The dependence of the car’s performance on organizational factors

N I Yurieva\textsuperscript{1,2} and E E Vitvitskiy\textsuperscript{1}
\textsuperscript{1}Siberian State Automobile and Road University, 5 Mira Ave., Omsk, 644080
E-mail: \textsuperscript{2}yureva_ni@mail.ru

Abstract. Solving operational tasks in the planning of road freight transportation requires the transportation organizer to take into account the possible impact of a set of factors on the performance of vehicles: the volume of transportation, transport work performed at the specified time, transportation costs, and the cost of the transportation contract. Modern theoretical and methodological provisions in the field of operational planning of road freight transportation are the basis for the development of a more correct theoretical and practical base for the cost of road transportation. The previously established theoretical dependencies of the impact of technical and operational indicators on the effectiveness of road transport systems of cargo transportation (RTSCT) and the operation of rolling stock do not take into account the specifics of the organizational and legal forms (OLF) of Carriers. The practice of cargo functioning of road transport systems, but also on the complex of organizational factors of the functioning of Carriers.

Studies and calculations of possible results of one car on the pendulum route with a return unloaded mileage during the time spent in the duty were carried out using the example of transporting sand by car-dump truck in the city of Omsk, as part of a Carriers with different OLF with the number of cars in the composition of up to 20 units.

1. Introduction
In modern economic conditions, road transport companies provide services for the transportation of goods of a wide range in cities, the performance of which determines the relationship between customers (clients) and performers of transportation (Carriers) on the main points of the contract for transportation.

The solving of operational tasks in the planning of work of cars: traffic volume, transport work completed within the specified time, the cost of transportation and cost of transportation contract, require the consideration of the possible impact of set of factors on the possible outcomes.

D. P. Velikanov noted that ignoring or not fully taking into account factors that affect the organization of operational work can lead to unreasonable planning of resource requirements for the transport process and the inability to ensure more efficient and economical operation of rolling stock [1].

Solving operational tasks in the planning of road freight transportation in cities requires Carriers to know the modern theoretical provisions of road freight transport and the specifics of their implementation, as well as taking into account factors, both dependent and independent of their economic activities, which may affect the results of car operation.
2. Methods of the research

Doctor of Technical Sciences, Professor D. P. Velikanov in his work [1] noted a number of factors that affect the efficiency of vehicle use:

1. the perfection of its design;
2. compliance with its operating conditions;
3. transportation organization: daily duration of time on duty, number of days of work per year, the rational organization of transportation routes, mechanization of loading and unloading, duration of downtime when making or receiving delivery of the goods, the rational organization of storage, maintenance, repair, etc.

Created by Doctor of Technical Sciences, Professor Nikolin V. I. theoretical and methodological provisions are the basis for the development of a more correct theoretical and practical base for the cost of road transportation, the theoretical dependences of the influence of technical and operational indicators on the efficiency of transport systems of cargo transportation (RTSCT) of the lower level and the work of rolling stock are established [2].

The authors, in works [1-4], paid special attention to the analysis of the impact of technical and operational indicators, both on the performance of cars and on the cost of transportation, which was displayed by characteristic graphs of linear and hyperbolic dependence.

There are various research areas in the field of development of the theory of road freight transportation [1-9], based on the results of the review, the lack of problem statements and their solutions about the impact of organizational factors on the performance of cars is established.

However, the practice of freight transportation shows that the cost of transportation of goods depend not only on the operating conditions of rolling stock and of the functioning of RTSCT, but also on the complex organizational functioning factors of Carriers.

These factors include:

- capacity of the transport organization (number of rolling stock, units);
- composition of the rolling stock fleet by load capacity;
- availability of production and technical base in the property of the transportation organizer;
- mode of operation of cars per week, days;
- organizational and legal form (OLF) of the transportation organizer and others.

In modern economic conditions, there are many transport companies of various organizational and legal forms that perform cargo transportation in cities.

The all-Russian classifier [10] defines various organizational and legal forms for individuals and legal entities engaged in cargo transportation, both on a commercial basis and for the needs of their own production (Carriers), such as individual entrepreneurs (IE), limited liability companies (LLC), as well as public and non – public joint-stock companies (PJSC and NPJSC).

In accordance with the restrictions on the number of rolling stock, the maximum amount of revenue from the sale of transport services, and the total number of employees employed, article 346.43 of the Tax Code of the Russian Federation provides for the application of various tax systems: the patent tax system (PTS), the simplified tax system (STS), the unified imputed income tax (UTI), and the general tax system (GTS) [11].

Table 1 shows the practical options for the complete set of Carriers by the number of rolling stock and the applicable insurance premium rates [11-13] for various tax systems.
Table 1. Applicable tax systems and insurance premium rates for various OLF of the transportation organizer as of 01.12.2019.

| OLF of the transportation organizer | Number of rolling stock in the property, units. |
|-------------------------------------|-----------------------------------------------|
| IE, without employees using PTS     | 1 in a fixed amount for yourself                |
| IE, with number of employees up to 15 persons. using PTS | 15 not provided |
| LLC, with number of employees up to 15 persons. using PTS | 20 not provided |
| IE and LLC, with number of employees up to 50 persons. using STS | 20 |
| PJSC and NPJSC using GTS           | 20 |
| IE, with number of employees up to 15 persons. using PTS | 20.7 % from the wage fund for employees |
| LLC, with number of employees up to 15 persons. using PTS | 20.7 % from the wage fund for employees |
| PJSC and NPJSC using GTS           | 30.7 % from the wage fund for employees |

3. Results of the research
It is known that in the practice of road freight transport in cities, the justification of the Carrier’s production decisions is based on shift – daily (operational) planning, in which it is necessary to take into account the variety of parameters that determine the production situations in which goods are transported by one car with a full load on a pendulum route with a return unloaded mileage.

The practice of transportation of goods on a pendulum route with a return unloaded mileage, on which, according to the need for transportation, no more than one car is enough to work, is referred to the micro RTSCT, a model for describing the functioning of such a transport system was developed [14].

We will perform research and calculations of possible results of one car on the pendulum route with a return unloaded mileage during the time spent in the duty (8 hours) on the example of transportation of sand by car-dump truck in the city of Omsk, alternately, from the Carriers of various OLF with the number of cars in the composition of up to 20 units. Loading is carried out by a crawler excavator model VEKS-30L produced by JSC “VEKS” in Voronezh. The distance of cargo transportation is 15 km. The transportation is carried out in urban environments in the summer. Maintenance and current repairs, and storage of the car is carried out by third-party organizations. The car’s working hours are 5 days, and the driver’s payment form is piecework.

The source data is shown in figure 1 and table 2.

Figure 1. Diagram of a pendulum route with a return unloaded mileage. where ln1,2 – zero mileage, respectively, the first and second, km; lc -loaded mileage per ride, km; lx -idle mileage per ride, km; L-point of loading; P - point of unloading.

Calculation of the recommended car load capacity, t

\[ q = \frac{(nb \cdot V_{exc} \cdot C_{fb} \cdot \rho)}{Cl} \]

\[ q = \frac{(4 \cdot 1.45 \cdot 0.9 \cdot 1.6)}{1.15} = 7.27 \text{ t} \]

The closest truck to the estimated load capacity is car-dump truck KamAZ-43255-6010-69(G5) with a nominal load capacity of 7.5 tons.

Calculations of the car’s performance results were performed using software and mathematics support [17], where the calculation of the car’s output when working on a pendulum route with a return unloaded mileage was performed using the micro RTSCT model [14], and the calculation of
transportation costs was performed using the Research Institute of Automobile Transport method [16,18], adapted for the operational planning mode, using norms and standards [15], current prices and tariffs for December 2019.

Planned results of car’s production in the micro RTSCT for the company with any OLF:

- output, tons-43.62;
- output, t∙km-654.3;
- total mileage, km-181.0;
- actual operating time, hours-7.72.

Table 2. Initial data.

| Indicators                                      | Convention | Values of indicators |
|------------------------------------------------|------------|----------------------|
| Static coefficient of utilization of the carrying capacity | γ          | 1.0                  |
| Time on duty, h.                                | Tн(с)      | 8.0                  |
| The distance of transportation, km              | lc         | 15                   |
| Zero mileage when leaving the ATF, km           | ln1        | 1.0                  |
| Zero mileage when returning to the ATF, km      | ln2= lc    | 15                   |
| The utilization ratio of the mileage for a trip | β          | 0.5                  |
| Geometric bucket capacity of crawler excavator, m³ | Vexc.      | 1.45                 |
| The filling ratio of the bucket                 | Cfb        | 0.9                  |
| (STO NOSSTROI 2.33.51-2011)                     |            |                      |
| The coefficient of loosening rocks              | Cl         | 1.15                 |
| (STO NOSSTROI 2.33.51-2011)                     |            |                      |
| Average density in the natural state without impurities, t / m | ρ          | 1.6                  |
| Number of buckets                               | nb         | 4                    |
| Standard idle time for loading and unloading per 1 ton of cargo, min [15] | tnt        | 1.75                 |

Taking into account the specifics of calculating insurance premiums for various tax systems, the amount of insurance premiums and deductions for mandatory social insurance against industrial accidents and occupational diseases was calculated in accordance with the current legislation of the Russian Federation [11,12,13].

Table 3. Production and total cost of transportation depending on the organizational and legal forms of the transportation organizer.

| OLF of the transportation organizer | Indicators including: | Input cost | - insurance premium | Total cost  |
|------------------------------------|------------------------|------------|---------------------|-------------|
| IE, without employees using PTS    |                        | 9643.46    | 100.05              | 12253.28    |
| IE, with number of employees up to 15 persons. using PTS |                        | 10157.02   | 613.61              | 12766.84    |
| LLC, with number of employees up to 15 persons. using PTS |                        | 10318.62   | 777.26              | 12927.96    |
| IE and LLC, with number of employees up to 50 persons. using STS |                        | 10054.77   | 513.41              | 12664.11    |
| PJSC and NPJSC using GTS           |                        | 10302.79   | 761.43              | 12912.13    |
Results of calculations of production and total cost of sand transportation by a car KamAZ-43255-6010-69 (G5) in the micro RTSCT for each of the enterprises’ OLF are presented in table 3.

4. Discussion and conclusion
Based on the results of calculations, the following conclusions can be drawn:

1. The use of the same vehicle brand and model in the same operating conditions in micro RTSCT, from different enterprises with different OLF, is accompanied by the same results in t and t∙km, kilometers and hours.
2. The use of a vehicle of the same brand and model in the same operating conditions in the micro RTSCT, from different enterprises with different OLF, may be accompanied by different costs for cargo transportation, from 12253.28 rubles (with OLF No 1-IE, without employees using PTS) to 12927.96 rubles (with OLF No 3-LLC, with the number of employees up to 15 people using PTS).
3. If a vehicle of the same brand and model is used in the same operating conditions in micro RTSCT, from different enterprises with different OLF, the maximum difference in costs is equal to 674.68 rubles, which is 5.506% of the lowest cost of cargo transportation per shift for an individual entrepreneur with OLF No 1, without employees using PTS.

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