ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ

Л.Н. ГУМИЛЕВ АТЫНДАҒЫ ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ
КӨЛІК – ЭНЕРГЕТИКА ФАКУЛЬТЕТІ

«КӨЛІК ЖӘНЕ ЭНЕРГЕТИКАНЫҢ ӨЗЕКТІ МӘСЕЛЕЛЕРІ: ИННОВАЦИЯЛЫҚ ШЕШУ ТӘСІЛДЕРІ» Х ХАЛЫҚАРАЛЫҚ ҒЫЛЫМИ-ТӘЖІРИБЕЛІК КОНФЕРЕНЦИЯСЫНЫҢ БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ X МЕЖДУНАРОДНОЙ НАУЧНО – ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ: «АКТУАЛЬНЫЕ ПРОБЛЕМЫ ТРАНСПОРТА И ЭНЕРГЕТИКИ: ПУТИ ИХ ИННОВАЦИОННОГО РЕШЕНИЯ»

PROCEEDINGS OF THE X INTERNATIONAL SCIENTIFIC-PRACTICE CONFERENCE «ACTUAL PROBLEMS OF TRANSPORT AND ENERGY: THE WAYS OF ITS INNOVATIVE SOLUTIONS»

Нұр-Сұлтан, 2022

УДК 656/621.31
ББК 39/31
А43

Редакционная коллегия:
Председатель – Мерзадинова Г.Т., Член Правления – Проректор по науке, коммерциализации и интернационализации ЕНУ им. Л.Н. Гумилева, д.т.н., профессор; Заместитель председателя – Султанов Т.Т., заместитель декана по научной работе, к.т.н., доцент; Сулейменов Т.Б. – декан транспортно-энергетического факультета ЕНУ им. Л.Н.Гумилева, д.т.н., профессор; Председатель «Әдеп» – Ахмедьянов А.У., к.т.н., доцент; Арпабеков М.И. – заведующий кафедрой «Организация перевозок, движения и эксплуатация транспорта», д.т.н. профессор; Тогизбаева Б.Б. – заведующий кафедрой «Транспорт, транспортная техника и технологии», д.т.н. профессор; Байхожаева Б.У. – заведующий кафедрой «Стандартизация, сертификация и метрология», д.т.н. профессор; Жакишев Б.А.– заведующий кафедрой «Теплоэнергетика», к.т.н., доцент.

А43 Актуальные проблемы транспорта и энергетики: пути их инновационного решения: X Международная научно – практическая конференция, Нур-Султан, 17 марта 2022 /Подгот. Г.Т. Мерзадинова, Т.Б. Сулейменов, Т.Т. Султанов – Нур-Султан, 2022. – 597с.

ISBN 978-601-337-661-5

В сборник включены материалы X Международной научно – практической конференции на тему: «Актуальные проблемы транспорта и энергетики: пути их инновационного решения», проходившей в г. Нур-Султан 17 марта 2022 года.

Тематика статей и докладов участников конференции посвящена актуальным вопросам организации перевозок, движения и эксплуатации транспорта, стандартизации, метрологии и сертификации, транспорту, транспортной техники и технологии, теплоэнергетики и электроэнергетики.

Материалы конференции дают отражение научной деятельности ведущих ученых дальнего, ближнего зарубежья, Республики Казахстан и могут быть полезными для докторантов, магистрантов и студентов.

© ЕНУ имени Л.Н.Гумилева, 2022

СЕКЦИЯ/ SECTION 1
Көлікті пайдалану және жүк қозғалысы мен тасымалдауды ұйымдастыру/ Организация перевозок, движения и эксплуатация транспорта/Organization of transport, traffic and transport operation

UDK 707. 578

DEVELOPMENT OF A MODEL FOR THE INTERACTION OF LOGISTICS PROCESSES IN THE DEVELOPMENT OF AN AGGLOMERATION

Suleimenov T.B.[1], Sadykova G.M.[2], Sultanov T.T.[1], Tlepiyeva G.M.[1]
[1]L.N.Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan
[2]University of international business, Almaty, Kazakhstan
(E- mail: STB2007@yandex.ru, gulnara.muratpek@mail.ru, rumit78@mail.ru, tlepievagm@yandex.ru)

Abstract: The purpose of the study is to develop theoretical positions and methodological tools for the formation of a model of interaction of logistic processes in the development of an agglomeration. The object of the research is material flows in the economic, social and institutional spheres of the agglomeration. The theoretical and methodological significance of the study lies in determining the model of the interaction of logistics processes in the development of an agglomeration. The practical significance of the study lies in the fact that the methodological approaches proposed in the work and the developed model contribute to the adoption of informed decisions in the formation of the logistics processes of agglomeration. The used proposals of methods and models will reduce logistics costs due to more optimal movement of internal and external material and other flows in the agglomeration.

The work was carried out as part of the research project on the topic BR05236340 "Creation of high-performance intelligent technologies for analysis and decision-making for the" logistics-agglomeration "system within the framework of the formation of the digital economy of the Republic of Kazakhstan".

Key words: agglomeration, model, logistics, costs, ecology, transport.

Introduction. At this time, the Republic of Kazakhstan has approved the Interregional Action Plan for the Development of 3/25 the Almaty Agglomeration in order to solve the problems of socio-economic development. The current development scheme of the Almaty agglomeration, the core of which is the city of Almaty, includes the city of Esik and 14 rural districts of the Enbekshikazakh district, 6 rural districts of the Zhambyl district, the village of Otegen-Batyr and 8 rural districts of the Ili district, the city of Kaskelen and 10 rural districts of the Karasai district, the city Talgar and 10 rural districts of Talgar district, the city of Kapshagai and 2 rural districts, administratively subordinate to the Kapshagai city administration, as well as the planned city of Gate City. These territories are included in the 1,5-hour isochron of transport accessibility (no more than 110 kilometers along the main lines of communication or no more than 75 kilometers in other areas) from the city of Almaty. This isochron is consistent with international practice of intensive daily labor migration to the core city from adjacent settlements.

The population of the Almaty agglomeration as of September 1, 2019 is 3,103,6 thousand people, of which 1,884,6 thousand people live in the city of Almaty [1].

he process of formation and development of agglomeration leads to the intensification of the development of industrial, service, transport, social and cultural ties between the cities and leads to the formation of a multicomponent dynamic system material, transportation, information, financial flows. Molal interaction of logistic processes (procurement, distribution, loading, unloading delivery) directly

depends on the development of the production process in the Republic of Kazakhstan and gross regional product the GRP further, if we are talking about the development of logistics in the Metropolitan area. The share of gross regional product in the Almaty agglomeration in 2019 amounted to 6,558 billions of dollars.

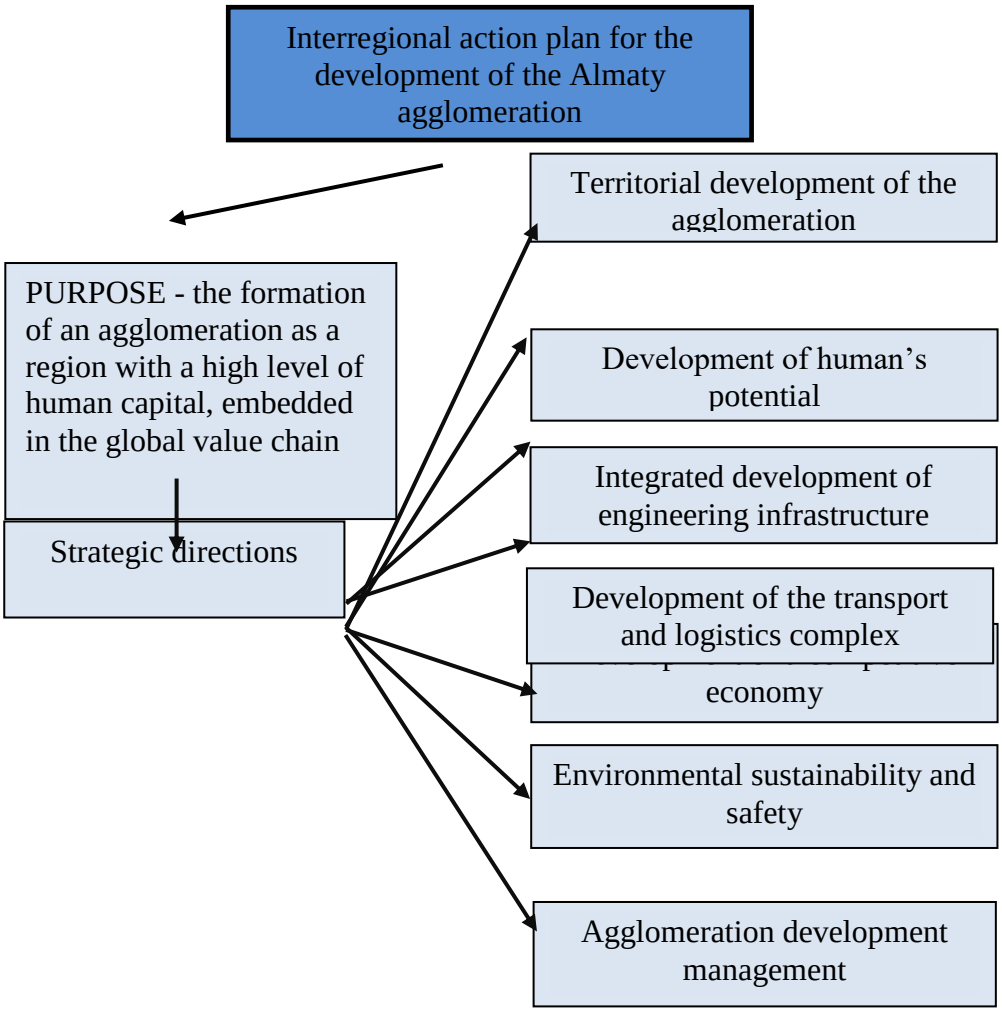

Figure 1–Goals and strategic directions of the Interregional action plan for the development of the Almaty agglomeration

Theoretical basis of the research method. In Almaty region, the development of agriculture, forestry and fishing. Almaty region ranks 5th in terms of manufacturing industry 20%, 7th in terms of transport and warehousing 12%, 4th in terms of construction 9% the region also shows results in the field of trade growth by 45% the Main production is concentrated in the Ili Karasai Talgar districts.

The formation of an agglomeration has a number of problems that affect the dynamism of the process of forming logistics processes. One of them is that the lack of methodological approach to the formation of agglomeration leads to such problems of urbanization as excessive load on the logistics infrastructure, which negatively affects the environmental situation and economic indicators. Comparative analysis by questionnaire respondents of Almaty agglomeration shows that there is a problem of an inefficiency of functioning of logistic processes, which leads to an increase in the cost of transportation of goods and passengers, increased losses of working time to environmental degradation and eventually to the emergence of complex social and economic problems in the Almaty region [2].

The author forms the dependence of growth of gross regional product as the main indicator of development of Almaty agglomeration due to the contribution of logistics agglomeration as a basic service component of the regional economy.

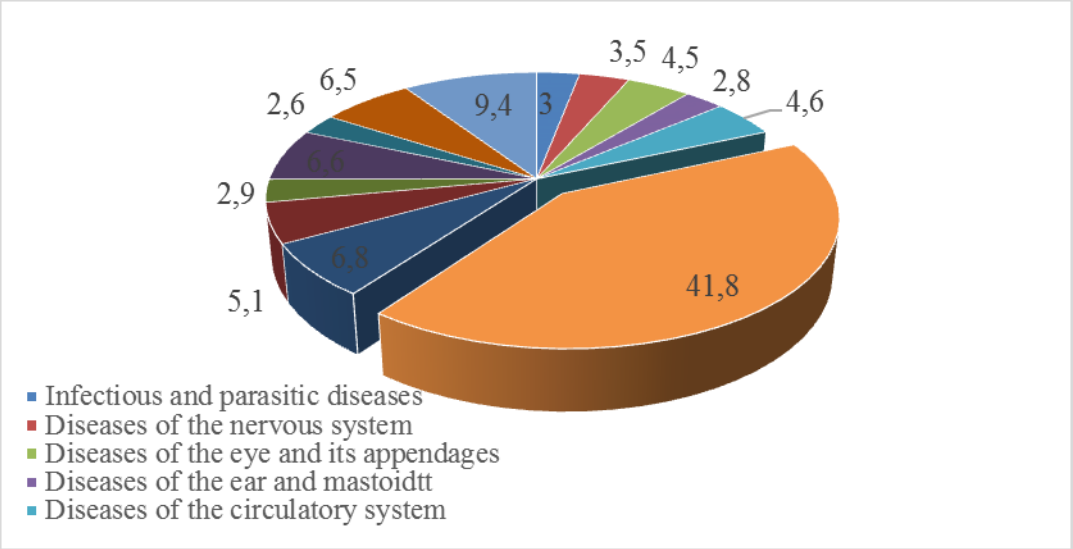

Figure 2–Structure of morbidity in the population of the Almaty agglomeration (according to the Ministry of Health of the Republic of Kazakhstan) %

Compiled by the authors based on the source of the statistical collection Health of the population of the Republic of Kazakhstan and the activities of the health organization in 2019 [3]. According to the statistical data of figure 2, respiratory diseases of the population in the Almaty agglomeration account for 41,8 %, which indicates the level of air pollution and environmental problems.

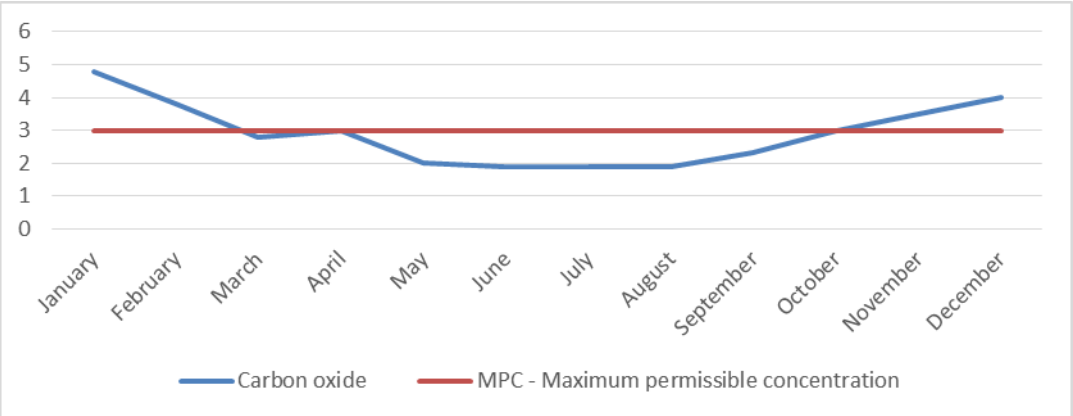

Figure 3 – Average annual distribution of oxide concentration carbon in the Almaty agglomeration, mg/m^3

Today, three indicators of air quality are used in the Almaty agglomeration:

1) API is the total index of atmospheric pollution.

2) SI - standard index (maximum one-time concentration of an impurity divided by MPC).

3) NP in% (the highest frequency of exceeding the MPC) [4].

Figure 4 shows the annual distribution of the average concentrations of carbon monoxide. As you can see, the excess of the MPC values occurs only during the heating season, their values reach 4,8 mg/m^3 in January, 4,0 mg/m^3 in December, with the maximum permissible no more than -3.0 mg/m^3. The increase in concentration in winter is associated with the work of heat and utility companies, as well as a weak wind regime in winter. In summer, more intensive mixing of air layers in the atmosphere occurs [5].

Therefore, its minimum falls in May, when the concentration reaches-9 mg/m^3 in 2019.

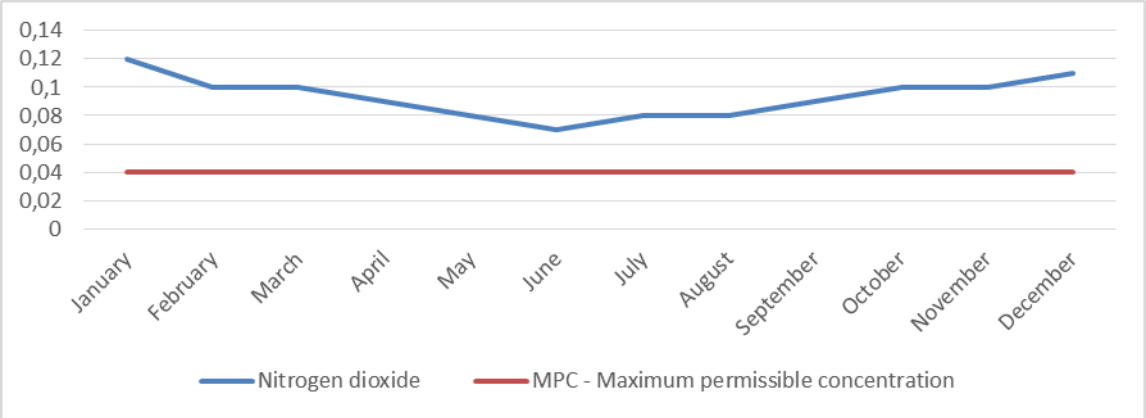

Figure 4 – Average annual distribution of nitrogen dioxide concentration, mg/m^3

Nitrogen oxides (NO_2) are formed during combustion at high temperatures by oxidizing some of the nitrogen in the atmosphere. Nitrogen dioxide is the main source of tropospheric ozone and nitrate aerosols, which constitute a significant part of the mass of atmospheric air, Figure 4.

The main sources of NO_2 emissions: combustion engines, industrial boilers, furnaces. Even at low concentrations nitrogen dioxide, breathing disorder, cough is observed.

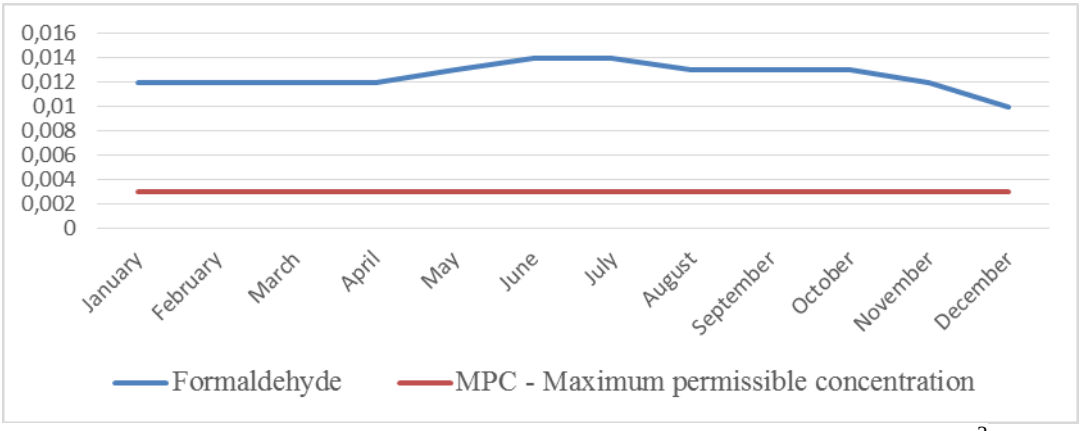

Figure 5–Average annual distribution of formaldehyde concentration, mg/m^3

The distribution of formaldehyde, as shown in Figure 5, is quite different from the distribution of the above pollutants.

The excess of the MPC is visible throughout the year, reaching its maximum values in the summer, where the values reach 4,7 MPC, for example, in June, July up to 0,014 mg/m^3. The minimum values fall on the month of December, where the value is less and is 0,011 mg/m^3.

In general, in the Almaty agglomeration, the average annual concentration of nitrogen dioxide was 2,1 MPC, and formaldehyde - 1,3 MPC, the content of suspended solids - 1,2 MPC, sulfur dioxide - 1,12 MPC, the content of other pollutants did not exceed the maximum permissible concentrations. The maximum individual concentrations of nitrogen dioxide was 5,0 MPC, suspended particles PM-2,5-3,9 MPC, suspended particles PM-10 - 3,2 MPC, carbon monoxide - 3,1 MPC, nitric oxide - 2,5. MPC, sulfur dioxide - 2,3 MPC, suspended solids - 1,8 MPC. MPC for phenols and formaldehyde is not exceeded, the data indicate the deterioration of the environmental situation in the Almaty agglomeration [6,7].

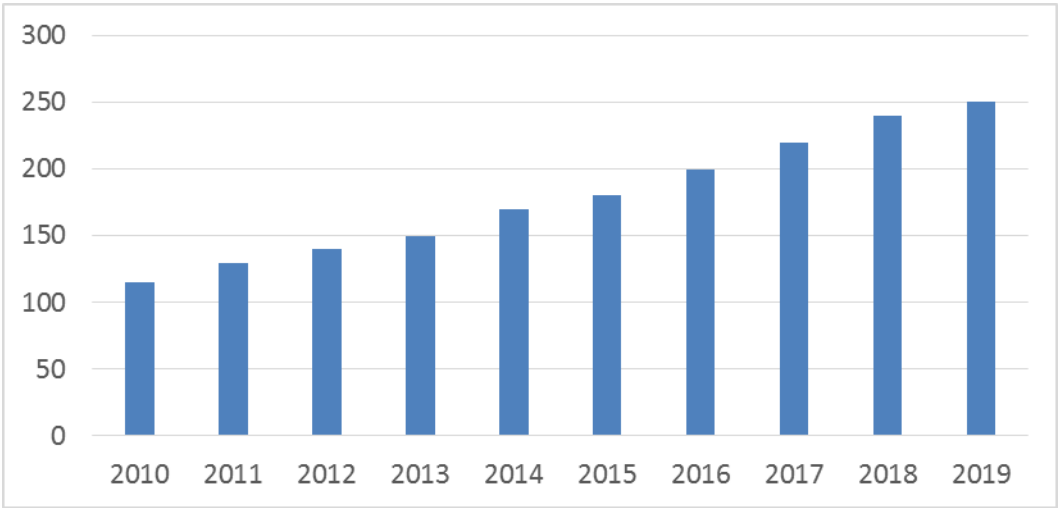

Figure 6–Transported (transported) cargo and luggage, cargo luggage by road in the Almaty agglomeration million tons

According to Figure 6, it is necessary to note an increase in the volume of transportation of cargo and cargo luggage in the Almaty agglomeration, if in 2010 the volume of traffic amounted to 120 million tons, then in 2019 it was 250 million tons, there was a 2-fold increase + 130 million tons in 10 years, which testifies to the development of road transport in the Almaty agglomeration.

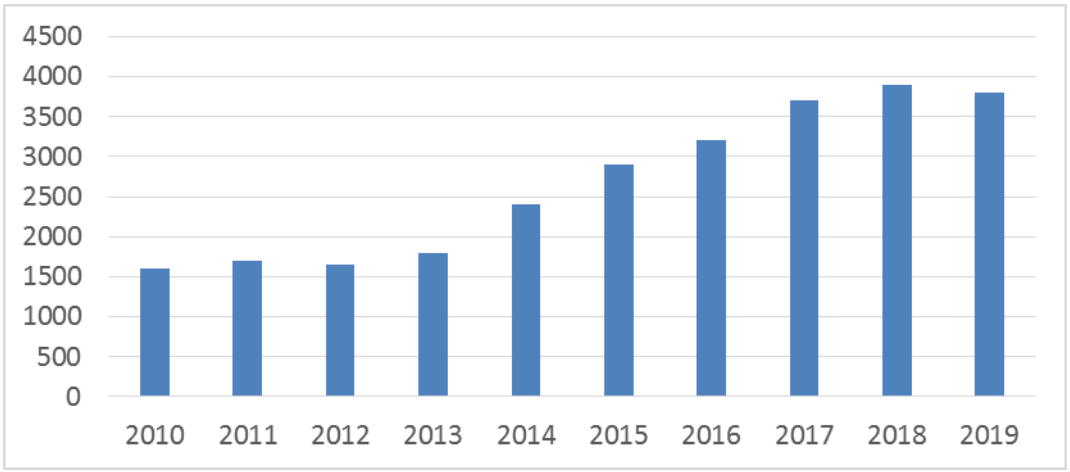

Figure 7–Passengers transported by road in the Almaty agglomeration thousand people

Note - Compiled by the author based on the source of the department of statistics of the city of Almaty statistical collection, Almaty 2014-2019.

According to Figure 8, it is necessary to note an increase in the number of passengers in the Almaty agglomeration, if in 2010 the number of passengers was 1,500 thousand people, then in 2019 3,700 thousand people, there was an increase of 2,5 times + 1,800 thousand people over 10 years, which indicates the development passenger traffic in the Almaty agglomeration [8, 9].

The growth in the number of cargo transportation and passengers by road transport of the Almaty agglomeration reveals one of the most important problems of the need to increase the throughput and carrying capacity of the road transport network.

It can be concluded that as a consequence of the territorial structure, insufficient development of transport communications between the regions of the Almaty agglomeration, increased loads on the road transport network have become, which leads to violation of the logistics rules "just in the lines", "optimal route", "high delivery speed". This factor increases the burden on logistics processes and prevents its integration [10, 11].

Table 1–Analysis of the types of population mobility and their share of the Almaty agglomeration

The structure of the cycles	Sequence of movement goals in closed loops	Specific weight of cycles,%	Specific weight of movements,%
Linear	Home ↔Work	36,6	33
	Home↔ Cultural and household facilities	31,1	28
	Home↔ Study	17,6	16,2
Triangular	Home ↔ Работа↔ Cultural and household facilities	6,4	8,6
	Home↔ Cultural and household facilities ↔ Home	2,6	3,8
	Home ↔Study↔ Cultural and household facilities	1,6	2,3
Quadrangular	Home↔Work ↔ Cultural and household facilities ↔ Home	2,6	4,8
Other		1,3	3,3

The analysis of the types of mobility of the population and their share of the Almaty agglomeration according to the data in Table 1 indicates the linear movement of 33% of the population “House↔Rabota”, 28% “House ↔ Cultural and household facilities” and 16,2% “House ↔ Study” [12, 13].

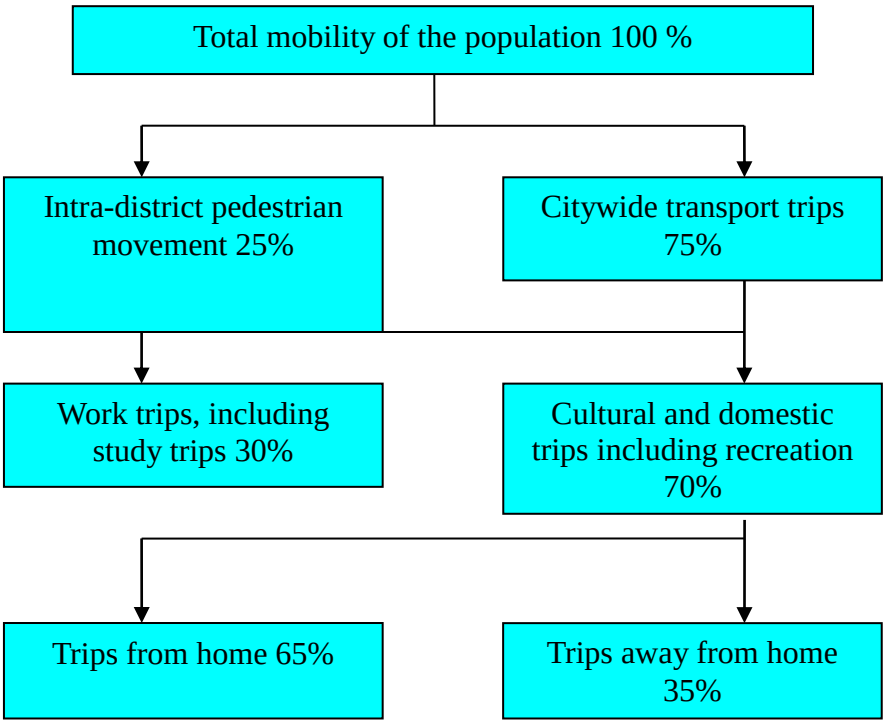

Figure 8–Analysis of the distribution of total mobility by purpose of travel in the Almaty agglomeration

Results. The analysis of the distribution of total mobility by purpose of travel in the Almaty agglomeration and the numerical values of Figure 8 indicate that 75% are citywide travel, and 65% are travel from home.

Table 2–Analysis of the main purposes of travel and mobility per inhabitant of the Almaty agglomeration per day.

Purpose of travel	Mobility per resident per day	Transport utilization rate
Labour	1,06	0,76
Educational	0,28	0,50
Household	0,83	0,48
Cultural	0,21	0,52
Resting places	0,45	0,53
Total for all purposes	2,83	0,60

Analysis of the main purposes of travel and mobility per inhabitant of the Almaty agglomeration per day in Table 2 show the labor purposes of travel with a transport utilization rate of 0,76.

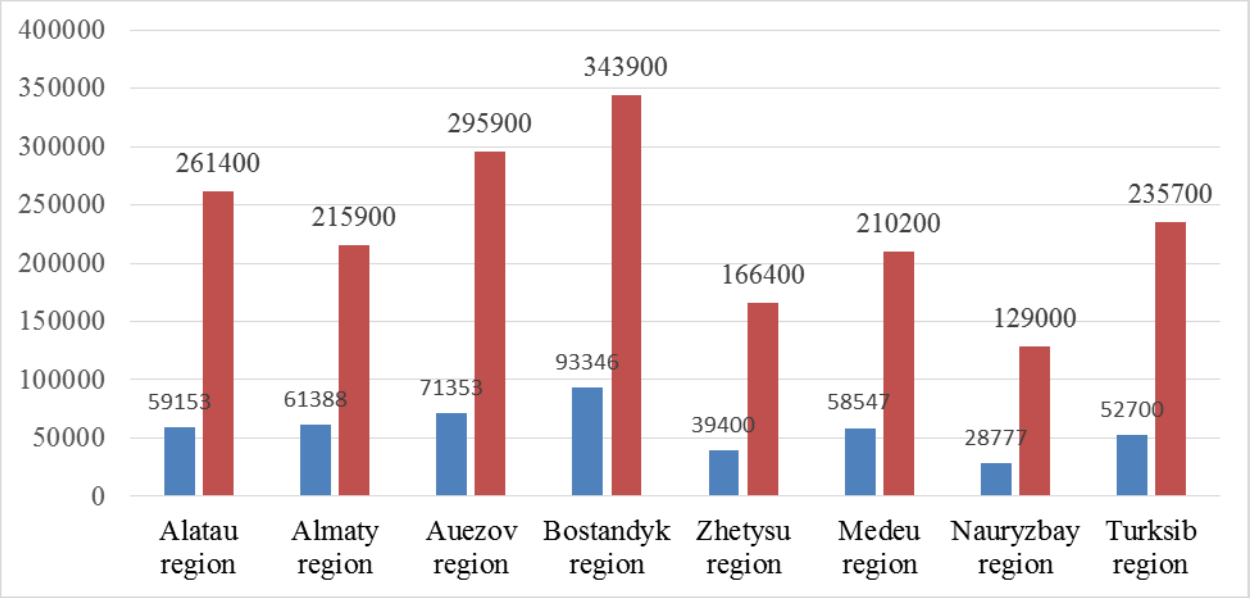

Figure 9 – Number of jobs and population in Almaty for 2019

Note - compiled by the author based on statistical data. According to Figure 9, the total number of employees in Almaty was 464,664 people. This number of residents move in the direction of "Home-Work".

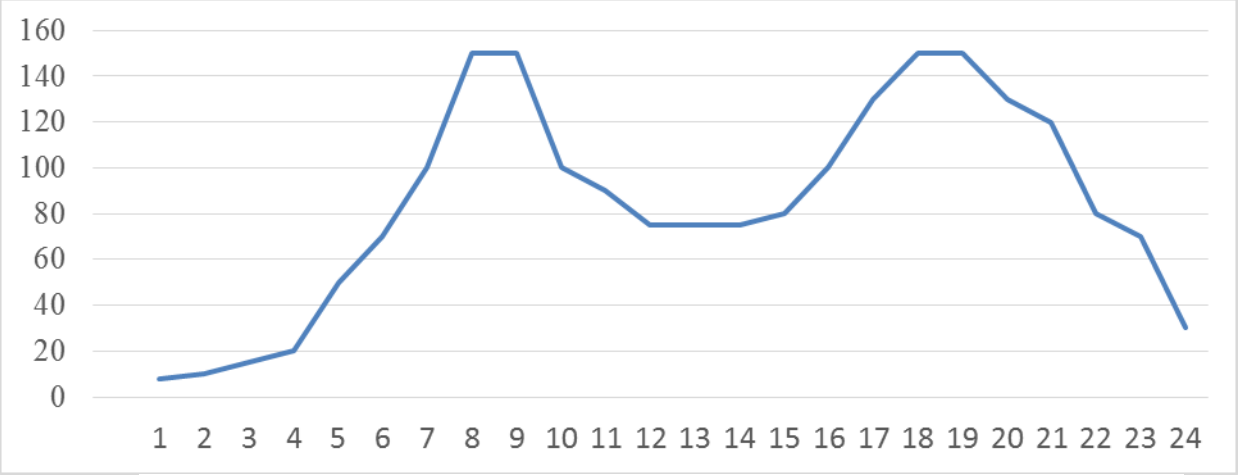

Figure 10–Change in traffic intensity during the day in the Almaty agglomeration

According to the data of the time study of the movement of motor transport, it is necessary to conclude that the main flow is concentrated from 6 am to 10 am, which indicates the movement of the

population in the direction "Home - Work" and "Home - Study" in relation to schoolchildren and students [14,15].

The next peak occurs in the time frame from 5 pm to 9 pm, which indicates the direction "Work-at-home","Study-at home".

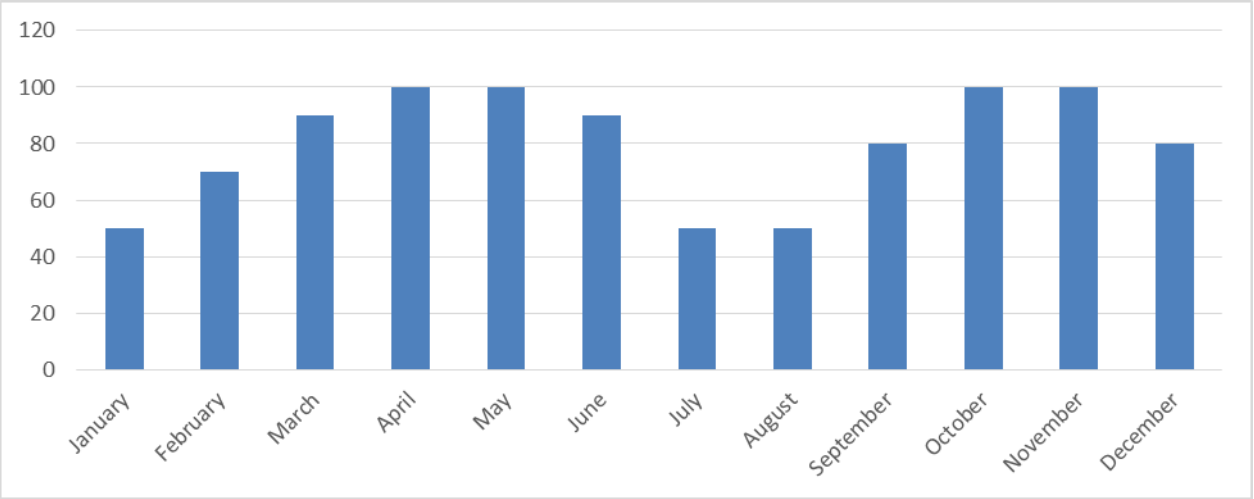

Figure 11 – Change in traffic intensity throughout the year in the Almaty agglomeration

According to the data of the chronometric study of the movement of road transport in Figure 11 during the year, it is necessary to conclude that the main flow is concentrated in the months of March, April, May, June, September, October, November, December. The decline in traffic intensity in January, July, August indicates a vacation period for the working population and a vacation period for students [16, 17].

		Agglomeration		
	Population of the agglomeration			
	People under the working age	People of working age	People over the working age	
	Agglomeration logistics			
	Production logistics	Transport logistics	Warehousing logistics	
Purchasing logistics	Information logistics		Ecological logistics	Lean logistics
	Inventory logistics	Sales logistics	Customs logistics	
	Logistic processes in the agglomeration			
	Transportation of cargo and passengers	Customer service	Organization of production	
	Storage and warehousing	Sales of finished products	Transfer of information	
Information service		Purchase of raw materials	Registration of customs documentation	
	Goals and objectives of agglomeration logistics			
Goal 1-meeting the needs of residents of the agglomeration		Goal 2-rational organization in space and time	Task 3-optimization of costs for production and sale of finished	
Task 1-integration of agglomeration into a single creative whole		Task 2-maximizing the utilization of production facilities	Task 4-reducing toxic and greenhouse gas emissions to the environment	

Figure 12–Model of interaction of logistics processes in the development of agglomeration

On the basis of the above data, a "Model of the interaction of logistics processes in the development of an agglomeration" was compiled, taking into account the types of logistics development, such as production, warehouse, information, environmental, lean, customs in accordance with the development of the domestic regional product in the Almaty agglomeration. Highlighted logistics processes such as transportation, storage, information services, customer service, production organization, customs clearance. The main goals of the logistics agglomeration are determined. When investigating the issue, the authors have developed a new definition as "logistics of agglomeration" - a complex of logistic solutions, actions, processes aimed at optimizing organizational solutions for the movement of material flow, vehicles within the agglomeration subsystems [18, 19].

The authors have developed a "Model for making a decision on the development of logistics in a specific agglomeration" based on the analysis of the development of the Almaty agglomeration. To make a decision on the quality of logistics services and processes, the main characterizing parameters in the conditions of the Almaty agglomeration, taking into account the intensity of the development of road transport and the growth of the throughput of highways and the inconsistency of the transport infrastructure, are what criteria as "the right place", "the right time" and "emission reduction". This indicates the deterioration of the ecological situation in the Almaty agglomeration. In conditions of the maximum intensity of the organization of the movement of automobile and urban transport, it is difficult to withstand the conditions for making the decision "the right place", "the right time" and "emission reduction". In this regard, the main evaluation criteria are set to parameters such as "speed of traffic", "quality of services in transport", "digitalization", "quality of roads", "delivery time", "optimal price of the service", "level of pollution", "traffic safety" [20, 21].

<table>
<tr><td colspan="5">Agglomeration</td></tr>
<tr><td colspan="5">Population of the agglomeration</td></tr>
<tr><td colspan="2">People under the working age</td><td>People of working age</td><td colspan="2">People over the working age</td></tr>
<tr><td></td><td colspan="3">Making a decision on the development of logistics in a particular agglomeration</td><td></td></tr>
<tr><td></td><td>Right place</td><td>Right time</td><td>Emissions reduction</td><td></td></tr>
<tr><td></td><td colspan="3">Parameters for making a decision on the development of logistics in a particular agglomeration</td><td></td></tr>
<tr><td>Starting point of the stream</td><td>The route</td><td rowspan="2"></td><td>Speed of moving objects</td><td>Time</td></tr>
<tr><td>Final point of the stream</td><td>Path length</td><td>The intensity of the flow</td><td>Intermediate flow points</td></tr>
<tr><td></td><td colspan="3">Evaluation criteria</td><td></td></tr>
<tr><td>The speed of traffic</td><td>Quality of transport services</td><td rowspan="2"></td><td>Digitalization</td><td>Quality of roads</td></tr>
<tr><td>Delivery time</td><td>Optimal price for services</td><td>Pollution level</td><td>Traffic safety</td></tr>
</table>

Figure 13–Model for making a decision on the development of logistics in a particular agglomeration

The implementation of the tasks proposed in the framework of the Model for making a decision on the development of logistics in a particular agglomeration will allow to form an integrated logistics of the agglomeration, creating the basis for the further development of the Almaty agglomeration [22, 23].

Conclusion. The section adopted a new definition, developed by the authors, "logistics of agglomeration" - a complex of logistics solutions, actions, processes aimed at optimizing organizational solutions for the movement of material flow, vehicles within the agglomeration subsystems.

A model of interaction of logistics processes in the development of an agglomeration has been developed.

A model has been developed for making a decision on the development of logistics in a specific Almaty agglomeration.

Practical recommendations have been developed for the model of interaction of logistics processes in the development of the Almaty agglomeration.

The proposed methods can be used to develop a model for the interaction of logistics processes in the development of an agglomeration in the Republic of Kazakhstan.

References

1. Decree of the Government of the Republic of Kazakhstan dated February 28, 2020 No. 88 On approval of the Interregional action plan for the development of the Almaty agglomeration until 2030. Approved by the Decree of the Government of the Republic of Kazakhstan dated February 28, 2020 No. 88.
2. Statistical compilation Health of the population of the Republic of Kazakhstan and the activities of healthcare organizations in 2019 http://www.rcrz.kz/index.php/ru/statistika-zdravookhraneniya-2.
3. Statistical collection Transport https://stat.gov.kz/.
4. Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan stat.gov.kz.
5. Granberg A.G. (2014). Fundamentals of regional economics: a textbook for universities. - M .: GU Vysh. shk. economy. 496 s.
6. Prokofieva T.A., Lopatkin O. M. (2013). Logistics of transport and distribution systems. Regional aspect. M.: RKconsult. 400 s. with silt.
7. Sergeev V.I. (2011). Logistics in business: a textbook for universities. M.: Infra-M. 326 p.
8. Bowersox D.J. Logistics: an integrated supply chain / D. J. Bowersox, D. J. Clos; per. from. English N.N.Baryshnikova, B.S.Pinsker. - M.: Olymp-Business, 2005 .- 640 p.
9. Burakov V.I. International logistics systems / V.I. Burakov.- Irkutsk: BSUEP Publishing House, 2009 .- 174 p.
10. Burakov V.I. Theoretical aspects of the formation of the corporate logistic concept of management / V. I. Burakov // Regional market of goods and services: innovative and logistic approaches (within the framework of the V Baikal Economic Forum): materials of the international. scientific-practical conf. (Irkutsk, September 30, 2008). - Irkutsk: BSUEP Publishing House, 2008. - P. 62–64.
11. Gadzhinsky A.M. Logistics: textbook./A.M. Gadzhinsky. - 2nd ed. - M.: Marketing, 1999.- 228 p.
12. Gaides M.A. General theory of systems (systems and system analysis) / M.A. Gaides. - M.: Globus-Press, 2005.- 201 p.
13. Kolodin V.S. Logistic infrastructure of the regional commodity market / V.S. Kolodin.- Irkutsk: Izd-vo IGEA, 1999.-173 p.
14. Logistics: textbook. / V.V. Dybskaya, E.I. Zaitsev, V.I. Sergeev, A.N. Sterligova; ed. V.I. Sergeeva. - M.: Eksmo, 2008.- 944 p.
15. Logistics: textbook. / ed. B. A. Anikina. - 3rd ed., Rev. and add. - M.: Infra-M, 2002 .- 368 p.
16. Lukinsky V.S. Theoretical and methodological problems of management of logistic processes in supply chains / V.S. Lukinsky, N.G. Pletneva, T.G. Shulzhenko; under total. ed. V.S. Lukinsky. - SPb.: SPbGIEU, 2011.-242 p.
17. Lukinykh V.F. Methodology of management of a multi-level regional logistics system / V.F. Lukinykh. - Krasnoyarsk: Litera-Print, 2010.- 292 p.

18. International aspects of logistics / V.I. Voronov, A.V. Voronov, V.A. Lazarev, V.G. Stepanov. - Vladivostok: VSUES, 2002.-168 p.

19. Mesarovich M. Theory of hierarchical multilevel systems / M. Mesarovich, D. Mako, I. Takahara; per. from English. ed. I.F.Shakhnova. - M.: Mir, 1973.- 344 p.

20. Mirotin L.B. Efficiency of integrated logistics / L.B. Mirotin, A.G. Nekrasov. - M.: Ekzamen, 2003.- 256 p.

21. Nerush Yu. M. Logistics: textbook. / Yu.M. Nerush. - 4th ed., Rev. and add. - M.: TK Welby; Publishing house Prospect, 2006.- 520 p.

22. Novikova N.G. Problems of the implementation of a logistic approach to managing an organization / NG Novikova // Regional market of goods and services: innovative and logistic approaches (within the framework of the V Baikal Economic Forum): materials of the international. scientific-practical conf. (Irkutsk, September 30, 2008). - Irkutsk: BSUEP Publishing House, 2008. - P. 25–28.

23. Stock J.R. Strategic management of logistics / J. R. Stock, D. M. Lambert; per. from. 4th eng. ed. V.N. Egorova; ed. V.I.Sergeeva. - M.: Infra-M, 2005.- 797 p.

UDK 567.941

MAGLEV`S TECHNOLOGY PRINCIPLES

Čarský J.[1], Arpabekov M. I.[2], Dauletov A.A.
1 Czech Technical University in Prague, Praha, Czech Republic
2 L.N. Gumilyov Eurasian National University, Astana, Kazakhstan
(E- mail: carsky@fd.cvut.cz, arpabekov_m@mail.ru, akadil_d@mail.ru)

Consider a train that has no wheels. Instead of rolling along the track, it hovers above it, softly gliding from point A to point B without ever hitting a rail. Although this may sound like science fiction, examples of this technology can already be found in a number of locations throughout the world. Maglev trains are what they're called (derived from the term magnetic levitation). These future locomotives open up a world of new and thrilling travel options. They have the potential to be more energy efficient, faster, and safer than traditional transportation methods. Despite the fact that such trains are few and few between at the moment, they are a beehive of study in the field of electrical engineering. As a result, maglev might become more prevalent than you think.

Recently, the aerodynamic characteristics of the rolling stock have been significantly improved. The resistance to movement of modern electric trains of the Shinkansen network (Japan) at a speed of 300 km/h is approximately the same as that of trains of the previous series of the same length (400 m) at a speed of 220 km/h. This, among other things, allows you to reduce the power consumption for traction.

Further improvement of the rolling stock is necessary to expand the range of lines for regular trains running at a speed of 300 km / h or more. The priority is the introduction of the following technical innovations:

- wheel-to-rail traction control systems that ensure effective acceleration of the train and its steady movement at a speed of more than 300 km / h, even in conditions of poor traction (for example, when the rails are covered with a crust of ice);
- design solutions that further reduce the resistance to movement (especially in the space between the bottom of the car bodies and the track);
- design solutions for rolling stock and track that reduce the impact interaction between the wheel and the rail;
- more efficient mechanical brake designs and other auxiliary brake systems;
- design solutions for the rail track, allowing the effective use of the eddy current brake.

It is also very important that passengers make effective use of their time on the train during the journey. For example, passengers in Europe and the United States often use personal computers on the