ABSTRACT

of the doctoral thesis in 6D071300 - "Transport,
transport equipment and technologies" by

BALTABEKOVA ALMAGUL

DEVELOPMENT AND RESEARCH OF A SIMULATOR COMPLEX TO IMPROVE THE RELIABILITY AND SAFETY OF DRIVERS' WORK

Relevance of the thesis topic. The modern development of the transport system is accompanied by an increase in traffic intensity and the complexity of road infrastructure, which leads to increased requirements for the reliability and safety of vehicle drivers. According to statistics, a significant number of traffic accidents are caused by human factors, such as decreased attention, errors in assessing the road situation, and violations of traffic rules. This highlights the need for effective methods of training and monitoring the professional reliability of drivers.

One of the promising areas is the use of specialized training complexes that allow simulating real road conditions, recording the driver's reactions and evaluating their psychophysiological characteristics. The use of training complexes provides an opportunity for safe and objective analysis of the driver's actions, identifying risk factors and forming skills that contribute to reducing accidents.

The development and research of a training system aimed at improving the reliability and safety of drivers' work meets the current challenges of the transport industry, contributes to the improvement of the professional training system, and has significant practical importance for reducing the number of traffic accidents.

Therefore, research on the development of automobile simulators to improve the reliability and safety of vehicle drivers is relevant.

Purpose of the dissertation work. Development of a car simulator design for assessing the reliability of vehicle drivers and determining the impact of their condition on road safety indicators.

Scientific novelty of the results obtained:

– the proposal of indicators and criteria for assessing driver reliability;

– the development of a driving simulator design intended for the evaluation of driver reliability;

– the formulation of a theoretical model of driver performance within a simulator environment, enabling the determination of parameters for a comprehensive assessment of driver reliability;

– the development of a methodology for conducting experimental studies of driver reliability using a driving simulator;

– the development of practical recommendations for the acquisition and improvement of driving skills under various road conditions.

Main provisions submitted for defense:

- indicators of the reliability of a vehicle driver;

- design of a vehicle simulator for assessing the reliability of vehicle drivers;

- theoretical model of driver activity on the simulator, which allows to determine the parameters of a comprehensive assessment of its reliability;

- the results of an experimental assessment of driver performance in a car simulator and the impact of different music styles on the driver's functional state.

The practical value and implementation of the results of the work.

The results of the driver's activity research obtained using car simulators-training devices are an effective tool for improving road safety. It provides a scientifically based improvement of the driver training system, contributes to reducing accidents and increasing the reliability of transport systems.

In addition, the use of research results has a socio-economic effect. Improving driver training and reducing accidents leads to a reduction in the costs associated with road accidents, vehicle repairs, medical care, and disability.

The results and materials of the work have been implemented and are used at the ‘Kazakhstan Institute of Science and Technology’ LLP, Pavlodar, as well as in the educational process of the Toraighyrov University and the Ekibastuz Engineering and Technical Institute named after Academician K. Satpayev.

Publications and testing of work. The results of the dissertation work were published in five articles, including:

1) one article in a journal included in the Scopus database (31th percentile):

- Baltabekova A.N., Bouchner P., Abishev K.K., Kasenov A.Zh., Mukanov R.B., Suleimenov A.D., Bolatova A.B. Development of an Interactive Car Simulator // Russian Engineering Research. – 2025. – Vol. 45, No. 5, – pp. 680-684. DOI:https://doi.org/10.3103/S1068798X25700716.

2) six publications in journals from the list of publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan for the publication of the main results of scientific activity:

- Kokaev U. Sh., Abishev K.K., Baltabekova A.N. Ways to identify the factors causing road accidents // Scientific journal "Mechanics and Technologies". – 2019, – №4(66). – pp. 165-171.

- Abishev K.K., Baltabekova A.N., Kasenov A.Zh. Analysis of Methods for Recording Brain Activity Signals in the Study of a Driver's Psychophysiological State // Scientific Journal "Industrial Transport of Kazakhstan". – 2020, – No. 3(68). – pp. 173-178.

- Baltabekova A.N., Bouchner Petr, Kassenov A.Zh., Abishev K.K. Prerequisites for Creating an Interactive Simulator for Training Drivers of Motor Vehicles // Scientific Journal "University Proceedings". – 2022, – No. 2(87). – pp. 195-202. DOI: https://doi.org/10.52209/1609-1825_2022_2_195.

- Abishev K.K., Kasenov A.Zh., Baltabekova A.N. Non-invasive Measuring Devices for Studying the Psychophysiological State of Vehicle Drivers // Theoretical and Applied Scientific and Technical Journal "Mechatronics, Automation, Control". – 2022, – Vol. 23, No. 3, pp. 152-157. DOI: https://doi.org/10.17587/mau.23.152-157.

- Baltabekova A.N., Abishev K.K., Mukanov R.B., Buchner P., Gabdolla Zh.Zh. Driver Reliability in Ensuring Road Safety // Scientific Journal "Science and Technology of Kazakhstan" – No. 1 – 2025 – pp. 311-321. DOI: https://doi.org/10.48081/CIFL5767.

- Baltabekova A.N., Bouchner Petr, Abishev K.K., Kasenov A.Zh., Mukanov R.B., Suleimenov A.D., Bolatova A.B. Development of an Interactive Car Simulator // Monthly Scientific and Technical Journal "Stanki INstrument" (STIN) – No. 4 – 2025. – pp. 27-31.

3) three publications in foreign scientific journals:

- Abishev K.K., Mukanov R.B., Kasenov A.Zh., Baltabekova A.N. An issue of intelligent road transport in Kazakhstan // Acta Polytechnica CTU Proceedings, Vol. 12. – 2017. – pp. 1-4. DOI: https://doi.org/10.14311/APP.2017.12.0001.

- Buss D., Abishev K.K., Baltabekova A.N. Driver's reliability and its effect on road traffic safety // Procedia Computer Science, Issue 149. – 2019. – pp. 463-466. DOI: https://doi.org/10.1016/j.procs.2019.01.148.

- Abishev K.K., Baltabekova A.N., Kassenov A.Zh., Mukanov R.B., Assylova K.B. Ways to Identify Factors Contributing to the Occurrence of Road Traffic Accidents // Acta Polytechnica CTU Proceedings, Vol. 51. – 2024.– pp. 1-5. DOI: https://doi.org/10.14311/APP.2024.51.0001.

The main provisions and results of the work have been tested and reported at domestic and foreign scientific and practical conferences:

- Abishev K.K., Baltabekova A.N., Sarsenkyzy A. Interactive Simulator for Training Motor Vehicle Drivers // Collection of Materials of the Republican Scientific and Theoretical Conference "Seifullin Readings – 14" (April 25). – Astana: KazATU named after S. Seifullin, Vol. 1, Part 2. – 2018. – pp. 13-16.

- Abishev K.K., Baltabekova A.N. On the issue of choosing a stand scheme for studying the driver's psychophysiological state // Collection of materials of the XIV International Scientific and Practical Conference "Progressive Technologies in Transport Systems" (November 20-22). – Orenburg: OSU, 2019. – pp. 5-10.

- Abishev K.K., Baltabekova A.N. Measuring Devices for Studying the Psychophysiological State of a Vehicle Driver // Proceedings of the international scientific and practical conference "Improving the quality of education, modern innovations in science and production", Ekibastuz: KuzSTU branch in Prokopyevsk, 2020. – pp. 480-485.

Structure and scope of the dissertation. The dissertation work consists of an introduction, content, the main part of 5 sections, conclusion and appendices. The content of the work is presented on 101 pages, includes 34 figures, 10 tables, a list of used sources from 120 titles and 3 appendices.