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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

# Х А Б А Р Л А Р Ы

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## ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК  
РЕСПУБЛИКИ КАЗАХСТАН  
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## NEWS

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OF THE REPUBLIC OF KAZAKHSTAN  
Kazakh national research technical university  
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Адрес редакции: Казахстан, 050010, г. Алматы, ул. Кабанбай батыра, 69а.

Институт геологических наук им. К. И. Сатпаева, комната 334. Тел.: 291-59-38.

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**N. Sabraliev<sup>1</sup>, A. Abzhapbarova<sup>2</sup>, G. Nugymanova<sup>2</sup>, I. Taran<sup>3</sup>, Zh. Zhanbirov<sup>2</sup>**

<sup>1</sup>Kazakh Automobile and Road Academy named after L. B. Goncharov, Almaty, Kazakhstan,

<sup>2</sup>Kazakh Academy of transport and communication named after M. Tynyshpaev, Almaty, Kazakhstan,

<sup>3</sup>Department of Transportation Management, National TU Dnipro Polytechnic, Dnipro, Ukraine.

E-mail: sabraliev51@mail.ru, ainur.abzhapbarova@mail.ru, janbirov\_jg@mail.ru

## **MODERN ASPECTS OF MODELING OF TRANSPORT ROUTES IN KAZAKHSTAN**

**Abstract.** Within the last decade Kazakhstan became the active participant of world integration processes. Important element of economic integration is the qualitative transport infrastructure providing internal and transit transportation of goods and passengers with the high level of field service.

Along with activation of interregional and international trade so significant increase in automobile transportations is in many respects caused by rough processes of automobilization. As in development of market infrastructure, expansion of insider and foreign trade an important role is played by the motor transport.

At the moment in Kazakhstan realization of the Third modernization – creation of new model of economic growth which will provide global competitiveness of the country is carried out. One of the main tasks put by the President of Kazakhstan is the maximum use of transport and transit capacity of the country. Kazakhstan is a country having high transit potential, which is located on a joint of Europe and Asia. The neighbourhood with the states having huge sales markets and productions does development of the domestic transport system perspective and necessary.

Transferring to work on a system "exactly on time" will require more deep analysis of the rolling stock on the route, the adjustment of the existing accounting standards and the existing excessive downtime, which will improve the accuracy and reality of targets, and eventually it will lead to an increase in reliability of logistics goals. In a market system an important requirement of the consumer of transport service is timely and qualitative delivery of cargo. Insufficient development of advanced logistics freight transport technology systems leads to an increase in transport costs, therefore, the loss of the market.

**Key words:** route of transportations; goods turnover; transport network; model of transportations; deliveries of freights; integration of transport system; logistics; criteria of optimization; car mileage.

**Introduction.** Within the last decade Kazakhstan became the active participant of world integration processes. Important element of economic integration is the qualitative transport infrastructure providing internal and transit transportation of goods and passengers with the high level of field service.

Along with activation of interregional and international trade so significant increase in automobile transportations is in many respects caused by rough processes of automobilization. As in development of market infrastructure, expansion of insider and foreign trade an important role is played by the motor transport.

**Main part.** For January-October, 2017 transport of the republic transported 3146,8 million tons of freights that there is 4,5% above than the level of January-October, 2016, goods turnover for this period made 452,4 billion ₸ (increased in comparison with January-October, 2016 by 8%), 18598,4 million passengers are transported (1,3% more, than in January-October, 2016), the passenger turnover made 224,4 billion ₸ (increased in comparison with January-October, 2016 by 3,4%).

In a total amount of the transported freights the share of the motor transport made 83,89%, in goods turnover a share of automobile – 28,69% and in a passenger turnover of-87,82% [1].

At the moment in Kazakhstan realization of the Third modernization – creation of new model of economic growth which will provide global competitiveness of the country is carried out. One of the main tasks put by the President of Kazakhstan is the maximum use of transport and transit capacity of the country. Kazakhstan is a country having high transit potential, which is located on a joint of Europe and Asia. The neighbourhood with the states having huge sales markets and productions does development of the domestic transport system perspective and necessary

The most important indicator of integration of the transport system of the Republic of Kazakhstan is the efficient use of existing transport networks, the realization of the benefits of their geographical location and communication skills, providing the shortest route to the Eastern European countries and Asian continents. But in order to improve the transport systems of the republic to get the characteristics of a world-class, it is necessary to carry out a comprehensive modernization of the industry, as in market conditions, an important requirement of the consumer of transport services is timely and qualitative delivery of cargo. The run of the specified conditions is possible with the use of logistics, that is, the control algorithm, which is with the help of a variety of economic and mathematical techniques allows to optimize the performance of individual elements of the transport process and to combine these elements into a single system. Insufficient development of logistics progressive freight transport technology systems leads to an increase of transport costs, therefore, to the loss of the market [2, 3].

The difficult economic situation in our country requires from workers of road transport increased attention in dealing with the organization and management of road transport. In particular the modeling of routes, as one of the important and serious problems in transport controlling, requires a rethinking of the methods and approaches to solution, as well as the use of the latest achievements in the field of information technology.

The modern approach to the problem of modeling the routes includes [4]:

- intellectualization of algorithms of solutions and extensive use of heuristic methods;
- complexity of the problem by switching from the classical scheme of one-criterion optimization to the method of vector ( multi-criteria ) optimization of solutions;
- the use of modern computer tools and communication for the solution of problems of transport management in real-time.

The problems solved in transport are often characterized by high complexity and are so-called DP-difficult problems [5]. In this regard, the traditional methods of problem solving here are powerless – the effect of the increased demands on machine resources in the implementation of these algorithms. Another problem facing the task of modeling of transport routes is the right choice of optimization criterion that can effectively solve the problem and help to justify the choice, regardless of ownership trucking companies.

Nowadays every transporter determines the route, timetable, negotiates the price and tries to fulfill customer's orders. However, due to the lack of feedback from suppliers or motor transport enterprises from another region, on the way back without finding customers or associated cargo basically returns empty, thus wasting time and expected income. Many people agree on the way back to deliver the goods at half price to reimburse fuel costs.

**Work purpose.** Increase in efficiency of use of trucks of the Republic of Kazakhstan.

**Research part of work.** Figure 1 shows the current pattern of using trucks on the example of transportation of goods from Almaty city to regions of the Republic. The main recipient and sender are the markets and logistics centers in Almaty, where is entered and distributed the main stream of consumer goods, electrical engineering, construction materials, etc.

Therefore, to motor carriers of Almaty and other cities these figures formed the most simple one-criterion function. The most frequently used are:

- maximizing of quantity of cargo;
- minimizing the number of used cars to carry out a predetermined amount of cargo;
- minimization of the total transport work;
- minimization of the total distance, etc.

When using the truck utilization rates run up to 0.5-0.6. These indices in transportation to a distance of over 200 km, demonstrated inefficiency, since downtime of vehicles for loading and unloading, rest time of drivers, etc., has become much higher [6]. Thus, the ratio of trucks on the job was not effective

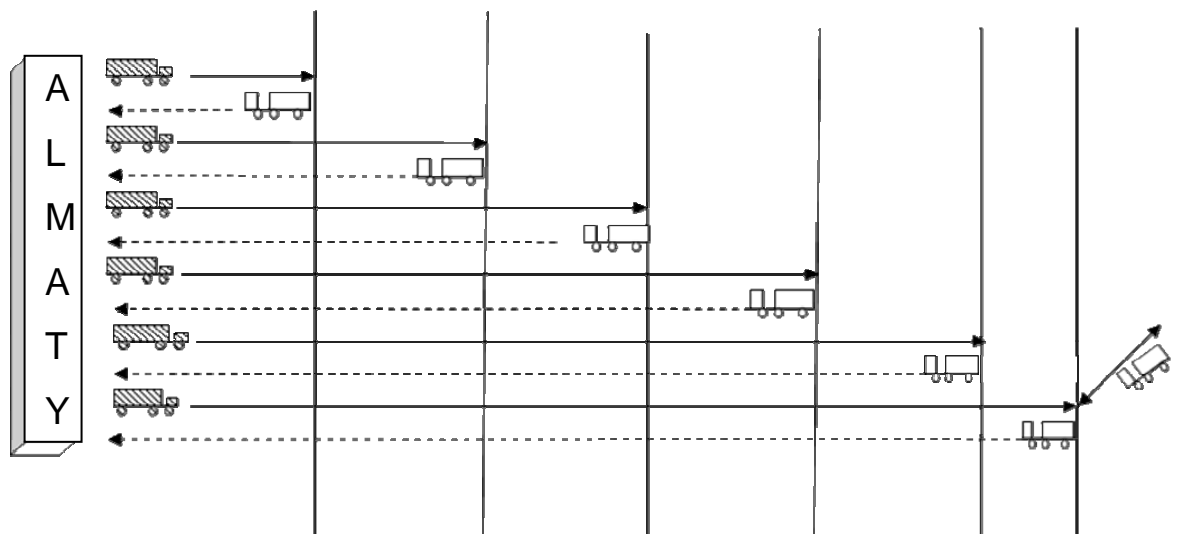


Figure 1 – The current model of organizations of long-distance and domestic road transportation from Almaty, Republic of Kazakhstan

enough. As a result, many trucking companies lose potential revenue and its place in the market of transport services. The main disadvantage is the lack of modern infrastructure, inter-connections between motor transport enterprises, etc.

On the other hand, with the organization of the Customs Union and introduction of the uniform import duties at the most part of the Kazakhstan transport companies opportunities to buy both new and old vehicles disappeared. With introduction of the Common customs tariff of the Customs union were defined, almost prohibitive, rates of custom duties on import of the vehicles which were in operation since on them custom duties of 2,2 euros for each cubic cm of engine displacement (over 26 thousand euros) were established [7].

Within the Common economic space, since 2010 carriers of Belarus and Russia could buy new truck tractors of the ecological class Euro-4 above, operation term up to 3 years on which the custom duty of 5% was established. While in Kazakhstan vehicles till 1 year and a run up to 10 thousand km, i.e. almost rolled off the production line which were 20-30% more expensive were considered as operation term as new. The Kazakhstan operators acquired the right to buy new vehicles by operation term up to 3 years on a custom duty of 5% only from the second half of 2012. Thus, national carriers were almost deprived of an opportunity to buy any vehicles during the 2010-first half of 2012.

Besides, since January 1, 2015 the Kazakhstan certification bodies and metrology were absolutely not ready for enforcement of Technical regulations of the Customs union "About safety of wheel vehicles" (TP TC 018/2011), and the transport companies occupied on the international automobile transport lost an opportunity to deliver during 2015 the new vehicles acquired in the third countries as could not get the approval like the vehicle (ALV) for their registration, at that time when transport companies of Russia and Belarus bought new vehicles [8].

Proceeding from the developing situation, the Kazakhstan Side appealed to the Commission of the Customs union, to install for the next several years a zero rate of custom duties on the vehicles imported from the third countries with operation term over 3 years. What to Kazakhstan it was refused [9].

Now the industry has the task of forming multi-criteria optimization functions on the basis of one-criterion functions. To have the parameters of these functions are conducted the evaluation of mutual closeness of the criteria. Formulation of optimization problems in transport planning with multiple criteria optimization is a consequence of a transport market and the natural tendency of trucking companies to satisfy the interests of all participants in the transportation business, not just the consignees or consignors.

Modern transportation becomes faster and the route between two entities, with proper organization and management of work trucks, could take less time. In such situation it is necessary to create and implement real-time systems that can allow operational management decisions. Drivers of vehicles can



find out the situation on the road, adjust their route taking into account the prevailing circumstances and cause the necessary assistance in case of emergency situations.

On the basis of modern information systems for organizations of long-distance freight traffic with the assistance of local (regional) road transport is more advantageous to use the principle of "Amanat". The proposed model of organizations of freight is different in that the route change cars, trucks, trailer loaded with one document is transmitted from the towing vehicle to the next, so the time of goods in transit is reduced (figure 2).

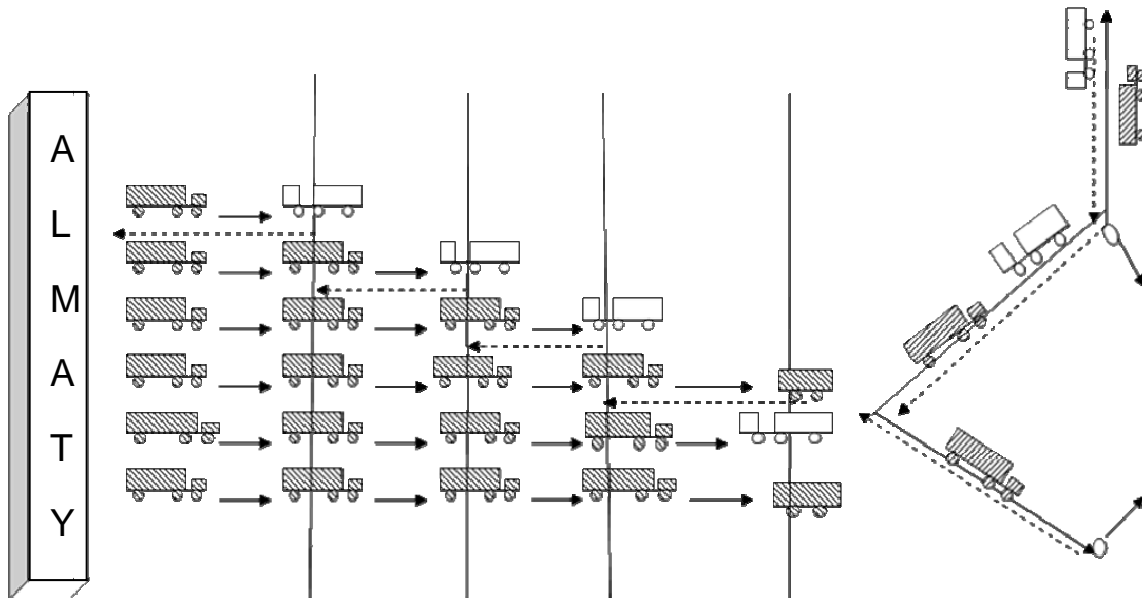


Figure 2 – The proposed model of long-distance road transport organizations of Almaty city

The positive impact of the trucking business model is increase of employment, reduce of unemployment, increase of incomes by attracting local, regional vehicles and infrastructure development of road transport industry.

To implement the proposed model "Amanat" at first it is required a lot of number of workers, but the time of their employment will be temporary, limited by term of infrastructure of construction and road transport industry. While the employment is in the second stage the development of repair and service facilities will be permanent. And it excludes the possibility of sequential involvement of employees during all phases. This is especially important for the local population and filling the budget [10, 11].

There will be a need for highly skilled workers, specialists with higher and secondary special education, both directly in the office or on the line. Thus, the proposed model is more efficient from a social point of view. Competition in the market increases, it becomes more difficult to hold the position. And the most important place takes the qualification of personnel of companies for long distance and international road transportation. It's not only about customer service, but also economic losses which is incurred due to errors in the fleets of the preparation of documents and violations of customs clearance and border crossings. Thus there is the question of how to organize cargo transportation with the involvement of local transport companies. Currently, freight transportation is a specialization for a sufficient number of companies and firms. The best center of road transportation must have these qualities:

- to guarantee the security of cargo during the transportation;
- to have imputed prices for freight traffic;
- to carry cargo in a timely manner;
- to have a proper service for cargo transportation;
- to carry out transportation of various ranges;
- to provide transportation of large, heavy and general cargo;
- to have a car park, which is up to-date;
- to have experienced drivers in a staff.

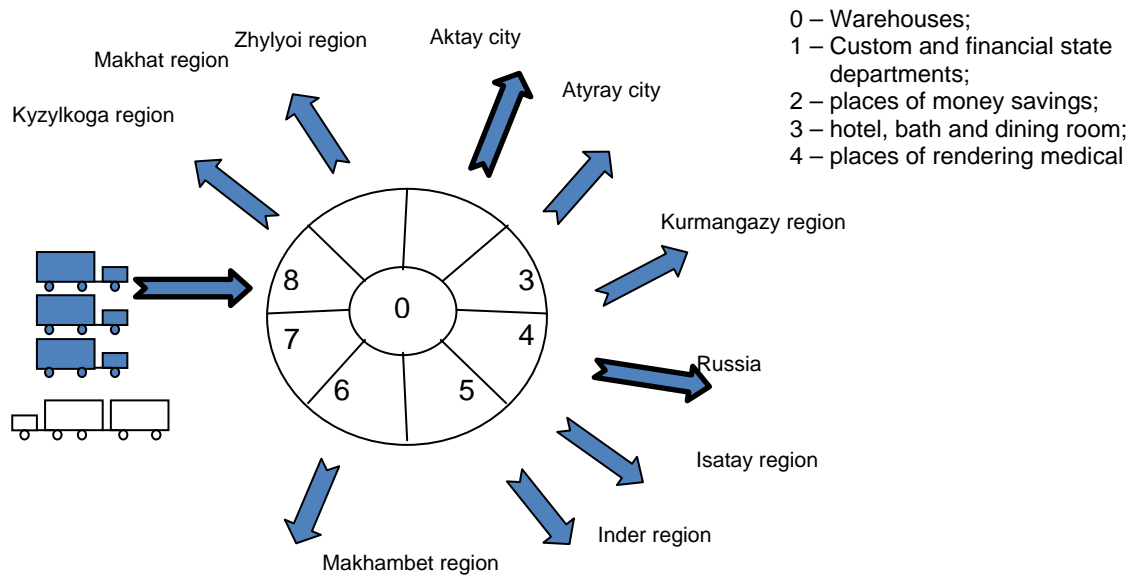


Figure 3 – Schematic diagram of the organizations of centralized form of goods delivery on the example of Atyrau region

The next form of organization of quality management of cargo transportation in regions of Kazakhstan – centralized (figure 3).

Centralized transportation is not common, as they require a well-established supply of large volumes of cargo. They are mainly used in the construction industry for the transport of concrete, brick, mortar, concrete products, etc. This form of quality management implementation is characterized by the full freight of forwarding service. Transportation of the total volume of goods by the supplier for permanent clientele, detailed allocation of responsibilities between the clients and the freight carrier are characteristics of this type of management, financial calculations are made by the party entered into an agreement.

**Results.** Due to the fact that a centralized form of organization of quality management involves all cargo capacity of local companies to undeniable benefits. It includes increasing efficiency of delivery of cargo; carriers monitor the traffic increase productivity, and develop the best options, the conditions for the consolidation of the supply and use of goods trains, mechanization the whole complex handling. The disadvantages of centralized form of freight management should include reducing the reliability of delivery of goods to consumers, the benefits do not meet the condition of carriage of goods and also change the order of delivery of cargo sales organizations. So you must estimate and calculate what to choose: to carry more quickly or light trucks by the shortest route - cars Gazelle class, Iveco, Daily, Mercedes Sprinter and others (7-22 m and 1.5-2.5 etc.), or to download a couple of vehicles KAMAZ class, Iveco Euro Cargo, Mercedes Atego (35-60 m. and 4-10 tons), or even hire a Euro- wagon (82-86 m. and 20 t.) and move them all at once.

The advantage of road transportation is the ability to deliver cargo "door to door". Therefore, when choosing a mode of transport for distant transportation of oversized and heavy cargo the central place takes the cost. World practice proved that the transport costs of transportation of oversized and heavy cargo justified even at 30 % of its value.

In organizing the transportation can be developed several routes of delivery of cargo:

- the route of cargo (need to cross any geographic or national boundaries),
- the nature of the cargo,
- the desired delivery rate.

Another type of transportation is decentralized road transportation, which is different by consignees leading role: they order transport from cargo carriers by their own, organize loading and unloading, without the consent order with the shipper, management of freight, so at the expense of the recipient. For the carriage by company the consignees have a staff of experts: movers, forwarders, supply agents. The

advantages of this form of organization of transportation are the timely and reliable delivery of cargo as well as traffic management is dependent on the needs of the implementor. Disadvantages are reducing of the efficiency of freight in connection with an independent buyer of the cargo, without the expertise of transportation organizations, i.e. increases the number of involved people (stevedores, freight forwarders), in this regard, there is an increase of the cost of shipping goods.

**Conclusion.** Transferring to work on a system "exactly on time" will require more deep analysis of the rolling stock on the route, the adjustment of the existing accounting standards and the existing excessive downtime, which will improve the accuracy and reality of targets, and eventually it will lead to an increase in reliability of logistics goals. In a market system an important requirement of the consumer of transport service is timely and qualitative delivery of cargo. Insufficient development of advanced logistics freight transport technology systems leads to an increase in transport costs, therefore, the loss of the market.

**Н. С. Сабралиев<sup>1</sup>, А. Абжапбарова<sup>2</sup>, Г. Нугыманова<sup>2</sup>, И. А. Таран<sup>3</sup>, Ж. Г. Жанбирова<sup>2</sup>**

<sup>1</sup>Л. Гончаров атындағы Қазақ автокөлік-жолдары академиясы, Алматы, Қазақстан,

<sup>2</sup>М. Тынышбаев атындағы Қазақ көлік және коммуникациялар академиясы, Алматы, Қазақстан,

<sup>3</sup>Ұлттық техникалық университет, Днепр, Украина

### **ҚАЗАҚСТАН ЖАҒДАЙЫНДА ЖҮК АВТОКӨЛІКТЕРІН ПАЙДАЛАНУДЫ БЕЙНЕЛЕУ**

**Аннотация.** Қазақстан соңғы он жылдықта дүниежүзілік қауымдастықтың танымал қатынасушыларына айналды. Осы тұста экономикалық қауымдастықтың негізгі элементінің бірі автокөлік инфрақұрылымдары, ол ішкі және транзиттік жүк және жолаушылар тасымалдауда ең сапалы қызмет көрсетуге мүмкіндік береді.

Сонымен қатар аймақ және халықаралық сауда айналымында автокөлікпен тасымалдау жұмыстарының күрт өсуі, ол автокөліктер санының артуына тікелей байланысты. Себебі нарықтық инфрақұрылымдарында ішкі және сыртқы сауданың дамуына автокөліктер маңызды орын алады.

Қазақстан Республикасының әлемдік көліктер жүйесі қауымдастығына сәтті енуінің басты көрсеткіші, ол бүгінгі уақыттағы ел ішіндегі көліктер жүйесін тиімді пайдалану, еліміздің географиялық орналасу ерекшеліктеріне сәйкес және коммуникациялық мүмкіндігіне қарай, Еуропа мемлекеттерімен Шығыс пен Азия құрылықтарын ең қысқа жолмен қамтамасыздандыру. Бірақ Республиканың көліктер жүйесі әлемдік деңгейдегі көліктер жүйесіне айналуы үшін, еліміздің барлық көліктер жүйесіне күрделі өзгерістер керек. Өйткені нарық жағдайында көліктер қызметін сұраушылардың басты талабы, ол тасымалдаудың дәл уақытында және сапалы орындалуы.

Көліктер қызметін ұсынушылар үшін тасымалдаудың «дәл уақытында» және сапалы орындалуы үшін жылжымалы құрамдардың маршруттарына талдау жасап, қолданыстағы нормативтермен шамадан тыс бос тұру уақыттарын есепке алып, сол арқылы жоспарлы тапсырманың дұрыс және нақты атқарылуына және логистикалық тізбектің орындалуының сенімділігінің артуына қол жеткізу. Сонымен қатар көліктік-логистикалық жүйелердің жетіспеушілігімен сапасыз болуы көлік тасымалдауының шығындарының өсуіне әкеледі және нарықтан шығып қалуына соқтырады.

**Түйін сөздер:** тасымалдау маршруты, жүк айналымы, көлік жүйесі, тасымалдау моделі, жүк әкелу, көліктер жүйесінің қауымдастығы, логистика, ықшамдау өлшемдері, автокөлік жүрісі.

**Н. С. Сабралиев<sup>1</sup>, А. Абжапбарова<sup>2</sup>, Г. Нугыманова<sup>2</sup>, И. А. Таран<sup>3</sup>, Ж. Г. Жанбирова<sup>2</sup>**

<sup>1</sup>Казахская автомобильно-дорожная академия им. Л. Б. Гончарова, Алматы, Казахстан,

<sup>2</sup>Казахская академия транспорта и коммуникации имени М. Тынышпаева, Алматы, Казахстан,

<sup>3</sup>Национальный технический университет, Днепр, Украина

### **МОДЕЛИРОВАНИЕ ЭКСПЛУАТАЦИИ ГРУЗОВЫХ АВТОМОБИЛЕЙ В УСЛОВИЯХ КАЗАХСТАНА**

**Аннотация.** В течение последнего десятилетия Казахстан стал активным участником мировых интеграционных процессов. Важным элементом экономической интеграции является качественная транспортная инфраструктура, обеспечивающая внутренние и транзитные перевозки грузов и пассажиров, с высоким уровнем сервисного обслуживания.

Наряду с активизацией межрегиональной и международной торговли столь значительное увеличение автомобильных перевозок во многом обусловлено бурными процессами автомобилизации. Так как в разви-

тии рыночной инфраструктуры, расширении внутренней и внешней торговли важную роль играет автомобильный транспорт.

Важнейшим показателем интегрирования транспортной системы Республики Казахстан является рациональное использование существующих транспортных сетей, реализация преимуществ их географического расположения и коммуникационной способности, обеспечивающей кратчайший путь европейским странам с Восточным и Азиатским континентами. Но чтобы транспортные системы Республики как можно быстрее преобразились в транспортные системы мирового уровня, необходимо осуществить комплексную модернизацию всей транспортной отрасли.

Переход на работу по системе «точно-во время» потребует более глубокого анализа работы подвижного состава на маршруте, корректировке существующих нормативов и учета имеющихся сверхнормативных простоев, что позволит повысить достоверность и реальность плановых заданий, а в итоге это приведет к повышению надежности функционирования логистической цепи. Так как в рыночных условиях важным требованием потребителя транспортных услуг является своевременная и качественная доставка груза. Недостаточное развитие логистических прогрессивных транспортно-технологических систем перевозок приводит к увеличению транспортных расходов, следовательно, к потере рынка.

**Ключевые слова:** маршрут перевозок, грузооборот, транспортная сеть, модель перевозок, лицензирование, поставки грузов, интеграция транспортной системы, логистика, критерии оптимизации, пробег автомобиля.

#### **Information about authors:**

Sabraliev N., Kazakh Automobile and Road Academy named after L. B. Goncharov, Almaty, Kazakhstan; sabraliev51@mail.ru; <https://orcid.org/0000-0002-2950-5315>

Abzhapbarova A., Kazakh Academy of transport and communication named after M. Tynyshpaev, Almaty, Kazakhstan; ainur.abzhapbarova@mail.ru; <https://orcid.org/0000-0001-7013-0909>

Nugymanova G., Kazakh Academy of transport and communication named after M. Tynyshpaev, Almaty, Kazakhstan; <https://orcid.org/0000-0001-6035-9590>

Taran I., Department of Transportation Management, National TU Dnipro Polytechnic, Dnipro, Ukraine

Zhanbirov Zh., Kazakh Academy of transport and communication named after M. Tynyshpaev, Almaty, Kazakhstan; janbirov\_jg@mail.ru; <https://orcid.org/0000-0002-6444-0836>

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