EVALUATION OF NEW TECHNOLOGIES TO IMPROVE TRUCK SAFETY PERFORMANCE (HIGH SAFETY VEHICLE PROJECT)

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RENAULT V.I.'S CONTRIBUTION TO ROAD SAFETY

Improving safety is and will remain one of truck manufacturers 's top priorities, as it constitutes a decisive aspect in the development of road transport.
Beyond the obvious necessity of reducing the number and seriousness of road accidents, what is also at stake is the image of this mode of transport and its acceptance by the public at large.
This is why RENAULT V.I. decided many years ago to devote a significant amount of resources to the improvement of safety **-** both active and passive **-** and to give this policy a very special dimension by making it one of its main strategic lines.

The comprehensive approach

For RENAULT V.I., improving road safety not only requires making continuous technical changes in the product, but also needs to take place in a genuine comprehensive approach associating a maximum of players.

- **Accidentology studies** are the point of departure in our understanding of accident-generating phenomena, of their consequences and of the priorities that need to be set in our safety improvement policy.

- **Involving partners -** companies or universities specialised in certain technologies or functions **-** is **needed** to achieve the best results, each partner being in a position to make the most of his special know-how.

- **Integrating in the product** all the technological improvements likely to improve safety, the results of our experience as a manufacturer, and also of the contributions on the part of our partners.

- **Involving users** of the vehicle, be it drivers or fleet managers, by having them take into account the quality services that we can offer in the fields of maintenance, driver training and communication about safety-related issues.

RENAULT V.I.'s commitment naturally concerns the introduction of technological solutions likely to improve road traffic safety, as well as operations that are not linked to traffic (getting into and out of cabs, loading operations, etc.). But its true role is first and foremost to be the driving force of this comprehensive approach.

The demands of road users and professionals of road transport legitimately never cease growing in the area of safety. Years of effort are still needed to continue making progress in this field. RENAULT V.I. is meeting the challenge so that road transport can regain the respect of all the citizens.

RESEARCH ACTIVITY IN ACCIDENTOLOGY

CEESAR (Centre Européen d'Études de Sécurité et d'Analyse des Risques, *European Centre for Studying Safety and Analysing Risks*) is an organisation which studies truck accidents in real time by sending a team of specialists within minutes after an accident occurs; this team studies the accidents in great detail.
CEESAR has been leading accidentology's study for the past 20 years. This is how a large amount of high-quality information has been gathered, which constitutes an incomparable accident database at the service of safety improvement.

Available databases

Quality		Database	Number		Quantity
	-	National Statistics	6 500	+	
		Death reports 1990	1 000		
		E.A.C.S.** European Base	90		
	+	Accidentology Base (CEESAR)	715	-	

*** E.A.C.S.: European Accident Casualty Survey*

Methodology used for passive safety files

The method consists in analysing the accident involving a truck in the field, under the sole aspect of passive safety.
Additional work helps to make further progress in the analysis of active safety, taking into account the environment of the accident and driver-related data.
Certain studies concern more special cases that meet target demands. They concern analysis of accidents involving the most recent RENAULT V.I.-brand trucks only.

Development of methodology for active safety files

What needs to be done is studying in detail accidents involving a truck and the conditions of occur, by analysing active and passive safety simultaneously. This work is performed, in the field, by three accidentologists which will deal with:

- the environment, the infrastructure and the reconstruction of the accident,
- the vehicle,
- and human behaviour.

This means that 670 parameters are collected for each accident / vehicle / occupant.

Accidentology objectives

Accidentology helps to assess the efficiency of the safety improvement measures implemented on the company's products.
Finally, by studying and monitoring all the new models in RENAULT V.I.'s range to know their actual safety level, accidentology directs future research on safety and helps to make choices concerning tomorrow's technologies.

PRESENTATION OF H.S.V. - HIGH SAFETY VEHICLE

Why this project

The studies being conducted in the framework of the HSV project aim at bringing about significant improvements in the passive and active safety of commercial vehicles, and advances of the same magnitude in the improvement of the working conditions of drivers of heavy trucks.

Principle of the project

Building a demonstrator vehicle called HSV (High Safety concept Vehicle) helped to complement the advances made by the R&D teams in technologies and principles through vehicle architecture studies on a complete heavy duty tractor-trailer vehicle.

The project was based on a partnership with the automobile world (*RENAULT's Research Division*), with laboratories (*CEESAR*) and was developed by RENAULT V.I. with the major innovative suppliers and equipment manufacturers world-wide: *A.F.L., DAV, General Trailers, Fichet S.A., Hella, Knorr, Magnetti Marelli, Messier Bugatti, Meritor, Michelin, Petri, RBE, Recaro, Sekurit Saint Gobain V.I., Thomson, Valéo Eclairage Signalisation, Valéo Systeme d'Essuyage, Valéo Vision Belgique, VDO Kienzle* .

The project used a MAGNUM tractor with deeply modified characteristics in order to integrate the many safety systems that this experimental vehicle needed to test. **This prototype looked like a laboratory-on-wheels similar to the VE 10 and VE 20 trucks that RENAULT V.I. developed in the past.**

The HSV programme leads to validating systems in terms of actual and perceived safety, and of service to the customer.
The programme prepares for their integration on vehicles that could be marketed in a more or less distant future.

The structural work materialised by the building of a demonstrator vehicle helps to ensure:

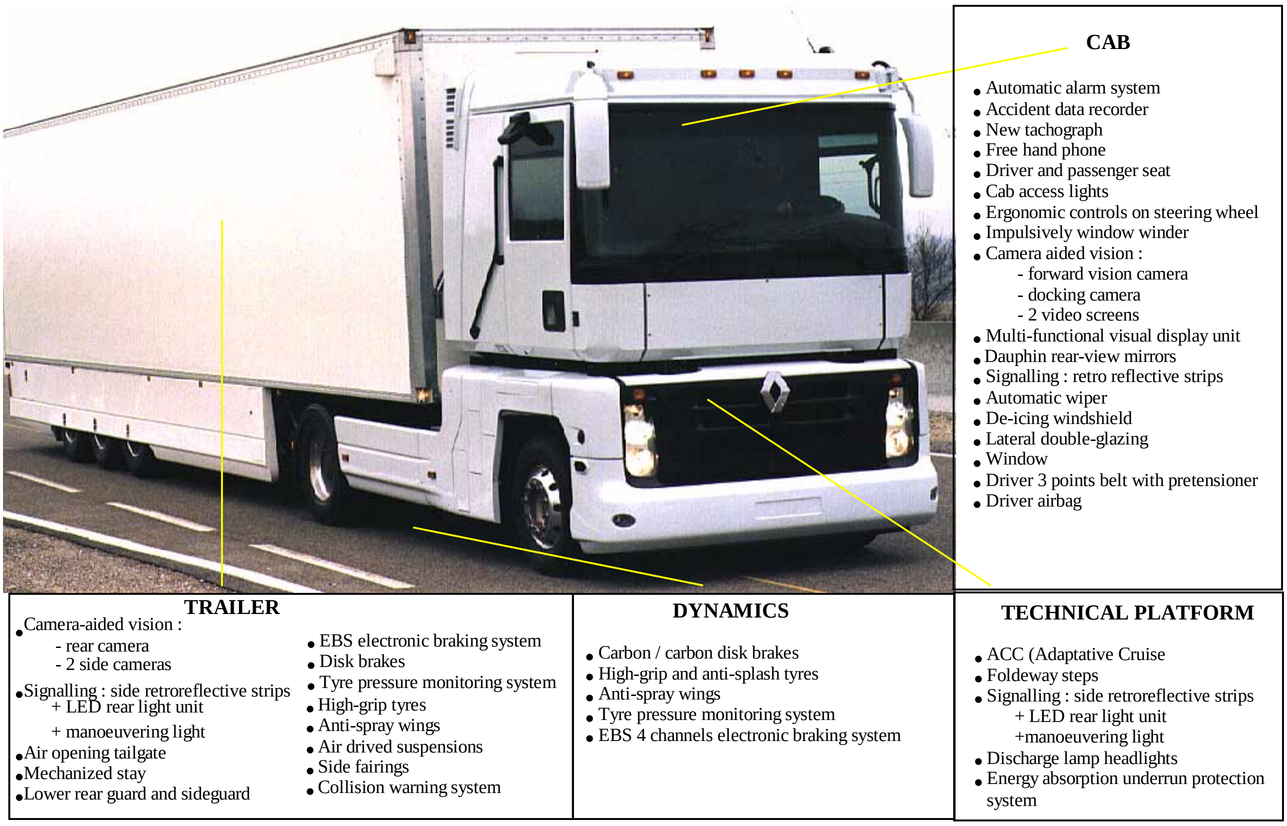
- the integration of systems and components on the vehicle,
- their compatibility in terms of physical, electrical and electronic structures,
- their consistency in terms of ergonomics and comfort of drivers at work.

The experimental assessment phase (or virtual assessment phase depending on the systems) leads to determining and characterising the physical performance of a system (or group of systems) in actual operating conditions.

These physical results are then used as input data for the assessment phase concerning the potential gains of these systems (or groups of systems) from the standpoint of road safety. These gains are expressed, depending on cases, by a reduction in the number of accidents involving CVs and by a reduction in the number of victims (fatalities, seriously injured and slightly injured).

The accidentology analysis methodology is presented in the following section.

Safety components integrated in the HSV



ACCIDENTOLOGY ANALYSIS OF POTENTIAL BENEFITS OF H.S.V. SAFETY TECHNOLOGIES

The physical performance of a system (determined by experimental or numerical assessment phase) is used as input data for the evaluation of the potential gains of each system (or groups of systems) in terms of road safety improvement.
These gains are expressed, depending on cases, by a reduction in the number of accidents involving Trucks or by a reduction in the number of victims (fatalities, seriously injured and slightly injured).
This analysis depends on a methodology adapted to each studied solution, which is based on the following principles :

- Statistical information concerning all the accidents (over a given period of time) involving commercial vehicles (number and type of accidents, reports on victims, etc.).

- Detailed information concerning the circumstances and consequences of accidents which constitue the CEESAR database (715 *in situ* investigations). This database can be used for in-depth studies on the lesion-causing mechanisms and suitable countermeasures.

- For each technology (or groups of technology), we choose a relevant sample of accidents among CEESAR database. So, one of the main difficulties lies in the determination of sample with a sufficient size.

- Crash reconstructions (using PC CRASH software) allow to establish, for each accident of this relevant sample, the most probable scenario for the events leading to and taking place in each accident studied in this way.

- Then, one of the more difficult part of this analysis is to quantify the reductive effect of the own performance of a system on the accident physical parameters (absorbed energies, decelerations, deformations, speed,...).

- The next step consists in conducting a new serie of crash reconstructions in which the reductive effect of the studied technology is taken into account.

- Afterwards, based on the informations obtained through the crash reconstructions sequences for a suitable protection system, thus we can evaluate the influence of this system on the way the accident unfolds.

- There are also more conventional methods to analyse the level of protection given by a safety improving system.
  These methods rely on the cumulated experience and observation concerning accidents and their consequences in terms of personal injuries.
  We can use either the most adapted method for a given technology or, as possible, the two methods.

- Finally, the last part of this analysis, based of the evaluation of one given system, consist to estimate the benefits of this system , in terms of avoided accidents or personal injury reduction.

When all technologies, integrated in VHS, have been evaluated individually (or in a group) in terms of safety improvment, the last work consists in making a synthesis of the benefits in this way for the VHS vehicle.
Then, one of the difficulties lies in the identification and the elimination of overlap in benefits linked for each technology (or group of technologies).

Examples

- With the next front underrun protection system (FUPS) according to the R93 regulation (which will become obligatory in Europe in August 2003), we will obtain a very significative reduction of occupants of car killed in car-to-truck front-head collisions. This reduction is about 25 %. It means that in France, each year, the R93 FUPS will save around 85 lifes according to 1999 figures.
- A wellknown countermeasure to protect occupants of trucks is the three points seat belt with pretensioner. With a such simple system, at least 12 % of occupants of trucks will be saved. In France, it means that, each year, around 15 lifes could be saved.

CONCLUSION

The HSV demonstrator vehicle allowed to integrate a wholeset of technologies dedicated to road safety improvement in a commercial use context. This prototype allowed to initiate an evaluating method of improving safety ability for each technology then, in a second time, the wholeset of technologies fitted in the vehicle could be evaluated .
This analysis, completed by an economic study, will determine a grading of safety technologies to be progressively introduced on the market.