

THE ANALYSIS OF WORKING CAPACITY CHANGES IN PROFESSIONAL DRIVERS

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Summary

The causes of traffic events are predetermined by abundant factors that affect simultaneously the driver and the vehicle involved in traffic. According to the statistics, the most important is the human factor, i.e. the totality of physical and psychological characteristics predetermining successful activities of a driver. Namely the human factor is the principal potential for increasing a reliability of drivers. Improper behaviour of drivers on driving most frequently is the principal cause of traffic events. One of the ways for minimizing the number of a driver's errors is an assessment of the factors that predetermine the driver's behaviour on the road to the maximum possible extent. Emergency situations and their consequences directly depend on proper and well-timed actions of the driver.

The article presents a study on professional drivers' working capacity, defines the main criteria influencing it and provides an overview of the general impact of professional drivers' performance on road safety. A questionnaire survey method, aimed at identifying professional drivers' working capacity changes during on-duty hours, was applied in this article. It has been established how the respondents – professional drivers of the Joint Stock Company "Vilnius Public Transport" (Lith. – UAB „Vilniausviešasistransportas") – evaluate their working capacity changes according to the following indicators: direct fatigue, physiological changes during a work shift, the fatigue during the first (5-14 h.) and the second (14-23 h.) work shift, as well as the probability of alcoholic beverage consumption during off-duty (rest) hours.

Keywords: professional drivers, working capacity, road safety, questionnaire survey

1. Introduction

Creation of systematic safety management is a long-term process, which has been under development in countries with a high standard of living for a very long period of time. Nevertheless, practical road safety is essentially still the most important problem discussed by politicians and road safety experts in many countries with a high motorization level.

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The following major causes of road accidents are in particular distinguished (Ignatov 1981):

- a) Committing road traffic offences;
- b) Driving a vehicle under the influence of intoxicants;
- c) Driving a technically faulty vehicle;
- d) Infringing road traffic regulations and personal negligence of drivers.

Among other important factors is a rational design of the workplace (control instruments, seat, dashboard, etc.) and roads designed that account for human driving capabilities. Peculiarities of an automobile driver's work should be comprehensively analysed and methods for improving drivers' work efficiency, for maintaining health and good working capacity should be developed (Sundin et al. 2004).

The reliability of a driver is conditioned by the following major factors: a driver's fitness to drive a vehicle, his preparation and working capacity. A driver's fitness to drive a vehicle is currently established only during a medical examination. However, checking a person's condition, vision and hearing provides no real evidence for judgementing his abilities as a driver..

For instance, during a medical examination no data is obtained about perception, ability to orient in the dark and light, about attentiveness, operational thinking, psychomotor reaction time and emotional stability. All these limit the ability to assess professional qualities of drivers and provides no opportunity to reasonably decide on their suitability for the profession chosen. Emotional stress and high responsibility, are connected to the, the activities of a driver. He has to be ever ready to react to rapidly changing circumstances, to frequently drive a vehicle under maximum stress conditions, facing various distractors (noise, vibration etc.), which have a negative impact on working capacity. A driver with a slow reaction time may fail to timely take the necessary actions in case of an emergency and thus cause a road accident (Michael et al. 2010).

In order to properly evaluate a driver's actions, to analyse them and to make conclusions on the causes of road accidents, one has to know the driver's psychological qualities, which should be evaluated as an integral part of driving skills. Unfortunately, such an analysis is sometimes performed only for establishing whether or not the rules of the road were breached. A driver might be punished, though another road accident may occur in the future for the same reason (Rotter 2003).

Psychophysiological qualities of a driver must be analysed not upon occurrence of a road accident, but rather before an accident and preferably be performed prior to issuance of a driver's license. Therefore, driving school candidates should be selected not only according to their health condition, but also according to their psychophysiological test data (Rotter 2003).

Road accidents may be caused by both very difficult and very comfortable driving conditions. In the case of the former, the prevailing circumstances may exceed the driver's abilities. In case of the latter, very easy driving conditions either make the driver relax, which decreases his attentiveness and alertness, or influence the driver's wish to take risks in order to restore proper activity of his organism. Therefore, there is a certain probability

that upon introduction of innovations for improving traffic conditions drivers' behaviour will become even more dangerous and will result in the negation of such improvements. Solving the problems which are considered purely technical – road construction, traffic organization and design of vehicles – is impossible without taking into account the human factor (Gstalter and Fastenmeier 2010; Jevtiukov 2005).

The working capacity of a driver depends on the following factors: 1) peculiarities of the incoming information (speed of an information flow, strength of signals, their duration, spacial location of an information source, ease of perception); 2) activity conditions (uniformity of the incoming information, information overload or lack of information, characteristics of a workplace); 3) operator's personal qualities (psychophysical and personal qualities, resistance to negative external factors and distractors, the level of professional qualification, the years of experience and age); 4) operator's condition (fatigue, illness, excitement, drunkenness and the effect of drugs and medicines) (Romanov 2002; Kirsanova and Petrenko 2004).

According to many scientists, the reasons influencing a driver's reliability can be classified as follows: 1) a driver is unable to safely control a vehicle (poor psychophysical qualities, psychological disturbances, illnesses which entail prohibition of driving a motor vehicle, heavy fatigue, stress condition, etc.); 2) a driver is unwilling to safely drive a vehicle (a negative attitude towards obeying the rules of the road, a lack of the sense of justice and culture, aggressive traits of character, irresponsibility, susceptibility to drug and alcohol abuse); 3) a driver lacks knowledge on safe driving (inaccurate, incomplete or poor knowledge of the rules of the road, the automobile or traffic safety essentials); 4) a driver lacks safe driving skills (poor or incomplete acquisition of safe driving skills, loss of skills) (Romanov 2002).

A driver's experience and professionalism are highly important for road safety, which is confirmed by a large number of road accidents caused by inexperienced young drivers. The research has shown that young drivers get involved into road accidents 4 times more frequently than their experienced colleagues (Gonzales et al. 2005).

A significant number of psychophysiological examinations have been conducted in Austria in order to determine whether drivers are fit for driving vehicles. It has been revealed that 78.5% of drivers were completely fit for driving, 13.4% were temporarily unfit and 8.1% of drivers were completely unfit for driving (Ignatov 1981).

2. Driver's Working Capacity Criteria and the Research Methodology

Human working capacity does not remain at the same level throughout the work process. The difference between working capacity levels during a working day is clearly defined in Fig. 1.

The first phase is characterized by an increasing working capacity. The run-in period of

getting involved in work or getting used to the work rhythm is followed by a steady working capacity level required for a particular work. The duration of the run-in period can vary greatly, depending on the working conditions, as well as on the human condition and individual peculiarities. At this phase the speed and, in some cases, the accuracy of human actions is lower. This is exactly what explains the high rate of road accidents caused by driver mistakes, which at this phase is higher than during the subsequent 2-3 hours.

The second phase is characterized by a relatively high and consistent working capacity. During this period a maximal result is achieved with a minimal energy input. The second phase lasts for 2-2.5 hours.

During the third phase the working capacity decreases due to fatigue, which is in turn reduced by a lunch break. The more time passes from the beginning of the third phase, the higher the probability of driver mistakes.

The duration of the run-in phase after a lunch break is shorter, which is explained by getting used to the work rhythm before the lunch break. The duration of consistent working capacity decreases as well, whereas the fatigue accumulated before the break also influences the driver's condition.

When a driver gets tired, only the most basic skills which have reached the level of automatic behaviour, i.e. the skills which allow correct handling of well-known and standard situations, remain. At first, complex mental activity is disturbing, which reduces preparedness for taking actions in case of unexpected and unusual changes of situation on the road. This impairs the quality of drivers' work and leads to mistakes, which cause road accidents. Thus the most important factor for ensuring road safety is retention of drivers' working capacity.

An anonymous questionnaire survey of bus drivers (respondents) has been conducted at the JSC "Vilnius Public Transport" Bus fleet division. It was aimed at identifying professionally important factors of psychological and psychophysiological qualities, which influence drivers' working capacity (fatigue, sleepiness, etc.). The questionnaire was composed of the following blocks:

- 1) Direct fatigue study;
- 2) Study of physiological changes during a work shift period;
- 3) Study of fatigue during the first work shift (5-14 h.) and the second work shift (14-23 h.);
- 4) Study on probability of alcoholic beverages consumption during the off-duty (rest) hours.

Seeking to ensure accuracy and validity of the results, one of the questions was a control question. It was used to check whether the replies to the block questions were honest.

The questionnaire survey was based on replies of 243 respondents.

Respondents were divided into groups according to their age.

Distribution of respondents according to the age groups was as follows:

- 1) 23-40 years old - 17%;

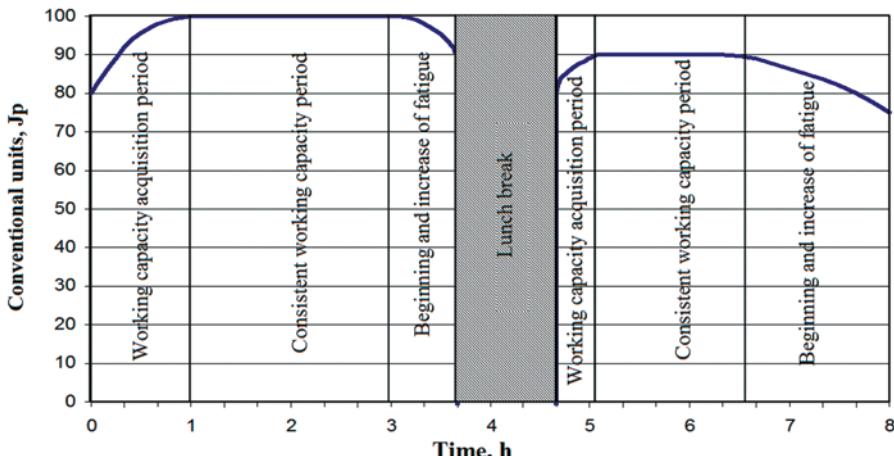


Fig. 1. Working capacity dependence on time (Romanov 2002)

- 2) 41-50 years old – 34%;
- 3) 51-60 years old – 35%;
- 4) over 61 years old – 14%.

They were randomly selected from 739 drivers, i.e. 32.8% of the division's employees were questioned.

A 100% response rate has been achieved in this survey, since the anonymous questionnaire survey was conducted at the company's premises during lectures on drivers' professional competence. Thus no calculations of response rate to the anonymous questionnaires and reliability of the survey results have been performed.

4. Overview of the Study Results

Having analysed the data of the anonymous questionnaire survey conducted at the JSC "Vilnius Public Transport" Bus fleet division, it was established that certain parameters (fatigue, sleepiness) have a significant influence on a driver's working capacity (Fig. 2).

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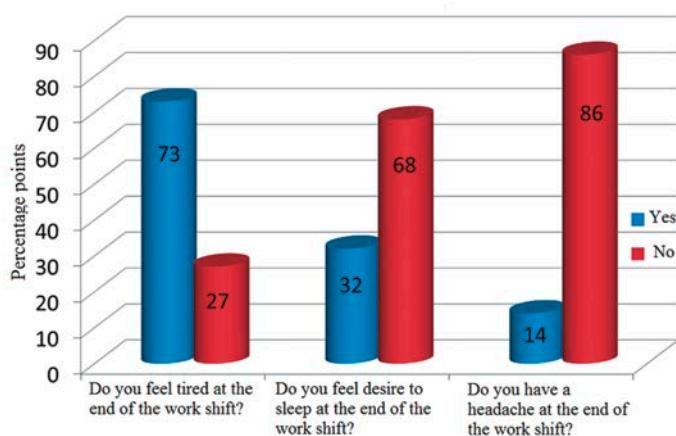


Fig. 2. Results of the questionnaire survey on direct fatigue of professional drivers

Drivers' work is distinguished by a difficulty of getting used to the work rhythm, which extends the duration of the run-in phase. This is especially noticed among bus and truck drivers, who tend to overestimate their abilities during this period, which may lead to mistakes and risky actions posing a threat to road safety (Fig. 3 and Fig. 4).

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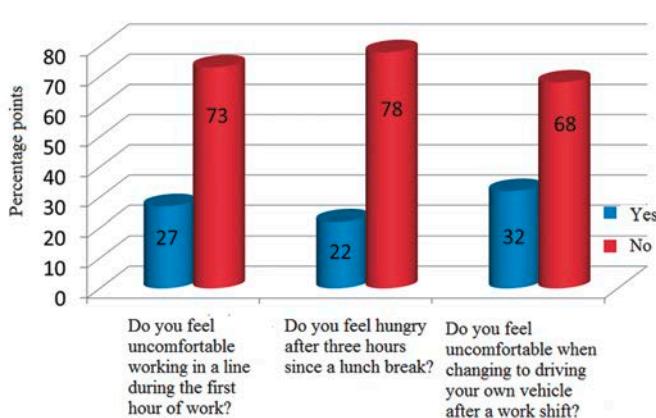


Fig. 3. Results of the questionnaire survey on physiological changes in professional drivers during a work shift period

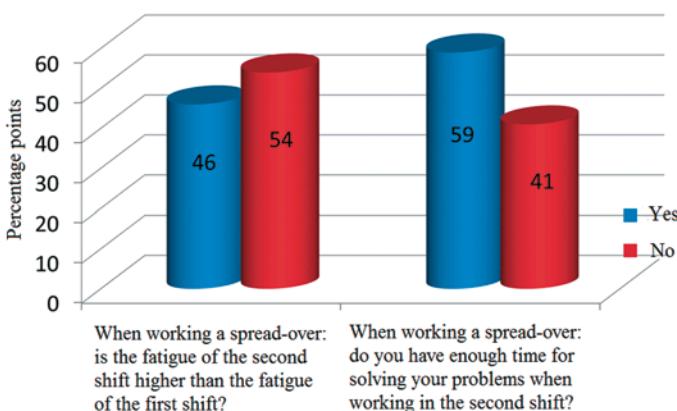


Fig. 4. Results of the questionnaire survey on professional drivers' fatigue during the first work shift (5-14 h.) and the second work shift (14-23 h.)

The survey has revealed that 46% of the respondents think that consuming insignificant amounts of alcohol could help to partially relieve the fatigue after a work shift. These results are relatively consistent with the results of the driver survey described in the scientific literature (Romanov 2002). However, even small amounts of alcohol consumed before taking a rest prevent a driver from having a proper rest, since sleep after alcohol consumption does not relieve the fatigue, accumulated during a working day. This implies that the next day the driver will have a lower capacity for work, which will in turn influence his reliability (Fig. 5).

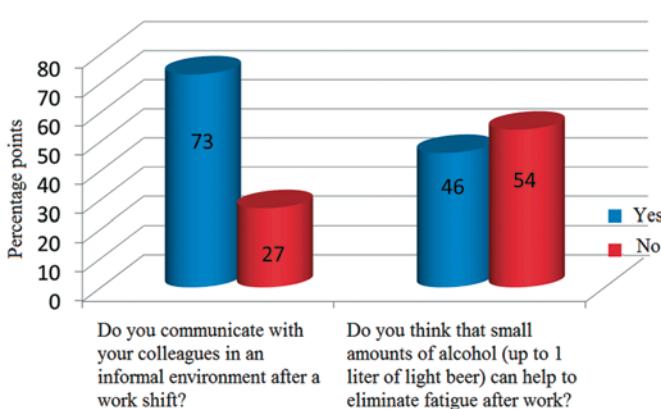


Fig. 5. Results of the questionnaire survey on the probability of alcoholic beverages consumption by professional drivers during off-duty (rest) hours

6. Conclusions

1. The majority (73%) of professional drivers feel fatigue at the end of a work shift, yet only 32% of them need a rest. They fall into a high-risk group, the working capacity of which must be controlled in order to prevent road accidents.
2. Having analysed physiological changes in professional drivers, it is noteworthy that only a small part of them are able to feel these changes. It should also be emphasized that one third of drivers feel uncomfortable during the first hour of work and this is an essential run-in stage, thus it is important to find out and to eliminate the causes of discomfort before they result in a road accident.
3. It can be claimed that a work shift has a negligible significance for working capacity of a professional driver.
4. Alcohol consumption as a means of relaxation after work is acceptable for 46% of respondents. This can influence the next-day working capacity of a professional driver. Moreover, it can be supposed that this indicator has been reduced by the respondents, since the analysis of replies to the control question shows that as many as 73% of respondents communicate with their colleagues in an informal environment after work.

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