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META–ANALYSIS AS A TOOL TO EVALUATE THE EFFECTIVENESS OF SAFETY MEASURES IN ROAD TRAFFIC[1]

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Abstract

Highly developed countries, ambitiously and seriously engage in quality management system for road traffic safety. Their vision is to reduce the number of deaths and injuries in traffic accidents, using a wide range of effective measures to increase road safety. The concept of well-developed traffic and transport system lies in the analysis and application of appropriate tools and methods and scientific research that help reduce or eliminate the shortcomings of the transportation system.

Statistical tool Meta-analysis, which applies to evaluating the effectiveness of safety measures in road traffic, is a method that practitioners and researchers in highly developed countries regularly use. The methodology is the statistical analysis of the results of the surveys and it is growing rapidly as an independent scientific discipline.

The aim of the paper is to indicate the need for applying the method of Meta-analysis in the field of road traffic safety, based on international practices and experiences, as well as its application so far in the Republic of Macedonia. This approach will allow the inclusion of professionals and researchers to contribute to the improvement of effective measures affecting safety in road traffic.

[1] Original scientific paper

Keywords -road safety; Meta–analysis; traffic accidents

INTRODUCTION

Road safety systemis a subject to constant technical and technological changes that seeks permanent management and maintenance. In order to control the road safety system, many countries worldwide use different methods to improve road safety. Institutes, agencies and universities for road safety conduct research, analyse and invest in reducing deaths and serious injuries in traffic accidents.

To evaluate the effectiveness of road safety measures, researchers and practitioners use the methodology of Meta-analysis by researching studies, reports and projects.The methodology helps investigate the effective measures used in road safety. Meta - analysis is a statistical method that is used to answer a specific question or test the hypothesis. It is an invaluable research tool, which is growing rapidly as an independent scientific discipline.

The purpose of Meta-analysis is to submit balanced and impartial report on existing research that would enable effective decision-making, based on all relevant studies of adequate quality. This approach provides a quantitative assessment of the statistical advantages, summarized in all included studies. A meta-analysis provides a rational way of dealing with numerous practical difficulties, all those who are trying to get positive effects of the research.

This paper will help researchers and practitioners in the Republic of Macedonia, whose main interest of research is road safety, to start applying such method in order to evaluate the effectiveness of road safety measures.

AN INTRODUCTION TO META – ANALYSIS

The method of Meta - analysis first appeared in the 12th century in China, when the famous philosopher Chu Hsi (1130-1200) built his philosophical theory by summarizing a series of related literature. This research was called "Theory of systematic rules."[2] While in the western countries, the roots of Meta - analysis originate from the 17th century. The researchers studied in the field of astronomy. The British statistician Karl Pearson[3] used the approach of Meta – analysis in his studies. He studied the effects of the vaccination against typhus, and in 1904,he published the first paper in the British medical journal.

However, the first Meta-analysis of all conceptually identical experiments conducted by independent researcherswas published in the book

[2] http://ir.lib.ntnu.edu.tw/retrieve/52215/

[3] www.british.medical.journal

"Extrasensory perception after sixty years". The authors of the book were J.G. Pratt and J.B. Rhine[4] and their collaborators who did the research in the field of psychology. The application of sophisticated analytical methods using Meta-analysis began in 1970 with research in education. The effects of using different methods in education were studied by the researchers Gene V. Glass, Frank L. Schmidt and John E. Hunter.[5]

The approach of Meta-analysis is widely used in medicine, psychology, epidemiology, sport, education and road safety. Meta – analyses techniques in road safety are used to evaluate the effects on road safety measures such as effects on mass media campaigns against drink and driving, texting on mobiles while driving, wearing seat-belts; measures for traffic calming, roundabouts; speed and road accidents etc.

META ANALYTICAL STUDIES ON ROAD SAFETY

Many studies have been concluded using the method of Meta – analysis in the field of road safety. The authors Rune Elvik, Peter Christensen, and Astrid Amundsen have investigated the effects of changes in speed on the number of road accidents. They have analysed 98 studies and the results show that there is a strong statistical relationship between speed and road safety, respectively when the mean speed of traffic is reduced, the number of accidents will usually go down and vice versa.

The following authors F. Bunn, T. Collier, C. Frost, K. Ker, I. Roberts, and R. Wentz have used Meta – analysis and researched 16 studies on traffic calming for the prevention of road traffic injuries in high-income countries. The results were that area-wide traffic calming in towns and cities have the potential to reduce traffic injures. Rune Elvik from the Institute of Transport Economics in Norway conducted a Meta – analyses of 37 studies evaluating the safety effects on public lighting as accident countermeasure. The outcome showed that fatal accident in night-time were reduced for 65 percent, severe injuries were reduced 30 percent and there was 15 percent reduction in night-time property-damage. The team from the British organization „Transportation research laboratory" have evaluated the effects of road safety at traffic signals and signalized crossings, searched literature mainly from UK, Australia, New Zealand and USA, and identified 145 studies. The results showed that signalization reduces accidents by 15% at 3-arm junction, and 30% at 4-arm junction.

[4]www.extrasensory/perception/after/sixty/years
[5]www.Gene V. Glass, Frank L. Schmidt, John E. Hunter

THE EFFECTS OF LEAD AGENCIES FOR ROAD SAFETY – META - ANALYSIS

The authors of this paper have used the method Meta – analysis to evaluate the effects of appointedleadagencies for road safety on road safety. The aim of the evaluation was to indicate the need to establish a lead agency for road safety in the R. Macedonia and propose a model of the lead agency.

35 studies of papers and reports were included for further investigation and data collecting. The research was based on Internet and hand search literature published from 2000 – 2014. Web pages of some lead national agencies, universities and institutes for road safety were also included in Meta – analysis. 27 countries and their lead agencies for road safety were included. The following countries were subject to research: Serbia, Slovenia, R. Srpska, Italy, Spain, Greece, Germany, France, Holland, Finland, Poland, Russia, Sweden, UK, Ireland, USA, Argentina, Australia, New Zealand, China, Malaysia, India, Indonesia, Ghana, South Africa, Zambia, and Cameroon and the number of fatal accidents per 100.000 population for these countries.

The studies were selected upon few criteria, respectively the studies had to answer the following questions: What rathermodel the lead agency for road safety has? What are the working elements of lead agency for road safety? Does the appointed lead agency for road safety successfully manages traffic and transportation system and to what extent?

After thorough research of the studies the following working elements of lead agencies for road safety, which represent the safety measures, were defined: model and role of the lead agency; financing, national strategy, action plan, political support, horizontal and vertical coordination, cooperation, knowledge and experience transfer, marketing and promotion, research and development, monitoring and evaluation, interventions, identifyingrisk groupsofroad users, preventive measures, certification, licensing and trainings, education and conference organization, collection andprocessingof accidents data; identifying dangerous road spots and road safety system management.

Collected data was processed by using SPSSstatisticalsoftware program.

The results for the processed data are presented in the following graphs. The first graph shows the normal plot of the regression standardized residual that is expected cumulative probability and observed cumulative probability of the dependent and independent variables used in SPSS program. Dependent variables present the fatal traffic accidents, and independent variable present the working elements of the lead agency for road safety for the selected countries.

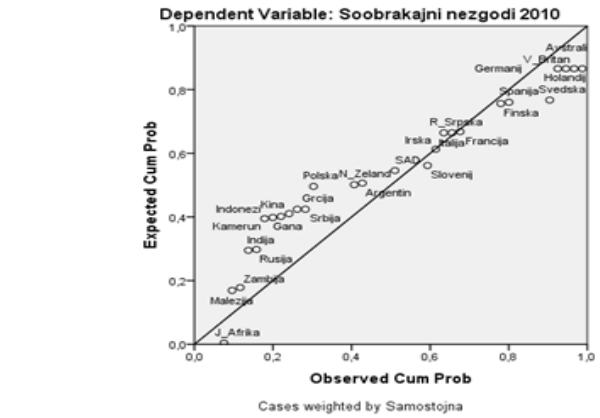

Fig.1. Normal P – P Plot of Regression Standardized Residual

The second graph the Scatterplot represents theregressionstandardised residual and regression standardized predicted value for the dependent and independent variables.

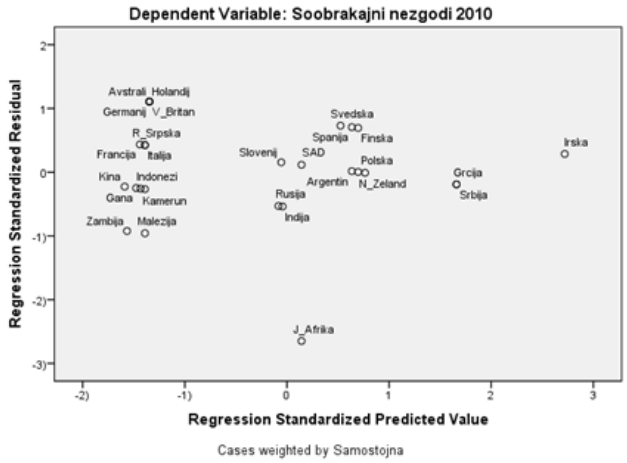

Fig.2. Scatterplot

The results showed that 60% of the lead agency for road safety working elements, have effects on road safety, respectively decrease the number of fatal accidents, 30% have light effects and 10% have no effects on decreasing the fatalities on road accidents.

DISCUSSION

The results of our research shows that the method Meta – analysis is widely used by researchers and practitioners in almost every field of study such as medicine, psychology, sport, education, and especially inroad safety, the field of our interest. Highly developed countries like UK, Germany, Norway, Australia, Canada and others, use the methodology to evaluate the effects on safety measures used in road safety, where they conduct research and surveys. The methodology helps future development and management of road safety system, as well as modelling the system according to its needs. The countries that have seen the need of using the trending methods for road safety have increased the road safety, which is decreasing the number of fatality and injuries in road accidents.

Unfortunately, a growing trend in road accidents in the Republic of Macedonia is reported on daily basis. The country's situationimposes the needto act appropriately for increasing roadsafety. Therefore,it is necessary toapplyadequateexperiencesand practicesfrom the world countries andstartidentifying and using the appropriate methodologies to coordinate, control and manage the road system.

International experiences and practices in using Meta – analysis in road safety was our main aim, and practitioners and researchers in the Republic of Macedonia should start using the methodology in order to evaluate the safety measures on road safety.

CONCLUSION

Meta – analysis is a statistical technique designed to summarize the research findings, evaluate and clarifies the results of the research findings. The method requires the identification of primary studies, coding the information from them and testing the model using Meta regression analysis.It offers systematic and quantitative approachto synthesizing evidence in order to answer important questions.

This paper indicates the importance and the need of using the method Meta – analysis in road safety. The methodologyof the studycan serveas a good basisfor further researchin the field of road safety. Synchronizedactionsand cooperation with relevantinstitutions, organizations, the business sector, government and non-governmentalorganizationsdealing withissuesof road safety, can contribute to increasing the road safety.

International experiences and practices have many successes in implementing the methodology and should not be ignored by the researchers and practitioners in the Republic of Macedonia.

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