ISRG Journal of Multidisciplinary Studies (ISRGJMS)

ISRG PUBLISHERS
Abbreviated Key Title: isrg j. multidiscip. Stud.
ISSN: 2584-0452 (Online)
Journal homepage: https://isrgpublishers.com/isrgjms/
Volume – II Issue - VIII (August) 2024
Frequency: Monthly

METHODOLOGY OF TRANSPORT AND LOGISTICS SYSTEMS OF THE KYRGYZ REPUBLIC

Salmorbekova R.B.[1*], Kurmanov U.E.[2]

[1] Doctor of Sociological Sciences, Professor Kyrgyz Aviation Institute named after. I. Abdraimova, Bishkek, Kyrgyz Republic ORCID: 0000-0002-7580-9694

[2] Candidate of Technical Sciences, Professor Kyrgyz Aviation Institute named after. I. Abdraimova, Bishkek, Kyrgyz Republic ORCID: 0000-0003-3326-104X

| **Received:** 14.08.2024 | **Accepted:** 19.08.2024 | **Published:** 21.08.2024

***Corresponding author:** Salmorbekova R.B.
Doctor of Sociological Sciences, Professor Kyrgyz Aviation Institute named after. I. Abdraimova, Bishkek, Kyrgyz Republic ORCID: 0000-0002-7580-9694

Abstract

Annotation. *The article discusses the methodology for studying the synthesis of transport and logistics systems, adapted to the conditions of the Kyrgyz Republic, which is due to the need to increase the competitiveness of the national economy and fulfill the country's transit potential through the creation of an effective logistics infrastructure. In the context of growing globalization and integration into international supply chains, an effective transport system is becoming a key factor for sustainable economic development.*

The relevance of the topic is determined by a set of factors, including geographical features, the specifics of the mountainous terrain of Kyrgyzstan and the need to integrate various modes of transport into multimodal transportation. The methodology includes the use of modern theories and concepts from the field of transport logistics, such as modeling of logistics processes and the use of geographic information systems (GIS). The principles of "green" logistics and sustainable development are also considered, which involves minimizing the negative impact on the environment during the transportation and handling of goods.

The methodological basis of the study includes the stages of creating an optimal network of logistics centers and transport hubs. This will ensure the concentration of cargo flows and facilitate their efficient processing, which is critical to improving the overall performance of the transport system. An important aspect is the implementation of intelligent transport systems and information technologies, which will allow for the integration of supply chain participants, monitoring of transport flows and optimization of logistics processes.

DOI: 10.5281/zenodo.13352655

The study uses methods of system analysis and modeling, which allows predicting the effectiveness of the proposed solutions and assessing their impact on the development of the country's transport and logistics system. Particular attention is paid to identifying factors that facilitate or hinder the implementation of proposals, as well as analyzing existing problems and proposing solutions.

Thus, successful implementation of the proposed methodology will create a competitive transport and logistics system integrated into global supply chains that meets modern requirements for efficiency and sustainable development. The need for the results of this study is emphasized by the strategic importance of transport for economic growth and the realization of the transit potential of the Kyrgyz Republic.

Keywords: *logistics, methodology, process, synthesis, system, transport logistics, technology.*

INTERODUCATION

Efficient transport and logistics systems play a key role in ensuring the smooth movement of goods and material flows, as well as in optimizing costs and increasing the competitiveness of enterprises. The relevance of the topic is due to the growing demands for the efficiency and flexibility of transport and logistics systems in the context of globalization, urbanization and the development of e-commerce. Competent synthesis of such systems allows to reduce logistics costs, increase the speed and reliability of cargo delivery, optimize the use of vehicles and logistics infrastructure, and ensure a high level of service for customers. The methodology of synthesis of transport and logistics systems is of significant relevance for the Kyrgyz Republic due to a number of factors:

1. Geographical position of Kyrgyzstan. The country is landlocked and located in the center of the Eurasian continent, which makes it a transit corridor for cargo flows between Europe and Asia. An effective transport and logistics system will allow Kyrgyzstan to realize its transit potential and develop logistics services.
2. Development of trade and export. For Kyrgyzstan, which is a member of the EAEU and the WTO, it is extremely important to ensure the competitiveness of its export products by reducing logistics costs. A competent synthesis of transport and logistics systems will optimize logistics processes.
3. Modernization of transport infrastructure. Construction and reconstruction of regional and international roads and railways is actively underway in Kyrgyzstan. The synthesis methodology will allow for the effective integration of new transport facilities into the overall logistics system.
4. Attracting investment. A developed transport and logistics system increases the country's investment attractiveness by creating favorable conditions for the placement of production facilities and logistics centers.
5. Mountainous terrain. Kyrgyzstan's complex terrain creates additional challenges for transport logistics, requiring the use of special modeling methods and route optimization.
6. Environmental aspects. The methodology for the synthesis of transport and logistics systems allows for environmental factors to be taken into account and the negative impact of transport on the environment of mountainous regions to be minimized.

Thus, the development and implementation of a modern methodology for the synthesis of transport and logistics systems is a strategically important task for the Kyrgyz Republic. This will improve the efficiency of logistics, reduce transport costs, create favorable conditions for trade and investment, and ensure sustainable development of the transport sector, taking into account environmental factors.

Synthesis of transport and logistics systems involves a comprehensive approach to the design and creation of integrated systems that combine various modes of transport (road, rail, air) and logistics operations (cargo handling, warehousing, inventory management, etc.).

The methodology for the synthesis of transport and logistics systems is an important area of research that contributes to improving the efficiency and competitiveness of enterprises, as well as the development of the economy as a whole. The main theories in the study of the synthesis of transport and logistics systems in Kyrgyzstan.

Systems theory and systems analysis is a fundamental concept that allows us to consider the transport and logistics system as a set of interconnected elements, such as vehicles, infrastructure, information flows, etc. A systems approach helps to identify and analyze these relationships. Systems theory and systems analysis have made a significant contribution to the development of transport science. Authors and their works that influenced the application of the systems approach in the transport sector: Ludwig von Bertalanffy - Austrian biologist, one of the founders of the general systems theory. In his work "General Systems Theory" (1968)[1], he laid the foundations for systems thinking and an interdisciplinary approach to the study of systems. Jay Forrester - American scientist and pioneer in the field of system dynamics. His book "World Dynamics" (1971)[2] demonstrated the application of systems modeling to the analysis of complex socio-economic systems, including transport. Peter Checkland[3] - developed the Soft Systems Methodology for solving problems in weakly structured systems. His approach was applied in transport planning and management. Enrico Fermi - made a significant contribution to the development of general systems theory and its application in

[1] Берталанфи Л. фон. Исторический статус общей теории систем // Системные исследования. Ежегодник 1973. - М., 1973. - С. 20-37 [Электронный ресурс]. - URL: https://systems-analysis.ru/assets/ systems_research_1973.pdf (дата обращения: 23.02.2022).

[2] Джей Форрестер: Мировая динамика. / Перев.: Ворощук А., Пегов С. Ред.: Кривцова Е. Г.
Издательство: АСТ, 2003. 384 с.

[3] Checkland, Peter B. & Poulter, J. Learning for Action: A short definitive account of Soft Systems Methodology and its use for Practitioners, teachers and Students, Wiley, Chichester. 2006.

DOI: 10.5281/zenodo.13352655

transport engineering[4]. His works are devoted to modeling and optimization of transport systems. Vasily Kudryavtsev - Soviet and Russian scientist, founder of the scientific school "Systemology in Transport"[5]. He developed the concepts and methods of system analysis for planning and management of transport systems. Mikhail Blinkin - scientist, specialist in the field of transport modeling and systems analysis. His works are devoted to optimization of traffic flows and design of transport systems[6]. These and other scientists and researchers laid the scientific foundations for the application of the systems approach in the transport sector, contributing to the development of methods for modeling, analysis and optimization of complex transport systems.

Operations research. This area of mathematics deals with process optimization and decision-making problems. In transport logistics, it is used to model and optimize routes, allocate resources, create schedules, etc. Operations research is an important mathematical discipline that has made a significant contribution to the development of optimization and decision-making methods in various fields, including transport logistics. Authors who have made significant contributions to this area: George Dantzig is an American mathematician and one of the founders of linear programming. His work "Linear Programming and Extensions" (1963)[7] laid the foundation for optimization methods in operations research. John von Neumann and Oskar Morgenstern are the authors of the classic work "The Theory of Games and Economic Behavior" (1944) [8], which presented game theory, an important section of operations research used to model conflict situations. Richard Bellman is a mathematician who developed the dynamic programming method, which is widely used to optimize multi-step processes, including transport logistics problems[9]. Leonid Kantorovich and Tjalling Kuna are Soviet and Dutch mathematicians, winners of the Nobel Prize in Economics in 1975 for their contribution to the theory of optimal resource allocation[10]. Jack Addis is a British scientist, one of the pioneers in the application of operations research methods in the transport sector. His works are devoted to modeling traffic flows and optimizing transport systems[11]. In his works, Addis developed mathematical models for the analysis and optimization of traffic flows, using methods of queuing theory, linear programming and other tools of operations research. He applied these models to solving problems of vehicle routing, cargo distribution, scheduling, etc. Richard Warenkamp, a specialist in the application of operations research in logistics and supply chain management[12]. His works are devoted to the optimization of logistics processes and solving problems of transport logistics. These and other scientists have made an invaluable contribution to the development of operations research, having developed powerful mathematical methods and algorithms that are widely used in transport logistics for route optimization, resource allocation, planning and decision making.

Graph Theory. Graphs are a powerful tool for representing and analyzing network structures, such as transportation networks. Algorithms based on graph theory are used to find shortest paths, plan routes, and optimize flows. Graph theory is a branch of discrete mathematics that studies the properties of graphs and their applications in various fields, including transportation logistics. Authors who have made significant contributions to the development of graph theory: Leonhard Euler - a Swiss mathematician and physicist, considered one of the founders of graph theory. His famous paper on the problem of the seven bridges of Königsberg (1736) marked the beginning of the study of graphs [13]. William Hamilton - an Irish mathematician known for his work in graph theory, including the discovery of Hamiltonian cycles[14]. Claude Berger - a French mathematician who made significant contributions to the theory of perfect graphs and their applications in various fields[15]. Frank Harary - an American mathematician known for his work in graph theory and its applications, including in the field of transportation networks [16]. Graph theory is widely used in modeling transport networks, route optimization, planning logistics operations, and other transport logistics problems. The works of the authors listed laid the foundation for the use of graphs in this area.

Queuing Theory. This discipline studies the processes of servicing random flows of requests (vehicles, cargo, etc.) in systems with limited resources. Its methods are used to analyze and optimize the capacity of transport hubs. Queuing Theory (QT) is a section of probability theory and operations research that studies processes associated with flows of requests and their servicing. This theory has found wide application in modeling and analysis of transport and logistics systems. Authors who made significant contributions to the development of QT: Felix Pollaczek, who developed methods for analyzing queuing systems with various service disciplines[17]. David George Kendall is a British statistician who

[4] Горев, А. Э. Теория транспортных процессов и систем : учебник для вузов / А. Э. Горев. — 3-е изд., испр. и доп. — Москва : Издательство Юрайт, 2020. — 193 с.

[5] Кудрявцев В.Н. Планетарные передачи. - Машиностроение, 1966. - 307 с.

[6] Блинкин М.Я., Гордеев С. Транспортная несостоятельность // Эксперт. 2012. № 34(671)

[7] Линейное программирование, его обобщения и применения. — М.: Прогресс, 1966. — 602 с.

[8] Нейман, Моргенштерн: Теория игр и экономическое поведение. – М.: 2013. – 708 с.

[9] Математики. Механики. Биографический справочник / Сост. А. Н. Боголюбов. — Киев: Наукова думка, 1983. — С. 37. — 639 с.

[10] Koopmans, Tjalling C.; Debreu, Gérard (December 1982). "Additively decomposed quasiconvex functions" (PDF). *Mathematical Programming*. **24** (1). Springer: 1–38. doi:10.1007/BF01585092

[11] Jack Edmonds, Existence of k-Edge Connected Ordinary Graphs with Prescribed Degrees, J. Res. Natl. Bur. Stand. 68B, 73-74 (1964).

[12] Richard Vahrenkamp. *The Logistics Revolution: The Rise of Logistics in the Mass Consumption Society*. Lohmar/Köln: Josef Eul Verlag GmbH, 2012. viii + 281 pp.

[13] Полякова Т. С. Леонард Эйлер и математическое образование в России. — КомКнига, 2007. — 184 с.

[14] Bruno, Leonard C. (2003) [1999]. *Math and mathematicians: the history of math discoveries around the world*. Baker, Lawrence W. Detroit, Mich.: U X L. ISBN 0787638137.

[15] Claude Jacques Berge. Théorie générale des jeux à n personnes (General theory of games for n players), 1957, trans. in Russian, 1961.

[16] Harary, Frank; Moser, Leo (1966), "The theory of round robin tournaments", American Mathematical Monthly, 73 (3): 231–246, doi:10.2307/2315334

[17] Queueing Systems. 63 (1–4): 3–4. doi:10.1007/s11134-009-9147-4.

DOI: 10.5281/zenodo.13352655

made significant contributions to the development of QT[18]. He developed a widely used notation for denoting various types of queuing systems. James R. Jackson is an American engineer and mathematician who developed important results for queuing networks[19]. Queuing theory is widely used to model traffic flows, analyze congestion, and optimize logistics processes. The works of the listed authors laid the foundation for the application of QT in transport logistics.

Logistics and supply chain management. These are fundamental concepts that describe methods for planning, organizing, and controlling the flow of materials, information, and finance from sources to end consumers. Authors who have made significant contributions to the development of logistics and supply chain management: Martin Christopher is a British scholar and the author of Logistics and Supply Chain Management, which is considered one of the seminal works in the field[20]. Donald J. Bowersox is an American scholar and the author of influential works on logistics, including Logistics: The Integrated Supply Chain[21]. Michael Porter is the author of the value chain concept, which has formed the basis for many ideas in supply chain management[22]. John Gattorna is an Australian scholar and the author of numerous works on logistics and supply chains, including Logistics and Supply Chain Management[23]. James Stock and Douglas Lambert are the authors of the influential book Strategic Logistics Management, which has made a major contribution to the development of a strategic approach to logistics[24]. These scholars and their works have played a key role in the establishment and development of logistics and supply chain management as scientific disciplines, as well as in the development of modern concepts and strategies in this field.

Transport modeling. This area combines methods and tools for creating and analyzing mathematical models of transport systems, including traffic modeling, demand forecasting, and evaluating various development scenarios. Authors who have made significant contributions to the development of transport modeling: John Glen Wardrop is a British mathematician and engineer who developed the Wardrop equilibrium principle and developed transport flow modeling[25]. Michael J. Beckmann is an American scientist who has made a great contribution to the development of methods for modeling transport networks and determining optimal transportation routes[26]. Thomas Lee Magnanti is an American scientist known for his work on linear and nonlinear programming, widely used in transport modeling[27]. Frank Haight is a British mathematician and engineer who developed a trip distribution model and made a great contribution to the development of a four-stage transport planning model[28]. Hani S. Mahmassani is a scientist in the development of dynamic models of traffic flows and methods for their assessment[29]. These scientists and their works contributed to the development of transportation modeling as a scientific discipline, as well as the development of various methods and models for the analysis and optimization of transportation systems, including traffic flow modeling, transportation demand distribution, travel mode selection, and much more.

Information technologies and systems. Information technologies are widely used in modern transport and logistics systems for collecting, processing and transmitting data, automating processes and making decisions. In the field of information technologies and systems for transport logistics, the following authors and their works can be distinguished: Michael R. Linders, Harold E. Fearon - "Supply and Inventory Management: Logistics" (1999)[30]. The authors consider the use of information systems for managing supply chains and logistics processes. Donald J. Bowersox, David J. Kloss - "Logistics: Integrated Supply Chain" (2008)[31]. The authors analyze the impact of information systems on the efficiency of logistics operations. Levkin G.G. - "Logistics: Theory and Practice" (2005)[32]. The book includes chapters devoted to the use of information systems in logistics. James R. Stock, Douglas M. Lambert - "Strategic Management of Logistics" (2005)[33]. The authors examine the role of information technology in strategic planning and management of logistics systems. Sergey Sergeev -

---

[18] Кингман, Дж. Ф. К.; Атия (октябрь 1961 г.). "Очередь на одном сервере при интенсивном трафике". Математические труды Кембриджского философского общества. 57 (4): 902. Bibcode:1961PCPS ... 57..902K. doi:10.1017/S0305004100036094.

[19] Jackson, J. R. (1957). "Networks of Waiting Lines". Operations Research. 5 (4): 518–521. doi:10.1287/opre.5.4.518

[20] М. Кристофер. Логистика и управление цепочками поставок. – Питер, 2004. – 320 с.

[21] Бауэрсокс, Дональд Дж. Логистика: интегрированная цепь поставок / Доналд Дж Бауэрсокс, Дейвид Дж. Клосс; [пер. с англ. Н. Н. Барышниковой, Б. С. Пинскера]. - 2-е изд. - Москва : Олимп-Бизнес, 2006 (М. : Типография "Новости"). - 639 с.

[22] *Porter M. E., Elizabeth Olmsted Teisberg E. O.* Redefining Health Care: Creating Value-Based Competition on Results. — Boston: Harvard Business School Press, 2006. — 506 p.

[23] Гатторна Дж., Дэй А. и Харгривз Дж. (1991), "Эффективное управление логистикой", Управление логистической информацией, том. 4. № 2, стр. 2-86. https://doi.org/10.1108/09576059110143603

[24] Сток, Джеймс Р. Стратегическое управление логистикой : [учебник] : пер. с англ. / Джеймс Р. Сток, Дуглас М. Ламберт; науч. ред. и предисл. В. И. Сергеева. - Москва : ИНФРА-М, 2005 (АООТ Твер. полигр. комб.). - 797 с.

[25] Wardrop, J. G.; Whitehead, J. I. (1952). "Correspondence. Some Theoretical Aspects of Road Traffic Research". *Proceedings of the Institution of Civil Engineers*. 1 (5): 767–768. doi:10.1680/ipeds.1952.11362

[26] Beckmann, M., 1952. A Lagrangean multiplier rule in linear activity analysis and some of its implications. Cowles Commission discussion paper: Economics no. 2054. Chicago, 20p.

[27] Magnanti, T.L., Perakis, G. (2002). Computing Fixed Points by Averaging. In: Gendreau, M., Marcotte, P. (eds) Transportation and Network Analysis: Current Trends. Applied Optimization, vol 63. Springer, Boston, MA. https://doi.org/10.1007/978-1-4757-6871-8_12

[28] Хейт, Фрэнк Эвери. Математическая теория транспортных потоков [Текст] / пер. с англ. Е. Г. Коваленко ; [предисл. И. Н. Коваленко и В. А. Падни] ; под ред. д-ра техн. наук И. Н. Коваленко. - Москва : Мир, 1966. - 286 с.

[29] Mahmassani, Hani S (2003), "Dynasmart-IP: Dynamic Traffic Assignment Meso-Simulator For Intermodal Networks", *Advanced Modeling for Transit Operations and Service Planning*, Pergamon

[30] Линдерс, Фирон: Управление снабжением и запасами. Логистика. – М.: 2006. – 768 с.

[31] Доналд Дж. Бауэрсокс, Дейвид Дж. Клосс. Логистика. – М.: 2008.

[32] Левкин Г. Г. Логистика: теория и практика / Г. Г. Левкин. – Ростов н/Д : Феникс, 2009. – 221

[33] Джеймс Р. Сток, Дуглас М. Ламберт - Стратегическое управление логистикой. - М.: 2005. – 797 с.

DOI: 10.5281/zenodo.13352655

"Supply Chain Management" (2015)[34]. The Russian author analyzes the use of information systems in supply chain management. These and other works by domestic and foreign authors cover various aspects of the use of information technology and systems to improve the efficiency of transport logistics, modeling and optimization of logistics processes, and the integration of supply chain participants.

Conclusion

The development of an effective methodology for the synthesis of transport and logistics systems is of key importance for Kyrgyzstan in order to realize its transit potential, increase the competitiveness of the national economy and attract investment. The methodology should be based on the integrated application of modern theories and concepts of transport logistics, modeling, geographic information systems, intelligent transport systems, and take into account the principles of "green" logistics and sustainable development. Taking into account the specific features of the mountainous terrain of Kyrgyzstan requires the development of special models and algorithms for designing optimal transport and logistics systems, including multimodal transportation and effective interaction of various modes of transport. The methodology should provide for the creation of a network of logistics centers and transport hubs that allow concentrating cargo flows and ensuring their effective processing.

The implementation of information technologies and systems is critical to ensure the integration of supply chain participants, monitoring of transport flows, modeling and optimization of logistics processes. The developed methodology for the synthesis of transport and logistics systems should be adapted to the realities of Kyrgyzstan and take into account the specifics of the national transport infrastructure, cargo flows and legal framework. Successful implementation of the methodology will create a competitive transport and logistics system of Kyrgyzstan, integrated into global supply chains and meeting modern requirements for efficiency and sustainable development. Thus, the comprehensive methodology for the synthesis of transport and logistics systems will become a key tool for the Kyrgyz Republic in modernizing national logistics, attracting investment and improving the efficiency of foreign economic relations.

References:

1. Beckmann, M., 1952. A Lagrangean multiplier rule in linear activity analysis and some of its implications. Cowles Commission discussion paper: Economics no. 2054. Chicago, 20p.
2. Bertalanffy L. von. Historical status of the general theory of systems // Systems research. Yearbook 1973. - M., 1973. - P. 20-37 [Electronic resource]. - URL: https://systems-analysis.ru/assets/systems_research_1973.pdf (date of access: 02/23/2022).
3. Blinkin M. Ya., Gordeev S. Transport insolvency // Expert. 2012. No. 34 (671)
4. Bruno, Leonard C. (2003) [1999]. Math and mathematicians: the history of math discoveries around the world. Baker, Lawrence W. Detroit, Mich.: U X L. ISBN 0787638137.
5. Bowersox, Donald J. Logistics: An Integrated Supply Chain / Donald J. Bowersox, David J. Kloss; [translated from English by N. N. Baryshnikova, B. S. Pinsker]. - 2nd ed. - Moscow: Olimp-Business, 2006 (Moscow: Novosti Printing House). - 639 p.
6. Checkland, Peter B. & Poulter, J. Learning for Action: A short definitive account of Soft Systems Methodology and its use for Practitioners, teachers and Students, Wiley, Chichester. 2006.
7. Claude Jacques Berge. General Theory of Games for Players (1957), trans. in Russian, 1961.
8. Christopher M. Logistics and Supply Chain Management. – Piter, 2004. – 320 p.
9. Donald J. Bowersox, David J. Closs. Logistics. - M.: 2008.
10. Gattorna J., Day A. and Hargreaves J. (1991), "Effective Logistics Management", Logistics Information Management, Vol. 4. No. 2, pp. 2-86. https://doi.org/10.1108/09576059110143603
11. Gorev, A. E. Theory of transport processes and systems: a textbook for universities / A. E. Gorev. - 3rd ed., corrected. and add. - Moscow: Publishing House Yurait, 2020. - 193 p.
12. Harary, Frank; Moser, Leo (1966), "The theory of round robin tournaments", American Mathematical Monthly, 73 (3): 231–246, doi:10.2307/2315334
13. Haight, Frank Avery. Mathematical Theory of Traffic Flows [Text] / trans. from English by E. G. Kovalenko; [foreword by I. N. Kovalenko and V. A. Padnya]; edited by Dr. of Engineering Sciences I. N. Kovalenko. - Moscow: Mir, 1966. - 286 p.
14. Jay Forrester: World dynamics. / Transl.: Voroshchuk A., Pegov S. Ed.: Krivtsova E. G. Publisher: AST, 2003. 384 p.
15. Jackson, J. R. (1957). "Networks of Waiting Lines". Operations Research. 5 (4): 518–521. doi:10.1287/opre.5.4.518.
16. James R. Stock, Douglas M. Lambert - Strategic Management of Logistics. - M.: 2005. - 797 p.
17. Jack Edmonds, Existence of k-Edge Connected Ordinary Graphs with Prescribed Degrees, J. Res. Natl. Bur. Stand. 68B, 73-74 (1964).
18. Kudryavtsev V. N. Planetary gears. - Mechanical Engineering, 1966. - 307 p.
19. Koopmans, Tjalling C.; Debreu, Gérard (December 1982). "Additively decomposed quasiconvex functions" (PDF). Mathematical Programming. 24 (1). Springer: 1–38. doi:10.1007/BF01585092 11.
20. Kingman, J. F. K.; Atiyah (October 1961). "Queuing on a Single Server under Heavy Traffic". Mathematical Transactions of the Cambridge Philosophical Society. 57 (4): 902. Bibcode:1961PCPS ... 57..902K. doi:10.1017/S0305004100036094.
21. Linear programming, its generalizations and applications. - M .: Progress, 1966. - 602 p.
22. Linders, Fearon: Supply and Inventory Management. Logistics. - M.: 2006. - 768 p.
23. Mathematicians. Mechanics. Biographical reference book / Comp. A. N. Bogolyubov. - Kyiv: Naukova Dumka, 1983. - P. 37. - 639 p.

[34] Сергеев В.И. Управление цепями поставок: учебник для вузов / В. И. Сергеев. — Москва: Издательство Юрайт, 2024. — 480 с.

DOI: 10.5281/zenodo.13352655

24. Levkin G. G. Logistics: Theory and Practice / G. G. Levkin. - Rostov n / D: Phoenix, 2009.
25. Magnanti, T. L., Perakis, G. (2002). Computing Fixed Points by Averaging. In: Gendreau, M., Marcotte, P. (eds) Transportation and Network Analysis: Current Trends. Applied Optimization, vol 63. Springer, Boston, MA. https://doi.org/10.1007/978-1-4757-6871-8_12
26. Mahmassani, Hani S (2003), "Dynasmart-IP: Dynamic Traffic Assignment Meso-Simulator For Intermodal Networks", Advanced Modeling for Transit Operations and Service Planning, Pergamon
27. Neumann, Morgenstern: Game theory and economic behavior. - M .: 2013. - 708 p.
28. Polyakova T. S. Leonard Euler and Mathematical Education in Russia. - KomKniga, 2007. - 184 p.
29. Porter M. E., Elizabeth Olmsted Teisberg E. O. Redefining Health Care: Creating Value-Based Competition on Results. — Boston: Harvard Business School Press, 2006. — 506 p.
30. Queueing Systems. 63 (1–4): 3–4. doi:10.1007/s11134-009-9147-4.
31. Richard Vahrenkamp. The Logistics Revolution: The Rise of Logistics in the Mass Consumption Society. Lohmar/Köln: Josef Eul Verlag GmbH, 2012. viii + 281 pp.
32. Sergeev V.I. Supply Chain Management: textbook for universities / V. I. Sergeev. - Moscow: Yurait Publishing House, 2024. - 480 p.
33. Stock, James R. Strategic Logistics Management: [textbook]: trans. from English / James R. Stock, Douglas M. Lambert; scientific. ed. and foreword. V. I. Sergeeva. - Moscow: INFRA-M, 2005 (JSC Tver. polygraph. comb.). - 797 p.
34. Wardrop, J. G.; Whitehead, J. I. (1952). "Correspondence. Some Theoretical Aspects of Road Traffic Research." Proceedings of the Institution of Civil Engineers. 1(5):767–768. doi:10.1680/ipeds.1952.11362

DOI: 10.5281/zenodo.13352655