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МОДЕЛЬ РОЗРАХУНКУ ВЕЛИЧИНИ ПЛАТИ ЗА ДОСТУП ДО ОБ'ЄКТІВ МІСЬКОЇ ПАСАЖИРСЬКОЇ ІНФРАСТРУКТУРИ З УРАХУВАННЯМ УЧАСТІ ПІДПРИЄМСТВ ТРАНСПОРТНОГО БУДІВНИЦТВА У ПРОЦЕСАХ ЇЇ РОЗВИТКУ

Обґрунтована необхідність вдосконалення методології тарифоутворення для пасажирського міського транспорту, з урахуванням заходів з розвитку транспортної інфраструктури та

вказана роль підприємств транспортного будівництва в цих процесах. Наголошується на високому рівні зносу об'єктів основних засобів. Основна проблема встановлення плати за користування об'єктами міської пасажирської інфраструктури полягає в тому, що необхідність платити перевізникам за економічні вигоди, які вони генерують, розуміється не завжди й не всіма.

В роботі удосконалено методичні підходи до операційного аналізу витрат, який на відміну від існуючих, базується на нелінійних залежностях витрат, прибутку будівельних організацій від відтворювальної діяльності об'єктів транспортної інфраструктури, що дозволяє знайти оптимальне співвідношення «результати-витрати», відповідно до якого обґрунтовуються рішення щодо доцільності реалізації відтворювальної діяльності.

У сімох Європейських країнах введена так звана двохелементна структура тарифу з фіксованою й змінною складовими. Перша визначається за допомогою залежностей між плановаными потребами перевізника й постійних видатків за користування об'єктами міської пасажирської інфраструктури. Змінна визначається по факту використання ресурсів мережі.

Одноелементна розраховується виходячи з фактичної відстані експлуатації, тобто плата прямо пропорційна фактичному використанню інтенсивності експлуатаційної діяльності.

Саме при одноелементній структурі, більша частина маргінальних видатків визначається виходячи зі статистичних даних, що значно спрощує методику визначення їх рівня. Але, істотним недоліком одноелементної структури є низький рівень обґрунтування частини умовно-постійних видатків.

Одержали подальший розвиток методичні підходи до визначення ефективності системи управління відтворювальною діяльністю об'єктів транспортної інфраструктури на основі показників оцінки ефективності виконання окремих функцій підприємств транспортного будівництва за рахунок розробки узагальнюючого показника для проведення комплексної оцінки

ефективності процесів управління відтворенням основних засобів.

***Ключові слова*:** міський пасажирський транспорт, рухомий склад, тариф, собівартість перевезення, підприємства міського транспорту, транспортного будівництва, економічна ефективність.

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MODEL OF CALCULATION OF THE COST OF ACQUISITION OF ACCESS TO OBJECTS OF CITY PASSENGER INFRASTRUCTURE WITH ACCOUNTING OF THE PARTICIPATION OF TRANSPORT CONSTRUCTION ENTERPRISES IN THEIR DEVELOPMENT PROCESSES

The necessity of perfection of methodology of tariff formation for passenger urban transport, based on measures on development of transport infrastructure and the role of enterprises of transport construction in these processes is substantiated. The high level of depreciation of fixed assets is highlighted. The main problem of setting fees for the use of urban passenger infrastructure is that the necessity to pay carriers for the economic benefits that they generate is not always understood and not by everyone.

The methodical approaches to operational analysis of costs are improved, which, unlike existing ones, is based on the nonlinear dependencies of costs, the profit of construction organizations on the reproduction of transport infrastructure objects, which allows us to find the optimal "cost-benefit" ratio, according to which decisions are justified on the expediency of realization of reproductive activity.

In seven European countries introduced a so-called two-element structure of the tariff with fixed and variable components. The first one is determined by means of dependencies between the planned needs of the carrier and constant expenses for the use of objects of the city passenger infrastructure. The variable is determined by the use of network resources.

One element is calculated based on the actual operating distance, ie, the charge is directly proportional to the actual use of the intensity of operational activity.

It is in the one-element structure that most marginal expenditures are determined on the basis of statistical data, which greatly simplifies the methodology for determining their level. However, the significant disadvantage of the one-element structure is the low level of substantiation of part of fixed-term expenditures.

Further development of methodological approaches to determining the effectiveness of the management system for reproduction activity of transport infrastructure objects was obtained on the basis of indicators of assessing the effectiveness of performing certain functions of transport construction enterprises through the development of a generalized indicator for a comprehensive assessment of the effectiveness of the processes of managing the reproduction of fixed assets.

Key words: urban passenger transport, rolling stock, tariff, cost of transportation, urban transport companies, transport construction, economic efficiency.

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МОДЕЛЬ РАСЧЕТА ВЕЛИЧИНЫ ПЛАТЫ ЗА ДОСТУП К ОБЪЕКТАМ ГОРОДСКОЙ ПАССАЖИРСКОЙ ИНФРАСТРУКТУРЫ С УЧЕТОМ УЧАСТИЯ ПРЕДПРИЯТИЙ ТРАНСПОРТНОГО СТРОИТЕЛЬСТВА В ПРОЦЕССЕ ЕЕ РАЗВИТИЯ

Обоснована необходимость совершенствования методологии тарифообразования для пассажирского транспорта, с учетом мероприятий по развитию транспортной инфраструктуры и указана роль предприятий транспортного строительства в этих процессах. Отмечается высокий уровень износа объектов основных средств. Основная проблема формирования платы за пользование объектами городской пассажирской инфраструктуры заключается в том, что

необходимость платить перевозчикам за экономические выгоды, которые они генерируют, понимается не всегда и не всеми.

В работе усовершенствованы методические подходы операционного анализа затрат, который в отличие от существующих, базируется на нелинейных зависимостях расходов, прибыли строительных организаций от воспроизводственной деятельности объектов транспортной инфраструктуры, позволяющей найти оптимальное соотношение «результаты-расходы», согласно которому обосновываются решения о целесообразности реализации воспроизводственной деятельности.

В семи европейских странах введена так называемая двухэлементная структура тарифа с фиксированной и переменной составляющими. Первая определяется с помощью зависимостей между планируемыми потребностями перевозчика и постоянных расходов за пользование объектами городской пассажирской инфраструктуры. Переменная определяется по факту использования ресурсов сети.

Одноэлементная рассчитывается исходя из реального расстояния эксплуатации, то есть плата прямо пропорциональна фактическому использованию интенсивности эксплуатационной деятельности.

Именно при одноэлементные структуре, большая часть маржинальных расходов определяется исходя из статистических данных, что значительно упрощает методику определения их уровня. Но, существенным недостатком одноэлементной структуры является низкий уровень обоснования части условно-постоянных расходов.

Получили дальнейшее развитие методические подходы к определению эффективности системы управления воспроизведенной деятельностью объектов транспортной инфраструктуры на основе показателей оценки эффективности выполнения отдельных функций предприятий транспортного строительства за счет разработки обобщающего показателя для проведения комплексной оценки эффективности процессов управления воспроизводством основных средств.

Ключевые слова: городской пассажирский транспорт, подвижной состав, тариф, себестоимость перевозки, предприятия транспорта, транспортного строительства, экономическая эффективность.

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Problem definition.

The main problem of setting fees for the use of urban passenger infrastructure objects is that the necessity to pay carriers for the economic benefits that they generate is not always understood and not by everyone. Therefore, carriers are interested in the evaluation and offering of benefits that are able to provide the society and the arguments for compensation. Sources of payment will be different in each case, but they can be grouped into several categories.

Analysis of the recent research and publications

Determination of the level of payment for the use of objects of urban passenger infrastructure should be implemented in accordance with the experience of European countries EU-28 [EU regional and urban development: https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/priority-themes/urban-mobility_en].

In seven European countries, the so-called two-element structure of the tariff with fixed and variable components has been introduced. The first one is determined by means of dependencies between the planned needs of the carrier and the constant expenses for the use of objects of the city passenger infrastructure. The variable is determined by the use of network resources.

One-element calculation is based on the actual operating distance, that is, the charge is directly proportional to the actual use of the intensity of operational activity.

It is in the one-element structure that most marginal expenditures are determined on the basis of statistical data, which greatly simplifies the methodology for determining their level. However, the essential disadvantage of one-element structure is the low level of substantiation of part of fixed-term expenditures.

If it is necessary to create and maintain internal competition, with the presence of more than one carrier it is expedient to apply a two-element payment. In cases where there is no need to form competition, the expediency of one-element fee is expedient.

At different times, the solution of various aspects of this problem involved such domestic and foreign specialists: Gurnak V.M. [3], Boyd Colin W. [1], Ortuzar J. de D [5], Winston C. [7], Butkavichius J.P. [2], Kotik V.O. [4], Pinchuk S.O. [6].

Considering the importance of the theory and practice of the results obtained, some issues still remain insufficiently highlighted.

Unsolved aspects of the problem the article is dedicated to.

Carriers and representatives of urban passenger infrastructure, in this case, have to set a fee based on the level of projected costs, desirable income and the solvency of passengers. But today there is no model for charging for the use of urban passenger infrastructure.

Purpose of the article

Proceeding from the above objective of this article is the development of a one-and two-element model for calculating the payment for the use of objects of urban passenger infrastructure.

Basic research material

One-piece model of payment calculation is based on a level that provides compensation for costs and profits, sufficient for the economic stimulation of efficient carriers.

Recently, the EU-28 pays great attention to the issue of the efficient functioning of urban passenger transport [8].

At the moment, passenger transportation in cities is carried out according to schemes, routes of which were formed over a long period of operation. But this does not mean that these routes are optimal. Every day the city is developing, its infrastructure is changing. The elements of the system are changing: place of residence - place of work. The points of concentration of passenger traffic, the guiding directions of movement, the average distance of transportation, the number of passengers transported, the specific gravities of different types of passenger transport in the urban passenger traffic change. Therefore, it is advisable to periodically revise the existing system of passenger urban transport in order to optimize its parameters. Optimization of urban routeing schemes of

passenger traffic is mainly limited to bus routes. Changing the bus route does not require large investments, especially in infrastructure. Another thing - trolley buses, trams, subway. Here in the optimization process will be significantly stretched in time with the need to attract significant investment. Also, the payback period of such investments will be quite significant. However, electric transport is a recognized leader in urban transport in many European countries in terms of parameters: the cost of transporting one passenger, the total number of passengers carried, and the passenger turnover. In addition, electric transport allows you to get a lot of indirect effects. This and reducing the burden on the ecosystem, the use of renewable fuels, safety and high level of comfort. The high regularity of their messages can significantly reduce the load on congested urban roads. Changes in bus routes due to the appearance of a new route or changes in their length, the movement of stopping points, and the creation of new ones occur at regular intervals. Besides the fact that these actions do not have a proper feasibility study, they do not significantly affect the optimization of parameters of the passenger transport system.

The development of an optimal scheme for the functioning of passenger transport includes the solution of the following problems and tasks: identification of passenger traffic points, development of travel routes and public transport stops, distribution of passenger traffic over time and space, reasonable choice of vehicles according to parameters passenger capacity and type of transport, development of proposals on the regularity of messages, the formation of timetables, linking schedules of movement of various types passenger transport. In large cities, communications and their number between corresponding points can be significant. Therefore, the number of options for transport schemes that potentially form is also quite a large number. This greatly complicates the decision-making process to optimize the passenger transport system of the city. Here, as criteria, we can recommend the minimum duration of transportation and the number of transfer points, which will inevitably lead to a reduction in the cost of the trip. As an effective tool for optimizing the passenger urban transport system, you can use the method of combinatorial analysis, by analogy with rail transport,

where it is used everywhere. Taking into account modern methods of automated calculation, the solution of such a problem does not require much time. However, significantly increased requirements for the reliability of the source data, which should cover not only the retrospective, but also the future development of urban infrastructure. There are also no major restrictions that make it possible to reduce the number of circuits and routes. The basis for the formation of the optimal supply of transport schemes for the future city route is the minimum duration and distance of the passenger transportation. Given the lack of duplicate options. At the moment, as we believe, the stated approach is the most rational. It must be said that the criteria for the formation of messages are focused on the development of a route that includes the longest elements. Today there is sufficient experience in solving such problems with various indicators of final performance. Despite the possibility of widespread use of this method, it still has the potential for further development. The method proposed above includes several stages of sequential implementation. Initially, the main criterion is minimization of time costs for moving. At the next stage, it is necessary to form a route taking into account the minimum length and the number of transfer points. Based on the above, over time we have clearly formed directions for solving the stated scientific problem. First, empirical studies - which are performed on the basis of real data of operational processes. Secondly, analytical studies - analytical models are being formed. Third, modeling, including the development of simulation, mathematical, and economic-mathematical models.

When calculating the market price for construction products, including the improvement of urban transport infrastructure, the conditions for the reproduction processes of the main means of transport, taking into account the peculiarities of this process during the period of transformation processes, should be developed.

The main general economic precondition for an uninterrupted process of production in any society is the constantly repeating process of reproduction of all factors of production: labor, means of production and natural resources. Consideration of the process of reproduction of manpower and natural resources requires independent research.

At the stage of formation of market relations in the investment sphere, the process of reproduction of fixed assets is changing. This is due in the first place to the fact that subcontractors operate on the basis of self-financing of production costs and capital investments, which cover both the investment of fixed assets.

At the present time, the acquisition of fixed assets is carried out at free market prices, which, in conditions of economic instability, are jump-free. As a result of inflationary processes in the economy, accrued depreciation is not enough to implement reproductive processes. In this case, fixed assets, machinery and vehicles are significantly outdated, morally, physically and in need of upgrades. Depreciation of equipment is in some cases up to 90%. Therefore, transport organizations, in order to maintain their production potential, to ensure safe and reliable transport connections, must, to a certain extent, use part of their net profit for reproduction processes. Previously, this phenomenon in the economic practice of transport industry enterprises was not observed, as traditionally the reimbursement of fixed assets was accounted for depreciation, and their expansion - at the expense of profits remaining at the disposal of the company after the repayment of all taxes, payments, fees.

Thus, in the conditions of transformation processes, the aforementioned feature of the reproductive processes of the main means of transport was revealed.

Principal changes in the reproductive conditions of fixed assets (both in natural-material and in value forms) can have a negative impact on the crisis situation in the national economy. Lack of depreciation resources, even for simple reproduction, can slow down the process of write-off of fixed assets (after the expiration of the normative terms of their service).

The deceleration of the write-off process leads to accumulation on the balance of the morally and physically obsolete technology, equipment, mechanisms. This, in turn, leads to a reduction in the production capacity of the organization, safe, uninterrupted, reliable operation (due to lower productivity of old technology, increased downtime of technical equipment, due to a greater number of breakdowns and accidents, extension of the repair cycle, reduction of inter-repair intervals), the impossibility

application of the latest technologies in the construction of objects that meet the requirements of world standards. And, as a result, this negative tendency can cause a disturbance of the reproductive process on the scale of the national economy as a whole (both quantitatively and qualitatively). Reduce the competitiveness of transport.

The process of artificial restraint of the write-off of fixed assets will increase. This is explained, firstly, by the fact that, when profits become the main source of funds for investing, the growing recession of physical volumes of capital construction produces a shortage of funds from the contractor due to a decrease in profits and multiple increases in fixed asset prices. Secondly, there was a negative tendency to change the proportions in the distribution of profits in the direction of reducing the share of funds for the development and improvement of transport production.

Given that at the expense of these funds, enterprises now have not only to develop production, but also to provide reproductive processes of fixed assets, the situation in the national economy is alarming.

The methodical approaches to operational analysis of costs are improved, which, unlike existing ones, is based on the nonlinear dependencies of costs, the profit of construction organizations on the reproduction of transport infrastructure objects, which allows us to find the optimal "cost-benefit" ratio, according to which decisions are justified on the expediency of realization of reproductive activity.

The necessity of using profit reproductive processes of fixed assets is, in our opinion, a problem of the transition period of the formation of an economic system based on a system of markets and prices. With the stabilization of market relations and the formation of a coordinating mechanism of a market economy, which is a pricing system, reproduction processes will be carried out at the expense of the accumulated depreciation fund, which for the period of service life of fixed assets will have to be adjusted, with different means, to the replacement cost of replacement fixed assets moment of purchase One such mechanism may be the revaluation method, the revaluation of fixed assets, taking into account the dynamics of prices and

official statistical indicators, reflecting the inflation component of the national economy.

The peculiarity of the method of statistical tests is that when modeling a system of mass servicing whenever an event interferes with the process, its influence is taken into account by the playout of the value of a random variable having its distribution law. Therefore, the technological data for modeling the transport service process should include the laws of the distribution of random variables and their parameters.

In order to properly organize the simulation procedure, the above data should be divided into two groups: data entered into the simulation algorithm in the finished form before the start of simulation (output data); data obtained in the simulation process on the basis of processing of output data (simulation results).

For ease of presentation, the raw data should be determined in the general sequence of simulation indicated in the information logic. According to the information logic, the transport service modeling process begins with a program module that generates the parameters of the flow of applications of the highest priority (traffic flow).

Further development of methodological approaches to determining the effectiveness of the management system for reproduction activity of transport infrastructure objects was obtained on the basis of indicators of assessing the effectiveness of performing certain functions of transport construction enterprises through the development of a generalized indicator for a comprehensive assessment of the effectiveness of the processes of managing the reproduction of fixed assets.

In order to objectively calculate the costs and further calculate the level of payment for the use of objects of urban passenger infrastructure, it is necessary to take into account the time factor in economic calculations.

The total cost of repairs for the entire lifecycle of the city passenger infrastructure, taking into account the timeliness of their implementation, is defined as:

$$\sum P_j^p = \sum_{t=1}^{LC} P_j^p \cdot \alpha_t$$

where α_t - the discount rate, which leads to costs before the beginning of the life cycle of the city passenger infrastructure, is determined from the expression:

$$\alpha_t = (1 + r)^{-t}$$

where r - real (cleared from inflation) rate of income (discount rate).

Taking into account the foregoing, and taking into account the annual expenses for the current maintenance, we will write a formula for calculating the cost of the life cycle of objects of urban passenger infrastructure:

$$C_j^{LC} = P_j^M + \sum_{t=1}^{LC} P_j \cdot \alpha_t + \sum_{t=1}^{LC} P_j^{C.M.} \cdot \alpha_{t\,c.m.} - P_l \cdot \alpha_{t\,l.c.}$$

where t is the serial number of the year for the implementation of repairs or current maintenance;

P_j^M - cost of modernization of the city passenger infrastructure;

$P_j^{C.M.}$ - annual cost of work on the current maintenance of the city passenger infrastructure.

Thus, the average annual cost of repairs and the current maintenance of urban passenger infrastructure, based on the cost of the life cycle, is:

$$C_j^p = \frac{C_j^{l.c.}}{T_{l.c.}}$$

where $T_{l.c.}$ – established the life cycle of the object of urban passenger infrastructure, years.

Previously, it was emphasized that the guiding factor for the implementation of the repair complex is the normative timing of their implementation, and not the work. But introduction of norms for repairs without regard to the economic principles of work, repair and replacement. Proceeding from this it would be advisable to propose a mechanism for economic optimization of the regulated list and the volume of repairs.

The solution of such a problem is possible using the Bellman equation.

Conclusions of the research

The paper proposes one and two elemental models for calculating the payment for the use of objects of urban passenger infrastructure, taking into account the existing requirements of European transport legislation, which provides compensation for costs and profits, sufficient for the economic stimulation of effective activity of carriers and objects of urban passenger infrastructure. .

Prospects for further developments in this area

Carriers and representatives of urban passenger infrastructure objects must independently establish a fee (fee), based on the level of projected costs, desirable income and the solvency of passengers.

The most promising method for calculating the payment for the use of urban passenger infrastructure objects - the budgetary method proceeds from the state forecasting of the socio-economic development of the national economy, the ecological, demographic situation and the needs for the specified volumes of passenger traffic, taking into account modern requirements to ensure the required level of quality.

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