ANNOTATION

of the thesis of Nurzhaubayev Meiram Makhanovich on the topic: «Ensuring efficient organization of cargo railroad car traffic flow according to economic and technological criteria», submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D11301 – Transport services

Relevance of the research topic. In conditions of increasing demands on delivery times, uneven arrival of wagons for accumulation, limited capacity of individual sections and stations, as well as the need to increase the economic efficiency of operational work, traditional approaches to organizing wagon flows no longer fully provide the required result. This problem is particularly acute when it is necessary to coordinate two interrelated groups of criteria: economic, focused on reducing wagon downtime, reducing operating costs and speeding up wagon turnover, and technological, related to ensuring the stability of train formation, the rhythm of train departure and compliance with the established traffic regime.

A significant factor determining the relevance of the study is the adverse effect of uneven carriage flows and train delays on the efficiency of railway operations. The uneven supply of wagons to technical stations, fluctuations in accumulation volumes and deviations from the established timetable cause an increase in the time spent waiting for wagons to be processed and shipped, a decrease in the stability of train formation and an increase in total operating losses.

The practice of organizing the transportation process shows that significant losses occur at the stages of accumulation of wagons and decision-making on the appointment, cancellation or departure of trains with varying intensity of car traffic. At the same time, the lack of adaptability of existing approaches to changing operating conditions leads either to excessive downtime of wagons in anticipation of the accumulation of trains, or to deviations from the established timetable, which together reduces the efficiency of the entire transportation system. Consequently, there is an objective need to develop scientifically sound solutions that make it possible to link the parameters of car accumulation and train departure with the economic and technological results of the work of railway units.

This problem is of particular importance for the railways of Kazakhstan, where the high length of the network, significant volumes of transit and export-import traffic, the concentration of car traffic in certain directions and stations, as well as the need to improve the quality of transport services require improved operational management methods. In these conditions, improving the efficiency of the organization of car traffic should be based not only on the analysis of actual performance indicators, but also on the formation of a methodological apparatus that allows assessing the rational parameters of train formation, the conditions of application of the "flight model" and the consequences of operational decisions.

Railway transport is a complex multilevel system, the functioning of which is determined by the interaction of infrastructure, rolling stock, transportation technology

and management mechanisms. In this system, carriage flows are a key object of operational and strategic management, determining the operational and economic results of the railways.

From the point of view of a systematic approach, carriage traffic should be considered as a dynamic element of the railway transport system with the following characteristics:

- spatial extent (direction and length of following);
- time structure (intensity, unevenness, stability);
- technological complexity (the number of operations of processing, sorting and forming trains);
- economic importance (impact on costs, wagon turnover and profitability of transportation).

Thus, car traffic is not just a consequence of cargo formation, but an independent object of management that requires targeted planning and regulation.

The degree of scientific development of the topic. A great contribution to the study of the problem of efficient organization of car traffic was made by domestic and foreign scientists, whose works developed the theory of railway operation, organization of car traffic, rationing of car accumulation processes, innovative technical means and technologies, as well as evaluating the economic effectiveness of technological solutions - Bekzhanov Z.S., Kobdikov M.A., Borodin A.F., Baturin A.P., Panin V.V., Bekzhanova S.E. Izbairova A.S., Bolatkyzy S., Lukinykh V.F., Sharov V.A., Svetashev A.A., Sarbaev S.Sh., Bogdanovich S.V., Vakhitova L.V., Mukhametzhanova A.V., Kiseleva O.G., Aikumbekov M.N., Bessonenko S.A., Ageev R.V., Imasheva G.M., Klimov A.A. and others.

In the available studies, the theoretical foundations of the classification and routing of wagon flows have been formed, approaches to choosing rational parameters of train operation have been substantiated, the features of the interaction of station and train technologies have been revealed, and the influence of the timetable, the processing capacity of stations and the uneven arrival of wagons on the results of operational activities has been shown. At the same time, the analysis of scientific publications shows that the issues of a comprehensive assessment of the organization of car traffic according to economic and technological criteria, especially in conditions of a fixed train schedule and the need to adapt solutions to changing accumulation parameters, remain insufficiently developed. This necessitates the further development of scientific and methodological provisions aimed at reconciling the economic interests of reducing wagon downtime with the technological requirements of stability and rhythmicity of the transportation process.

The purpose of the study is to develop scientific and methodological foundations and solutions for the effective organization of carriage flows based on the technological consistency of the processes of accumulation of wagons, formation and departure of trains, ensuring a reduction in total operating costs.

To achieve this goal, the thesis assumes the solution of the following **tasks**:

1. To analyze the evolution of theoretical approaches to the organization of carriage flows and identify economic and technological criteria for their effectiveness.

2. To investigate the current state of the organization of car traffic on the backbone network with the identification of systemic limitations (high downtime, uneven accumulation, deviations from the schedule).

3. To formalize the relationship between the parameters of accumulation of wagons, the frequency of departure of trains and the economic indicators of the transportation process.

4. To develop an economic and technological model for optimizing the accumulation of wagons, taking into account the limitations of the throughput and processing capacity of stations.

5. To substantiate the principles of introducing a "flight model" of freight train traffic as a tool for stabilizing wagon flows.

6. To develop an option for coordinating the process of accumulation of wagons and the formation of trains for departure according to fixed schedule lines.

7. To test the developed version at the technical stations of the Almaty freight transportation department with the calculation of the economic effect.

The object of the study is the processes of accumulation, formation, departure of car traffic from technical stations and the promotion of car traffic on the main railway network.

The subject of the research is methods for ensuring the effective organization of carriage flows based on the improvement of the process of accumulation of wagons and the introduction of a "regular" model of freight train movement.

Research methods. The thesis uses a systematic and process approach, a retrospective review, a structural and functional analysis, a criterion analysis, a comparative analysis, and an analysis of practical data.

The scientific novelty of the dissertation is:

- the influence of the parameters of accumulation of wagons, the unevenness of carriage flows and the departure mode of trains on the efficiency of the organization of carriage flows has been established;

- the selection of acceptable train formation options and the identification of critical deviations affecting the implementation of the train formation and departure plan is methodically ensured;

- the process of accumulation of wagons has been studied, taking into account the arrival of individual groups of wagons and the conditions of departure of trains according to the «flight model».

The practical significance of the study is determined by the fact that the use of the research results will allow more accurate and reasonable rationing of idle wagons under accumulation.

According to the general idea, goals and objectives that define the content and form the main directions of research, the following **provisions** are put forward for protection:

- patterns of influence of parameters of accumulation of wagons, unevenness of carriage flows and departure mode of trains on economic and technological efficiency of the organization of carriage flows;

- determination of the threshold moments for the end of train accumulation and a predictive assessment of the impact of delays on the implementation of the train formation plan during the implementation of the "flight model" of train movement;

- the results of a study of the accumulation of wagons, taking into account the arrival of individual groups of wagons, their temporary unevenness and the influence of the supply structure on the conditions of formation of trains;

- an approach to the organization of the accumulation of wagons and the departure of trains according to the "flight model", which ensures the alignment of the parameters of the supply of wagons with the established departure mode of trains;

- the results of an economic and technological assessment of the variant of the organization of car traffic, based on the joint accounting of the cost of car hours for accumulation, train formation parameters and conditions for the implementation of the «flight model»;

- recommendations for improving the efficiency of the organization of carriage flows by coordinating the process of accumulation of wagons with the departure mode of trains, aimed at reducing downtime of wagons and increasing the stability of the transportation process.

Approbation of the work. The main provisions and results of the dissertation research were presented at the II International Conference "Innovative Technologies in Transport: education, Science, production" (Almaty, 2022), the International Scientific and Practical Conference International Satbayev conference 2023 "Science and Technology: from idea to implementation" (Almaty, 2023).

Scientific publications. 4 scientific papers have been published on the subject, including 1 article in international peer-reviewed scientific journals included in the Scopus database, 3 articles in publications recommended by the Quality Assurance Committee for Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and 1 author's certificate:

1. М.М. Нуржаубаев «Жүк пойыздарды құрастыру үрдісін автоматтандырылған жүйе арқылы оңтайландыру», авторлық құқықпен қорғалатын объектілерге құқықтардың мемлекеттік тізімге мәліметтерді енгізу туралы куәлік 2026 жылғы «27» ақпан №68119, https://1drv.ms/b/c/754e0a944448bb68/IQAxPZV1djZ_SIVibY4ZPhQjAex09d7kC05qhhgKj0rjl4w?e=l1x1na

2. Nurzhaubayev M., Grevtsov S., Korobiova R., Manafov E., Abdukarimov S., Arpabekov M. «Optimization of track distribution of industrial railway stations between car designations», «Научный вестник Национальный горный университет», Украина, 2023, №3, процентиль-37, https://doi.org/10.33271/nvngu/2023-3/131

3. А.С.Избаирова, Ж.Ж. Альтаева, М.М. Нуржаубаев, Д.Әлиакпарқызы «Пути повышения транспортной безопасности», «Вестник КазАТК», №2(125) - Алматы 2023. – с. 60-70, https://doi.org/10.52167/1609-1817-2023-125-2-60-70

4. М.М. Нуржаубаев, А.С. Избаирова, С. Болатқызы, Сарсенбаева Л.Х., Лукиных В.Ф. «Теміржол станцияларында жолдар мен вагондардың маршруттарын тиімді бөлу», «Вестник АГА», №4(39) - Алматы 2025. – с. 46-61, https://doi.org/10.53364/24138614_2025_39_4_4

5. М.М. Нуржаубаев, Н.К.Булатов, А.С. Избаирова, С. Болатқызы «Повышение потенциала и эффективности международного грузового транзита в казахстане за счет развития транспортной инфраструктуры», «Вестник КазАТК», №6(141) - Алматы 2025. – с. 51-64. DOI 10.52167/1609-1817-2025-141-6-51-64, https://doi.org/10.52167/1609-1817-2025-141-6-51-64

6. М.М. Нуржаубаев, С. Болатқызы, В.Ф. Лукиных «Автоматтандырылған бақылау жүйесін енгізу арқылы жүк пойыздарды құрастыру жоспарын жетілдіру», «Труды Международной научно-практической конференции International Satbayev conference 2023 (Сатпаевские чтения). Наука и технологии: от идеи до внедрения», Алматы 2023 – с. 54-64., https://conference.satbayev.university/index.php/journal/issue/view/6/6

7. М.М. Нуржаубаев, Рақым.Р.И. «Характеристика железнодорожных участков Республики Казахстан и их пропускная и провозная способность», «Материалы II Международной конференции «Инновационные технологии на транспорте: образование, наука, производство», Алматы 2022 – с. 208-215., https://alt.edu.kz/wp-content/assets/docs/%D0%9D%D0%B0%D1%83%D0%BA%D0%B0/%D0%9C%D0%B0%D1%82%D0%B5%D1%80%D0%B8%D0%B0%D0%BB%D1%8B%20%D0%BA%D0%BE%D0%BD%D1%84%D0%B5%D1%80%D0%B5%D0%BD%D1%86%D0%B8%D0%B9/%D1%81%D0%B1%D0%BE%D1%80%D0%BD%D0%B8%D0%BA%20%D0%86%D0%86%20%D0%BC%D0%B5%D0%B6%D0%B4.%20%D0%BA%D0%BE%D0%BD%D1%84%D0%B5%D1%80%D0%B5%D0%BD%D1%86%2029%20%D0%B0%D0%BF%D1%80%D0%B5%D0%BB%D1%8C%202022.pdf

8. М.М. Нуржаубаев, С. Болатқызы, Қ.Т. Алданазаров «Анализ существующей системы планирования процесса организации вагонопотоков, разработки и корректироваки плана формирования поездов при изменении обьемов вагонопотоков», «Материалы II Международной конференции «Инновационные технологии на транспорте: образование, наука, производство», Алматы 2022 – с. 194-198., https://alt.edu.kz/wp-content/assets/docs/%D0%9D%D0%B0%D1%83%D0%BA%D0%B0/%D0%9C%D0%B0%D1%82%D0%B5%D1%80%D0%B8%D0%B0%D0%BB%D1%8B%20%D0%BA%D0%BE%D0%BD%D1%84%D0%B5%D1%80%D0%B5%D0%BD%D1%86%D0%B8%D0%B9/%D1%81%D0%B1%D0%BE%D1%80%D0%BD%D0%B8%D0%BA%20%D0%86%D0%86%20%D0%BC%D0%B5%D0%B6%D0%B4.%20%D0%BA%D0%BE%D0%BD%D1%84%D0%B5%D1%80%D0%B5%D0%BD%D1%86%2029%20%D0%B0%D0%BF%D1%80%D0%B5%D0%BB%D1%8C%202022.pdf

9. А.С. Избаирова, М.М. Нуржаубаев «О культуре безопасности движения» «Материалы III Международной конференции «Инновационные технологии на транспорте: образование, наука, производство», Алматы 2023 – с. 270-274., https://alt.edu.kz/wp-content/assets/docs/%D0%9D%D0%B0%D1%83%D0%BA%D0%B0/%D0%9C%D0%B0%D1%82%D0%B5%D1%80%D0%B8%D0%B0%D0%BB%D1%8B%20%D0%BA%D0%BE%D0%BD%D1%84%D0%B5%D1%80%D0%B5%D0%BD%D1%86%D0%B8%D0%B9/2023/III%20%D0%9C%D0%95%D0%96%D0%94%D0%A3%D0%9D%D0%90%D0%A0%D0%9E%D0%94%D0%9D%D0%90%D0%AF%20%D0%9A%D0%9E%D0%9D%D0%A4%D0%95%D0%A0%D0%95%D0%9D%D0%A6%D0%98%D0%AF-28.04.23.pdf

10. Избаирова А.С., Болатқызы С., Нуржаубаев М.М., Суенишова М.Е. «Қазақстанның халықаралық көлік дәліздерінің тиімділігі: математикалық модельдер және болжау» «Материалы XXV международной научно-практической конференции ППС, студентов, магистрантов и докторантов посвященной 190-летию Шокана Уалиханова», Алматы 2025 – с. 53-60., https://mtgu.edu.kz/storage/app/media/materials%20xxv%20.pdf

The structure and scope of the thesis. The dissertation work consists of an introduction, three sections, a conclusion, a list of sources used and appendices. The total volume of the manuscript is _127_ page, 29 - illustrations, _17_ tables.