"SEG" INDICATOR: AN INNOVATIVE TOOL FOR A SCENARIO-BASED ANALYSIS ON CRASH INJURY RISK PREDICTION AND SUSTAINABLE MOBILITY

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EXTENDED ABSTRACT

Road crashes are still the biggest cause of death and disability for young people, in both the world and Europe. Every year, more than 1.2 million people die on the world´s roads [1]. Road traffic accidents in the European Union (EU) claim 34,000 deaths and more than 1.1 million people injured per year, representing estimated costs of 140 billion Euros [2]. In 2010, in the EU, 14,463 car occupants were killed in road crashes [3]. Road accidents and the resulting public health impacts are a critical issue in Portugal where mortality rates from vehicle crashes exceed the European Community average. The latest road safety indicators from the Portuguese National Authority for Road Safety (ANSR) show that during the year 2011, there have been a total of 32,541 crashes with injuries and fatalities on the Portuguese mainland roads. From these crashes, there were 689 fatalities and 2436 serious injuries [4]. In addition, during the last two decades, the number of registered vehicles has increased exponentially worldwide leading to a significant increase in road emissions, as well as the fuel used by the transportation sector. Since motor vehicle become a common means for transportation, not only traffic injuries are a major concern, but also reduction of greenhouse gases emissions (GHGs) and fuel consumption become a main issues for health, environmental and transportation authorities. Reductions in traffic fatalities and injuries, as well as transport-generated emissions are currently problems of global interest and represent two very important factors in setting national transportation policy.

In previous safety studies, most attention focused on vehicle body type, rather than vehicle specific technical characteristics [5-7]. From literature, there is a lack of research to analyze vehicle technical data effect on road crash risk, expressed by injuries and fatalities risk to all occupants within the vehicles involved in the crash. In addition, the concept of optimization is related to the quest of one or more acceptable solutions which corresponds to extreme values of one or more objectives. The optimization methods assume great importance on practical problem's solutions mainly in the engineering field. In spite of being extensively used in

transportation analysis, multi-objective optimization for safety and emission assessment is not yet explored intensively.

Thus, the main purpose of this research is to develop an innovative tool for an integrated scenario based analysis of: **S**afety, **E**fficiency and Environmental (**G**reen) vehicle' performances, more specifically named "SEG", using data mining techniques. The specific objectives are to:

- Develop an advanced crash severity injury prediction model as a function of the vehicle fundamental characteristics to secondary safety;

- Estimate vehicles' emissions and fuel consumption based on vehicles individual attributes;

- Develop an integrated scenario based methodology to establish rankings on vehicle characteristics for road safety, fuel consumption and pollutant emissions.

Figure 1 summarizes the research steps.

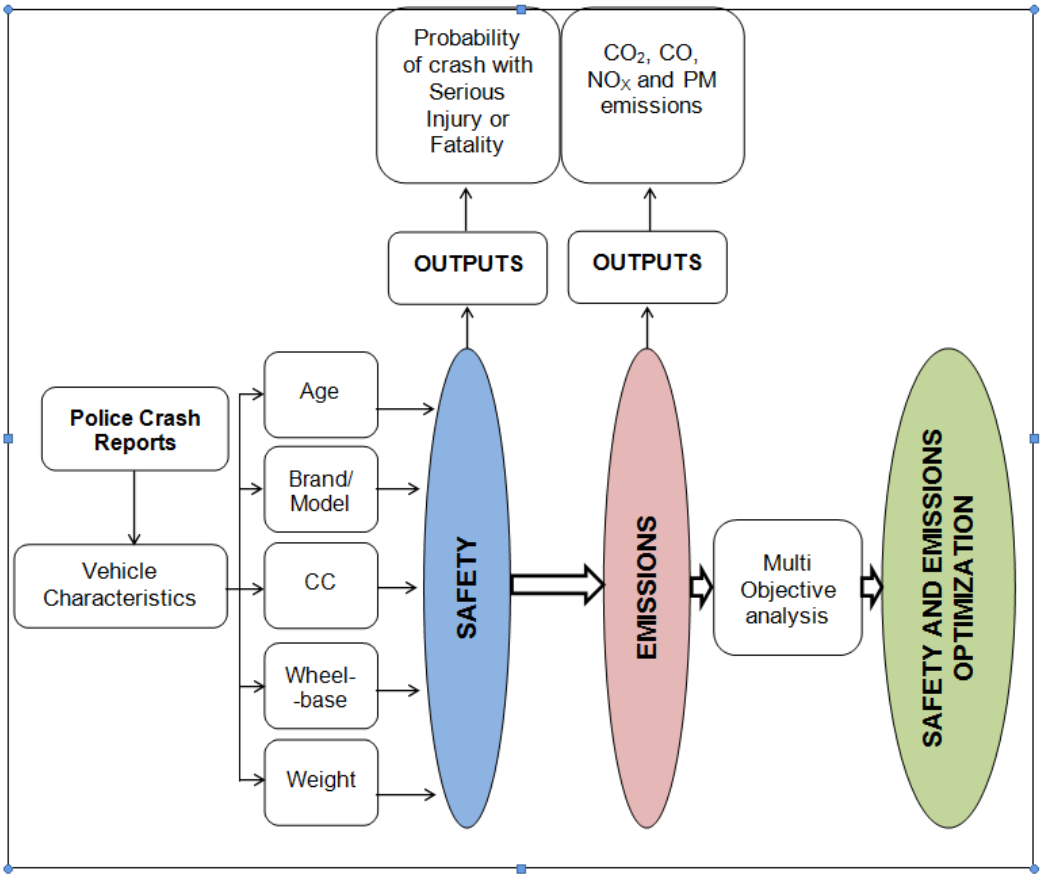

Figure 1 - Methodology overview towards an integrated scenario-based analysis of energy, environmental and safety vehicle performance.

Data were collected from the Portuguese Road Safety Police National Republican Guard (GNR) and the Portuguese Public Safety Police (PSP). Recorded crash reports involving property damage only were excluded. Crash reports that involved injuries and/or fatalities outcomes were exclusively selected. A total of 2270 reports were extracted, as indicated in Table 1.

Data Source	Crash report recorded by police force, by year					
	2006	2007	2008	2009	2010	Total
GNR Porto, PT	298	548	508	161	184	1699
GNR Porto, PT	-	65	65	-	-	130
GNR Porto, PT	-	166	275	-	-	441
Total data	298	779	848	161	184	2270

Table 1 - Relevant crash frequencies in the study made.

Police crash reports allow the contention between vehicle specific technical characteristics and occupants injuries risk. This analysis estimates the effects of the vehicle characteristics: make and model, age, engine size, mileage, length, weight, wheelbase and vehicle model year, and the crash severity based on the number of injuries and fatalities amongst all the occupants of the vehicles involved in a crash. Particular attention was dedicated to car-to-car collisions to analyze not only vehicle crashworthiness but also the risk to the occupants of the opponent vehicle. The strategy was to develop advanced injury severity prediction model and include them into an integrated scenario based analysis of vehicle characteristics effects on occupant's protection. During the data mining analysis with SAS and Enterprise Miner, several types of models were attempted, and the target and the outcome percentage of each model were evaluated. It must be emphasized that this research focused exclusively on post-crash consequences rather than on pre-crash contributing factors to the event.

This research further explored the vehicle characteristics from the real crash population in terms of environmental performance. The final step was to assess the vehicle characteristics which optimize both safety, fuel use and emissions levels. The estimation of vehicle's fuel consumption emissions was based on CORINAIR methodology [8]. This methodology focuses towards the European emission standards which are related to the acceptable limits for exhaust emissions of new vehicles sold in EU member states. Emissions standards for passenger cars and light commercial vehicles are coded as Euro Stage: pre Euro, Euro1 to Euro 5, based on the year that the vehicle model starts to be sold in the market. For the SEG indicator, CO was chosen as the most relevant pollutant for gasoline vehicles, and NOx and PM for diesel vehicles. CO_2 serves as the fuel consumption indicator, both for gasoline and diesel vehicles.

In summary, this research is attended to develop an advanced injury severity predictive model with valuable interest for the insurance companies and support the decision making process for accident analysis and prevention. It will also provide important information for automotive industry for advanced safety and environmental performance.

ACKNOWLEDGMENTS

This work was partially funded by FEDER Funds through the Operational Program "Factores de Competitividade – COMPETE" and by National Funds through FCT – Fundação para a Ciência e Tecnologia within the project PTDC/SEN-TRA/113499/2009, and by the Strategic Project PEst-C/EME/UI0481/2011. G. A. Torrão also acknowledges the support of FCT for the Scholarship SFRH/BD/4135/2007. The collaboration between Drs. Coelho and Rouphail was under the auspices of the Luso-American Transportation Impacts Study Group (LATIS-G). Any opinions, findings, conclusions or recommendations expressed in this document are those of the author(s) and do not necessarily reflect the views of FCT or LATIS-G.

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