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SUBJECTIVE FACTOR IN TRAFFIC ACCIDENTS

Tsvetoslava Peneva
tsvetoslava_peneva@abv.bg

Todor Kableshkov University of Transport
Sofia, 158 Geo Milev Str.
THE REPUBLIC OF BULGARIA

Key words: *road safety; subjective factor; road accident*

Abstract: *The majority of traffic accidents are caused by the driver's behavior and are determined by his psycho-physiological qualities and professional training. The statistical distribution of road the accidents shows that over 90% of the accidents are due to human behavior. Accident-free driving is a complex process consisting of the interaction of the main elements of the transport process, which are inextricably linked. The driver is the person who received and processes the information from the other three elements and controls the managed object - the vehicle, and the purpose of this impact is its trouble-free movement. This process is extremely dynamic and so far the only universal regulator in the process is the human brain. Therefore, the driver has to be able to meet the high requirements related to his psycho-physiological and professional qualities.*

INTRODUCTION

Many factors influence road transportation safety standards across all over the world. These factors include road safety policy, traffic flow, vehicle condition, road network characteristics, human behavior and attitudes, travel conditions, environment, etc. These issues have been studied for a number of decades and have improved our understanding of risk assessment in the context of safe movement and travel for all road users. They can be summarized in three main groups: technical, subjective and environmental. The technical factors include: the constructive and technological perfection of the technical means, the reliability of the various facilities and devices. Subjective factors are determined by the driver's violations, mistakes and actions. The impact of the environment is determined by the impact of the other (direct or indirect) participants in traffic as well as the atmospheric influences. The majority of traffic accidents are caused by the driver's behavior and are determined by his psycho-physiological qualities and professional training. The statistical distribution of road the accidents shows that over 90% of the accidents are due to human behavior.

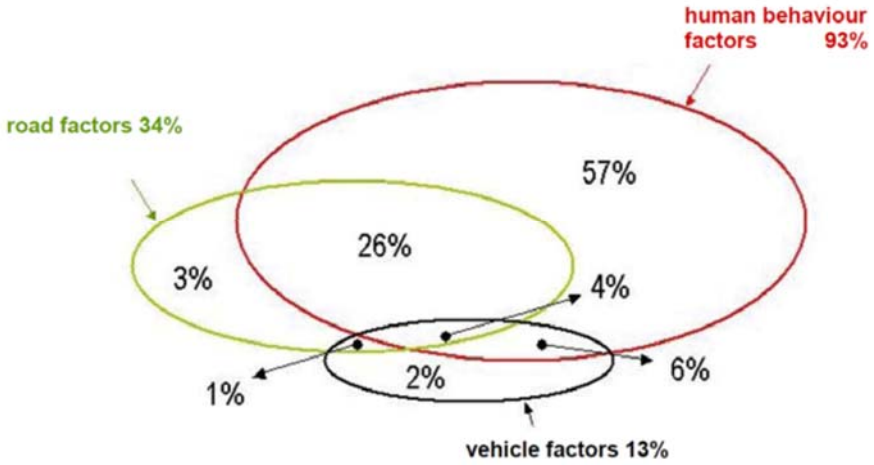
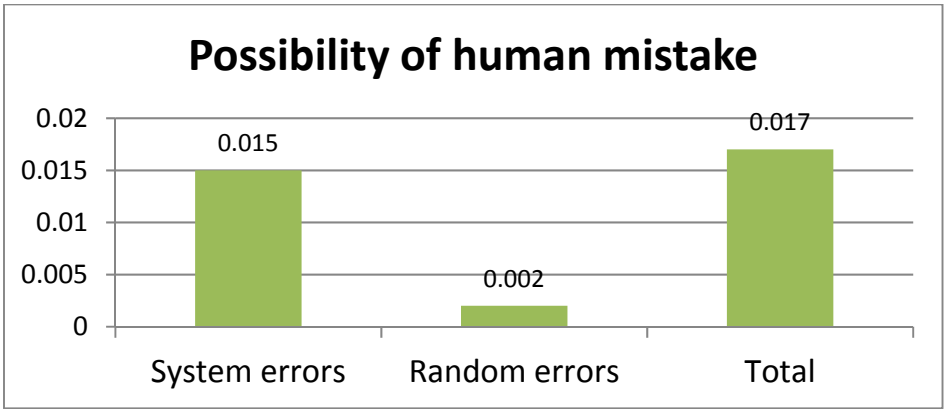


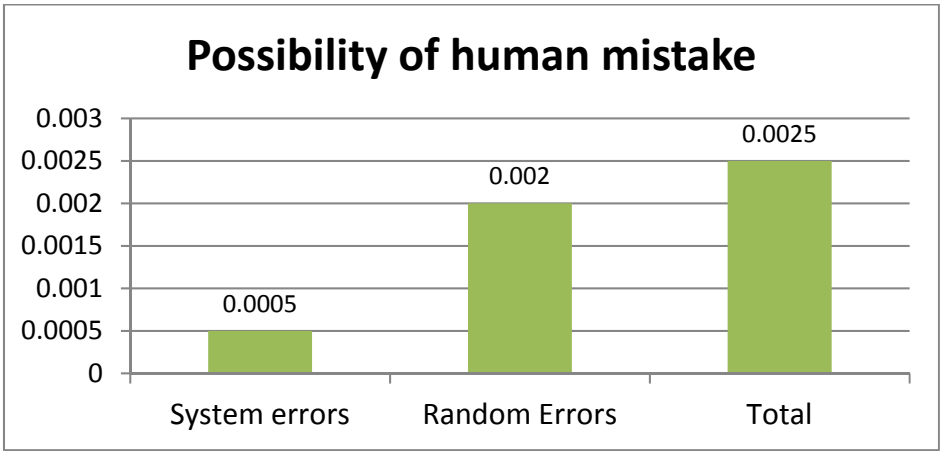
Fig. 1. Contributing factors to road accidents

RELATIONSHIOP BETWEEN THE FACTORS AFFECTING ROAD SAFETY

More and more safety systems are used in modern vehicles. According to the research in [4], as the technical condition of the system improves the probability of the occurrence of human error decreases.



Graphic 1 Errors before improving the system



Graphic 2 Errors after improving the system

Comparing the two graphs shows that the probability of error is lower when the technical condition of the system is improved but random human mistakes are not affected by

this improvement. The purpose of the two graphs is to show that it is impossible to completely eliminate the influence of the human factor, but through measures to reduce road traffic accidents and improvements in the training of candidate drivers to control motor vehicles, the number of accidental errors can be significantly reduced.

HUMAN PERFORMANCE MODELING

Let's assume that for the execution time of set functions "t" in a given man-machine system an emergency situation occurs (a prerequisite for a traffic accident). We also assume that its removal requires the execution of certain actions, the actual implementation of which requires time T_L. Let T_S denote a maximum allowable time within which the corrective actions must be performed. Then, for the successful prevention of an emergency situation (traffic accident) of the considered man-machine system, in general, it can be written:

(1) $P[(T_S - T_L \geq 0)] = P(t)$;

P(t) – probability of safe operation of the system in the event of an emergency situation (a prerequisite for a road accident).

In real conditions, during the execution time of a given operation, the occurrence of several emergency situations is possible, requiring corrective actions by the staff (vehicle driver). Thus, for the operating time "t" of a given man-machine system, the following states are possible: a period of normal operation, the occurrence of one emergency situation, the occurrence of two emergency situations, etc.

Let's assume that when an emergency situation occurs (in order to prevent it), it is necessary to perform regulated corrective actions, which must be performed sequentially (in a certain order), and for each of them a certain execution time τ_i, is required, which is exponentially distributed. The assumptions thus established make it possible to use the Markov random process to model the probability of timely implementation of corrective actions for a given time t:

(2) $P(t) = P(T \leq t)$,

$T = \sum_{i=1}^{n} \tau_i$ – time for execution of n specified actions in order to prevent an accident

In accordance with the features of the Markov random process, the sequential execution of operations in the process of controlling a given man-machine system in order to prevent an accident can be modeled by means of the equations:

(3)
$$\begin{cases} \frac{dP_0(t)}{dt} = -\lambda_0 P_0(t) \\ \frac{dP_1(t)}{dt} = -\lambda_1 P_1(t) + \lambda_0 P_0(t) \\ \frac{dP_n(t)}{dt} = -\lambda_n P_n(t) + \lambda_{n-1} P_{n-1}(t) \end{cases}$$

λ_n - intensity of the transition of the system from n to n+1
$P_n(t)$ – probability of the system being in n.

The intensity of performance of a certain situation is calculated by the formula:

(4) $\lambda_n = \frac{1}{m_{\tau_n}}$

System (3) is characterized by the following initial conditions (at t=0):

(5) $$\begin{cases} P_0(0) = 1, \\ P_n(0) = 0. \end{cases}$$

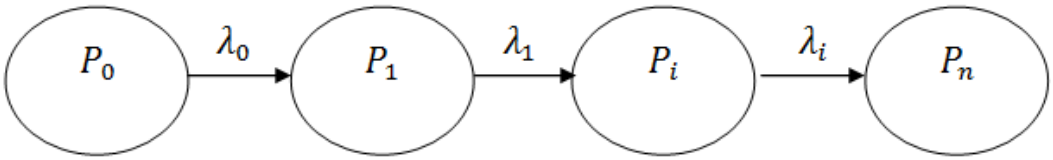


Fig. 2. Consecutive execution of n operations

CONCLUSION

Although the human factor cannot be completely eliminated, by improving the factors that affect road safety, road traffic accidents would be significantly reduced. The combination of quality driver training, good awareness of road conditions, serious penalties for offenders and maintaining a good technical condition of the vehicle would significantly reduce the number of traffic accidents.

The shown method of human performance modeling can be applied to traffic accidents in order to extract information about the most common mistakes made by drivers and the probability of their occurrence which would significantly reduce them.

REFERENCES

[1] Георгиев, Николай. Основи на теорията на надеждността. София, 2009г.
[2] Castro, Candida. Human factors of visual and cognitive performance in driving.
[3] Lin, Chen. A Stochastic Model for Highway Accident Predictions with Winter Data.
[4] Elvik, Rune. The handbook of road safety measures.
[5] Georgiev, Nikolay. Human performance assessment in the event of an emergency in a railway man-machine system.
[6] McCarthy, Tim. Risk Assessment Review.

СУБЕКТИВЕН ФАКТОР ПРИ ПТП

Цветослава Пенева
tsvetoslava_peneva@abv.bg

Висше училище по транспорт "Тодор Каблешков".
София, ул. Гео Милев 158
РЕПУБЛИКА БЪЛГАРИЯ

Ключови думи: *пътна безопасност; субективен фактор; пътен инцидент*

Резюме: *По-голямата част от пътнотранспортните произшествия са причинени от поведението на водача и се определят от неговите психофизиологични качества и професионална подготовка. Статистическото разпределение на пътните произшествия показва, че над 90% от произшествията се дължат на човешко поведение. Безаварийното шофиране е сложен процес, състоящ се от взаимодействието на основните елементи на транспортния процес, които са неразривно свързани. Водачът е лицето, което получава и обработва информацията от останалите три елемента и управлява управлявания обект – МПС, като целта на това въздействие е безпроблемното му движение. Този процес е изключително динамичен и засега единственият универсален регулатор в процеса е човешкият мозък. Поради това водачът трябва да отговаря на високите изисквания, свързани с неговите психофизиологични и професионални качества.*