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Selection of a relevant indicator – Road casualty risk based on final outcomes

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ABSTRACT

There are no dilemmas among the academics and experts whether it is important and necessary to analyze the road casualty risk. The road casualty risk analysis is a very efficient way of filtering the most dangerous sections, roads or specific territories. In previous analyses of road safety in Serbia, a value and type of a specific risk according to the size of the observed area (state, region, district, municipality), section length or the importance of a road category, were not explicitly determined. Differences in values of the analyzed parameters could be expressed to such an extent that the acquired values of differences, among some of the units that are being observed, represent range divided into risk bands. These differences are primarily the result of the severity of injuries and types of accidents used for calculating individual risk categories. In this paper, a model for selection of an "acceptable" risk in selected municipalities in Serbia is presented. Here presented model will be used for future researches and final assessments of the state of road safety, i.e. for the reliable risk mapping of the Serbian municipalities. The practical contribution of the risk analysis is in defining a reliable way of choosing acceptable final outcomes – rates for a defined unit of observation.

1. Introduction

According to the data on the number and consequences of road accidents, population, registered motor vehicles, road network length, AADT value (Average Annual Daily Traffic) or kilometrage, the values of so-called "public", "traffic", "collective" and "dynamic" risks can be calculated. These are the most prominent relative indicators or final outcomes – rates of road safety in the scientific area of Road safety. They are most often used for risk mapping and also as the most important elements for describing the level of road safety on the particular territories, roads or road sections.

Researches in which road safety levels and also safety risks among countries have been compared (Koornstra et al., 2002; Wegman et al., 2005 and Wegman et al., 2008), used several final outcomes, as well as several safety performance indicators (SPIs). Namely, the following final outcomes have been used:

- Distribution of fatalities per road transport mode (passenger cars, commercial vehicles, motorcycles, bicycles, pedestrians, etc).
- Fatalities per road user's age groups.
- Fatalities per different road categories (highways, main urban streets, rural roads, etc.).

Wegman and Oppe (2010) state that comparing road safety among countries is often conducted by using indicators – rates that take into account the number of fatalities, i.e. fatalities per population, and these indicators represent the so called public risk. Also Wegman and Oppe (2010) are of opinion that defining a risk which is based on the public risk has a disadvantage, as the degree of motorization has not been taken into account, and suggest that indicator obtained by fatalities and vehicle kilometers should be often used as the indicator that gives better results of road safety levels and risk assessments. This indicator is the so called "dynamic traffic risk" and it takes into account the mobility of the population. However, most countries do not register data about traveled kilometers. Therefore, indicator that is taking into account fatalities and the number of registered vehicles is used instead, and indicator is so called "traffic risk".

Hermans et al. (2009) state that it is necessary to analyze available data in order to make a review of road safety. For the purposes of ranking and comparing road safety among countries, data relating to accidents and consequences (fatalities, serious injuries and slight injuries) per population could be used.

In road safety comparison of two countries (China and USA), Zhang et al. (2010) used the "traffic risk" (the number of fatalities relative to the number of motorized vehicles and relative to the number of passenger cars), "public risk" (number of fatalities relative to the population) and the relation of the number of fatalities to the gross national product (hereinafter referred to as GNP). Also for the purposes of defining and comparing road safety levels between

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countries, Zhang et al. (2010) have also determined and compared the trends of certain analyzed indicators.

In his doctoral dissertation, Al-Haji (2007) has thoroughly analyzed the exposure (degree of motorization), "traffic" and "public" risk (rates of final outcomes such as number of fatalities divided by the number of vehicles or divided by the number of citizens), as well as trends in the degree of motorization, traffic and public risks and the ability of assessing the state of road safety.

Applying absolute figures of fatalities or other road safety outcomes and dividing them by a chosen exposure is the simplest and most commonly used method for comparing road safety performance of countries (Ekler, 2010). Exler produced risk maps for Belgian municipalities based on Bayes relative risks. Focus is on the final outcomes – fatalities per traffic and fatalities per traffic trend.

The Road Assessment Programme RAP (EuroRAP, usRAP and AusRAP) produces risk maps based on accident rates that combined effects of behavior, road and vehicle. RAP protocol focuses on fatal and serious accidents. RAP models are generally used in national targets and those that can have life-changing consequences. Consideration of fatal accidents alone would severely restrict the average accident frequency per site and make results more variable (Hill, 2010). RAP models are concretely intended for risk mapping of roads and road sections as observation units.

Nam and Song (2008) used Bayesian spatial modeling to estimate and map accident risk. This model analyses output indicators (the number of fatalities, serious injuries and slight injuries) and final outcomes -rates. The Model is based on account for spatial dependence in modeling and corresponding statistical inference. The model is using a Global spatial autocorrelation. This is a global measurement of spatial autocorrelation over the entire observations over an area of interest, used for testing spatial autocorrelation to detect departures from spatial randomness. Global spatial autocorrelation is a measure of the overall clustering of the data. One of the statistics used to evaluate global spatial autocorrelation is Moran's I (Anselin, 2005).

The reviews of the latest researches gave rise to the need for detailed analyses of each and every indicator that is included in a comprehensive road safety assessment. It also became necessary to include more and more indicators, according to the qualitative road safety assessment. In almost all recent researches, final outcomes have been used for the road safety assessment at the researched territory. Final outcomes of the road safety in Serbia are most often represented by a road casualty risk where the calculated risks are classified in five standardized classes that are labeled with marks ranging from 1 to 5. The lowest mark (1) is associated with the highest levels of risk and reflects the most unfavorable value of the observed indicator, while the highest mark (5) indicates the lowest risk and the most favorable value of the same indicator. The classification of the levels of road casualty risks has been made according to the *EuroRAP* model.

It is very important to select the indicator for the risk mapping in the observed area (municipalities) because of the significant number of various sorts of defined risks (public risk, traffic risk, etc.). In order to assess the road safety in the observed area, in the best

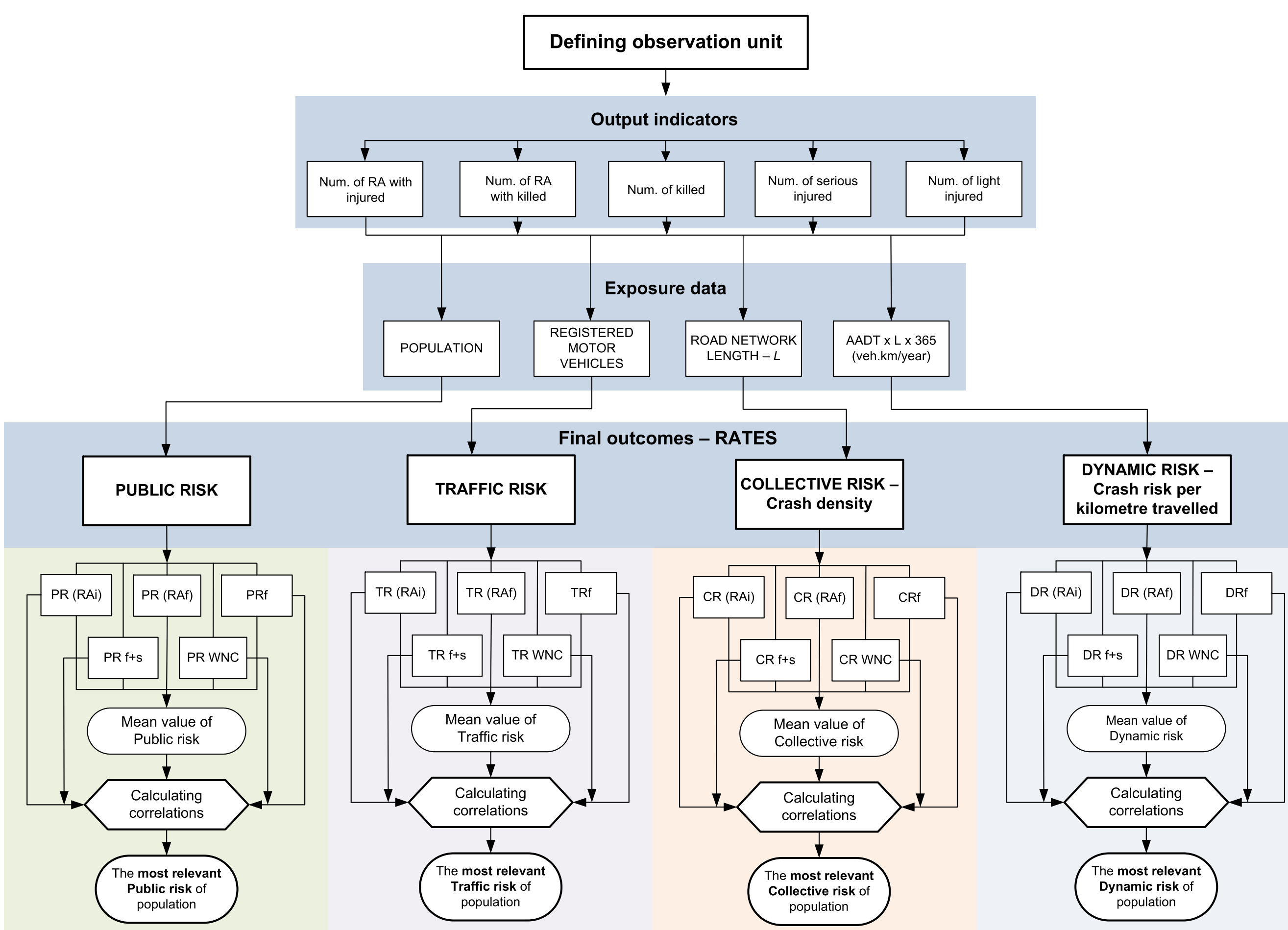

Diagram 1. A model for selection of a relevant indicator – road casualty risk.