Study of Vehicle Fleet Safety in Spain Based on Euro NCAP Results

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Abstract: The reduction of road deaths in Spain over the last few years is a reflection of the hard work invested by the administrations related to road safety and other entities related to this topic. Although an improvement has been achieved, a lot of work is still left to be done. In order to be able to apply measures that are more effective, obtaining reliable data and analysing it, is the key to greater improvement. Accident, medical, infrastructure or vehicle data need to be gathered in an exhaustive way in order to be able to know all the variables present in an accident.

For that reason, the DGT (Spanish Directorate-General for Traffic) and IDIADA have been working together with the aim of obtaining more data related to the vehicles registered in Spain and their safety. In order to do so, the DGT has gathered all the information about the vehicles registered in Spain. The data has been processed with a protocol developed for this project. An algorithm has been created to process all the information according to the type-approval number and the generation type of the vehicle. Furthermore, all the Euro NCAP data from its foundation until 2013 has been uploaded to the system manually according to the vehicle generation type.

The database has a sample of 6,757,317 vehicles, of which 99.87% have been normalized according to vehicle brand.

Keywords: Euro NCAP, Star Rating, Road Safety, Accidentology, Analysis

1 Introduction

The protection of car occupants in passive safety has been improved over the last years. In order to implement safety measures, and objectively evaluate them and their efficiency a programme has been developed, Euro NCAP. This programme assesses the most sold vehicles in the European market by a set of crash tests in a way that is easily understood by consumers.

With the aim of carrying out broader road safety studies and relating them with the Spanish vehicle fleet, the Euro NCAP star rating has been included as a variable in the Spanish vehicles registration database of the DGT (Spanish Directorate-General for Traffic). One of the outputs of this new database is that it is possible to correlate the Euro NCAP's star rating with injuries of real accidents as established in the "Plan de Investigación en Seguridad Vial y movilidad 2013-2016 de la DGT" [1]. Studies that correlate the Euro NCAP rating with accident injuries have been done before in Europe SARAC II [2], a study of the Advancement of Automotive Medicine [3] and the United States carried out by NHTSA [4]. This kind of project allows that the assessment obtained from the real accident analysis results to offer a more realistic vision of vehicle safety and the possibility of monitoring vehicle design improvements over the years [5]. Having a methodology that assesses each vehicle registered with safety level and at the same time knowing the potential risk of injury is very important for future investigations in road safety and for consumers' knowledge.

The project reported in this paper will make it possible to have a more homogeneous vehicle registration database with a new classification variable corresponding with the Euro NCAP rating. It will make it easier to study, develop and implement effective measures against accidents on Spanish roads.

2 Methodology

The creation of the database had the aim of unifying the vehicle registration data from DGT database with high quality criteria and optimizing vehicle classification. Moreover, the introduction of a new variable, the Euro NCAP rating, makes the database more valuable and a powerful tool in road safety investigation. To achieve both objectives, various steps were carried out: the original vehicle registration database was processes, then it was matched with a vehicle make, model and type list from IDIADA's database and finally it was matched with the Euro NCAP ratings.

First of all the DGT database was filtered with the aim of knowing which vehicles could be classified by the Euro NCAP rating. The methodology was as follows:

The vehicles introduced in the database were the ones registered until end 2013, the obtained sample was 30,672,620 vehicles.

1. As the Euro NCAP protocol mostly applies to cars, the vehicles that were not cars such as mopeds, motorcycles, vans, trucks, buses and other more private vehicles were excluded from the database. The total database was reduced and the obtained sample was 22,058,535 cars.

2. The first Euro NCAP tests were carried out in 1997, due to this fact the vehicles registered before that date were deleted from the database obtaining a final sample of 18,133,231cars.

3. Finally, the study only included the cars registered from 2009, obtaining a final database with a sample of 4,684,440 cars.

The following figure represents the unification and assignation process that was carried out during the second stage of the methodology.
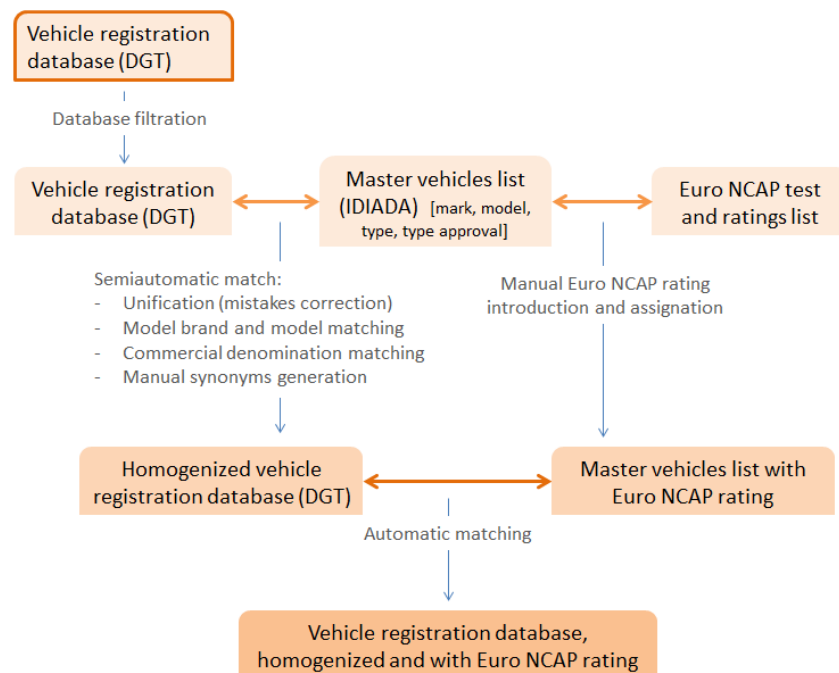

Figure 1: Methodology schema

2.1 Unification of the database

Once the sample of the database was reduced (4,684,440 cars), a search of pattern of errors and name duplications was carried out. A random sample of 200 vehicles from the total database was taken in order to find a pattern of errors.

This pattern was applied to the original database but many vehicles were not corrected as the error was not identified in the original sample. For this reason, a matching procedure of the vehicles brand and model was applied to the database in order to homogenize and correct such errors from the original data.

2.2 Make and model matching

This part of the procedure consisted of matching the database unified from DGT (4,684,440 cars) and the IDIADA's internal database (master vehicles list). The matching process included the following parameters: mark, model, type and type approval. The matching was carried out as follows:

Type-approval number: using this parameter 83% of the database was corrected

Vehicle type: using this parameter 14% of the database was corrected

Commercial name: 1.8% of the database was corrected by this parameter.

1,2% of the database could not be homogenized. In order to solve this, wrong database parameters, such as the type-approval numbers or the vehicle type, were corrected manually as a result 97% of the database was normalized.

The 3% that was not corrected was due to some vehicles in the database that were not linked to those parameters, because of that a procedure of normalization was developed for the commercial name and its synonyms.

2.3 Commercial name matching

Once the make and model matching was done, in order to normalize the vehicles that had the same commercial name algorithms were created in order to correct errors at the denomination of the commercial names that were not corrected in the previous phase.

The algorithm corrected the names by synonym association; the names were corrected by automatic itineration of the error detected. For example, the vehicles named ("Ibiza", "Ibiza TDI", Ibiza 1.4") were included at the main commercial name of "Seat Ibiza". The tolerance applied was of 4-5 more characters at the commercial name of the vehicle.

Since not all names could be normalized in the previous step because of spelling mistakes, automatic correcting algorithms were created for each typical mistake detected. Moreover, other vehicle name errors were corrected manually.

2.4 Euro NCAP ranking introduction and assignation

A parallel process was carried out at the same time. It consisted of introducing for each vehicle its Euro NCAP rating obtained in the official tests. The list of Euro NCAP's rating was manually assigned to IDIADA's list in order to have all vehicles correlated with one Euro NCAP test and rating.

2.5 Euro NCAP and vehicle registration database matching

Finally, the Spanish vehicle fleet database from the DGT, which was already normalized and homogenized, was matched with IDIADA's list, that had been already matched with the Euro NCAP ratings. A software application developed specially for this project, matched both. The matching of both lists achieved the aim to know the corresponding Euro NCAP rating for each Spanish vehicle of the fleet. The matching was by vehicle type and registration date.

2.6 Database maintenance

New vehicles have been registered from beginning 2014 until end of 2015 and the database has been updated. This new registered vehicles have also been matched with Euro NCAP rating list, which have also been updated with new performed tests. A total of 2,058,076 vehicle registrations were added. This update was carried out following the same method.

3 Results

With this project, the national Spanish vehicle registration database has been homogenized and the Euro NCAP ratings have been linked to it. The current total number of vehicles in the database is 6,742,516.

3.1 Normalization of vehicle registration database

Following the process defined above, 78% of vehicles in the database could be matched with the Master vehicles list using the homologation code (type approval), 19% could be normalized using the vehicle type, 1.4% were normalized with the commercial name and only 1.1% could not be normalized.
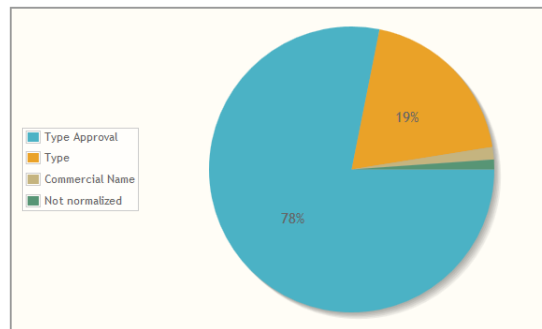

Figure 2: Normalization of vehicle registration database

Regarding the commercial names homogenization, 99.87% of all vehicles makes and 98.89% of vehicle models could be normalized.

3.2 Euro NCAP rating assignation

Regarding the Euro NCAP rating association, 84% of the vehicle registration database could be assigned to a Euro NCAP rating using the homologation number (type approval), achieving an exact match. The other 16% of the vehicles have only been approached to Euro NCAP rating using the first registration date.
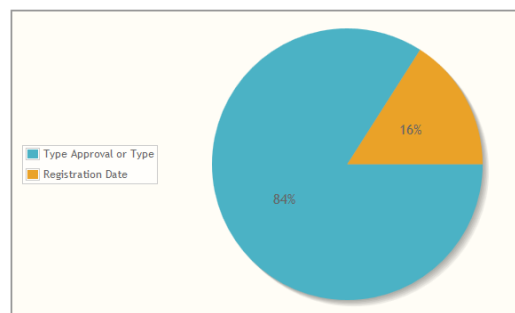

Figure 3: Euro NCAP ratings assignation method

3.3 Database study

The new database obtained after this matching process has been studied in order to obtain some conclusions about the Spanish passenger cars feet.

As can be seen in the following figure, 37% of the registered vehicles have been assessed by Euro NCAP before 2009, 52% have been related with Euro NCAP ratings from 2009 or later and 10% had no Euro NCAP association.
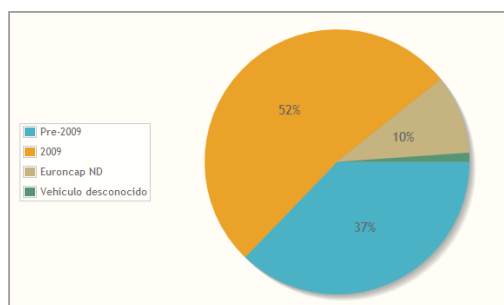

Figure 4: Euro NCAP rating assignation regarding assessment

Regarding all vehicles which have an Euro NCAP assessment pre-2009, it was observed that 73% have 5 Euro NCAP stars in the adult rating, 24% of vehicles have at least 4 stars and nearly 100% have 3 or more stars.

Regarding the rating in all vehicles with Euro NCAP protocol after 2009, 83% of registered vehicles have 5 Euro NCAP stars and 94% have at least 4 or more stars.
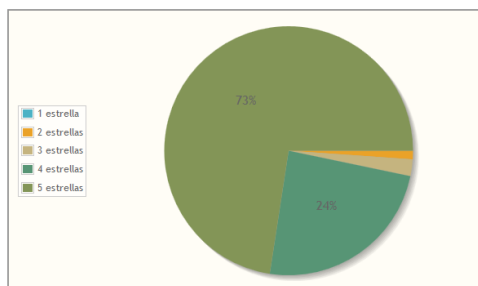

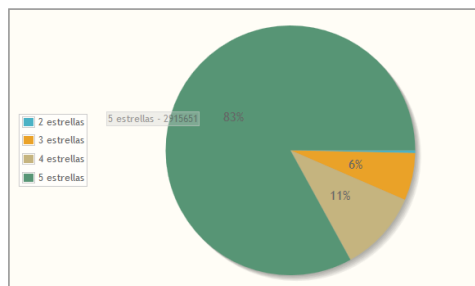**Figure 5: Euro NCAP rating pre-2009 (adult rating)**

Figure 6: Euro NCAP rating 2009 (overall rating)

4 Conclusions

The introduction of Euro NCAP rating in the vehicle registration database from the Traffic General Directorate of Spain is the first step towards offering greater information about safety level to vehicle owners.

The results of this project make it possible to define an approach towards Spanish fleet safety and to identify weak points to try to find a more effective solution.

The obtained data is a good opportunity to carry out accidentology studies and identify the influence of vehicle safety level on accident severity and frequency.

On the other hand, there are many vehicles registered before 1997, which have not been assessed by Euro NCAP. These vehicles, whose safety systems are not at the same level as the new vehicles, are an important part of the Spanish fleet, and this should be taken into account. Therefore, the results from the 6,742,516 vehicles that were studied in this project should be carefully analysed thus they are a small percentage of the total Spanish fleet. These results do not reflect the reality of the Spanish road traffic.

Besides, Euro NCAP assessments are changing every year, becoming more challenging and because of these changes it is very difficult to analyse the evolution of the results over time. Consequently, it is necessary to know in depth the Euro NCAP tests and assessment procedures to correctly interpret the results.

The observed results show that there are more vehicles with higher safety ratings (five stars) after 2009 than before. Therefore, this makes us think that the Spanish fleet is becoming increasingly safe.

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