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Review of a habilitation thesis

Author of the habilitation thesis:	**Eng. Marek Jaśkiewicz, PhD**
Title of the habilitation thesis:	**The Impact of Human and Technical Aspects on Vehicle Transport Safety**
Discipline:	**5.2.59 Transport**

At the request of the Dean of Fakulta Prevádzky a Ekonomiky Doprawy a Spojov, Žilinská Univerzita v Žilinie, Prof. Ing Anna Križanová, CSc., dated 25th November 2014, Č.j.: 1114/2014/PEDAS/Sem, I received for review the habilitation thesis by PhD Eng. Marek Jaśkiewicz entitled "The Impact of Human and Technical Aspects on Vehicle Transport Safety". I have prepared the review in accordance with §1, item 8 of Ordinance MŠ SR 6/2005 Z.z.

The habilitation thesis submitted for review has 97 pages. It consists of 4 chapters a 87-item list of references, preceded with a table of contents, a list of figures and tables, and a list of the main designations. In the first, introductory chapter, an analysis is presented of changes in the number of vehicles and accidents in Poland over the past ten and more years. Chapter two contains the author's own research concerning the response time at the moment of occurrence of a dangerous situation on the road. The third chapter analyses the systems used in cars in order to reduce injury to the upper part of the spine and the methods to minimise the effects of such injury. The thesis ends with chapter four which includes a brief summary and conclusions.

Relevance of the Subject

The financial costs of road accidents in Poland exceed USD 10 billion a year, while the continuously growing number of vehicles generates an increasing threat of accidents. The European countries are currently striving to reduce the number and effects of road accidents, reducing thereby the losses they generate. The issues of

the driver's response time in a dangerous situation and of the systems reducing injury of the upper part of the spine during an accident addressed by the author inscribe very well in the European trends in this respect. The learning of the driver's response in complex situations on the road will allow better design of the roads, means of transport and traffic organisation, which should result in improvement of safety. In turn, tests of active headrests may lead to minimising the effects of accidents.

In view of this, I affirm that the subject addressed by the author is relevant and promising, since it offers the possibility of improving road traffic safety.

Objectives of the Habilitation Thesis and their Execution

The author of the thesis achieved two goals related to road traffic safety.

The first one consisted in determining the driver's response times in selected cases of simulated road traffic situations. Three representative situations were chosen for the tests: a collision with a pedestrian, with a motor car and with a truck. The drivers participating in the tests were not imposed with the way of acting, i.e. with selecting a defensive manoeuvre. Particular attention was devoted to young drivers, who constitute the highest risk group. A population of young drivers predominated in the tests. The tests were conducted in two environments: on a car racetrack, using a real car and simulating a dangerous situation with relevant self-moving models, and in a driving simulator, AutoPW, at the Warsaw University of Technology.

The other objective was to analyse the operation of protective active headrests. In the tests, a numerical model of a driver sitting in a driver's seat with 13 freedom degrees, created in the Matlab environment, was used. The parameters of the model were identified on the basis of experimental research conducted at the Automotive Industry Institute in Warsaw. The protective function of the following headrest groups was tested through simulation of an impact from the front and from the back:

- mechanical active headrests,
- gas headrests,
- conceptual multisection active headrests.

Research Methods Used

The results presented in the thesis were obtained in the vast research conducted in field conditions, as well as with the use of a simulator and numerical studies. In the field tests on a car racetrack, appropriately designed and made self-moving models were used, simulating vehicles and a pedestrian, as well as light barriers and a test car equipped with, inter alia, a two-parameter head of the Correvit system, a steering wheel rotation converter, a radio signal transmitter, an AD16 recording and processing unit, and an eight-parameter Crossbow measurement unit to measure the speeds and accelerations connected with the movement of the vehicle.

In the scope of the numerical simulation studies, the author of the habilitation thesis used the MatLab environment.

The research methods applied in the thesis include complex measurements of different physical quantities, signal processing and numerical simulations which take advantage of the author's own algorithms and programme solutions. The research was performed in a correct manner, which allowed the achievement of the assumed objectives of the thesis.

Research Results and Their Usefulness

The results presented in the work regarding the drivers' response time have corroborated the thesis that the response times depend on the time of risk. It was shown that regardless the speed at which a test was performed, all the mean values of the response time and the standard deviation for the entire examined population of 100 drivers represent one trend.

An analysis of the protective function of active mechanical headrests moving in a direction opposite to the movement of the head, as well as of gas headrests, showed that during a head-on collision the headrests do not provide sufficient protection for the head, especially when positioned too low. The relative speed of the head's impact against such a headrest is too high. Such headrests provide the appropriate protection only in the case of a rear-end collision. During a head-on collision gas headrests offer a potentially better protection in relation to the mechanical ones, however, a good correlation between the triggering moment and the person's silhouette type is necessary for the correct operation of the gas headrest.

Another issue analysed in the habilitation thesis is the author's conception of a multisection gas headrest, which the author conceived as an ideal headrest designed to protect the head and the spine in the case of head-on and rear-end collisions. It was proved that for a correct operation of such a headrest it is necessary to correlate it with the silhouette of the sitting person and with the value of the person's horizontal dislocation. It is not possible to determine the mean times appropriate for all silhouettes. This conception is purely theoretical, however feasible in the today's technical conditions.

The presented research results are a significant contribution to the scientific development in the scope of human and technical aspects of vehicle transport safety. They may be useful for experts who deal with the reconstruction of road accidents and designers who construct safety systems in cars.

Questions to the Author

1. Please present the correlation of times of the "brake", "gas" and "turn" for the car racetrack and for the simulator.

2. Please describe how the driver's response time changes depending on the driver's age and experience.
3. Please present the operation of the proposed multisection gas headrest in the case of a rear-end and head-on collision.

Conclusions

The habilitation thesis by Eng. Marek Jaśkiewicz, PhD, entitled "The Impact of Human and Technical Aspects on Vehicle Transport Safety", which was submitted for review, meets all the requirements for granting the title of "docent" in accordance with §1, item 8 of Ordinance MŠ SR 6/2005 Z.z. concerning the procedures of obtaining academic degrees of "docent" and "professor" or titles in arts and pedagogy. Eng. Marek Jaśkiewicz, PhD, prepared his thesis at a very high scientific level and showed his extensive knowledge in the field of scientific research into the behaviour of drivers in accident situations, and the protective function of active headrests, thereby contributing to the scientific development in discipline 5.2.59 Transport.

Based on the review I propose that the Academic Council of Fakulta Prevádzky a Ekonomiky Doprawy a Spojov, Žilinská Univerzita v Žilinie, grants the Eng. Marek Jaśkiewicz, PhD, the title of

docent in discipline 5.2.59 Transport

Katowice, 19 January 2015

Prof. Bogusław Łazarz