RESEARCH ON THE NECESSITY OF POWER VEHICLE DATA REGISTRATION DEVICES

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Abstract. Research has been carried out in the necessity of registration of different power vehicle operation parameters in autotransport and power vehicle operation enterprises. To obtain the research data an enquiry was carried out in the enterprises. Depending on the kind of operation at the enterprises the necessity of parameter registration varies. As the main parameters to be registered the companies have mentioned the necessity to record the consumption of fuel, the covered distance and the time of engine operation.

Key words: automobiles, tractors, data registering devices, consumption of fuel, coverage, data recording.

Introduction

The Institute of Power Vehicles of the Faculty of Engineering of the Latvia University of Agriculture in co-operation with the Riga Technical University In June, 2006 started to work at elaboration of a device for registration of different operation and exploitation parameters of power vehicles.

The aim of the research was to state the needs of the owners of power vehicle fleets in recording of different operation parameters. The enquiries were carried out on the spot at power vehicle operation enterprises using especially in advance prepared questionnaires on the necessity for registration of the parameters. The enquiry was carried out in October and November, 2006.

Tracing and identification of different groups of power vehicles

In order to determine in which enterprises it is necessary to carry out the enquiry identification of different groups of power vehicles for which it is necessary to install the parameter registration devices or the "black boxes" is planned. Investigating different power vehicles according to the kind of their application the following basic groups of power vehicles are identified [1, 2]:

- automobiles used in freight transportation in locally and internationally;
- road repair, exploitation and maintenance machinery;
- specialized autotransport (forwarders, refrigerators etc.);
- passenger transportation;
- special means of transport (emergency, fire fighters, police);
- service automobiles;
- tractors, excavators and agricultural self-propelling machinery.

Methodology and development of the questionnaire for the enquiry

Seven participants of the project took part in carrying out of the enquiry. A questionnaire for the enquiry was elaborated in which six open questions characterizing the enterprise, its sphere of operation, the composition of the power vehicle fleet (the models used), the age and the number, the experience of usage of the power vehicle operation parameter registration devices (the "black boxes"), the possible price as well as the cases of inadequate application of power vehicles were included.

The second part of the questionnaire is devoted to finding out the different parameters to be registered. Every parameter to be registered was assessed in the system of five scores. The most essential parameters correspond to the score 5, but less important parameters correspond to the score 0.

Each of the seven project participants was given a task to carry out the enquiry in eight to ten enterprises in which the corresponding groups of power vehicles are operated. After the enquiry the total trends of the necessity of parameter registration are summarized about every of the identified groups of power vehicles at times dividing these groups also in smaller subgroups. The enquired geographical region is mainly related to Jelgava and Riga regions, but for some groups of power vehicles it covers also other regions of Latvia.

Analysis of the importance and the necessity of registration of parameters

In order to determine the parameters registration of which is the most important for the owners of power vehicles the data of the enquiry were summarized. Two kinds of evaluation were used. Carrying

out the enquiry the respondents were asked what parameters out of the offered ones are to be registered in their opinion. The respondents could choose the parameters offered in the questionnaires as well as express their wishes that were recorded in the questionnaires of the enquiry. The frequency of mentioning the parameters can be clearly seen in Figure 1.

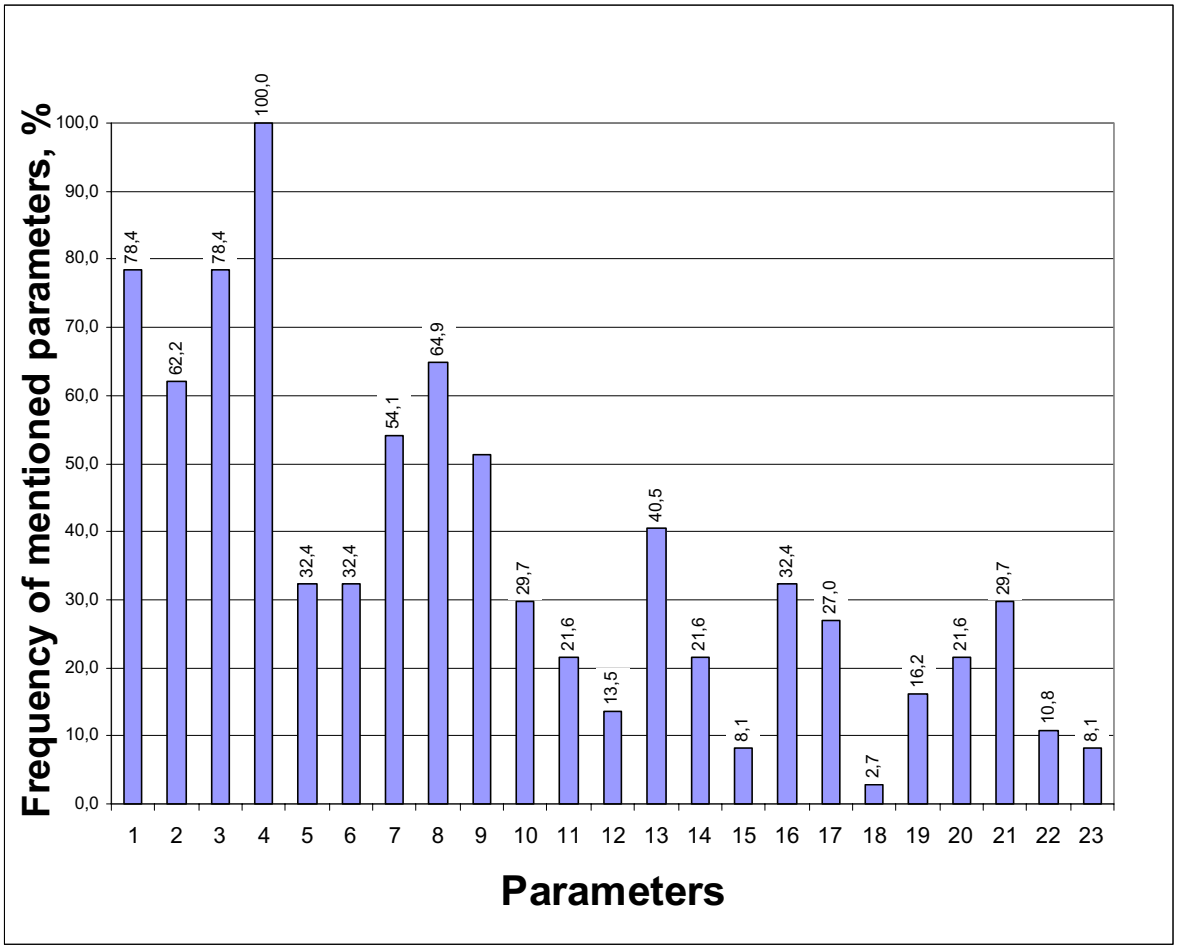

Fig. 1. **Frequency of mentioned parameters, %**

Designations: 1. Time of engine operation; 2. Driving speed; 3. Distance covered; 4. Consumption of fuel, fuel tank capacity; 5. Ambient temperature; 6. Fuel temperature; 7. Driver indicator, working hours; 8. GPS registers the place of location and the route; 9. Notification for violence of the operation requirements; 10. Load on each axle; 11. Meter of the number of passengers; 12. Operation time of the working machine; 13. Pressure in the automobile tires; 14. Temperature in the cab; 15. Temperature in the freight compartment; 16. Engine temperature; 17. Engine oil pressure; 18. Voltage of the board electro system; 19. Pressure of the pneumatic brake system; 20. Working hours idle and with load; 21. Engine load, %; 22. Ice cover on the road; 23. Cooling liquid temperature.

The diagram shows that in hundred percent all enterprises the owners wish to measure the consumption of fuel recording the level of fuel in the tank. In 78.4% of cases the respondents consider that it is necessary to register also the time of engine operation and the covered distance. 64.9% of the respondents want to use the GPS system as an auxiliary installation for the black box. 62.2% of the respondents wish to record the driving speed. 54.1% of the respondents want to record who has used the power vehicles. 51.4% of the respondents consider that it is necessary to record the violation of the operation requirements. 40.5% wish to register the pressure in the tires of the automobiles or also to install the pressure gauges. 32.2% of the respondents wish to know the engine, inside and ambient temperatures. 29.7% of the respondents wish to register the axle load and the engine load %.

The significance of every parameter has also been analyzed in the system of five scores. After calculation of the average evaluation the data are summarized in Figure 2.

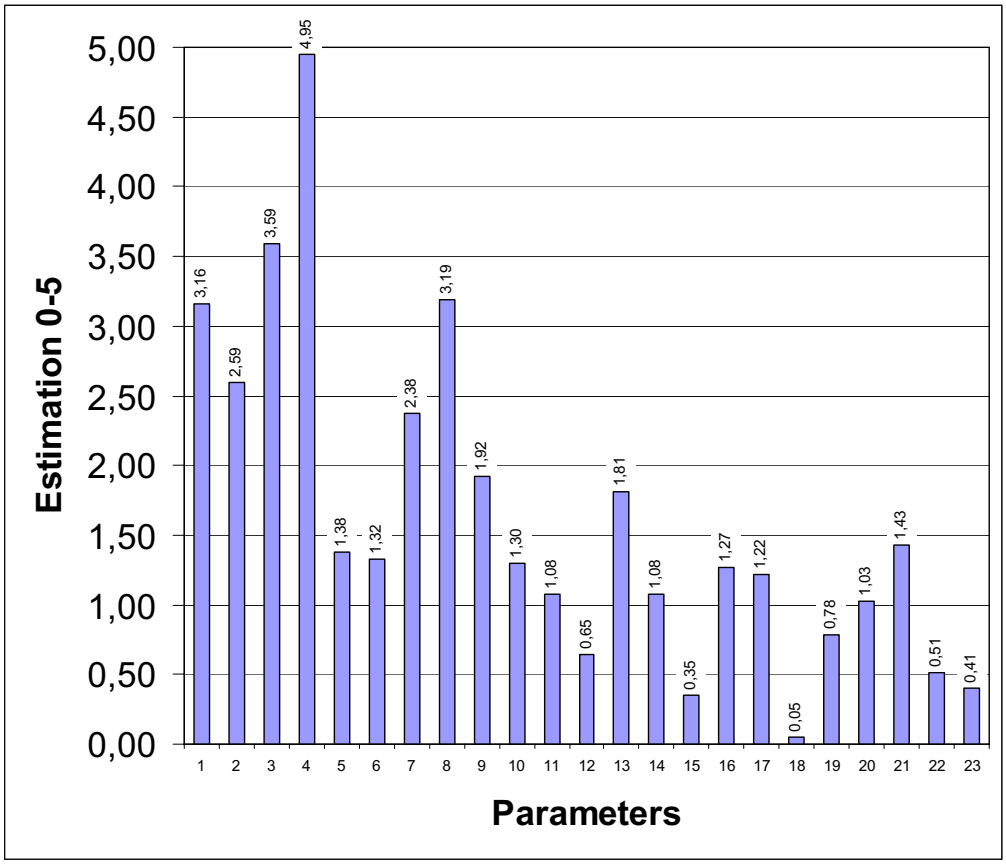

Fig. 2. **Average evaluation of the significance of the parameters**
(designations in Figure 2 are the same as in Figure 1)

The evaluation was done according to five score scale. The most important parameters get the score 5, but less important 0. The most important parameters are the consumption of fuel and the level in the fuel tank – 4.95 scores. The covered distance got 3.59 scores. The necessity for the GPS system was evaluated by 3.19 scores, but the time of engine operation – with 3.16 scores. The necessity to record the driving speed was evaluated with 2.59 scores and the indicator of the driver with 2.38 scores.

It would be useful to include all the parameters that have been evaluated with scores from 1 to 2 in the offers of the black box option. The parameters that are within the scores 2 to 5 should be included in the standard completion of the black box. In case, if any option, for instance, GPS, makes the black box essentially more expensive it should be envisaged as an additional option for the black box.

Requirements for the construction of the "black box"

Based on the carried out research and considering the demand, the requirements of the data registering system for the automobile parameter registration device or the "black box" have been elaborated. The main requirements:

- the device should be as possibly compact to be comfortably located in the cab of the driver;
- the operation temperature of the device should be ensured in the temperature range from –30 to +45 ^{o}C without refuse and reading corrections of the sensors;
- the desired location of the device – under the instrument panel so that it is not seen;
- the device must register and store in memory all operation parameters at least for ten days;
- possibility to carry out visual analysis of the stored data and to print;
- possibility to make own settings, for instance, debarking of the engine non-economic rotation zone;
- possibility to read the parameters only for definite employees;

- after disconnection of the feeding source the device should ensure storage of the data;
- possibility to connect also a wireless reading device;
- the device should be made of fireproof strong and light materials;
- the connecting wires should be made of oil and fuel proof materials as well as with sufficient heat resistance;
- the case of the device should have weak heat conductivity in order to ensure stable environment for the working elements;
- the connection of the sensors of the device should be as possibly simple without changing essentially the construction of the automobile or intruding in the standard electro system of the automobile;
- the fuel tank sensors should have as possibly high exactness, they must ensure air-tightness of the tank;
- the installation should be done based on the general regulations of electro safety and fire security;
- the device should be safe from easy damaging, for instance, connecting the wires of the fuel tank sensor or changing the polarity of the feeding voltage.

Conclusions

1. The wishes of different enterprises for continuous recording of parameters are different but enterprises of equal branches want to record similar parameters.
2. Almost in all enquired enterprises there is a necessity to register the consumption of fuel measuring the level of fuel in the tank.
3. It is advisable to make the “black box” with several completions and modules in order to be able if necessary to cover possibly larger range of the registered parameters.
4. In the basic completion of the black box only the registration of the fuel level in the tank and the time could be included.
5. It should be useful to include all parameters that according to the results of the enquiry are assessed with scores from 2 to 5 in the offers of the black box options.
6. Parameters that are in the range from scores 2 to 5 should be included in the standard completion of the black box.
7. In case if any option, for instance, GPS, makes the black box essentially more expensive, it should also be envisaged as an auxiliary option for the black box.

Literature

1. 2006. gadā reģistrētie automobiļi. http://www.csdd.lv/default.php?pageID=1098887752 – Resurss aprakstīts 2006. gada 24. oktobrī.
2. “2007 Автомобиль – ревю”, “Scan Web OY” Finland, 2006. 400 p.
3. Auto ceļvedis 2005/2006, Rīga, “Latvijas Tālrunis” – 2005. 336 lpp.