JOURNAL OF ENGINEERING annals OF FACULTY OF ENGINEERING HUNEDOARA

MAPPING OF RISKS ON THE MAIN ROAD NETWORK OF SERBIA

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Abstract:
Evaluation of traffic safety is very complex work. During this process it is necessary to define parameters which will represent on the best way risk in traffic.
In the paper are presented methodology of work and most important results from study "ROAD ASSESSMENT PROGRAM ON THE MAIN ROAD IN SERBIA". Investigation is taken for period of five year (2002.-2006.) with special consideration on analyze of traffic safety on the main road. We pay attention on the great significance of road assessment on traffic safety management in Serbia how we advance level of traffic safety and find out micro location with increase risk in traffic on the main road in Serbia.

Key Words:
Traffic Accident, Road, Road Assessment, Risk

1. INTRODUCTION

The road network takes a very high position in the hierarchy of significance of impact on traffic safety. Therefore, it is the obligation of the state (as the road manager) to monitor and manage traffic safety of road network through its own mechanisms (organisation, human and technical resources, methodology of work, finances etc.) within its responsibilities. "Risk mapping" is a suitable technique for identification, control, and management of risks on roads.

Risk mapping has been carried out based on the collected, systematised, and analysed quality data on traffic accidents and their consequences along road directions would make a quality basis for all further managing activities aimed at improvement of traffic safety.

It should be pointed out that such risk mapping is carried out for the first time in Serbia and that the best risk mapping practice in the world has been observed (in particular risk mapping in Europe – EuroMAP, risk mapping in Australia - AusMAP, risk mapping in America – usRAP)[2].

1.1. The research subject and objective

The subject of the research is the spatial analysis of traffic accidents on the main roads in the territory of municipalities in the Republic of Serbia based on the number of traffic accidents, casualties, and traffic load (AADT – average annual daily traffic).

The main objective of the paper is to calculate the collective and individual risk that was the basis for graphic presentation per sections on the 1st rank public roads based on the data on roads, traffic, accidents and their consequences, all aimed at simulating local communities, municipal administrations to do everything that is in their power, as decision makers in the territories they manage, and contribute to reduction of casualties in traffic accidents.

1.2. Research period and territory

The research encompasses the period of five years, i.e. the period from the year 2002 to 2006. The territory includes the first rank public roads in the territory of the Republic of Serbia. The research included 34 main roads in the total length of 4,912.5 km. Those road directions were divided into 558 micro-sections that are homogenous in the sense of road characteristics and traffic.

1.3. Limitations in the paper

The limitations refer to comprehensiveness because the research did not include the territory of Kosovo and Metohija. In addition to that, the Analysis is based on available data from the UIS (unified information system) of the Ministry of Internal Affairs (MIA) of the Republic of Serbia, namely, on other public databases so that the quality and access to data determine largely the quality of the research results.

2. METHOD OF WORK

The following methods were used in the research of mapping of risks in traffic on the first rank public roads in Serbia:

- Method of analysis (research based on explanation of the problem through dividing of complex thoughts onto simpler integral parts)
- Synthesis (reversed procedure in comparison to analysis);
- Classification method (finding of sets with similar properties);
- Method of comparison (comparison of the same or similar facts, phenomena or processes, namely finding of their similarities in behaviour and differences);
- Statistical method (finding of structures and rules of occurrence within certain intervals based on indicators).

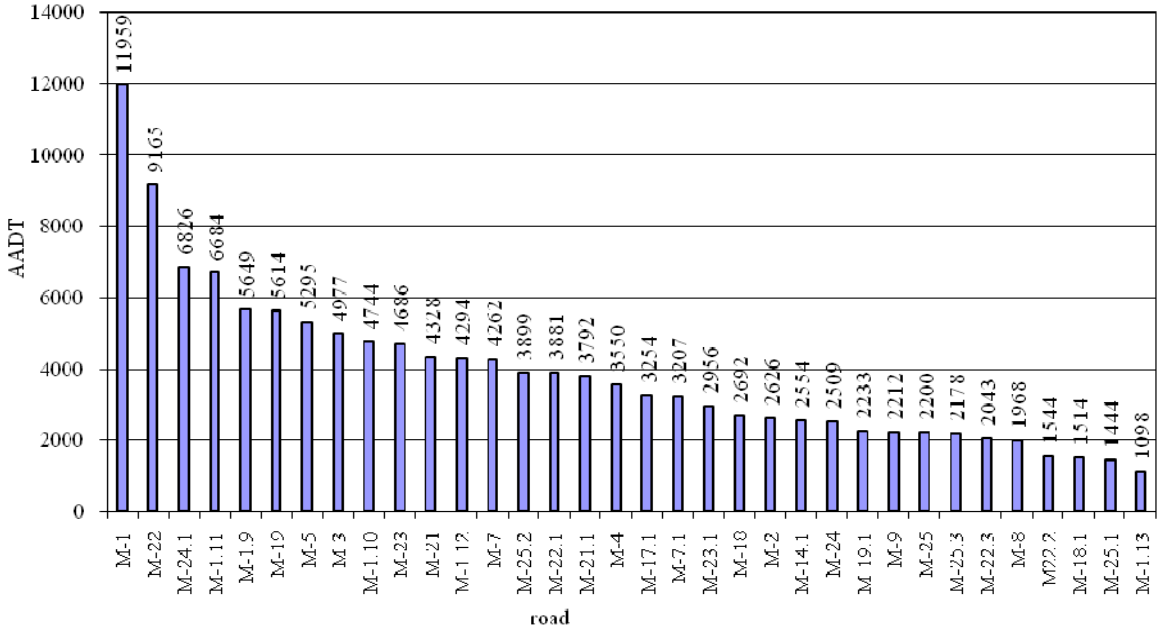
3. THE OUTLINE OF THE MOST SIGNIFICANT RESEARCH RESULTS

3.1. Structure of the first rank public roads in the territory of Serbia

Republic of Serbia is one of the European countries with a medium population density and well developed network of the first rank public roads (hereinafter we will use the term “main roads”). Geographical position of Serbia is favourable. A larger number of international roads pass through Serbia, which increases additionally the traffic scope and affects the traffic safety characteristics.

The research encompassed 34 main road directions in the total length of 4,912.5 km. Those road directions were divided into 558 micro-sections – traffic sections that are not homogenous in the sense of road and traffic properties.

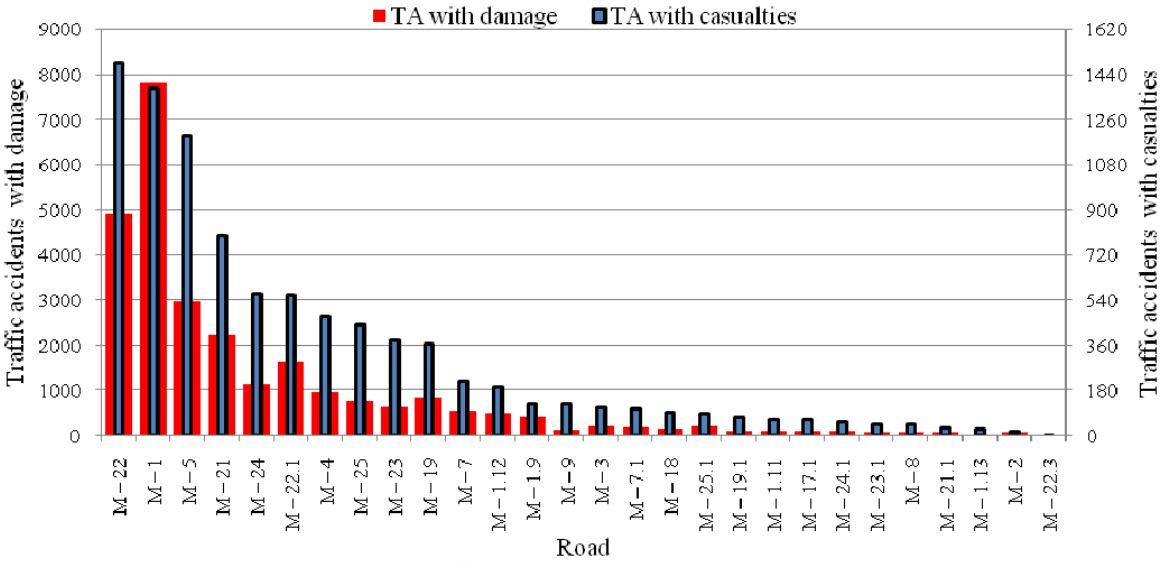
The length of roads differs significantly. The longest road is the M-1 road (a branch of the Corridor X through Serbia) with the total length of 494.5 km (10.1%). It is followed by M-22 road that is 487.9 km (9.9%) long and M-24 that is 475.7 km (9.7%) long. The shortest road is the M-14.1 road (2.2 km) (Graph 1).



Graph 1. Main roads distributed according to their length (Serbia, 2008)

3.2. Analysis of traffic accidents per main roads in Serbia

According to the number of traffic accidents on the main roads in Serbia, we can single out three road directions: M-1 where 9,205 (25.4%) of accidents happened during the analysed period, M-22 with 6,411 (17.7%) and M-5 with 4,176 (11.5%). Almost **55%** of all traffic accidents that happened on the main roads in Serbia happened on the above-mentioned three roads (Graph 2). There were 3,034 (8.4%) traffic accidents on M-21 road.

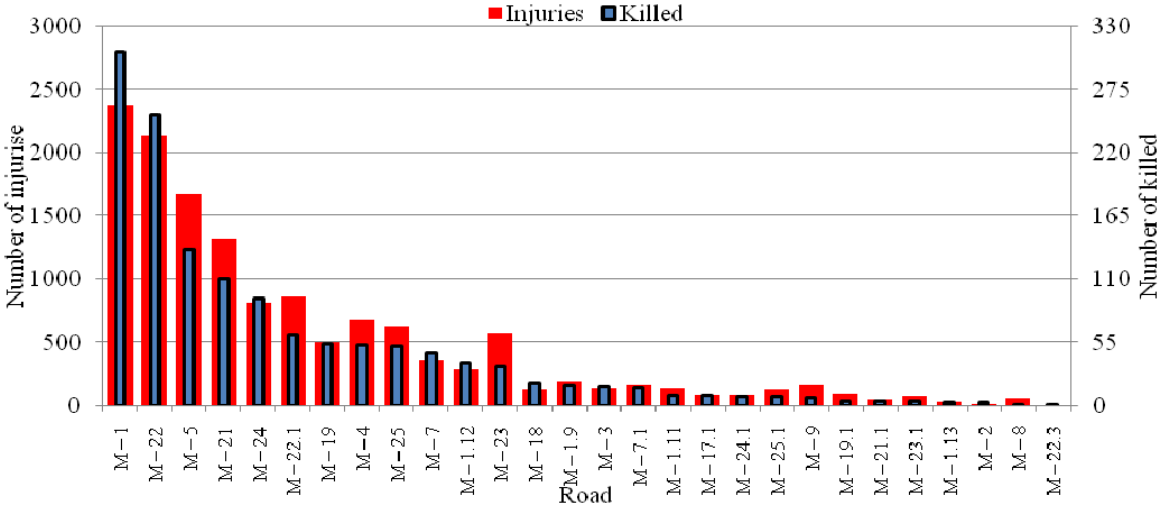


Graph 2. The number of registered traffic accidents with material damage and casualties, per main roads, Serbia, the period from 2002 to 2006

3.3. Consequences of traffic accidents

The above-mentioned three main roads in Serbia can also be singled out according to the number of casualties: M-1 with 2,690 (17.7%) casualties within the analysed period, M-22 with 2,383 (15.7%) and M-5 with 1,806 (11.9%) of casualties, along with the road M-21 with 1,432 (9.4%) of casualties (Graph 3). On those four roads, there was 54.8% of the total number of casualties on the main roads in Serbia.

The distribution of the number of casualties of all categories (killed, seriously and less seriously injured) is similar to the distribution of number of accidents with casualties per roads. The number of people who were killed in accidents and number of those who were injured is particularly high on the M-1 road (308 killed, namely 22.5% and 2,382 injured, or 17.3%), M-22 (253 killed, namely 18.5% and 2,130 injured, or 15.4%) and M-5 (136 killed, namely 9.9% and 1,670 injured, or 12.1%) in comparison to all other roads (Graph 3).



Graph 3. Number of injured and people who were killed per main roads, Serbia, the period from 2002 to 2006

3.4. Spatial distribution of risks per roads and traffic safety evaluation

Traffic safety evaluation is an exceptionally complex procedure. During that process, it is necessary to define parameters, which will represent the level of threats in traffic in the proper way and define their quantitative values that are meritory for comparison of results of the set parameters.

The following, generally accepted indices in experts circles were used in the process of identification of dangerous sections:

- **Individual Risk of the Killed and Seriously Injured**

Setting of the relationship between the number of the killed and seriously injured people in traffic accidents and the number of vehicle kilometres establishes the value of the Individual Risk of the Killed and Seriously Injured.

- **Collective Risk of killed and seriously injuried**

Collective risk represents relation number of killed and serious injuries in traffic accident and section length. This parameter is representative for ranking micro location according risk in traffic.

After defining of evaluation parameters, it was necessary to commence with their calculation. Based on the data on traffic accidents and their consequences (UIS MIA), each traffic accident and its consequences were "lowered" onto the appropriate road, onto the road section and onto one-kilometre section (kilometre of a road). Individual risks of occurrence of traffic accidents and risks of casualties were calculated for all road and one-kilometre sections of the main roads network.

In such a way, the lowest and highest risk values and risk scope were defined, based on which the following risk classes were adopted:

- Risk scope for Individual Risk is 8 (Table 1), number of the killed and seriously injured on 100 mil. vehic.-km,
- Risk scope for Collective risk of killed and serious injuries is 15 (Table 2)

The risk maps per roads for each micro-section were prepared for all the parameters.

Table 1. Number of the killed and seriously injured on 100 mil. vehic.-km,

Ordinal No (mark of traffic safety)	Level of risk (description)	Individual Risk Killed and Seriously Injured for section	
		class (interval)	rang (color)
1	low risk	up to 8	
2	low-medium risk	[8 – 16)	
3	medium risk	[16 – 24)	
4	high-medium risk	[24 – 32)	
5	high risk	over 32	

Table 2. Collective Risk of killed and serious injuries

Ordinal No (mark of traffic safety)	Level of risk (description)	Collective Risk Killed and Seriously Injured for section	
		class (interval)	rang (color)
1	low risk	up to 15	
2	low-medium risk	[15 – 30)	
3	medium risk	[30 – 45)	
4	high-medium risk	[45 – 60)	
5	high risk	over 60	

The risk map shows 30 of the most threatened sections on the main roads network of the Republic of Serbia according to the values of those two evaluation parameters.

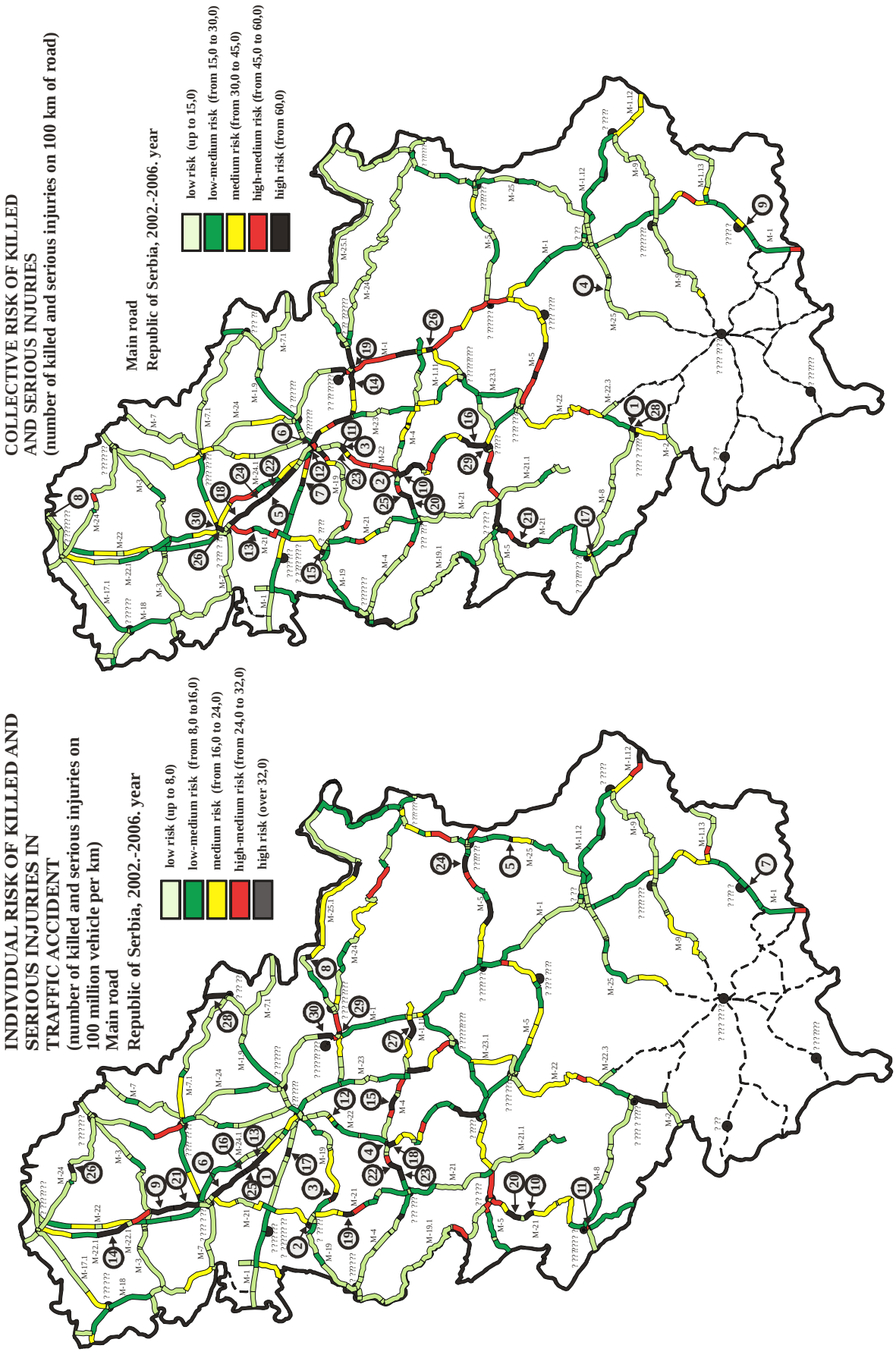


Figure 1. Individual and collective risk, main roads, Serbia, 2002-2006

4. FINAL CONSIDERATIONS WITH GENERAL PROPOSAL OF MEASURES

The basis of each activity of traffic safety increasing, namely preventing of traffic accidents and their consequences has to rely on precisely diagnosticised status and clearly defined conditions within which those phenomena occur. The detailed analysis and permanent monitoring of distribution (spatial, temporal) of traffic accidents, namely casualties, enables more efficient planning and implementation of measures and activities aimed at their prevention because the results of such analyses point us when and where we should undertake certain measures.

Risk mapping is one of the most significant techniques in realisation of the above-mentioned process. The efficiency of such approach has been recognised in many countries, which achieve the best results in prevention of traffic accidents and their consequences. Risk maps enable simple identification of the safest and most dangerous road sections within a region or a country while the comparison of maps from several countries enables the comparison of safety of the same ranked roads between them.

In the conditions that are currently valid in our country, it is necessary to prepare the data records on traffic accidents in a better quality way so that the accuracy and reliability of data would be at a high level.

At an annual level, it is necessary to carry out the analyses of spatial distribution of risks on the national road network and risk maps should be the output result of such analyses. Such an approach enables defining of priorities in work in the forthcoming period but it also creates the conditions for evaluation of efficiency of everything that has been done within the previous period in the field of improvement of traffic safety on certain roads.

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