

APPROACH TO DETERMINATION OF THE PASSENGER-HOUR COST IN URBAN PASSENGER TRANSPORTATIONS

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The functioning of urban passenger transport is always accompanied by a significant social effect. In this connection, in the conditions of a market economy, the problem arises to quantitatively measure the effect. If we consider only the economic performance of urban passenger transport, for example, income, then this assessment of operation will take into account only the partial transportation results, neglecting social ones, the most important thing of which is a free human time. The passenger being an employee of the social, production or scientific spheres spends some time on the manufacture of products or services. In this regard, the proper evaluation of the time that would be used on production needs is the most important. In time of public transport operation, a cost of passenger-hour should be used to compare the social results of passenger transportation and the costs to achieve these results.

Keywords: passenger, passenger-hour cost, travel time, transportation process parameters.

Problem statement. As noted earlier, travel time costs can be estimated in value terms. For this purpose, a criterion is used, such as the time saved during the trip, reflected in the cost of one passenger-hour. The calculation of the passenger-hour cost is conditional, since it includes a number of factors, the actual value of which is either not known or difficult to determine as the significance of the time loss for each member of society is individual [1].

During the economic assessment of the passenger-hour cost, we proceed from the assumption that it is possible to assess the economic or social benefits that would be achieved by improving the operation of public passenger transport; then it saves the time spent by passengers on their trip from place of residence to working places. This approach to make a price of working time is also used in other sectors, when the volumes of production of various goods are taken into account for a time window. We believe that it is also acceptable for the urban transport, since the passengers are, mostly, the employees of any of the branches of the economy, science or education.

The passenger willing to change the place of his stay should not only pay for it, but, in addition, he should spend some time on the trip. While the cost of transportation is the category measured in monetary terms, the trip duration is measured in units of time. Therefore, in order to summarize the transportation costs and the time consuming they should be brought to the general measurement scale.

Analysis of recent research and publications.

In the countries of the west from the 70s of the 20th century, a descriptive approach to determine the cost of passenger-hour based on a comparative analysis of alternatives differing in price and speed was widely developed [2, 3]: individual car trip, car pool, combined trips (car, high-speed urban passenger transport mode), various bus trips (for example, with the calling or pre-ordering). In the United States, a comprehensive time analysis has been carrying out based on the «cost-benefit» approach [4], i.e. in monetary terms, economic, cultural, social, environmental and other losses and gains of passengers and transportation industry should be estimated.

It is natural that the cost of a passenger's time may depend on the category of the population (for example, workers, employees, pensioners and students), the purpose of the trip (labor or social) and the time at which the trip takes place (peak, day or night hours). A detailed description of the different types of time [4] spent by the passenger on trips and the passenger viewpoint to this time are given, but there is no specific calculation of a passenger-hour cost.

There are several approaches to determine the cost of passenger-hour, in which the indicators are considered [5-8]: 1) the national income or the net value of products or services manufactured for 1 hour of working time; 2) own time passenger's evaluation; 3) losses in the labor productivity due to passenger's fatigue; 4) passenger's average salary; 5) percentage of the salary or household income, approximately up to 30%.

Consider briefly all the approaches. Approach (1) does not take into account the job quality and the employee skills. Approach (2) does not exclude a significant degree of subjectivity in the time valuation by the passenger, although it assumes some direct contact with the transportation service consumer. Approach (3) requires a special medical equipment and researcher's education to correctly explain the survey results. Approach (4) considers only the employee's salary without taking into account any other parameters (for example, the transportation process parameters). Approach (5) does not explain the value of 30% from an economic or technologic point of view.

In general, many authors [9-12] only point out the need to use a passenger-hour in evaluating the effectiveness of design solutions or innovations in passenger transport (changing the route, new rolling stock operation, operating new routes, etc.), however, do not provide a calculation technique.

At the same time the approach, in which an attempt was made to take into account the operational performance of passenger transportation had been proposed in [12]. However, its main disadvantage is the fact of development in the conditions of a plan-based economy and the use of the «car-kilometer» cost as the main transportation efficiency economic indicator, which currently is

believed to be obsolete and inconvenient in calculation practice.

Unsolved aspects of the problem. Resulting from the analysis of approaches to determining the cost of a passenger hour, it should be concluded that authors suggest very different content ways to solving this problem that, however, do not allow calculating the value of this indicator unambiguously. Moreover, some of them are difficult to use in practice.

The above approaches have a common disadvantage – mostly, they do not consider the performance of urban passenger transportation (for example, trip parameters) and its influence on the passenger, which, in most cases, can reduce or increase his labor productivity, change the psycho-emotional state and, eventually, change the cost of time spent in urban transportation.

In addition, in the economic literature, the issues of quantitative measurement of the social effect have not sufficiently developed yet, while in the current conditions of management the expression of the activity results is most appropriate in terms of money.

Purpose of the article. The purpose of the article is to propose a technique for determining the cost of a passenger-hour taking into account the transportation process parameters and to demonstrate its practical application.

Main study statement. The lack of a well-developed and universally applied economic evaluation of free time in practice leads to the fact that the limits of socially expedient investments into the service sector are often established unreasonably. In the proposed approach, it should be used three categories as initial indicators – economic (route vehicle operation costs per hour), technological (vehicle capacity, capacity rate, operating speed and traffic headway) and social (waiting time, average trip distance) ones that represent the trip parameters.

Waiting time

$$t_w = \frac{H}{2}, \tag{1}$$

Where H – traffic headway, hours.
Costs per 1 km

$$S_{km} = \frac{S_{hour}}{V_o}, \tag{2}$$

where S_{hour} – vehicle operation cost per hour, UAH/hour;

V_o – operating speed, km/h.

Cost per 1 passenger-km

$$S_{pass.-km} = \frac{S_{km}}{q \cdot \gamma \cdot V_o} = \frac{S_{hour}}{q \cdot \gamma \cdot V_o}, \tag{3}$$

where q – passenger capacity, pass.;

γ – capacity rate.

After converting the cost per 1 passenger-hour

$$C_{pass.-hour} = \frac{S_{hour}}{q \cdot \gamma \cdot V_o} \cdot \frac{l}{2 \cdot H} = \frac{2 \cdot S_{hour} \cdot l}{q \cdot \gamma^2 \cdot V_o \cdot H}, \tag{4}$$

where l – average trip distance, km.

The influence of each of the trip parameters on the cost of an hour is shown in Figure 1.

As can be seen from the graphical representation of the dependence, this indicator is highly

sensitive to changes in the passenger capacity, capacity rate, bus hour operation costs and passenger's trip distance.

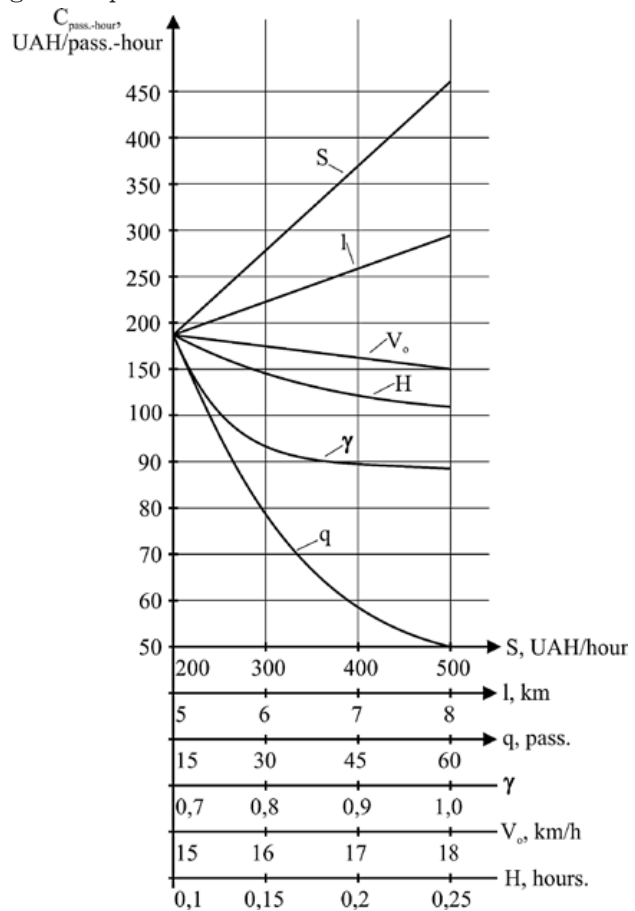


Fig. 1. The influence of the trip parameters on the passenger-hour cost

Source: developed by the author

Consider the practical application of the dependence obtained on the example of a bus route. Thus, the passenger-hour cost with the following average parameters: bus operation cost – 300 UAH/hour, passenger travel distance – 6 km, vehicle nominal capacity – 40 passengers, capacity rate – 0.7, operating speed – 18 km/hour and headway – 0.1 hour will make an average value of 102 UAH/pass.-hour.

It should be emphasized that the approach with the presentation of the time of passengers in value terms makes it possible to compare, for example, only the economic indicator, like the income of a passenger carrying enterprise with the social indicator – the total time spent by passengers and expressed in money terms.

Comparison of these two indicators can be used to assess the quality of urban passenger transport and ways to improve it. Here the following relations can be presented

$$\begin{cases} TC > I, \\ TC < I, \\ TC = I. \end{cases} \tag{5}$$

where TC and I – total cost of passenger-hours and transport income for the i -th period, UAH, respectively.

Wherein $TC > I$ testifies to the availability of significant reserves in improving the efficiency of transport services for urban passengers, then $TC < I$ and $TC = I$ indicates an almost perfect state of the urban passenger system functioning, which is not provided in practice.

Conclusions and recommendations. The proposed approach makes it possible to compare the social and economic results from the public transport functioning with the costs of achieving them, arising from the social standard – the passen-

ger-hour cost. The basis for calculations can be the transportation process parameters.

The above technique cannot be considered as an exceptional one, but the indicator can also be reflected in the total national income of the state, since the so-called «non-transportation» effect of urban mass transit expressed by the passenger-hour cost is not currently taken into account when planning the urban passenger transportation development and other facilities that are significant from social and economic point of view.

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ПІДХІД ДО ВИЗНАЧЕННЯ ВАРТОСТІ ПАСАЖИРО-ГОДИНИ ПРИ МІСЬКИХ ПАСАЖИРСЬКИХ ПЕРЕВЕЗЕННЯХ

Анотація

Функціонування міського пасажирського транспорту завжди супроводжується значним соціальним ефектом. У зв'язку з цим в умовах ринкової економіки постає питання кількісного виміру такого ефекту. Якщо розглядати тільки економічні показники роботи МПТ, наприклад, доходи, то така оцінка роботи буде враховувати лише один з часткових результатів діяльності пасажирського транспорту, залишаючи без уваги соціальні результати, найважливішим з яких є час людини, частку з якого вона витрачає на виробництво продукції, а частку – у особистих цілях. Таким чином, відповідна оцінка часу, що міг би бути використаний для потреб виробництва, є дуже важливою. Для порівняння соціальних результатів пасажирських перевезень та витрат на досягнення цих результатів використовується вартісна оцінка пасажиро-години.

Ключові слова: пасажир, вартість пасажиро-години, час поїздки, параметри транспортного процесу.

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ПОДХОД К ОПРЕДЕЛЕНИЮ СТОИМОСТИ ПАССАЖИРО-ЧАСА ПРИ ГОРОДСКИХ ПАССАЖИРСКИХ ПЕРЕВОЗКАХ

Аннотация

Функционирование городского пассажирского транспорта всегда сопровождается значительным социальным эффектом. В связи с этим, в условиях рыночной экономики возникает вопрос количественного измерения такого эффекта. Если рассматривать только экономические показатели работы МПТ, например, доходы, то такая оценка работы будет учитывать только один из частных результатов деятельности пассажирского транспорта, оставляя без внимания социальные результаты, важнейшим из которых является время человека, часть которого он тратит на производство продукции, а часть – в личных целях. Таким образом, соответствующая оценка времени, которое могло быть использовано для нужд производства, является важной составляющей процесса перевозок. Для сравнения социальных результатов пассажирских перевозок и расходов на достижение этих результатов используется стоимостная оценка пассажира-часа.

Ключевые слова: пассажир, стоимость пассажира-часа, время поездки, параметры транспортного процесса.