NOVO PARADIGMA DAS RESPONSABILIDADES

Lisbon, May 27th 2010

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ADVANCED ACTIVE SAFETY SYSTEMS FOR VEHICLES

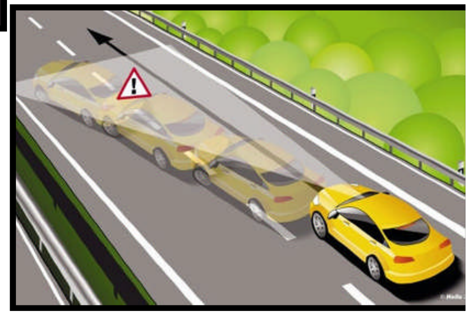
- Past: Improvements in passive vehicle safety (structural and restraint system aspects).
- Present: Focused towards advanced active safety systems. Providing accident avoidance and collision mitigation capability by automated interventions or appropriate driver guidance.
- Future: Self-driving cars.

CARS HAVE ALREADY STARTED TO TAKE CONTROL

- ELECTRONIC STABILITY CONTROL **ESC**
- ADAPTIVE CRUISE CONTROL **ACC**
- **LDW**-Systems **(L**ane **D**eparture **W**arning **S**ystem**)**
- INTELLIGENT SPEED ADAPTATION **(ISA)**
- PARK PILOT
- **FCW**-Systems **(F**orward **C**ollision **W**arning **S**ystems**)**

ESC

LDW

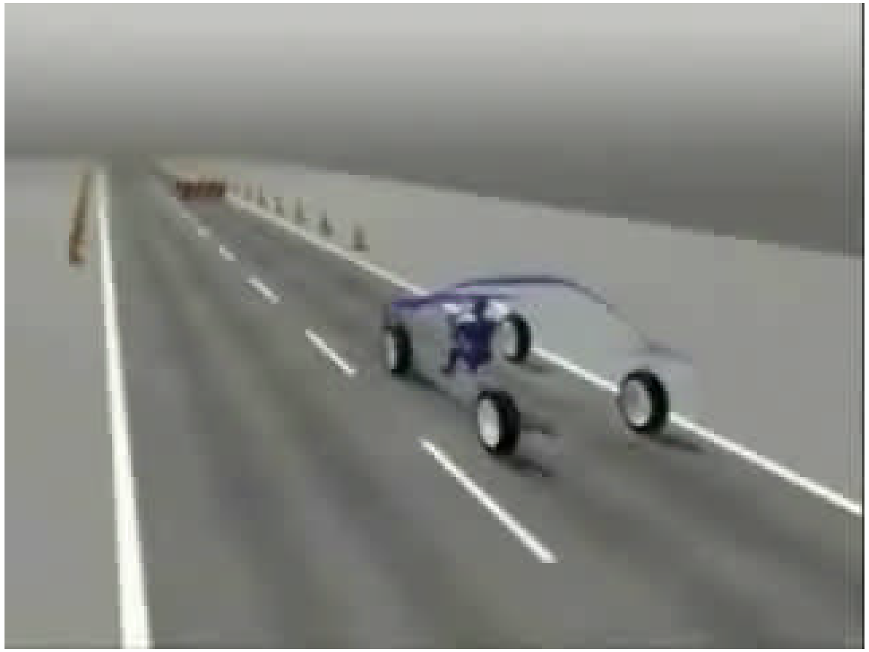


Park Pilot

FCW

ELECTRONIC STABILITY CONTROL ESC

- Stabilizes the vehicle (in critical driving manoeuvres) and reduces de risk/danger of skidding.



ELECTRONIC STABILITY CONTROL ESC

- Vehicle makers use diferent abbreviations.
- ESC **evaluates** the data measured from sensors.
- ESC **compares** the driver`s input with the actual behaviour of the vehicle.
- If an unestable condition occurs, ESC **intervenes automatically** via engine electronics and **brakes** system.

ADAPTIVE CRUISE CONTROL ACC

- ACC **keeps** the vehicle at a **set constant speed**, however, if a car with ACC is confronted with a slower moving vehicle ahead,it is **automatically slowed down**.

ADAPTIVE CRUISE CONTROL ACC

- ACC **monitors the area in front** of the vehicle using radar or lidar (Light Detection And Ranging) sensor.

- If a **slower preceding vehicle** is detected then ACC automatically **reduces the speed** through the engine management and/or applying the brake smoothly to maintain the safety distance that had been pre-defined.

- When there is **no preceding vehicle ahead** ACC maintains or **accelerates the vehicle** to the programmed speed.

LANE DEPARTURE WARNING

- Lane Departure Warnings **warns the driver** in case of **unintentional lane departures.**

LANE DEPARTURE WARNING

- Infrared sensors under front bumpers/ highly dynamic cameras → Register the lane markings

- Unintentionally cross the lane marking → System warns (Vibrations, acoustic or optic signals)

- Unintentional when the **turn indicator is not activated** during a lane departure or a lane change and can be activated at a minimum speed of 60 to 80 km/h.

INTELLIGENT SPEED ADAPTATION ISA

- ISA is a system by which the vehicle knows the permitted or recommended maximum speed for a road and makes this information available to the driver or limits the vehicle maximum speed to the local limit.

INTELLIGENT SPEED ADAPTATION : ISA

- ISA considers the vehicle position through GPS.
- ISA need to be connected to some elements of the vehicle's power train.
- The system should recognise that the vehicle is exceeding the recommended speed, it is able to actively reduce the vehicle's speed.

INTELLIGENT SPEED ADAPTATION ISA

- ISA will either adapt the speed for the driver automatically or produce a warning.

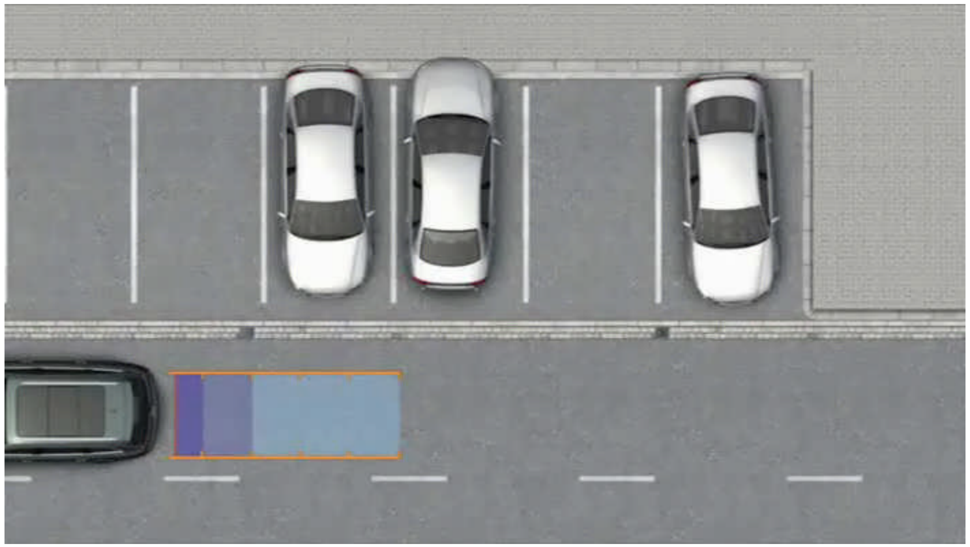
- Limitations: Speed limit borders, GPS reception and map validity, single track vehicles.

PARK PILOT

- Park Pilot relies automatically when reverse gear is selected on ultrasonic sensors for ultra-precise monitoring of the area behid the vehicle.

PARK PILOT

- The **ultrasound sensors** emit short sound pulses which are reflected by obstructions (echosounding principle).
- Wide detection range of **120º**.
- Self-test each time it is activated.



PARK PILOT

- Using the time lag between pulse and echo, the system calculates the distance of the vehicle from the obstacles.
- When this distance shrinks below a predetermined value, an **optical and/or acoustic signal is activated**.
- This shows the distance from 150 to 25 cm in several stages.

FCW SYSTEMS (Forward **C**ollision **W**arning **S**ystem including CMBS, etc)

FCW SYSTEMS (Forward **C**ollision **W**arning **S**ystem including CMBS, etc)

- DISTRONIC PLUS operates at speeds of between 0 and 200 km/h.
- It keeps the car a set distance behind the vehicle in front, applies the brakes as required and can even bring the car to a complete halt.
- If the gap to the vehicle in front narrows too quickly, the system gives the driver an audible warning.
- This technology helps the driver to gauge the level of risk and makes the calculated brake boosting force available instantly, even if the driver does not press the brake pedal forcefully enough.

DRIVER ASSISTANT SYSTEMS

Effectiveness studies

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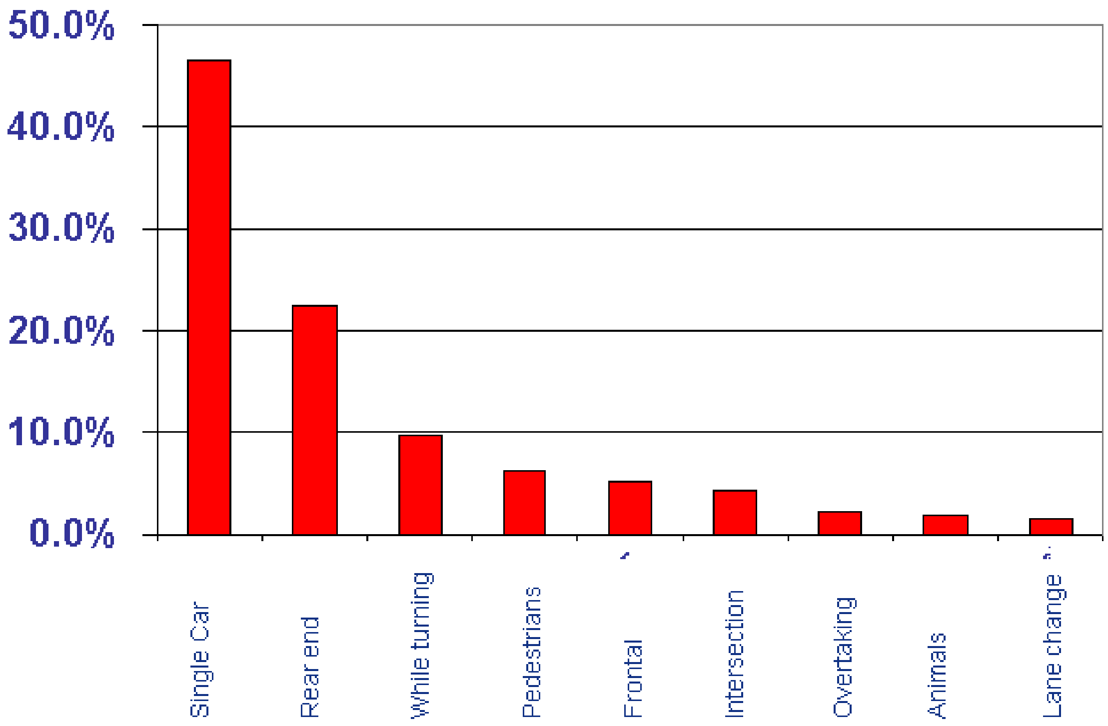
GOALS

- Estimate how many people would not be injured or killed if every car was fitted with the driver assistant system (based on the federal statistics)

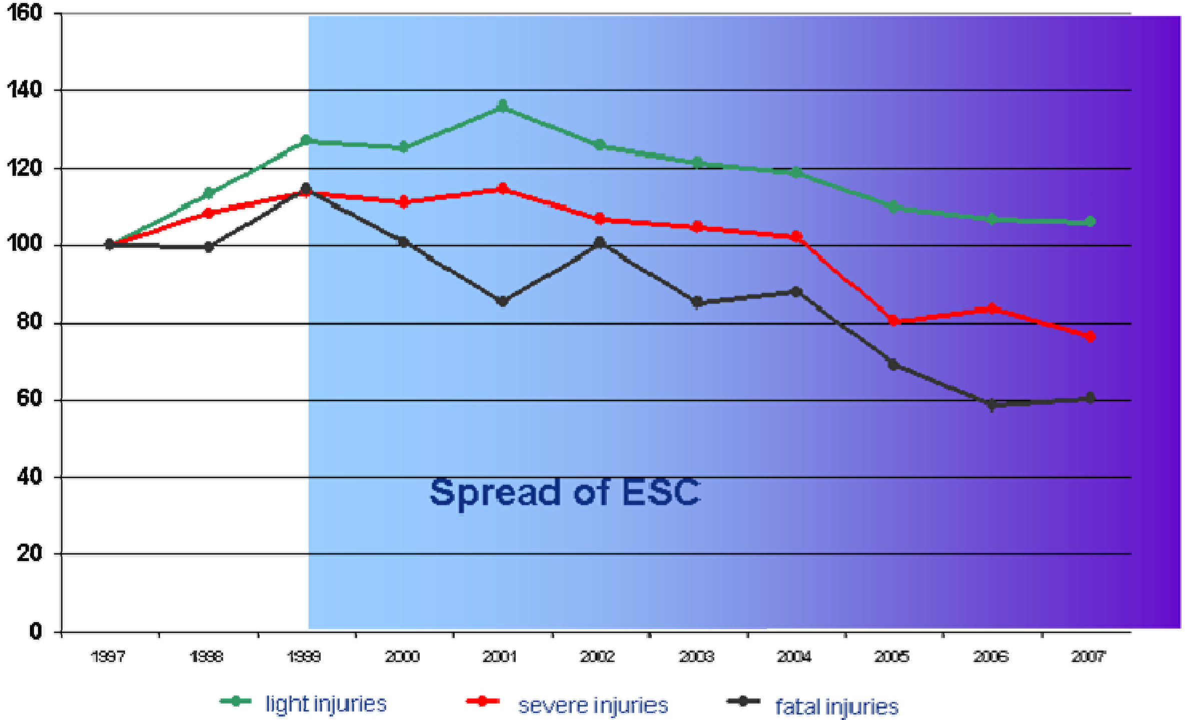
Source: Untersuchung der Effektivität von Fahrassistenzsystemen
Hochschule Konstat & Axa Winterthur, 2009

Average of the years 1997 to 2007.



Source: Untersuchung der Effektivität von Fahrassistenzsystemen
Hochschule Konstat & Axa Winterthur, 2009

SINGLE CAR COLLISIONS/ EFFECT OF ESC ALREADY VISIBLE



Source: Untersuchung der Effektivität von Fahrassistenzsystemen
Hochschule Konstat & Axa Winterthur, 2009

Example: ESC Package

Total number of accidents 13'267

Single car collisions 6'164

1. Filtering:
Which accident type is relevant for ESC?

Accidents of relevant accident type 6'164

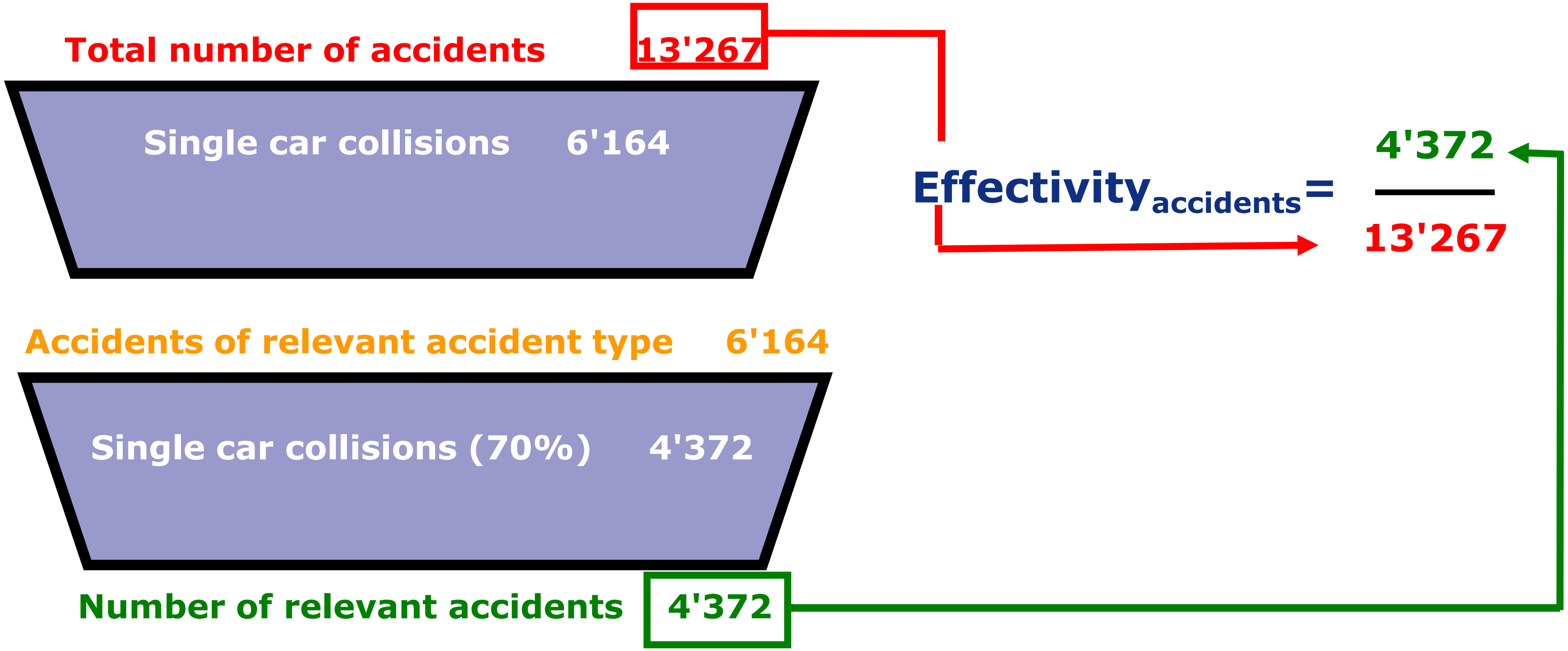
Single car collisions (70%) 4'372

2. Filtering:
Which part of accidents within this accident type group could be prevented (no accidents caused by Alcohol, drugs, etc.)

Number of relevant accidents 4'372

Source: Untersuchung der Effektivität von Fahrassistenzsystemen
Hochschule Konstat & Axa Winterthur, 2009

Example: ESC Package



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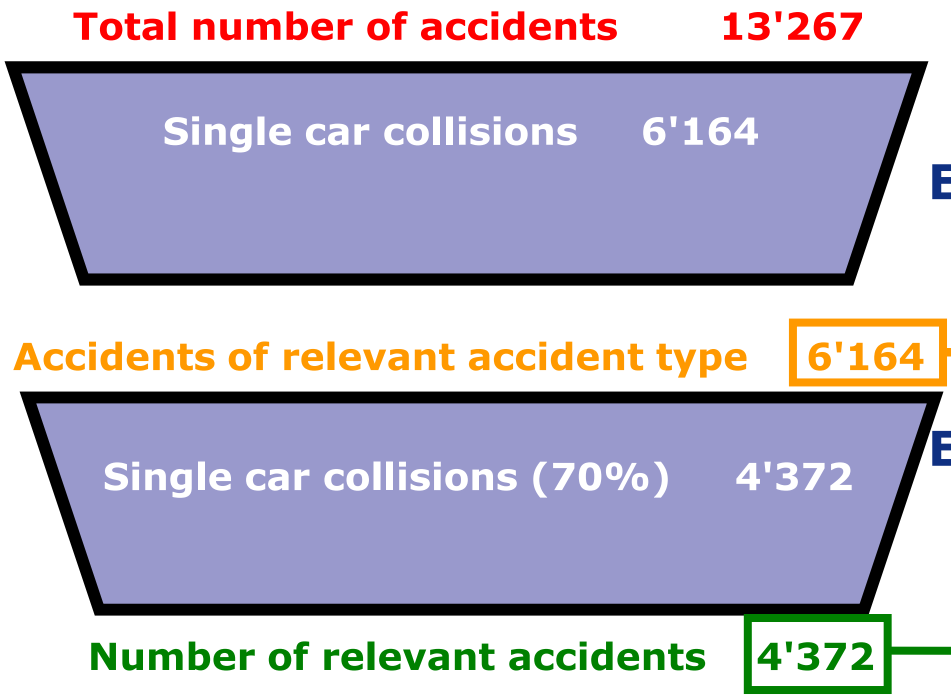

$$\text{Effectivity}_{\text{accidents}} = \frac{4'372}{13'267} = 33{,}0\%$$

$$\text{Effectivity}_{\text{Within Acc.type}} = \frac{4'372}{6'164}$$

Source: Untersuchung der Effektivität von Fahrassistenzsystemen
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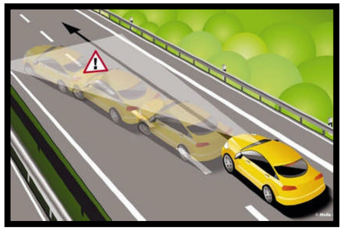
$$\text{Effectivity}_{\text{Within Acc.type}} = \frac{4'372}{6'164} = 70{,}9\%$$

Number of relevant accidents 4'372

Source: Untersuchung der Effektivität von Fahrassistenzsystemen
Hochschule Konstat & Axa Winterthur, 2009

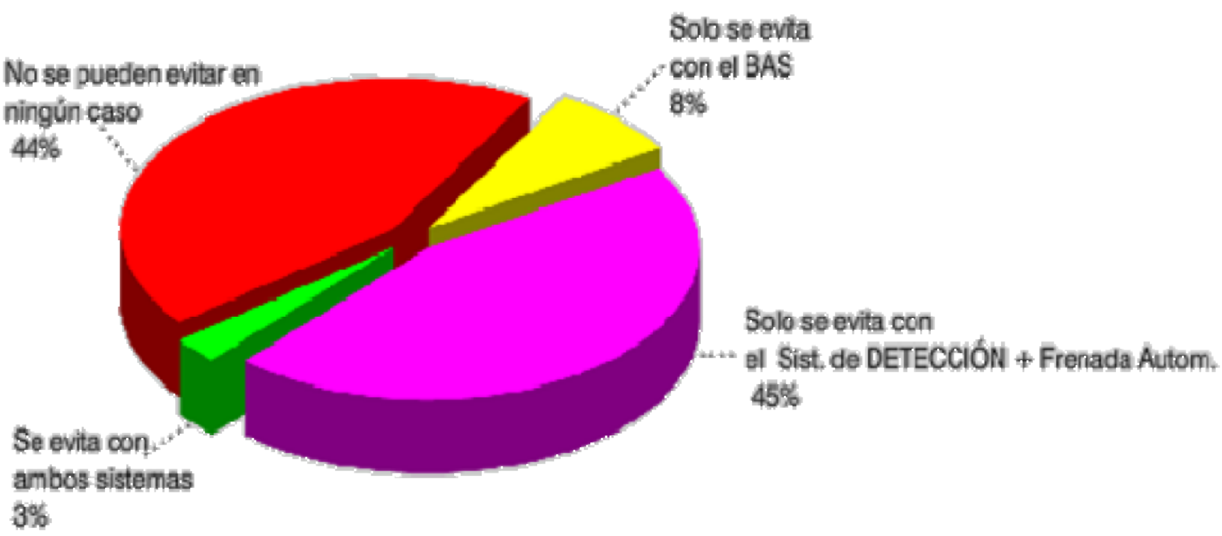
Potential benefits



	ESC	FCW	LDW
$\text{Potential}_{\text{Accident}}$	33,0%	28,4%	37,6%
$\text{Potential}_{\text{Acc.type}}$	70,9%	89,2%	70,0%

Source: Untersuchung der Effektivität von Fahrassistenzsystemen
Hochschule Konstat & Axa Winterthur, 2009

PEDESTRIAN ACCIDENTS THAT COULD BE AVOIDED BY MEANS OF THE USE OF THE PROTECTION SYSTEMS



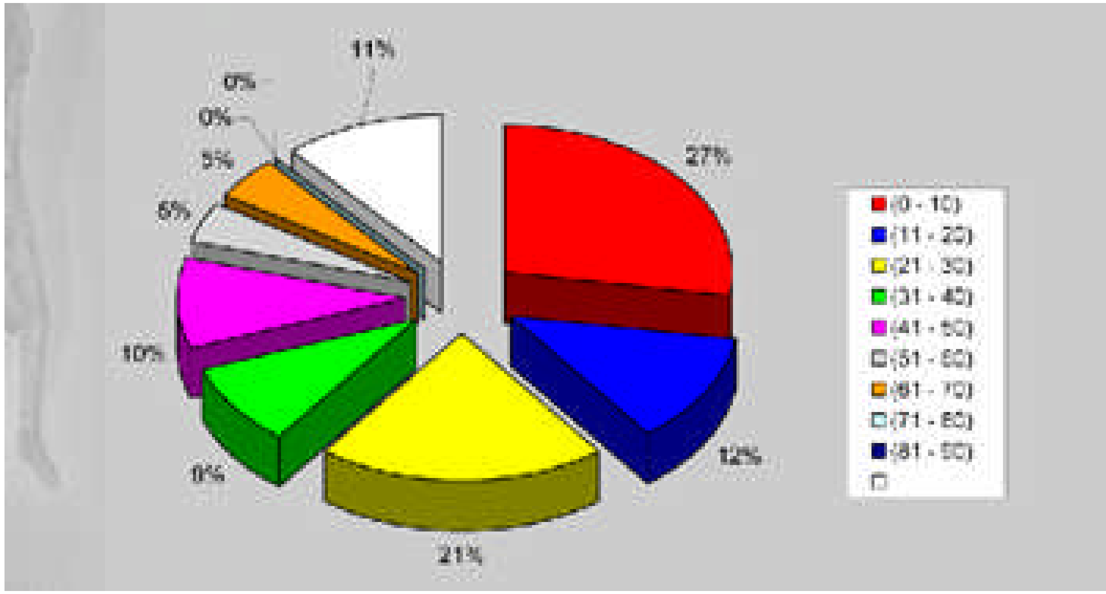
Source: Evaluation of the effectiveness of pedestrian protection systems through in-depth investigation of accidents in Madrid, Zaragoza and Barcelona. CZ, APPLUS IDIADA, INSIA, SERNAUTO.

PEDESTRIAN ACCIDENTS THAT COULD BE AVOIDED BY MEANS OF THE USE OF THE PROTECTION SYSTEMS

- In 71% of the cases the driver tried to do a braking maneuver.
- In 49% of the cases the vehicle was equipped with ABS, but only 8% of the total incorporated BAS.
- The brake system ABS+BAS would have helped the driver to avoid the accident in 11% of the cases.
- The Detection+Automatic Braking system would have avoided the accident in 45% of the cases.
- 44% of the accidents could not have been avoided with any of the analyzed systems.

Source: Evaluation of the effectiveness of pedestrian protection systems through in-depth investigation of accidents in Madrid, Zaragoza and Barcelona. CZ, APPLUS IDIADA, INSIA, SERNAUTO.

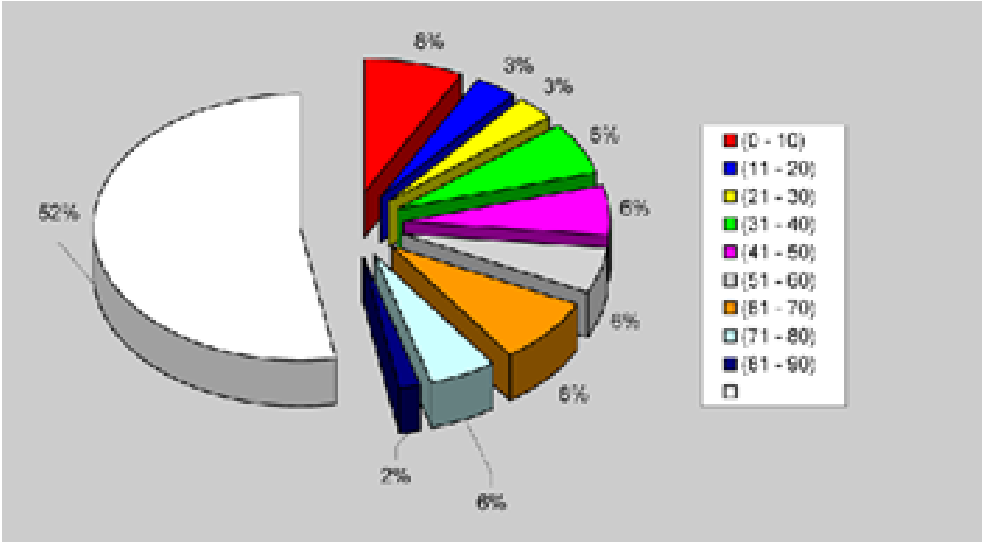
REDUCTION PERCENTAGE OF THE PEDESTRIAN ACCIDENT



In only 21% of the cases, the BAS System would have reduced vehicle speed in the moment of the accident to less than half of its initial dirving speed.

Source: Evaluation of the effectiveness of pedestrian protection systems through in-depth investigation of accidents in Madrid, Zaragoza and Barcelona. CZ, APPLUS IDIADA, INSIA, SERNAUTO.

REDUCTION PERCENTAGE OF THE PEDESTRIAN ACCIDENT SPEED WITH DETECTION + AUTOMATIC BRAKE SYSTEM



With the DETECTION + Automatic Braking System this reduction would have happened in 74% of the cases.

Source: Evaluation of the effectiveness of pedestrian protection systems through in-depth investigation of accidents in Madrid, Zaragoza and Barcelona. CZ, APPLUS IDIADA, INSIA, SERNAUTO.

CONCLUSIONS

- Both analyzed systems (ABS+BAS and Pedestrian Detection + Automatic Braking Systems) proved efficient for reducing severity of pedestrian accidents in the majority of cases.
  - BAS is being progressively incorporated in the current fleet.
  - Pedestrian Detection Systems are still being investigated as a prototype.
- Pedestrian Detection Systems would avoid run over cases by at least half and greatly reduce falling speed in the rest of the cases, which reduces the head injury risk.
- The brake assistance system (BAS) presents lower effectiveness in the prevention of pedestrian accidents compared to Pedestrian Detection Systems.

Source: Evaluation of the effectiveness of pedestrian protection systems through in-depth investigation of accidents in Madrid, Zaragoza and Barcelona. CZ, APPLUS IDIADA, INSIA, SERNAUTO.

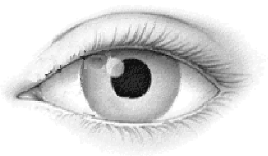
RISK HOMEOSTASIS THEORY

RISK OF THE `ADAPTATION TO THE TECHNOLOGY´

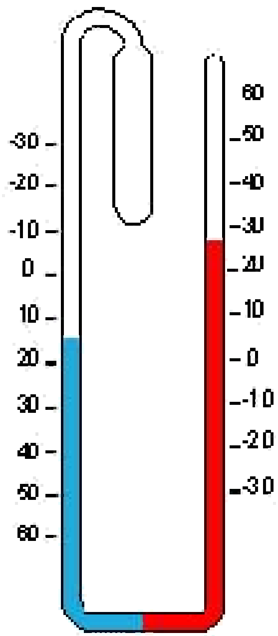
Homeostatic regulatory process to tend to zero the difference between level A and level B

PERCEIVED RISK

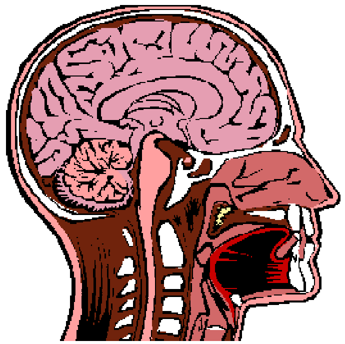
ACCEPTABLE RISK

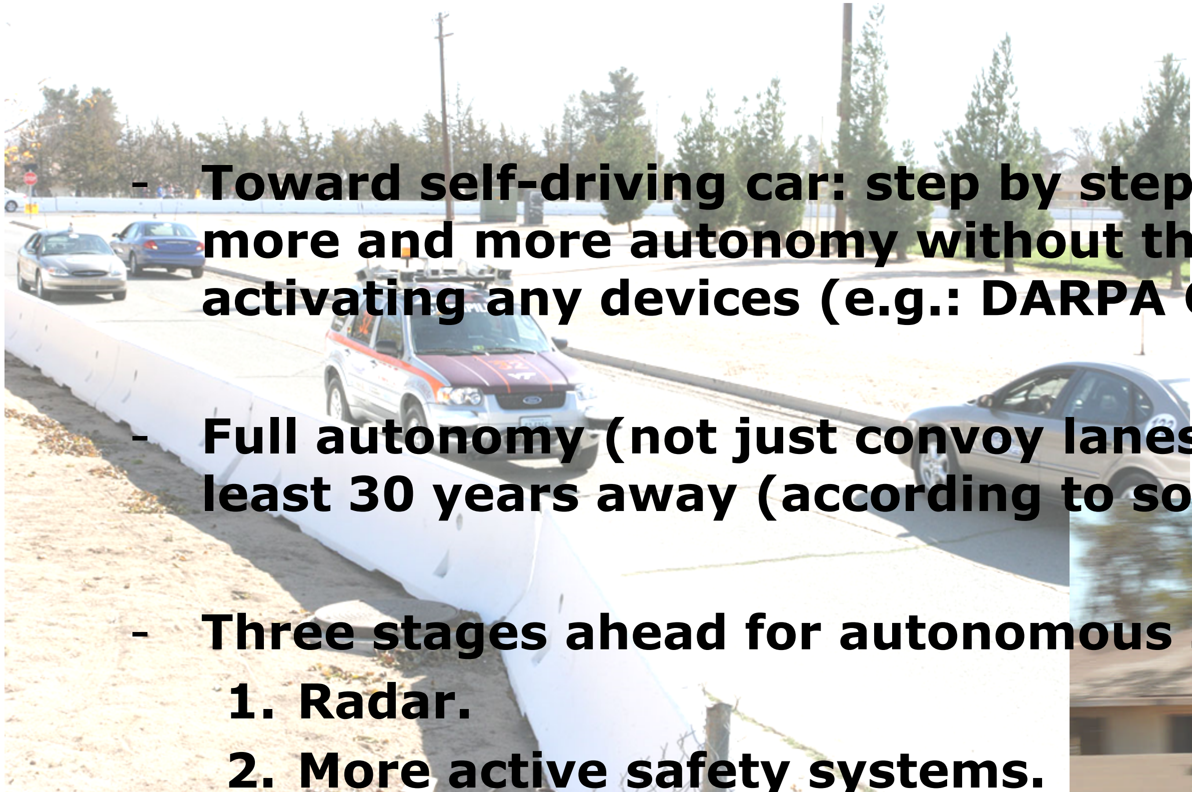


Level A



Level B





- **Toward self-driving car: step by step the automobile is getting more and more autonomy without the driver or passenger activating any devices (e.g.: DARPA Challenge).**

- **Full autonomy (not just convoy lanes on the freeway) is at least 30 years away (according to some experts).**

- **Three stages ahead for autonomous safety systems:**
  1. **Radar.**
  2. **More active safety systems.**
  3. **Full collision avoidance systems.**

DRIVER ASSISTANT SYSTEMS

Potential benefits and the legal context

Source: Extracted from eSafety Conference 2007, Brussels, by Wil Botman, FIA Managing Director

- Risk of excessive liability in the case of crashes.
- At the moment, crashes tend to lead to lawsuits against human drivers.
- Unless there is evidence that a mechanical defect caused the crash, car manufacturers tend not to be the target of most accident-related lawsuits.
- That would change if cars were driven by software.
- That could lead to the 'perverse' result that even safer self-driving cars would be more expensive to insure than human drivers.

- **Directive 85/374/EEC** covers liability for defective products and provides that manufacturers are liable without fault.

- Courts in the Member States have different ways to interpret the concept of defectiveness.

- **Austria and Portugal**: fault is assumed where a breach of contractural obligations is involved. To be realeased from liability, the manufacturer is required to prove that there is no defect.

- **Netherlands and Ireland**: the courts automatically assume the manufacturer’s fault, since there was a defect.

- The **Spanish Supreme Court** has held that the claimant is required merely to prove the damage and relate it causally to the manufacturer.

- Today, the drivers/owners/keepers of vehicles are facing different situations depending on the country in which they make their claim. The only remedy is a **more specific definition and harmonisation of the concept of defectiveness.**

- A **simpler rule covering the user's liability for damage caused by a defective system** would increase the acceptance of using such systems.

CONCLUSION

"A decade ago, self-driving cars were little more than science fiction. Recent advances have made it increasingly clear that self-driving vehicles are coming, and we need to start preparing for them."

"The liability, regulatory, and civil liberties implications of self-driving technologies are not well understood. Wise choices in these areas will determine how soon self-driving cars arrive and how much they benefit society."

Source: Timothy B. Lee, journalist expert in new technologies and public policies.

Obrigado pela sua atenção!

Juan Luis de Miguel
Deputy General Manager of Centro Zaragoza
jl.demiguel@centro-zaragoza.com