high level of innovation, which indicates that the cluster form of business organization requires a certain organizational and cultural readiness to establish innovative cooperation.

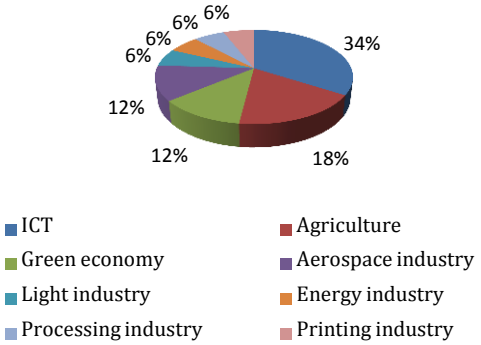


Fig. 3.14. Sectoral structure of Ukrainian clusters of ECCP participants [24]

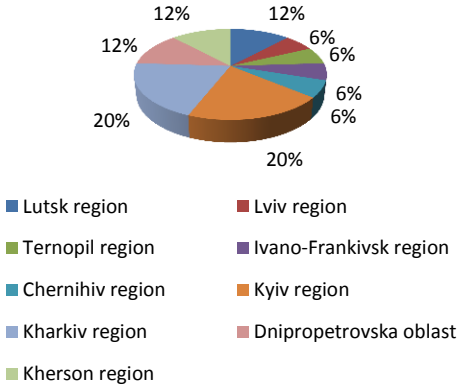


Figure 3.15. Regional structure of Ukrainian clusters of ECCP participants [24]

Summarizing all of the above, it can be argued that the success of enterprise clusters in the EU is directly related to a conscious, targeted and thoughtful policy of their support at different levels: national, regional and interregional (European). Studying and adapting the experience of EU countries in supporting and developing regional clusters can contribute to the development of cluster policy in Ukraine. Initial steps towards cooperation between Ukraine and the EU in this area are already being taken, in particular through joint cluster forums, involvement of enterprises in presenting their activities at the ECCP, funding of research and educational projects related to cluster topics, etc.

3. 3. Substantiation of the Conceptual Framework for the Need for State Regulation of Cluster Networks in Ukraine

The development of enterprise clusters is a natural process driven by the logic of technological and economic change. This means that their emergence and functioning in the economy can occur naturally, spontaneously, regardless of the state macroeconomic policy. This raises the question of the feasibility, scope and limits of state intervention in the formation of enterprise clusters.

Among some experts on territorial clusters, there is a widespread opinion about the ineffectiveness of the state policy of their regulation, based on a study of 700 clusters conducted by van der Linde, which showed that only one cluster network (Hsinchu, Taiwan) was the result of a targeted state policy [25]. According to G. Duranton, policy measures aimed at the development of clusters should be considered secondary, as they are aimed at solving complex and poorly understood problems

[26]. A study by a group of scientists led by F. Martin, which was conducted on the growth of factor productivity of companies as a result of the implementation of cluster policy in France, showed that in the period 1996-2004 it even decreased by 5%. [27]. The results obtained have become the basis for increasing skepticism in the scientific community about the state's activities in the field of regulation of innovative sectoral and regional networks.

However, it is worth noting that such conclusions should be based on studies covering a much longer time period (several decades), as this is the time required for the formation of innovative value chains of industrial importance. The difficulties in assessing network effects should also be taken into account, as they are multidimensional and cover not only manufacturing but also infrastructure, education, science, and the social sphere, and are situational, i.e., determined by environmental conditions.

Despite the existence of skeptical views on the positive regulatory impact of government agencies, it is worth emphasizing that economic practice contains many examples of the formation of new industries, in particular, due to rational and targeted government policy. A striking example is the UK's experience in developing "creative" industries, which include advertising, architecture, design, fashion, film and video production, programming, music, publishing, art, crafts, etc. The active development of these sectors was due to comprehensive government support, which included three important components: prioritizing these sectors in the policies of regional, in particular, city, authorities; developing systemic support, including preferential leases, a microcredit system, attracting venture capital funds, and consulting small and medium-sized companies on business issues; and developing and supporting innovation infrastructure, including special agencies that acted as intermediaries between business and government [28, c. 2].

It is also worth noting that state support for the development of innovative activities is never spread across the country, but is localized in certain territories, industries or sectors, which denies the idea that spontaneity and evolution are

dominant in the model of innovation cluster networks. In general, the development of breakthrough innovation areas in the economy is based on fundamental research, which is a recognized area of government responsibility. In today's world, the state's share of research and development expenditures is about 39%. The development of such world-famous networked agglomerations as Silicon Valley, the Massachusetts Institute of Technology, the Harvard University educational cluster, etc. was formed due to significant public funding of scientific activities.

The EU countries have also accumulated considerable experience in innovation policy, which includes both direct and indirect tools to stimulate innovation activity in the economy. The most common direct mechanisms of influence are subsidies, preferential taxation of research and development, development of venture capital and stock markets. Indirect measures include encouraging cooperation between universities and companies; intercompany cooperation; improving the protection of intellectual property rights; developing antitrust regulation; promoting training; establishing management consulting services; facilitating labor mobility; and creating scientific and technical infrastructure.

Analyzing the world experience of implementing the state innovation policy, it is possible to trace a certain stage of changes that have taken place in it. In particular, we can state the fact of a shift in emphasis towards indirect measures of innovation policy, a shift in concentration of efforts from technological aspects to the formation of cooperative networks that create an appropriate innovation, educational, and social environment.

European researchers identify three "generations" of innovation policy [29]:

- focus on a linear model of innovation creation - from a scientific idea through applied research to the development of a commercial product;
- focus on the complex nature of innovations, the diversity of sources of innovative ideas and areas of commercialization, including infrastructure support;

- focus on effective coordination of various policy segments that determine the nature of innovation processes in the economy (industrial, legal, antitrust, etc.), concentration on education development, and expansion of network cooperation (Table 3.4).

Table 3.4

Characterization of state innovation policy in the EU countries

Policy focus / Objective of the policy	Concentration on certain sectors of the economy	No concentration on certain sectors of the economy
Focus on economic growth	Support for the linear innovation model	Integrated innovation policy
Focus on sustainable economic growth and quality of life	Supporting innovation in certain industrial sectors	Horizontal (network) innovation policy

Source: compiled by the author based on [30]

Thus, support for the formation of cluster networks is an integral part of the third generation innovation policy instrument used to strengthen cooperation and intensify soft, mostly horizontal, cooperative relationships. In the European Union, these changes are reflected in the active development of regional networks - clusters.

Starting from the 70s and 80s, before the emergence of large-scale cluster support programs at the national level, local programs similar in nature were implemented in certain regions: the provinces of Emilia-Romagna and Veneto (Italy), Baden-Württemberg and North Rhine-Westphalia (Germany), and Styria (Austria).

Since the second half of the 1990s, national cluster development programs have been gradually taking shape in a number of countries. By the end of the 2000s, national cluster development programs were implemented in 26 European Union countries [31]. Such programs occupy an important place among innovation policy instruments, are included in national

and regional strategies, and significant budgetary funds are allocated for their implementation[32].

In the last few years, new strategic trends have emerged in the development of cluster networks and relevant government programs: transition to supporting world-class clusters; strengthening interagency coordination of cluster programs; stimulating inter-cluster interaction; professionalization of cluster management; involvement of clusters in the formation and implementation of regional strategies (smart specialization). The development of cluster projects is considered by most researchers to be a specific tool of innovation policy.

An important conceptual position is also the realization of the need for a comprehensive combination of innovation policy with industrial, antitrust and legal policies. This provision is especially significant for the domestic economic conditions, since ensuring the effective formation of cluster networks in Ukraine today is hampered primarily by institutional factors.

Summarizing the above, it can be noted that the implementation of cluster development support policies boils down to finding and maintaining a balance between natural and deliberately managed processes. An analysis of empirical material from international practice shows that the best results are usually found where the state has identified and supported cluster networks with the greatest innovation potential. Formation and development of network structures from scratch often turns out to be an extremely costly and inefficient area of the state cluster strategy. An example that demonstrates this is the Research Triangle in North Carolina. This is a cluster network that was formed by the state purposefully without taking into account the initial conditions. Huge amounts of funding from the US state budget were spent on its formation.

In general, the need for government intervention in the development of cluster structures is due to the emergence of economic imbalances that cannot be resolved by the "invisible hand of the market." Experts consider two types of situations to be market failure in the field of cluster formation and

development: a) inconsistency of the territorial location of productive forces with existing agglomeration effects; b) insufficient production of positive externalities by localized economic agents due to its incomplete reflection in the results of economic activity of these agents.

The first is that existing sectoral and regional aggregates of interdependent companies that have been formed and generate certain positive externalities for their members may lose this ability over time, due to economic and technological changes. This leads to the fact that companies either have to accept the decline in their own competitiveness or migrate to other industries, sectors or even territories where the possibility of obtaining additional effects remains.

However, even under conditions of perfect competition, there is limited scope for capital to flow to other industries and regions. Restrictive barriers are related to the peculiarities of the previous development of companies, such as investments in means of production and technology, limited information, existing regulations and obligations, territorial location, etc. They create a "rut effect" within which the company's activities develop. This pattern has been described in the works of a number of authors and reflects the inertia of economic entities in adapting to organizational, technological and institutional changes.

The most important for most economic sectors are the innovative effects generated by cluster networks, including reducing the cost of access to new knowledge, creating and diffusing innovations, increasing the speed of their implementation by creating an appropriate environment, increasing the innovative activity of participating companies, facilitating access to financing for innovative projects, etc. But by their economic nature, innovation effects are rather short-term, and therefore require constant support.

If this effect in a cluster is exhausted, moving to other industries, sectors, or more favorable regions for companies is

accompanied by additional transaction costs, which necessitates government assistance to such processes.

Another significant market imbalance in the development of clusters is related to the insufficient generation of positive synergies due to the lack of sufficient incentives for business entities to create free benefits for third parties, as they are not sufficiently reflected in the final performance of the business.

G. Duranton and D. Puga have identified three mechanisms for generating external positive effects in a cluster network that require government support because they are collective in nature: sharing, matching, and learning. The first implies that the market potential of a cluster creates advantages for sharing common resources, such as specialized infrastructure, specialized suppliers, specialized labor, etc., as well as risk sharing and specialization in the network structure. In addition, the high market potential in the cluster structure, which is formed by the possibility of choosing from a larger number of alternatives, improves the matching process between economic counterparties (consumers and producers; employees and employers; partners in joint projects; entrepreneurs and investors, etc.) Improved selection means that as the number of alternatives increases, the probability of finding the most optimal option increases.

G. Duranton associates the third positive external effect with the facilitation of the learning process, which consists in faster and better development of new technologies, marketing tools, new organizational forms, etc., since the cluster structure forms personalized relationships between employees that contribute to the accumulation and dissemination of knowledge and experience [33].

To the cluster effects described above, a number of scholars add other effects, including institutional ones, noting their exceptional importance for gaining market advantages when companies operate in cluster structures.

Undoubtedly, the cluster effects described above are specific and, in a sense, unique, as they are formed only if there

are network relationships, and between a significant number of entities, which provides sufficient diversity and variability in the choice. The problem is that companies often cannot take full advantage of the described effects to improve their business performance, as their impact is, at first glance, subtle and cannot be measured unambiguously. This circumstance reduces the incentives of companies to form a common infrastructure to ensure cluster effects and demonstrates the need for government involvement in the process of regulating clusters.

Thus, it is inappropriate to deny the role of the state in the formation of cluster structures, especially of the innovative kind, since ensuring cluster effects, which are collective in nature, can only be fully realized with the financial, institutional, informational, advisory, etc. participation of the state. The exclusion of the state from this process will lead to a slowdown in innovative development and fragmentation in the formation of cluster relations, which is observed today in the domestic economic environment.

Proving the necessity of regulatory involvement of the state in the processes of formation of cluster structures involves the study of possible risks that may reduce the effectiveness of such regulation. Among the basic reasons for the potential for reducing the effectiveness of the State's cluster policy are the following:

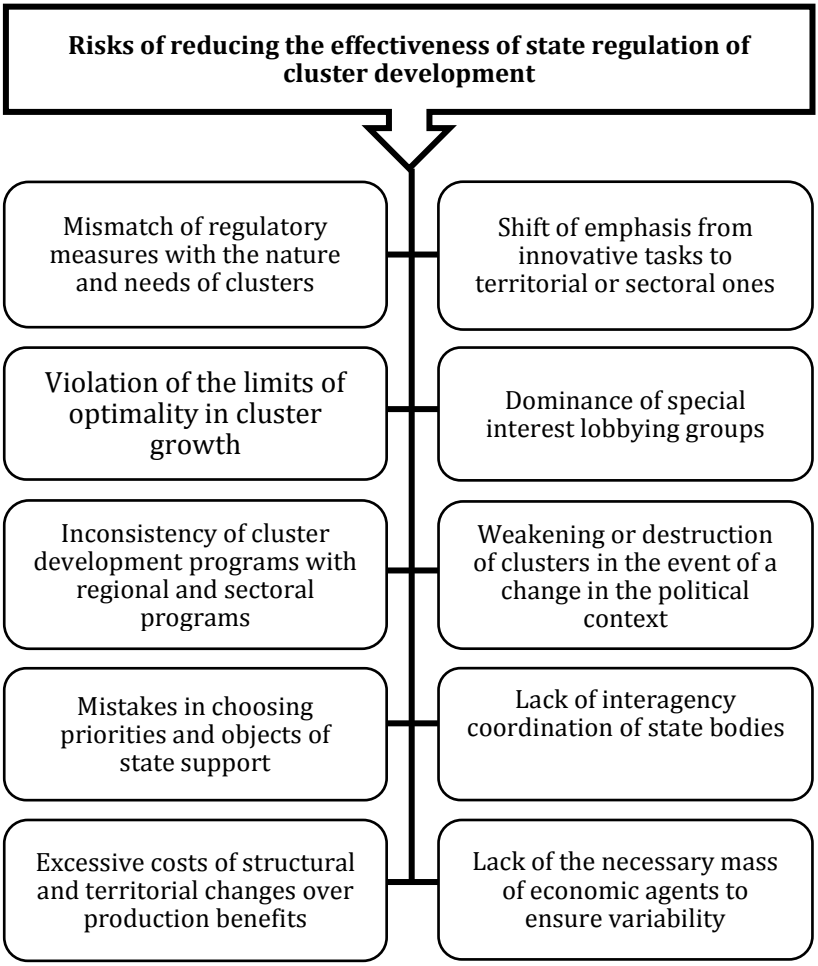
- the need to balance the conflicting interests of the cluster structure participants;
- asymmetry of information between the authorities responsible for implementing the relevant policy and groups of business entities applying for support;
- lack of sufficient economic trust between partners, which leads to non-transparent actions and incomplete information;
- difficulty in assessing synergies and related difficulties in identifying areas of priority support;
- the situational nature of obtaining effective results from the development of the cluster structure, their dependence

on the level and quality of organizational and managerial development of participants;

- high dependence of the cluster structure's efficiency on the quality of institutional conditions: legal framework for guaranteeing compliance with business agreements, level of entrepreneurial culture, and quality of social capital;
- rent-seeking behavior of government officials in the distribution of state support.

These problems give rise to a set of risks that are most common in European and global economic practice of regulating cluster relations (Figure 3.16).

The risk of inconsistency of state regulation measures with the nature and needs of cluster relations development is most often associated with the state's attempt to replace the natural way of forming economic relations with its participation. While the state's task is only to mediate in facilitating the establishment of intercompany and interindustry communications. The main danger is the possibility that companies may lose their ability to compete due to the creation of "excessively favorable" conditions caused by tax benefits, increased tariffs for foreign competitors, guaranteed placement of public orders, and the status of a natural monopoly. Such approaches, if used ill-considered, pose risks of reducing innovation activity in the long run.



Source: compiled by the author

Fig. 3.16. A set of risks of reducing the effectiveness of state regulation of cluster development

Excessive paternalism can cause companies to lose interest in finding options for cooperative cooperation in the open market.

In addition, the risk of reducing the effectiveness of public policy is also caused by the need to apply a set of tools and approaches adequate to the problems in each particular situation. This, to some extent, eliminates the possibility of using previous regulatory experience gained in other industries or regions.

When government agencies (sectoral or local) are involved in measures to support cluster development, there is always a risk of shifting the focus from innovation policy to solving narrow sectoral or localized problems. Moreover, this tendency may be reinforced by lobbying for their own interests by highly specialized groups. Due to the information asymmetry, business entities are better informed about their efficiency, real innovation activity, and prospects for technology development than representatives of government agencies responsible for this policy. Therefore, there is also a possibility that not the most promising market players will be able to obtain state support through lobbying.

Cluster synergies are extremely difficult to identify and calculate, so there is a risk that the costs of achieving them may be much higher than the final benefits. In addition, experts also note the danger of expanding a cluster beyond its optimal size, which may result from an attempt to increase the variability in the choice of partners by increasing the diversity of cluster elements. The policy of expanding the cluster structure by attracting a large number of participants may lead to higher costs, for example, due to higher prices for labor, real estate rent, lower prices for finished products, etc. Exceeding the optimal size of a cluster of enterprises may have the opposite effect - a loss of competitive advantage by its members.

The risk of choosing the wrong priorities and objects of support is quite relevant for domestic economic policy. Often, relying on past merits, managers of domestic companies, usually in traditional industries for the Ukrainian economy, try to get state support for unpromising and degrading companies and industrial sectors. State support for such clusters of companies

only diverts resources from the development of truly innovative companies and preserves the inefficient structure of the economy.

There is also a danger of making the wrong choice for state support of a cluster that does not have sufficient innovation and market development potential. Such risks can be avoided through the development and use of methodological approaches to cluster identification that can assess the prospective and existing opportunities for the development of a particular cluster formation.

It is also worth noting the risk of choosing a priority and object of state support under the influence of "fashionable" trends without taking into account specific territorial or sectoral conditions for its development. For example, in many countries, clusters in the fields of biotechnology, nanotechnology, and information and communication technologies are extremely popular. Practice shows that sometimes the risk lies in the attempt to cover a wide range of areas, which leads to the dispersion of financial and organizational resources.

Cluster organizers always try to involve as many participants as possible in cooperative interaction, which makes it possible, first, to increase the likelihood of each entity finding the most optimal partner for cooperation, and second, to create conditions for deepening the specialization of each participant and, as a result, increasing the efficiency of the entire cluster structure. However, as practice shows, excessive specialization can create certain pitfalls, especially for the territories covered by regional clusters. In situations of economic downturns or changes in technological trends, slowdowns in certain parts of the cluster structure can lead to a chain of problems throughout the industry or region. Economic downturns in regions with dense cluster networks have more protracted and devastating economic and social consequences. When designing cluster development programs, it is advisable to always consider opportunities for the development of additional or alternative activities.

One of the conceptual principles of cluster structures is to maintain competitive relations between its members. However, in practice, the coordination of market behavior often begins with agreements on price fixing and the exchange of certain preferential terms between participants, which in fact leads to cartel-like agreements. Thus, there is a risk of local monopolization of markets, which can have a destructive effect on macroeconomic indicators. To avoid such a situation, it is necessary to intensify control over the economic activities of business entities in cluster structures by state antimonopoly authorities and to adopt certain clarifications to the legislative norms that would regulate acceptable models of economic behavior.

Political risks that may adversely affect the effectiveness of state regulation of clusters include changes in economic policy that weaken the popularity of the idea of developing industrial networks, as well as changes in the territorial borders of the state, which lead to the breakdown of already established cluster relationships between industrial companies. In particular, the military events in Ukraine in 2014-2023 led to the loss of part of the country's economic potential with close production ties, including cluster ties. In the pre-crisis period, the largest number of regional clusters were initiated in Donetsk and Luhansk regions and Crimea, which today can no longer develop in accordance with the developed strategies. Thus, while recognizing the economic objectivity of the development of cluster relations in the economy, it is still impossible to state their complete independence from purely political factors. The study has shown that the risks of state economic policy in supporting the development of cluster structures described above can also be organized by the stages of cluster formation, which allows for a better understanding of the order of their occurrence and the measures to be taken to mitigate them (Figure 3.17).

In Ukraine, in addition to the above, there are specific risks that hinder the active institutionalization of cluster

structures and complicate the implementation of relevant policies. The main specific risks include: the existence of a significant shadow economy; lack of effective mechanisms of state support for cluster initiatives, including financial support; prevalence of depersonalized and institutional distrust between business entities; underdevelopment of small business, low business culture; lack of incentives and experience of innovation; underdeveloped market infrastructure; monopolization of access to cheap infrastructure; monopolization of access to cheap resources; lack of information transparency in the system of state and regional management and in the business environment; unfair competition and its aim to destroy the positive image of national markets and national producers.

As noted above, cluster policy is situational, which leads to the use of specific mechanisms and instruments depending on the combination of certain factors. Based on the research presented in Chapters 1-2 on the essence, nature, and methods of identifying cluster structures, we believe that it is advisable to develop options for the state's network policy based on combinations of the three defining criteria:

- the available number of potential participants;
- innovative activity of potential participants;
- the degree of development of cooperative relationships between potential participants.

The combination of these three criteria, which characterize the state of development of the cluster structure, makes it possible to obtain four situations that are fundamental for state regulation (Figure 3.18).

It is important to note that state support measures can be applied only if at least two criteria are met and combined. If the analysis of the sectoral or regional situation reveals the presence of only one criterion, it should be stated that there are no conditions for the development of a cluster structure.

The priority of state support should be given primarily to cluster structures with innovative potential. The allocation and

combination of the above criteria gives grounds to classify the conditions for the development of this type of cluster relations.

Combining two or more criteria makes it possible to identify four possible situations.

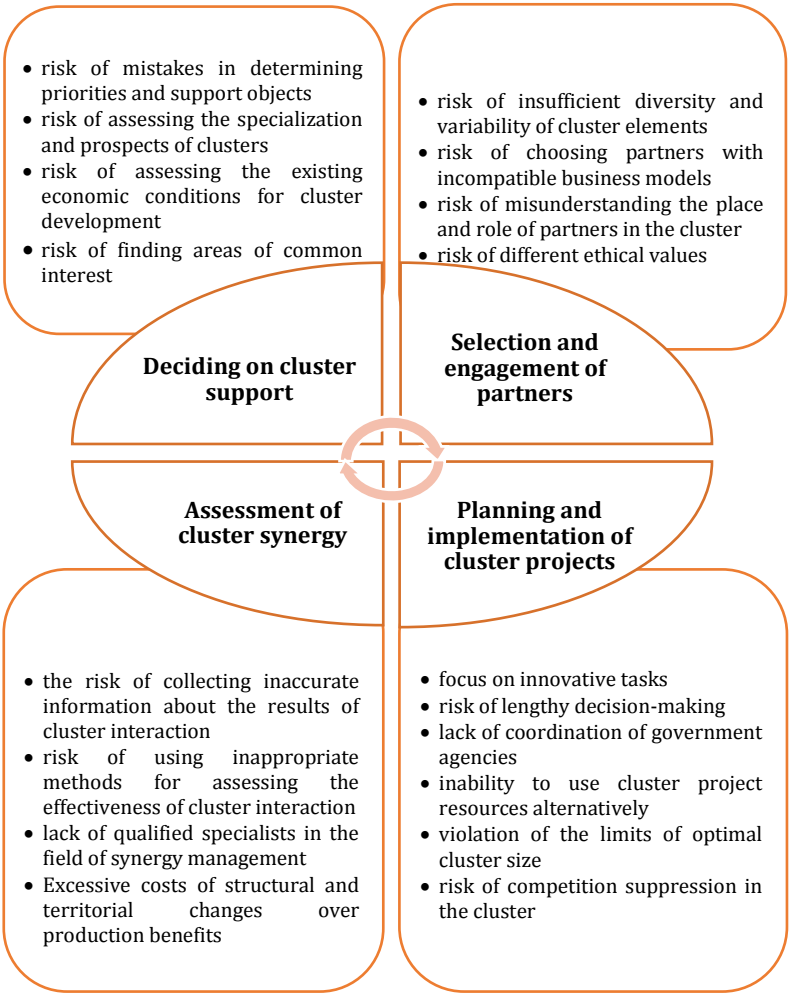
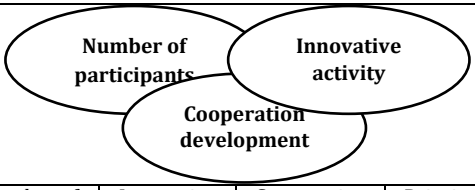


Fig. 3.17. Distribution of risks of reducing the effectiveness of public policy depending on the main stages of cluster formation

The I situation is characterized by the presence of a significant number of innovatively active companies that do not have close cooperative relationships with each other. Such conditions for the formation of network structures usually arise in a situation of rapid growth in the number of companies in a new, promising market, where intermediary organizations in establishing cooperative ties are still quite underdeveloped.



Options for combining criteria	Number of participants	Innovative activity	Cooperation development	Priority instruments and areas of state support
I	•	•		- development of cluster infrastructure - information and consulting support - development of legal mechanisms to support the development of business cooperation, protection of intellectual property rights, etc. - development and financial support of joint innovation projects
II	•		•	- Stimulation of innovative activity of companies - information and consulting support - support of innovative projects - establishing cooperation with scientific and educational institutions
III		•	•	- Promoting the involvement of new participants - development of cluster

				infrastructure - regulatory simplification of business start-up - SME development assistance programs
IV	•	•	•	- development of cluster infrastructure - support for intersectoral cooperation - support of venture capital financing mechanisms - development of international scientific and technical cooperation with other clusters

Fig. 3.18. Variants of criteria for selecting instruments and areas of state support for clusters

Sometimes this situation can occur in regions and industries that were formed as a result of foreign direct investment and where cooperation with a foreign parent company replaces cooperation with horizontal and vertical partners, making it inexpedient to organize it.

The II situation is characterized by the presence of a significant number of business entities that closely cooperate with each other. This situation is usually typical for traditional sectors of the Ukrainian economy (metallurgy, chemical and food industries, textile, leather and clothing production, transportation, etc.). Companies in these industries occupy certain market segments, producing a fairly wide range of products, but are not characterized by high levels of innovation activity.

The III situation is characterized by the presence of a small number of innovatively active companies that are in established cooperative relationships with each other. As a rule, such situations are characteristic of the periods of origin and formation of network structures, when a small number of small and medium-sized innovative companies cooperate with each other to obtain certain additional synergies from interaction. In

practice, this situation most often occurs in service sectors, where the organization of production on a large scale is impractical.

The IV situation is the most optimal combination of criteria and indicates that the network structure to be targeted for state support has a sufficiently high innovation and cluster potential. Such situations are favorable for supporting innovation clusters, which can be formed on the basis of three types of companies: large high-tech companies; groups of small and medium-sized innovative businesses; and leading scientific and technological centers.

The choice of public policy instruments should be differentiated depending on the combination of criteria that characterize the potential of the cluster network. The most typical instruments that can be used are shown in Fig. 3.18.

In general, the policy of supporting cluster networks involves maintaining a balance between state and market mechanisms of regulation. At the same time, cluster policy should be viewed as a component of the state's innovation and structural policy. The use of cluster instruments without their coordination with financial, tax, regulatory, and even legal instruments will not ensure successful results. A sound public policy should be based on the identification of cluster-specific characteristics and market problems that cannot be solved by participants independently and require joint efforts. The key to overcoming risks and ensuring positive effects in public policy for the development of network structures is to focus on the following fundamental principles:

- combining cluster support programs with state innovation programs;
- identification and justification of key growth points for industries and regions;
- use of flexible types of financial support for entrepreneurship, in particular small and medium-sized businesses;

- ensuring transparency and information openness in the formation of cluster structures;
- adequacy of state regulation measures to the needs of cluster structures;
- focus on comprehensive and long-term support of cluster structures;
- monitoring of costs and results of state support measures for cluster structures.

Violation of the above principles may cause the policy of supporting the development of enterprise clusters to lose its specificity, merge with other measures and instruments, reduce efficiency and raise doubts about the need to develop this tool for intensifying the innovation process.

3. 4. Strategic directions of state support for the development of transport cluster networks in Ukraine

The intensification of innovation development can be ensured only through the implementation of the state cluster policy, which should be developed and implemented simultaneously at three levels: sectoral, regional and national. As Mann R. V. notes, such a policy is usually considered as an alternative to the measures of traditional "industrial policy" of competition, which supports specific companies or industries [36, p.26]. The analysis of the European experience has shown that this approach is wrong and cluster policy should be considered not as an alternative to industrial and innovation policy, but as their integral part. Thus, the development of strategic directions for supporting cluster development in Ukraine will be based on this conceptual position.

The study has shown that cluster relations are currently developing quite actively in various industrial sectors and types of economic activity. However, government efforts to support and facilitate them cannot be comprehensive, as this would lead to a dispersion of efforts. That is why we believe it is necessary to note that priority should be given, first, to high-tech

industries, and second, to traditional industries that have significant innovation, import substitution and export potential and are directly related to the quality of life. In general, we can propose that government measures should focus on these three types of innovation clusters:

- based on the key role of high-tech companies;
- based on the key role of leading scientific and educational centers;
- based on small and medium-sized enterprises with innovative potential.

The development of transport and logistics belongs to the third type of clusters, as they contain a significant number of companies of this size. The main tasks and priorities of state support are shown in Fig. 3.19.

Based on the priorities of state support for the development of cluster structures, it is advisable to form mechanisms to support the measures listed in Fig. 3.19. measures. In particular, in order to stimulate demand for innovative products of companies that are part of innovation clusters, it is necessary to involve large companies with state participation that implement innovation development programs in cooperation. It is necessary to support, first of all, cooperation with state-owned companies in technological areas that are prioritized for the development of the state. Increasing the level of development of production, transport, engineering, social, educational and innovative infrastructure of sectoral and regional cluster structures, as well as overcoming the shortage of financial resources of participants, will be best facilitated by involving state institutions of innovative development in clusters.

In particular, technology parks, industrial parks, and other institutions for the development of science and technology that promote the improvement of research and educational programs and are carried out by entities that are part of cluster structures.

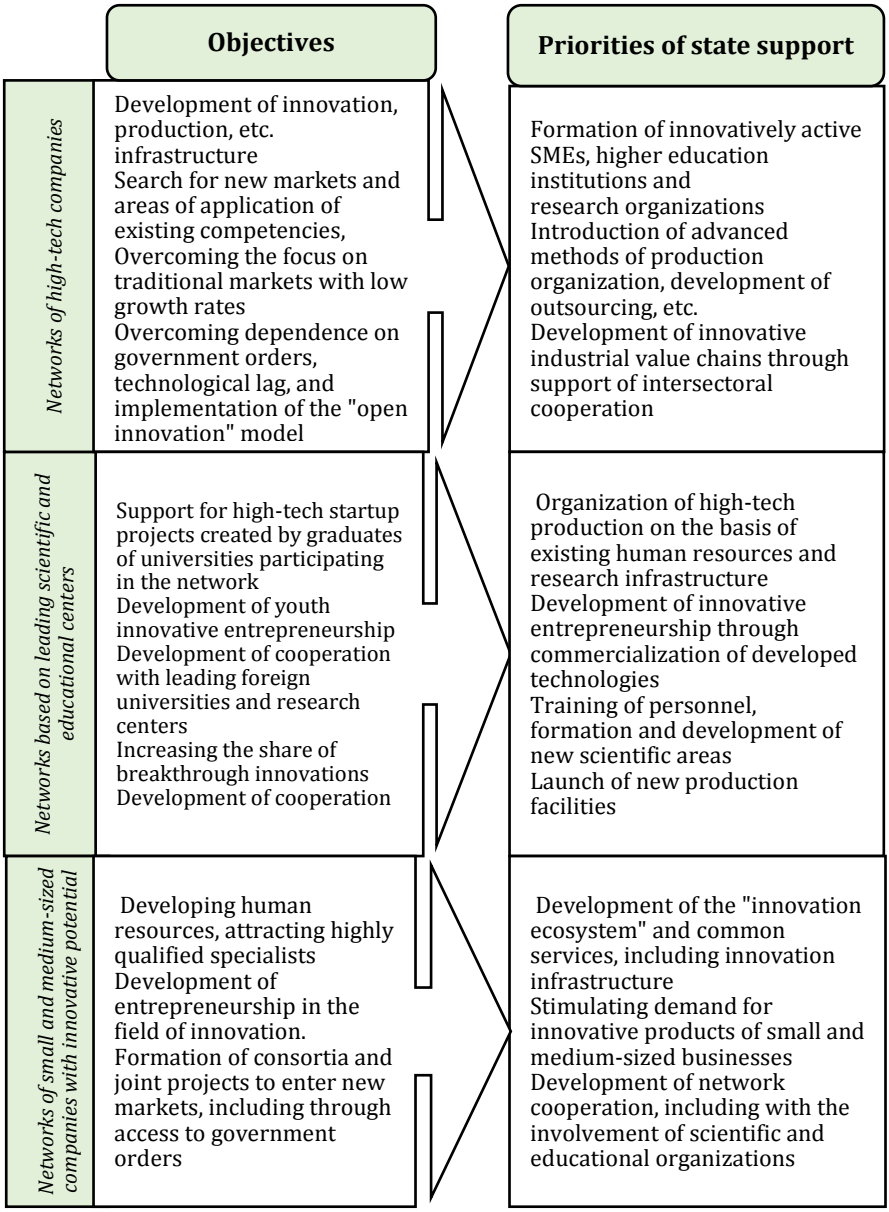


Fig. 3. 19. Objectives and priorities of state support for cluster development

To create additional incentives for participating companies to introduce breakthrough innovations, it is advisable to establish certain tax benefits, targeted subsidies, preferential lending, etc., in particular for small and medium-sized enterprises. Providing state support for the creation and operation of specialized services for the development of cluster relations should help to create additional preconditions for improving the efficiency of interaction between key participants, infrastructure entities, NGOs, public authorities and local governments; as well as the implementation of joint cluster projects. Ultimately, the state policy of supporting the development of cluster structures in the economy, including in transport and logistics, is aimed at ensuring a number of general goals, as listed in Fig. 3.20.

An analysis of the economic practices of leading European countries has shown that the main levers in supporting the development of cluster relations are: development of the institutional environment; development of cluster infrastructure; financial support; information and expert advisory support; development of research and educational infrastructure (Fig. 3.21).

Activation of the positive economic impact on the development of cluster structures using the above levers will help to increase the global competitiveness of the economy and create points of advanced innovative growth, increase labor productivity, support the development of clusters of enterprises in the economy and create highly productive jobs in the domestic industry. That is why it is advisable to direct the state policy primarily to:

- support for joint cooperative projects of cluster members (including transport and logistics clusters), primarily involving small and medium-sized businesses;
- support for clusters emerging in innovative segments and aimed at forming new markets;
- stimulating intersectoral cooperation and the intersectoral infrastructure that facilitates it;

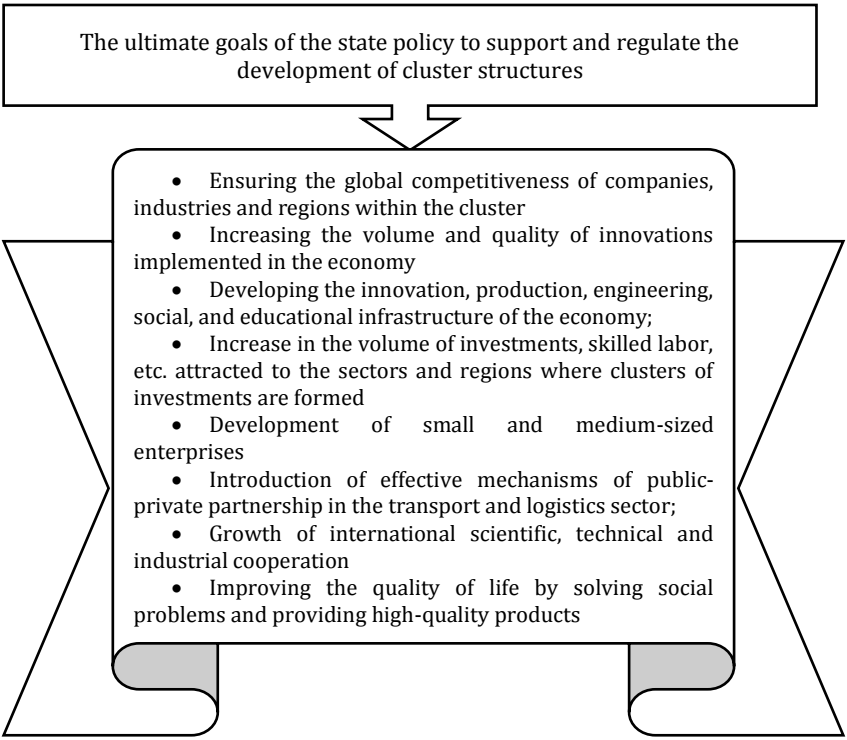


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Figure 3.20. Strategic goals of the state policy to support and regulate the development of transport and logistics clusters

➢ support for clusters that can become "growth points" for specific territories or industries.

The basis of any state policy is a set of legislative and regulatory acts that dictate the rules and limits of regulation. The analysis of the legal environment regarding the possibilities of regulating cluster relations in the Ukrainian economy has shown that the relevant legislation is practically absent. Although there are some discussions on the adoption of relevant legislation in the cluster aspect. That is, at the theoretical and practical level,

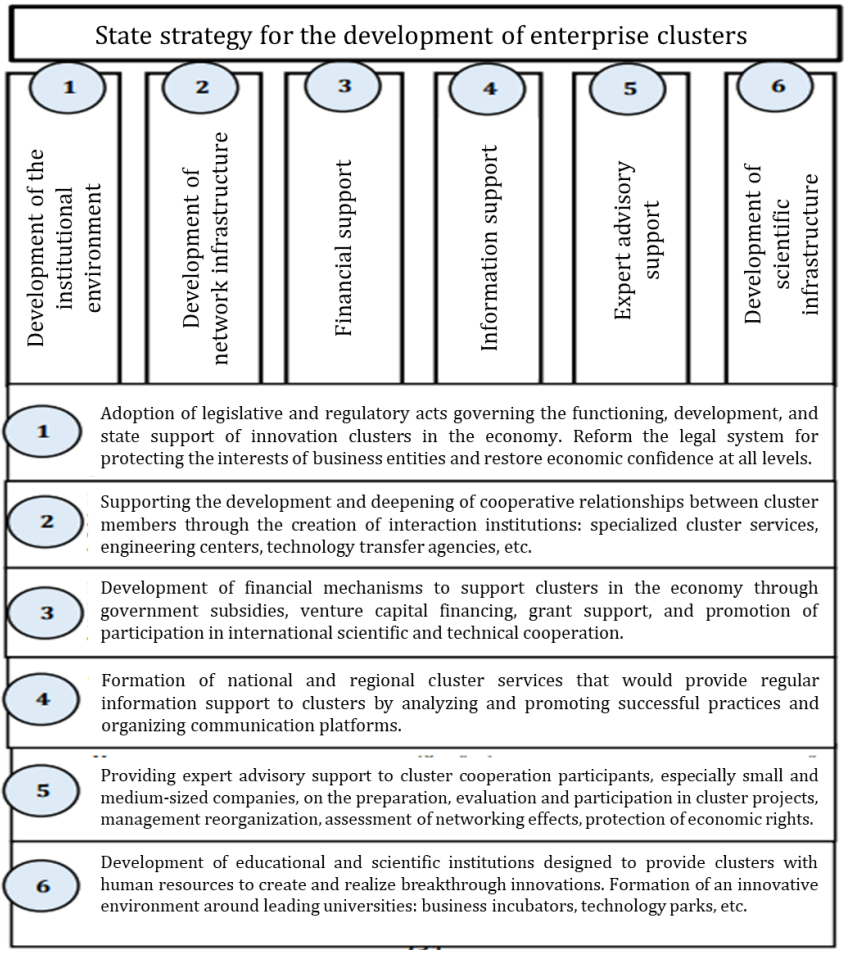

Figure 3.21. Content of strategic directions of state policy to support the development of transport and logistics clusters

there is a certain awareness of the need to develop only regional clusters of enterprises.

At the same time, regulation and support for the formation of regional clusters in Ukrainian legislation is often cursory, as there is still no legally enshrined definition of the concept of

"cluster", and the concept of cluster development proposed in 2008 has not been supported. At the same time, it is worth noting that the Law of Ukraine "On the Development and State Support of Small and Medium Enterprises in Ukraine" No. 1256 of December 4, 2014, already provides for the definition of a cluster, "clustering of small and medium-sized enterprises" and "cluster strategy".

Today, government support for the development of cluster networks is provided mainly through the approval of concepts and strategies that envisage the creation of research and innovation, production, technology and innovation clusters. In particular, the Concept of the Cabinet of Ministers of Ukraine on the National Program for the Development of Small and Medium-Sized Enterprises for 2014-2024 states that one of the ways to overcome problems in the development of small and medium-sized enterprises is "the development and implementation of programs for the integration of small and medium-sized enterprises into national and international innovation and technology clusters" [37]. The National Targeted Economic Program for Industrial Development for the period up to 2020 saw innovative development as possible through the creation of research and innovation and production clusters in high-tech industries based on the commercialization of their own scientific developments using the unused production capacities of state-owned companies and industry research institutes [38]. The Order on Reforming the State Policy in the Innovation Sphere [39] provides for the integration of small and medium-sized businesses into national and international innovation and technology clusters, as well as simplification of procedures for creating and financing research and innovation production clusters in high-tech industries. In addition, the Law of Ukraine "On Employment of the Population" provides for the possibility of developing clusters of folk art crafts as one of the ways to overcome unemployment. The Strategy for the Development of Ukrainian Seaports until 2038 also states that the main condition

for the development of the port industry is the creation of clusters and special zones in seaports [40].

Regarding the possibilities of regulating the development of other types of network structures, the Commercial Code of Ukraine provides for the possibility of creating business associations, but there are no clusters of companies among their possible forms. That is why it would be advisable to amend Article 120 of the Commercial Code of Ukraine, as well as to adopt separate laws that would regulate the activities of cluster structures, in particular the Law "On Cluster Networks", which would regulate the problematic issues regarding:

- definition of the terms "cluster", "network structures", "cluster policy", etc;
- types of clusters, their goals and objectives;
- the procedure for establishing clusters and their state registration (e.g., establishment is carried out in accordance with the memorandum of association and charter);
- composition of potential participants (e.g., three levels: key manufacturing companies; companies supplying and consuming products and services; supporting and complementary entities - higher education institutions, financial, consulting, engineering companies, etc;)
- types and forms of state support for clusters;
- rights of cluster structure participants (e.g., the right of participants to participate in the management of affairs, distribution of profits, termination of participation in the cluster structure);
- obligations of the participants, including compliance with the charter, fulfillment of economic obligations, and non-disclosure of trade secrets about the activities;
- governing bodies of the cluster structure (supreme governing body (general meeting of participants) and executive body (collegial or sole));
- ownership of the cluster structure's property, rights to dispose of the results of production and innovation activities;

- the procedure for participation in joint cluster projects;
- conditions of termination of the cluster structure;
- development of international relations for the purpose of cooperation and association with international networks [41].

Thus, the development of regulatory documents governing the activities of enterprise clusters, as well as the consolidation of the foundations of cluster policy in strategic socio-economic programs of economic development, are necessary initial conditions for establishing the foundation for effective state regulation of the development of innovative enterprise clusters.

The formation of a favorable institutional environment for the intensification of cluster relations involves not only providing the necessary legislative framework.

The biggest barrier is the lack of economic trust between business entities. One way to positively change the situation is to reform the legal system, create guarantees of legal protection of property rights and fair resolution of problematic business situations, as well as improve the system of legal protection of intellectual property, develop and approve a methodology for assessing the amount of damage caused by violations of such rights. The ongoing reforms of the political and legal system in Ukraine aimed at overcoming corruption in all branches of government, increasing transparency and efficiency of public administration are undoubtedly aimed at restoring institutional economic trust. Their effectiveness will also determine the efficiency of state support for the development of network structures.

The defining characteristic of clusters of enterprises at the sectoral and regional levels is the existence of cooperative relationships between participants. It is their support and regulation that should be the focus of government efforts. To identify effective tools to support cooperative relations in clusters, it is advisable to classify them by their main structural

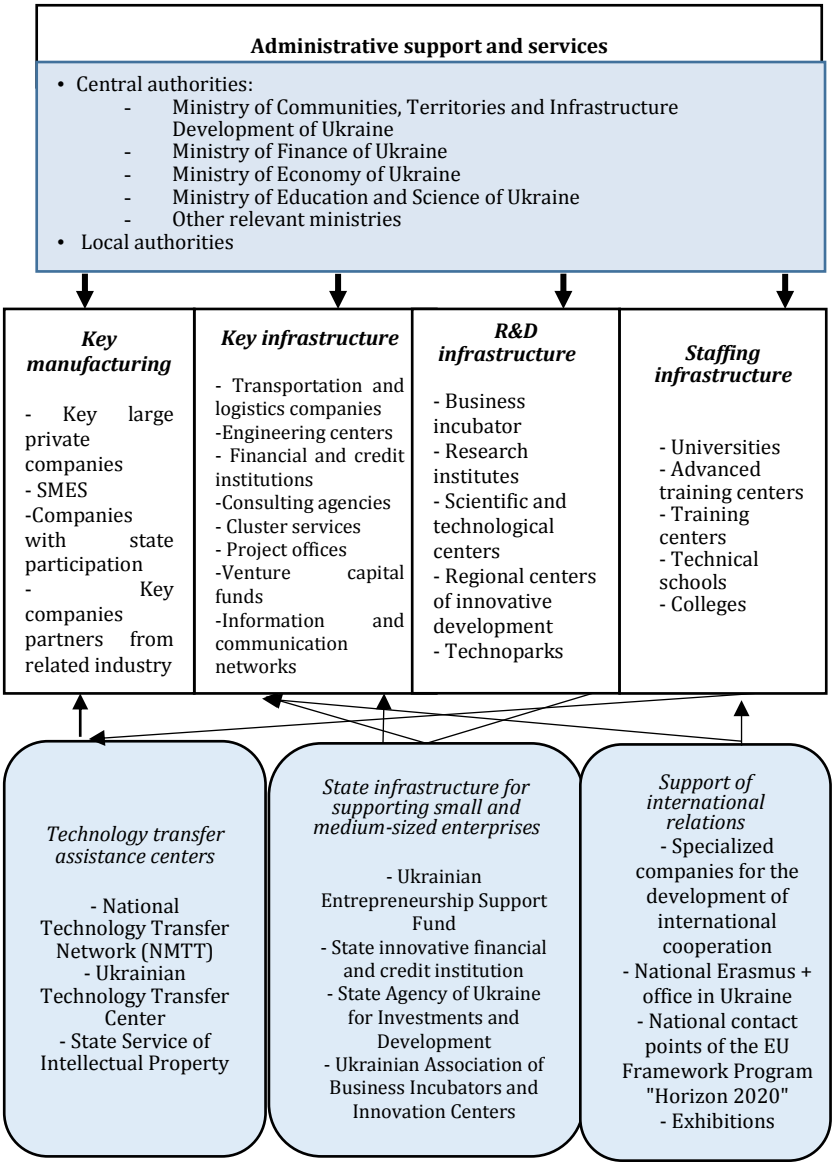

Fig. 3.22. State support of relationships in the cluster

components: key production; key infrastructure; research infrastructure; and personnel infrastructure (Figure 3.22).

A decisive role in the formation and maintenance of cooperative relationships in clusters is played by cluster services (cluster organizations/specialized organizations), which act as producers of specialized services for the cluster.

The types of services that can be provided by a specialized cluster service include the following:

- Promoting the development of international relations between cluster members, in particular in terms of entering foreign markets;
- assistance in obtaining state support for cluster members within the framework of existing industrial development programs;
- support for joint research projects of enterprise cluster members and assistance in attracting funding;
- expert evaluation of projects of the cluster members and prioritization of funding sources;
- facilitating access of cluster members to private sources of financing (establishing interaction with potential investors and funds);
- facilitating access to technological services for cluster members;
- providing consulting services to cluster members;
- promoting the development of cooperation between cluster members;
- Ensuring conditions for the joint use of technological and production assets;
- conducting foresight studies on technological development of clusters (search for ideas for innovative projects)
- regular preparation and distribution of information materials of the cluster of enterprises and its members;
- popularization of the cluster of enterprises, organization of thematic industry, regional and international events;

- support for knowledge transfer among cluster members;
- support for technology transfer among cluster members;
- Organizing and conducting educational events for the staff of the companies participating in the cluster of enterprises;
- Provision of services to cluster members in innovation management;
- Organization of mobility programs for the personnel of the cluster members;
- Providing services in the field of intellectual property rights protection;
- Assistance in attracting foreign direct investment in the industries and regions of the cluster of enterprises.

The role of the state in the activities of specialized cluster services varies depending on situational factors, the level of organization of the participants, their ability to negotiate, understanding and readiness for closer cooperation. As a rule, the state acts as a founder and one of the participants in a cluster service, especially in cases where the formation of a cluster of enterprises is actively encouraged by the state at the initial stages.

An important component of infrastructure formation for innovative clusters of enterprises is to support the development of engineering centers, which, according to experts, are one of the factors of entering global production cooperation.

Intensification of innovation activity in an industry or region, solving problems of commercialization of domestic intellectual property objects is closely related to the creation of engineering and marketing centers. An engineering center is an entity in the intellectual property market focused on the transfer, commercialization and after-sales service of innovative technologies and products. At the same time, it is initially focused on the technology marketing system and, as a rule, includes a system of marketing centers.

The formation of engineering centers is an essential component of the development of cooperative relations in an innovation cluster, as they ensure the initial sale of production-oriented intellectual property to end users, with the development of facilities taking into account regional and sectoral priorities.

By supporting the development of engineering centers, the state solves a number of important tasks:

- Increasing business receptivity to innovation;
- implementation of industry priorities in the organization of applied research and development;
- training, retraining and advanced training of personnel involved in technological, marketing and transfer support for commercialization of production-oriented intellectual property.

The trend in economic development is that large companies are refusing to manufacture high-tech machinery and equipment, as well as the necessary components and assemblies for the production of final products in their companies. Most of them prefer to invest in production logistics and outsource production orders. This is how global production supply chains are formed. The use of such mechanisms of international cooperation is one of the reasons for the sustainable innovative growth of industrialized EU countries.

Today, trade and production chains are most actively developing in trade corporate clusters. The practice of organizing cluster production and managing value chains is fragmented in the domestic economy. In these conditions, regulating network interaction by supporting the functioning of engineering centers can become a tool for promptly addressing the problems of technological lag in the domestic economy. International experience shows that government participation is a significant factor in the market of engineering and marketing services, as government orders are an integral part of the portfolios of the vast majority of large engineering and marketing companies. The creation of engineering centers in clusters of enterprises without

government involvement requires a long time, which has already been exhausted.

The most effective lever of state policy to support the development of enterprise clusters is financial. In Ukraine, due to the military-economic crisis and the related state budget deficit, the formation of financial mechanisms seems problematic. However, an analysis of the economic practice of foreign countries has shown that the range of financial instruments that can be used effectively is quite large and also involves the use of a number of rather "inexpensive" but effective instruments. For example, innovation vouchers are designed to encourage businesses to seek new knowledge outside their network by providing small amounts of funding (in the range of 500-7000 euros) for various purposes. An example of this type of service is the IN2LifeSciences cluster, which supports SMEs in eight regions of Europe in the following areas [42, 43, 44]: meetings and communications: up to €500, which can cover travel and meetings with relevant organizations in other regions; staff exchange, training, contracted experts to advise on markets, technologies, intellectual property rights, etc: 4000 euros; cooperation on an innovative product or service: 7000 euros.

In addition, clusters of enterprises, especially those focused on small and medium-sized businesses, are able to attract various types of grant support, both from government agencies and through programs such as Horizon 2020, for which the state has created appropriate opportunities and prerequisites for business entities to participate. The mechanism of financial support for the development of enterprise clusters with a list of instruments that are quite common in international practice and that can also be used to support domestic enterprise clusters is presented in Fig. 3.23.

The practice of enterprise clusters in economically developed countries shows that the most common way to support them financially is through various types of targeted subsidies that can be used to overcome bottlenecks in the development of specific clusters, in particular:

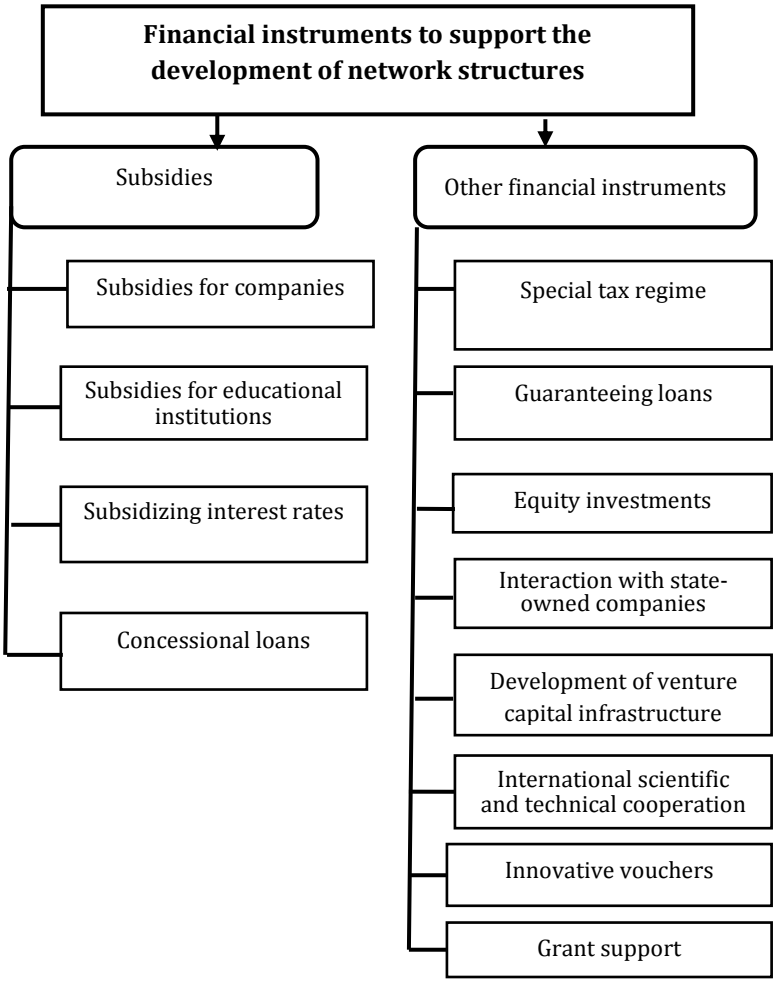

Figure 3.23. Mechanism of financial support for the development of enterprise clusters

- Supporting the activities of specialized organizations that provide methodological, organizational, expert, analytical and information support for the development of enterprise clusters;

- professional retraining, advanced training and internships for employees of participating companies (including abroad);
- advising companies participating in enterprise clusters on the development of investment projects in the innovation sector;
- organizing exhibitions and fairs, as well as participation of representatives of cluster member companies in exhibitions and fairs and communication events in Ukraine and abroad;
- development of innovative, educational, transport and energy, engineering and social infrastructure facilities.

It is worth noting that priority in providing targeted subsidies should be given to those cluster projects that are aimed, first, at generating breakthrough innovations, second, whose participants have significant innovative potential, and third, the projects should be comprehensive, i.e. correlated with other government support programs, in particular, for small and medium-sized businesses.

Higher education institutions are among the most active participants in the development of cluster cooperation. Educational organizations participating in enterprise clusters are actively involved in initiatives to create joint high-tech production facilities with industrial, transport and logistics companies, develop the innovative infrastructure of universities, and attract leading scientists, including foreign ones.

The development programs of educational institutions that are part of enterprise clusters should include a significant component related to stimulating innovative entrepreneurship and strengthening cooperative ties with companies. This makes them active participants in enterprise cluster development programs.

The main areas of interaction between universities and transport, logistics and other companies within the framework of innovation networks are:

- Implementation of educational programs in the areas of training, retraining and advanced training of personnel, primarily engineers, that are priorities for companies;
- conducting applied research in cooperation with business;
- joint use of the innovative infrastructure of universities, which allows them to utilize their human resources and material and technical base in the interests of business.

In order to intensify the development of enterprise clusters in the domestic industry, the state should strongly encourage the scientific and educational infrastructure, in particular, higher education institutions and research institutions to conduct commercial activities, ensure the implementation of scientific results through the national technology transfer network and direct part of its own funds to modernize scientific laboratories, purchase new scientific equipment and create small innovative companies.

A special role is assigned to the state in providing information and expert support for cooperation programs between research institutions, higher education institutions and companies, in particular those that involve co-financing activities for the development and production of innovative products, high-tech products, innovations and breakthrough technologies that are important for the development of the national economy.

Information, expert and analytical support for the development of enterprise clusters, including the development of conceptual frameworks for policy support for sectoral and regional clusters, is usually provided by a specialized organization operating at the macro level. In the EU, these functions are entrusted to the European Cluster Observatory. Its experts provide methodological and advisory support to public authorities, development institutions, territorial clusters and their members. Research results are regularly published in the

form of analytical reports, scientific articles and preprints. Information materials containing the most important news about the activities of regional networks and cluster policy are produced. The Observatory organizes scientific and practical seminars and roundtables on innovation and cluster policy, which are attended by representatives of government, business, development institutions, technology platforms, innovation clusters, and the knowledge generation sector. There may also be regional specialized network services whose function is to ensure a dialogue on the development of strategic priorities for regional innovation development, and to facilitate their reflection in state strategic planning documents, primarily regional strategies for socio-economic and innovation development, as well as state programs. One of the priorities of such specialized services is to promote cooperation between industry and regional networks operating in similar technological areas, as well as to expand cooperation with foreign partners.

Many EU countries have established large specialized organizations. Among them are the European Cluster Policy Group, European Cluster Alliance, Smart Specialization Platform, European Secretariat for Cluster Analysis, European Foundation for Cluster Excellence, European Cluster Collaboration Platform, European Cluster Observatory [45]. The main areas of their activity are the improvement of public policies and programs aimed at the development of clusters, as well as the improvement of their management, including the creation of specialized educational programs, the development of standards, and the development of professional associations.

From the above, it is obvious that there is a need to create appropriate structures at the state level and in Ukraine. To successfully solve this problem, there is a necessary organizational and personnel basis: first, Ukraine has a sufficient number of qualified specialists, which is confirmed by the presence of numerous scientific developments on cluster issues in the research environment; second, there is a business interest

in cluster cooperation, as demonstrated by numerous initiatives to create cluster networks; third, there is some experience in the implementation of network cooperation by both entrepreneurs and other stakeholders, in particular, the authorities All of the above, when complemented by state support measures, in particular through financial mechanisms, gives reason to hope for a positive result.

The areas and instruments of state support described above should be implemented through targeted support for those clusters of enterprises whose projects have won the competitive selection process on a competitive basis. To do this, the state should develop an appropriate program for the development of enterprise clusters, which would provide for a certain stage of state support (Figure 3.24).

The implementation of the program for the development of enterprise clusters in the economy should begin with the identification of innovative clusters of enterprises in the economy and the formation of a list of existing clusters by type, region, and industry. For this stage to be effective, it is necessary to use differentiated methodological approaches depending on the specifics of the market situation.

After identifying and defining promising clusters of enterprises, the next step is to organize project competitions. All members of sectoral and regional clusters of enterprises interested in receiving state support can prepare a project and submit it to the competition.

Competitive selection is a mandatory component of the state support system designed to ensure the growth of the most promising industrial, transport and logistics areas. The following groups of criteria should be taken into account in the competitive project selection procedure: scientific, technological and educational potential of the cluster of enterprises; production potential of the cluster of enterprises; impact on the quality of life and the level of development of transport, energy, engineering and social infrastructure of the industry or region where the cluster of enterprises is formed; level of

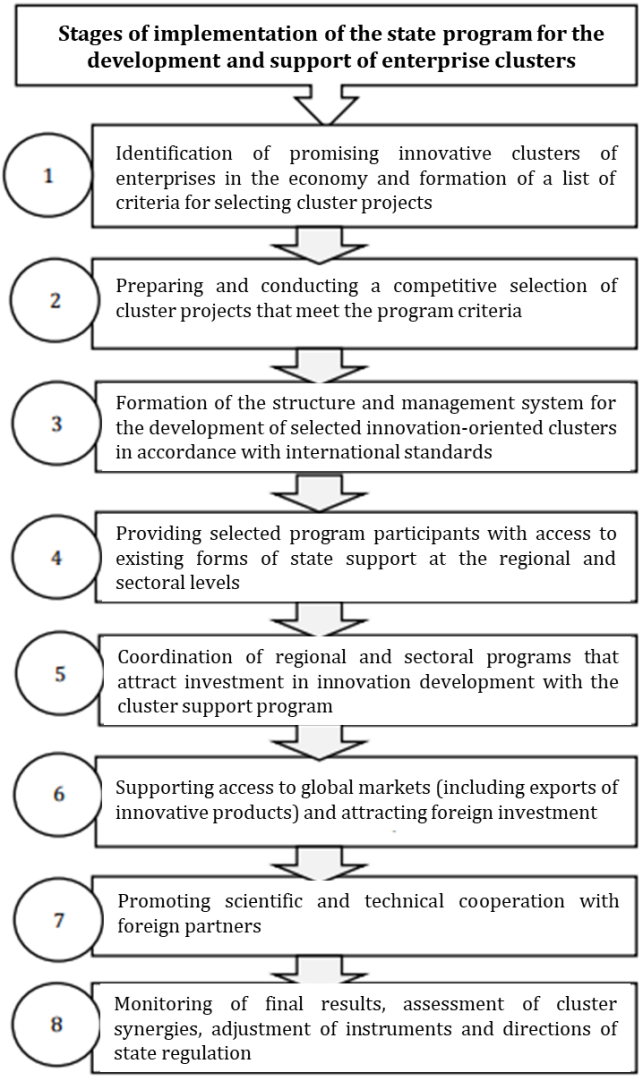

Figure 3.24. Stages of implementation of the state program to support the development of enterprise clusters

organizational development of the cluster of enterprises. The following aspects should be assessed for each of these groups of criteria:

- current level of economic development of the cluster;
- dynamics of the planned values of the target indicators of economic development of the cluster of enterprises;
- realism of the measures envisaged in the project in terms of the possibility of achieving the target indicators.

Priority in receiving state support should be given to projects for the development of enterprise clusters that combine significant production, research, scientific and educational potential of companies with the prospect of achieving global competitiveness, as well as projects involving a significant number of small and medium-sized companies with significant innovative potential.

European programs emphasize the development of small and medium-sized enterprises. Particular attention to the needs of small and medium-sized companies is due to their high interest in cooperation, as due to their limited size, they often cannot independently solve the problems of increasing innovation activity and ensuring competitiveness [46, 47]. Such companies, most of which are startups, received more than 60% of the total funding in European programs [48]. Businesses in this category also prevailed among the members of the German cluster network InnoRegio [49]. Under the French Competitiveness Clusters program, the share of small and medium-sized companies was 80%, with a total of 54% of the program budget allocated for their needs [50].

European programs involve rather long application preparation periods, and the competitive selection process takes place in several stages. In Germany, a two-stage system is practiced: after the preliminary selection, the remaining participants are asked to detail their bids. The state usually reimburses the costs associated with this and provides consulting support to the contestants. Under the terms of InnoRegio, the projects selected at the first stage received grants

of €153.4 thousand for in-depth project development. At the second stage, the winning projects are selected for full state support [51, 52].

The idea of a cluster of enterprises is to ensure cooperative interaction between the participants, which is why an essential criterion for selecting projects should be the existence of joint initiatives that benefit all cluster members. If only a limited number of participants benefit, then such a project cannot be considered a cluster project. Similarly, projects carried out by a large participating company with the involvement of subcontractors cannot be classified as such, despite the fact that bilateral contracts of contracting, hiring, sale and purchase, etc., provide for voluntary and mutually beneficial interaction between the parties.

The practice of European countries shows that the "portfolio" of joint projects often includes those related to the creation of infrastructure, including innovative infrastructure, such as a center for the collective use of equipment; the organization of consortia for participation in large orders, in particular in public procurement, as well as initiatives related to marketing and promotion of the cluster of enterprises (collective brand, joint participation in exhibitions and public events), employee training, etc.

The variety of models for the development of enterprise clusters determines the expediency of using the most flexible tools of state support, taking into account the specifics of the territories and industries in which they operate. In this case, we are talking about measures that relate not only to innovation policy, but also affect the solution of social and environmental problems.

The following indicators are proposed to be used as key indicators of express monitoring of the effectiveness of implementation of projects for the development of enterprise clusters:

- increase in the volume of products sold by the cluster members;

- growth in the number of highly productive jobs through the creation of new and modernization of existing jobs;
- growth in the volume of domestic and foreign direct private investment;
- increase in the share of innovative and environmentally friendly products manufactured by the cluster members;
- increase in the number of small and medium-sized companies included in the value chains of the cluster of enterprises and the dynamics of their production volumes.

Based on the results of the effectiveness assessment, decisions are made to continue or change state measures to support specific clusters of enterprises. A thorough analysis of the practice of state support for enterprise clusters is one of the mechanisms for their successful development. In this case, it is also of particular importance to organize and ensure effective and efficient communication between cluster members and representatives of government agencies responsible for the relevant policy. State support for the development of enterprise clusters in Ukraine should be based on such fundamental principles as flexibility, adaptability, and efficiency. The effectiveness of the policy will directly depend on the ability of the state to respond in a timely and adequate manner to market and socio-economic changes and, accordingly, the emergence of new needs for the development of enterprise clusters.

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