PECULIARITIES OF TAKING CERTAIN EFFECTS INTO ACCOUNT WHEN ASSESSING ECONOMICAL EFFICIENCY OF ROAD PROJECTS

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Abstract: *The article is devoted to the accounting of the cost of passengers' trip losses and the cost of automobile transportation. It shows the expediency of taking into account additional factors when estimating the mentioned kinds of effects, such as the structure of people's trips by aims, the structure of passenger car fleet by forms of ownership, and correction coefficients to the fuel consumption norms. At the same time, it is pointed out that it is expedient not to take into account some factors.*

Keywords: *efficiency, passenger-hour cost, automobile transportation costs*

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I. INTRODUCTION

When evaluating the effectiveness of road projects, as a rule, the most significant effects are:

- reduction of losses due to passenger stays on the road;

- reducing the cost of road transportation.

The procedure for calculating these effects, and performance indicators in general, is given in ODM218.4.023-2015 [1]. The specified document is a recommendation for the industry. The document also contains reference values for calculating these effects. Depending on the type of this or that analyzed project, it is possible to change the given indicators and take into account additional factors.

II. COSTS OF ROAD TRANSPORTATION

The following formulas for calculating this effect are given in ODM218.4.023-2015:

$$Cat = 365 * \sum_{j=1}^{m} N_{jt} * (S_{jt} * L + S'_{jt} * t_t^z) \quad (1)$$

Where *–Njt* is average daily traffic intensity of cars

Sjt - average cost of car mileage annually in rubles/ kilometer

S_j' ' demurrage costs annually in rubles/hour

L – length of the road section, km

t_t^z – average daily delay time of the vehicle, h.

$$S_j = S_{\text{пер}j} + \frac{S_{\text{пост}j}+d_j}{Vj} \quad (2)$$

$$S_j' = S_{\text{пост}j} + d_j \quad (3)$$

Where $S_{\text{пер}j}$– variable costs, rubles/km

$S_{\text{пост}j}$ – fixed costs, rub./h.

d_j – Driver's salary rubles/hour

Variable costs include:

- costs of fuel and lubricants (POL);
- maintenance costs;
- tire wear and tear costs.

Fixed costs include:

- depreciation;
- overhead costs.

Wages and salaries can also be classified as fixed costs if they are charged on a time basis.

Appendix D to ODM218.4.023-2015 contains values for each of the cost elements for different brands of vehicles.

In particular, we would like to draw your attention to some of the elements.

1. depreciation

Depreciation is a reflection of past costs, the transfer of the cost of the car to the cost of its operation in parts. Meanwhile, one of the principles of investment projects estimation according to inter-branch Guidelines [2] is the accounting of only future receipts and expenses. In another new edition by the authors of the Methodological Recommendations this principle is formulated differently - "the unmanageability of the past" [3]. The same edition states that depreciation is not taken into account directly in efficiency calculations. A number of calculation tables given in the editions suggest that only material, labor, and other costs should be taken into account. In view of the above, it seems advisable in assessing the effectiveness of road projects not to take into account depreciation of vehicles.

III. COSTS OF FUEL AND LUBRICANTS

These costs are the most important in the variable costs and are determined on the basis of the Fuel Consumption Standards [5]. This document, in addition to the values of fuel consumption standards for individual brands of vehicles, contains correction factors that must be taken into

account in some cases. Some of them are given below (Table 1)

Correction coefficients to fuel consumption rates

(according to[5])

	Factors	Correct coefficients
1	Winter conditions	1,05-1,2
2	Work in mountainous terrain at an altitude above sea level:	
2.1	300 - 800 m (low mountains);	Up to 1,05
2.2	801 - 2000 m (medium mountains);	Up to 1,1
2.3	2001 - 3000 m (tall mountains);	Up to 1,15
2.4	свыше 3000 m (tall mountains)	Up to 1,2
3	Operation of motor vehicles on roads with a complex layout (outside cities and suburban areas), where on average there are more than five curves (turns) with a radius of less than 40 m (or about 500 per 100 km of road) per 1 km of route	
3.1	on public roads of categories I, II and III	1,1
3.2	on public roads of categories IV and V	1,3
4	Work in localities	
4.1	Over 5 million people	Up to 1,35
4.2	1-5 million people	Up to 1,25
4.3	250 thousand – 1 million people	Up to 1,15
4.4	100-250 thousand people	Up to 1,1
4.5	Less than 100 thousand people	Up to 1,05
5	Work that requires frequent stops (e.g., dropping off and picking up passengers)	Up to 1,1
6	Reduced speed driving	
6.1	20-40 km/h	Up to 1.15
6.2	Less than 20 km/h	Up to 1,35

These coefficients should be taken into account for fuel costs when evaluating the effectiveness of projects in cities (clauses 4 -6), in difficult terrain (clauses 2-3), in difficult road conditions. Regarding clause 6, the document says that this applies to the transportation of non-standard, oversized, heavyweight, dangerous goods, cargo in glass and other similar goods, when moving in convoys with a vehicle escorted by backup vehicles). However, it seems that the appropriate factors can be taken into account if the speed is reduced when the road surface is slippery and under other adverse weather conditions. Such problems may arise. for example, when optimizing the timing of the elimination of winter slippery conditions, etc.

IV. SALARIES OF DRIVERS

A question arises here about the appropriateness of accounting for passenger car wages. Most light vehicle trips are made by the owners themselves. In this case there is no need to take into account their wages. This, in particular, was pointed out by A.V.Smykovskiy [7]. The methodology [4] suggests taking into account only the average cost per man-hour of cars working in the national economy. The data provided by Rosstat [8] used to calculate the structure of cars

by form of ownership. As of 2019, the share of cars owned by citizens was 95.59% of all cars in Russia. The corresponding values may vary by region and city.

Thus, formulas 2 and 3 can be presented as follows:

Mileage costs:

for passenger cars:

$$S_j = \gamma_{\text{сг}} * (S_{\text{гсм}} \prod K_k + S_{\text{пер}j}{}' + \frac{\text{HP}j}{Vj}) + \gamma_{\text{сп}} * (S_{\text{гсм}} \prod K_k + S'_{\text{пер}j} + \frac{\text{HP}_j + d_j}{Vj}) \quad (4)$$

for commercial and public transport:

$$S_j = S_{\text{гсм}} \prod K_k + S'_{\text{пер}j} + \frac{\text{HP}_j + d_j}{Vj} \quad (5)$$

demurrage costs:

for passenger cars:

$$S_j{}' = \gamma_{\text{сг}} * \text{HP}_j + \gamma_{\text{сп}} * (\text{HP}_j + d_j \ \ ) \quad (6)$$

for commercial transport

$$S'_j = \text{HP}j \quad (7)$$

where $S_{\text{гсм}}$ – the cost of fuel and lubricants;

Kk – correction coefficients to fuel costs;

HP- overhead costs

$S'_{\text{пер}j}$ - other variable costs (maintenance costs, tire wear);

$\gamma_{\text{сг}}$ – the share of passenger cars owned by citizens;

$\gamma_{\text{сп}}$ – the share of passenger cars owned by enterprises.

Losses associated with the time of passengers.

In accordance with the ODM they are determined by the formula:

$$Pt = 365 * C_t^{\text{пас}} * \left[N_t^{\text{л}} * \text{В}^{\text{л}} * \left(\frac{L}{V_t^{\text{л}}} + t_t^z \right) + N_t^{\text{авт}} * \text{В}^{\text{авт}} \left(\frac{L}{V_t^{\text{авт}}} + t_t^z \right) \right] \quad (8)$$

Where $C_t^{\text{пас}}$ - Passenger cost-an-hour rubles/person-hour

$N_t^{\text{л}}, N_t^{\text{авт}}$- traffic, respectively, of cars and buses avt./day;

$\text{В}^{\text{л}}$, $\text{В}^{\text{авт}}$ -the average number of passengers per passenger car and bus;

$V_t^{\text{л}}, V_t^{\text{авт}}$- speed of a passenger car and a bus, respectively.

Appendix D to the ODM provides passenger capacity values, but in order to determine the

average number of passengers it is necessary to additionally take into account the vehicle occupancy factor, which is proposed by a number of methods, for example [4], where the corresponding coefficients are taken equal to 0.5.

Another aspect is the cost per passenger-hour. In the preparation of the ODM, this indicator was determined by the following formula.

$$C^{пас} = \frac{ВВП}{Чз * 365 * 8} \quad (9)$$

Where ВВП – GDP; Чз - the number of employed people in the Russian Federation

In this regard, it seems advisable to take into account two considerations:

1) GDP or GRP should be divided not by the calendar number of days, but by the average number of days of work, determined by the production calendar. This was pointed out, in particular, by Dr. D. Mustafin. Sh.[6].having taken an appropriate number equal to 250 days.

2) Not all trips are made with labor purposes and not all passengers participate in the creation of GDP (GRP). Travel varies by purpose. This was pointed out by D.Sh. Mustafin and A.V. Smykovskiy.

In the methodology[4] the share of passengers working in the production sphere is taken as equal to 0.7. Also the statistics of trips in Russia as a whole is presented in the study [9] and below is given in Table 2 and in Fig. 1.

Table 2. *Distribution of intraday transportation trips by purpose (based on data[9])*

Purpose of travel	Share, %	
	Bus	Car
Work	32	32
Education	3	1
Shopping	25	21
Personal / Family affairs	31	32
Entertainment	9	14

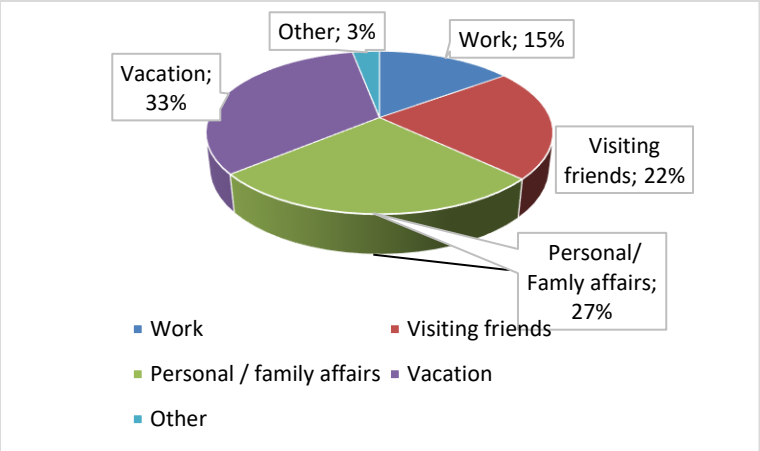

Fig. 1. *Distribution of long trips (over 200 km and overnight trips) by purpose, %*

The diagram in Fig. 1 shows the overall transport sector without division by type, but according to this study 52% of all long-distance trips are made by car, 21% by bus (when traveling in Russia), and 7% (travel abroad).

D. in his dissertation, A.V. Smykovskiy analyzes ways of accounting for passenger hours for various purposes of travel, basing in a number of cases [7, Table 2.3] on average wages or average per capita income, and also citing a number of calculated formulas [7, Appendix 8]. Livshits V.N., Vilensky P.L. and Smolyak S.A.[3] consider that 50-100% of average wage may be used for evaluation of free time. Candidate of economic sciences Mustafin D.Sh. proposes to divide all trains into labor and cultural and household. In this case, the cost of one hour of passenger for cultural and domestic trips is taken into account at a rate of 1/3 of the cost of labor. Whatever the case may be, the question of cost estimation remains a matter of debate.

However, for the evaluation of road projects, the cost of 1 passenger hour is proposed to be determined by the formula:

$$c^{\text{пасс}} = C_{\text{т}}^{\text{пасс}} * \gamma_{\text{т}} + C_{\text{п}}^{\text{пасс}} * \gamma_{\text{пр}} \quad (10)$$

Where $C_{\text{т}}^{\text{пасс}}$– the cost of a passenger-hour on work trips;

$\gamma_{\text{т}}$ – the share of trips made with labor purposes;

$C_{\text{п}}^{\text{пасс}}$ Passenger-hour costs for trips not related to labor purposes;

$\gamma_{\text{пр}}$ – The share of trips not related to labor purposes.

V. CONCLUSIONS

1. In assessing efficiency, it is not recommended to evaluate depreciation of cars as a reflection of past costs.

2. It is necessary to take into account correction coefficients to the rates of consumption of PGM.

3. For passenger cars, in most cases it is not advisable to take into account the wages of drivers.

4. When estimating losses associated with passenger stays on the road, it is recommended to take into account occupancy factors (passenger capacity factors).

5. When estimating the cost of the passenger-hour, it is advisable to take into account the distribution of passenger trips by purpose and different estimates of 1 hour of delay depending on the purpose.

These circumstances are additional to DPM 218.4.023-2015.

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