Acta of Turin Polytechnic University in Tashkent, 2023, 30, 17-21
Published Online December 2023 in Acta TTPU (http://www.acta.polito.uz/)

ECONOMIC LOSS DURING VEHICLES ARE DELAYED AT THE CROSSROADS

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Abstract– The article calculates economic losses when vehicles are delayed at regulated intersections. The studying aims to calculate the economic costs for various methods of regulation at intersections. Studies of the traffic flow have been carried out, transport delays and economic losses have been calculated. The results of the studying show how it is important to optimize traffic regulation.

Key words– road transport, regulated intersection, delaying, socio-economic consequences.

I Introduction

The growth of the country's car park, along with a positive impact on the economy, can make worse the working conditions of drivers due to the oversaturation of the road and street network with vehicles or cause negative socio-economic consequences (traffic accidents, reduced vehicle speeds, etc.).

The social effect is characterized by the improvement of social relations, changes in the ecological environment, conditions and labor protection, and the comprehensive development of the individual. The economic effect, in this case, is characterized by an increase in national income obtained by improving the organization of traffic, as a result of scientific and technological progress.

However, the economic and social effects can grow at different rates. In addition, a positive economic effect may be accompanied by a negative social effect. Therefore, the main task in the field of organization and road safety is the implementation of such measures and the development of such technical means that would provide positive values for both types of effect.

II Publication analysis

The analysis of the existing types of classification of intersections showed that they have a purely formal division and do not take into account the characteristic features of the intersection, the geometry, the characteristics of the development area of the intersection, stopping points for urban passenger transport, as well as the traffic intensity of pedestrian and traffic flows. In most cases, the class of the transport hub is determined by the technical category the city streets that form it.

The basis of the study was theoretical and practical works in the field of regulation and ensuring road safety of scientists, including V. Silyanov, M.B. Afanasiev, D. Drew, M.J. Beckman, F.V. Webster, K.Kh. Azizov, Zh. Sodikov, A.Ernazarov and many other specialists [1-8].

It should be noted that all existing models to determine transports delays either limitations or do not take into account specific road conditions or require a large number of different parameters and coefficients, which leads to errors in calculations and, as a result, reduces their practical significance. Delayings create the basis for suboptimal traffic signals, reduced service levels and capacity at intersections, increased emissions of harmful substances into the environment, travel time at a regulated intersection, excessive fuel consumption by cars.

III Research methods

One of the important problems in evaluating the effectiveness of measures aimed at improving the organization of traffic is the identification and determination of socio-economic losses associated with the imperfection of the organization of traffic. Improvement of the constructive safety of cars, the technical condition and arrangement of roads, and the professional training of drivers can have a significant impact on their reduction.

In a general video about the effectiveness of activities that improve traffic management, patterns:

- Reducing vehicle time loss;
- Reducing the loss of time for passengers in public and individual transport;
- Reducing the loss of time for pedestrians at the intersection of streets and highways;
- Reducing the level of traffic noise;

№	Crossroads	Number of phases in a cycle	Cycle time (Sec.)
1	The intersection of I. Karimov Avenue with the street Mustaqillik	4	96
2	The intersection of I. Karimov Avenue with the street Bainalminal	4	68
3	The intersection of I. Karimov Avenue with the street. S. Khamrokulova	2	32
4	The intersection of I. Karimov Avenue with the street Shifokor	3	48
5	The intersection of st. Tukimachilik to I. Karimov Avenue	2	32
6	The intersection of I. Karimov Avenue with the street Ortikova	2	32
7	The intersection of I. Karimov Avenue with the street Kaliya	4	72
8	The intersection of I. Karimov Avenue with the street Tashkent	4	82

TABLE 1: CHARACTERISTICS OF INTERSECTIONS.

- Improving the sanitary condition of the air basin (reducing the concentration of air pollutants);
- Reducing the concentration of harmful substances polluting the roadside.

Measures to organize traffic, making specific changes either to the condition and length of the road and street network, or to the conditions for the movement of vehicles, passengers and pedestrians on an existing network, affect the level of transportation costs in road transport and the loss of transportation costs for road transport and losses in industry, agriculture, construction associated with insufficient satisfaction of transportation needs. In addition, the sphere of economic influence of measures for the traffic management also includes an increase in net output in the sectors of material production that do not belong to the transport industry, cost reduction or profit growth in non-production organizations while meeting the corresponding social needs [12]. In addition to the economic effect, traffic management activities cause some types of socio-economic effect, mainly reducing the losses of the national economy and society as a whole while reducing the number of road accidents and losses associated with the time spent on the journey of pedestrians and passengers using both public passenger transport and individual vehicles. In the latter case, the side effect is expressed in the reduction of traffic fatigue during the journey of passengers (which contributes to the growth of labor productivity and higher quality products), as well as in the economic assessment of the saved free time of passengers.

IV RESEARCH RESULTS

At the period July-August 2021, the studying of the traffic flow along the entire length of I. Karimov Avenue (Jizzakh city) was carried out. This urban transport highway was chosen as the busiest, connecting the main transport routes of the city of Jizzakh, through further both intra-city routes for vehicles and urban inter-city routes.

The total length of I. Karimov Avenue is 7197 m.. The width of the carriageway is 23 m.;

Number of lanes in each direction – 3.

Number of intersections with traffic lights – 8 (Figure 1).

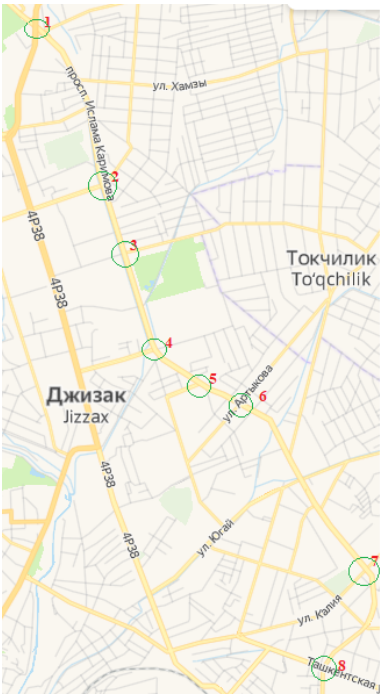

Fig. 1: Regulated intersections on I. Karimov Avenue.

On the avenue, there are intersections of various types, as well as a different types of the traffic flow throughout the entire avenue.

For regulated intersections, the frequency of operation of traffic lights is determined, taking into account the action of the prohibiting ("red") and allowing ("green") traffic light signals. An example of the intersection of avenue I Karimov with the street. Mustakillik (Figure 2).

Counting of vehicles passing through intersections on the

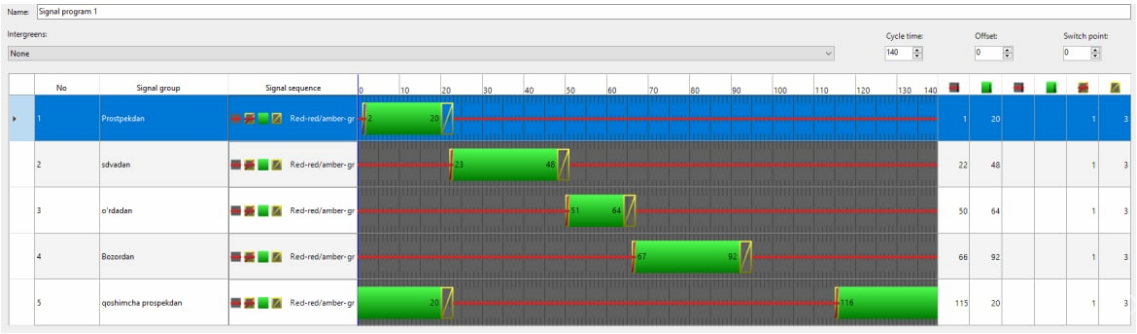

Fig. 2: Cyclogram of the intersection of I Karimov Avenue with Street Mustaqillik.

avenue was also made. The calculation was carried out on a weekday from 7-00 to 19-00. Results in Table 2.

№	Crossroads	Number of vehicles
1	The intersection of I. Karimov Avenue with the street Mustaqillik	59 138
2	The intersection of I. Karimov Avenue with the street Bainalminal	52 707
3	The intersection of I. Karimov Avenue with the street S. Khamrokulova	32 841
4	The intersection of I. Karimov Avenue with the street Shifokor	57 735
5	The intersection of st. Tukimachilik to I. Karimov Avenue	28 198
6	The intersection of I. Karimov Avenue with the street Ortikova	26 354
7	The intersection of I. Karimov Avenue with the street Kaliya	36 822
8	The intersection of I. Karimov Avenue with the street Tashkent	32 314
	Total:	**326 109**

TABLE 2: THE NUMBER OF VEHICLES CROSSING INTERSECTIONS IN 12 HOURS.

Calculation of the average delay of cars at a controlled intersection t_p is determined as a weighted average of those calculated for each phase [10]. Determination of delays for an intersection with a four-phase cycle by the formula:

$$t_p = 0.9\left[\frac{T*(1-\lambda)^2}{2(1-\lambda\chi)} + \frac{\chi^2}{2N(1-\chi)}\right] \quad (1)$$

$$t_p = 0.9\left[\frac{55*(1-0.327)^2}{2(1-0.3327*0.9)} + \frac{0.9^2}{2*0.796(1-0.9)}\right] = 19,2s$$

Delay definitions for a dual zone traffic intersection:

$$t_p = 0.9\left[\frac{46*(1-0.395)^2}{2(1-0.3395*0.7)} + \frac{0.7^2}{2*0.548(1-0.7)}\right] = 12,2s$$

Based on the results of the calculations, you can calculate the total daily delay of cars.

According to the results of the calculations, it can be seen that vehicles crossing the intersection on I. Karimov Avenue have a total of 120 hours of delay in one hour. Calculate losses from vehicle delays on I. Karimov Avenue

The cost of one machine-hour $(C_{(m-h)})$ must be determined, taking into account the additional costs of vehicle owners, per hour of lost time. These expenses include additional wages of the driver (except for vehicles owned by individuals), depreciation deductions, additional costs for fuel and lubricants [11].

The salary E_w can be determined based on the data on the average monthly earnings of drivers. E and the monthly fund of working hours F, which averages 170-180 hours:

$$E_w = k\frac{E}{F} \quad (2)$$

where $k = 1,26$ - coefficient taking into account deductions for a single social contribution [106]. Depreciation deductions for one hour Ea are calculated on the basis of the standard service life of vehicles T_n (available within 8-10 years), the annual fund of working hours F_w (1800-2000 hours) and the market value of the vehicle C_v :

$$E_a = \frac{C_v}{T_n F_w} \quad (3)$$

№	Crossroads	The number of intersections within 1 hour	Average vehicle delay (sec)	Vehicle delay within 1 hour
1	The intersection of I Karimov Avenue with the street Mustaqillik	4549	19,2	24,3
2	The intersection of I. Karimov Avenue with the street Bainalminal	4054	19,2	21,6
3	The intersection of I. Karimov Avenue with the street S. Khamrokulova	2526	19,2	8,6
4	The intersection of I. Karimov Avenue with the street Shifokor	4441	19,2	23,7
5	The intersection of st. Tukimachilik to I. Karimov Avenue	2169	19,2	7,4
6	The intersection of I. Karimov Avenue with the street. Ortikova	2027	19,2	6,9
7	The intersection of I. Karimov Avenue with the street Kaliya	2832	19,2	15,1
8	The intersection of I. Karimov Avenue with the street. Tashkent	2486	19,2	13,3
	Total	**25085**		**120,7**

TABLE 3

Additional costs for fuel and lubricants E_f per hour of vehicle operation are determined taking into account fuel consumption rates per 100 km of run R_c, average technical speed V_t and the cost of 1 liter of fuel F_l:

$$E_f = \frac{R_C V_t F_l}{100} \tag{4}$$

In order to obtain real values of E_w, E_a, E_f, statistical data on these values for 2021 was processed using the example of an Isuzu bus $C^{bus}_{(m-h)}$ is 87 thousand soums/hour.

The cost of one machine-hour of operation of passenger cars can be used from the data given in, $C^{pas}_{(m-h)}$ 38 thousand sum/hour.

The average cost of one machine-hour of vehicles operation, taking into account the composition of the vehicles, is determined by the sum:

$$C_{m-h} = C^{pas}_{m-h} n_{pas} + C^{bus}_{m-h} n_{bus} \tag{5}$$

where n_{pas}, n_{bus} are the number of cars and buses in the traffic flow, respectively.

According to this amount, it is possible to determine the cost of one car-hour of operation of vehicles to obtain a traffic flow, in which, for example, 70% of passenger cars and 30% of buses (trucks):

$$C^{70-30}_{m-h} = 0.7 * 38000 + 0.3 * 87000 = 26600 + 26100 = 52700 \quad sum$$

Calculate the economic losses of vehicles from downtime at the intersection:

$$Losses = C^{70-30}_{m-h} * t_{p-hour} = 120,7 * 52000 = 6276400 \quad sum/h$$

V RESULTS AND DISCUSSION

VI CONCLUSION

The economic efficiency of investments in measures that reduce delays at intersections is determined by comparing the cost savings that the implementation of measures provides with the costs necessary for their implementation.

The cost savings consist of:

- reducing the time spent by vehicles at intersections;
- reduction of losses associated with a reduction in the travel time of passengers and pedestrians;
- reduction of damage from road accidents;
- improving the sanitary condition of the air basin (reducing the concentration of air pollutants);
- the effect of improving the psycho-physiological working conditions of drivers.

Based on the above, it can be concluded that vehicle delays bring great economic losses. Adjustments to the durations of the resolving signals in the control cycle, as well as the number of phases in the cycle, allows you to save money by reducing the total delays of vehicles.

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