WP5
(INRETS - VSRC - LMU - LAB - LMS)

Human Factors in a traffic accident production model

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Outline of Presentation (Partners: VSRC – LMU – LAB – LMS)

- What is Accident Causation from a Human Factors viewpoint
- Which methods have been developed in TRACE
- For which purposes
**Accident story**

- **A car driver vs. a pedestrian**
  - On a dual carriageway, limited to 110 KPH
  - The car driver was circulating at 90 KPH
  - The pedestrian was on the pedestrian crossing

- **A problem of infrastructure?**
  - The car driver has his driving license for only one week
  - His BAC is 0.4 g/ l

- **Human Factor!**
Difficulties with accident causation

- An implicit tendency to develop a mono causal approach
- An accident factor can hide another one
- A factor can become a factor only when combined with another one
- An implicit tendency to think only about
  - Anomalies
  - Responsibility
- Which drastically reduces the scope of analysis
- And drastically reduces the range of counter measures
A need to think further than anomalies

- We tend to recognize only the elements that are considered unusual.
- But drivers compensate most of the times a lot of usual weakening elements linked with the vehicle and the environment.
  - That they are not anymore able to compensate under certain over-solicitant situation (high speed traffic, shared attention, tired, distracted, etc.)
A need to think further than responsibility

We tend to search for guiltiness in accident

Which leads to the common conclusion that "human factors" (i.e. road users) are the main cause of road accident

- So many progresses have been made on vehicles and road infrastructure...
- So that the safest solution would be to suppress the road users!

It is more efficient to think more comprehensively

- The driving system has to be designed in a suitable way for its users, their capacities and their limits
- There are also Human Factors in conception, management, maintenance, etc., even if less evident

The purpose of accident causation is not to punish,

It is to help the driver avoiding to produce errors, or to reduce the consequence of these errors
What is Accident Causation?

- **The result of a malfunction**
  - The driving system has not been defined to generate accidents
  - If it happens, something has not functioned correctly

- **The result of a wrong interaction**
  - Driving activity is continuously confronting 3 basic components
    - The weakness of one component will lessen the efficiency of the other ones

- Accident causation is searching for the mechanisms beyond the appearances
What are "Human Factors"

Human Factors of driving

- No other disposal than human is able to operate efficiently in situations which are as complex, variable, uncertain and poorly structured as in driving
- Human beings are at the basis of driving system functioning, thanks to their capacity to adapt, even if this adaptation capacity is subject to limits.

Human Factors of accidents

- Qualify the causes attributed to road Users, which interact with the causes attributed to the road Environment and the Vehicle to produce a malfunction
- A typical problem in accident causation studies: a tendency to confuse human factors and human errors (i.e. the causes and the consequences)

Human Failures in accidents

- Are the result of factors affecting the User, the Vehicle and the Environment
- Show the limits in human adaptive functional processes that the driving system must cope with
Human and driving activity

- **Driving is an apparently easy task** (nearly everybody performs it!)
- **But a counter-nature activity**

A speed disproportioned as regard to human physical capacities elaborated through evolution

- **A task which over-solicits human capacities of adaptation**...

  ... the limits of which are shown by accidents
Pre-accident Situation
Describes the driving task pursued and its demands

Explanatory Elements
Endogenous
(Originating within the driver)

Exogenous
(Arising from the environment)

Functional failure
(at the "rupture" in the driving situation)

Resulting critical situation
(maneuver undertaken or continued)

ACCIDENT

Plus a prospective work toward the further upstream factors to be found in the social and cultural sphere of the road users

Individual Sphere

Context sphere /

Social situation, social space

Other obstacles

ACCIDENT
From Human factors to safety functions

Road accidents are the witnesses that Driving is sometimes a too complex activity for which drivers need an help

Technological functions are a means among others to provide this help (by informative or automatic devices)

To be really helpful, these aids must fit with the effective needs of the drivers
- They have to be related to the true difficulties encountered by drivers

Devices must be adapted and devoted to driving reality
- The real contexts of activity
- The effective human functioning modes (not forgetting their variability and weaknesses)
Drivers' needs, contextual constraints & safety functions

- **Define drivers' safety needs as they are expressed by human failures** (e.g. a need in detection)

- **Evaluate the capacity of safety functions to meet these needs**

- **Characterize accident contextual constraints**
  - Contextual parameters that would impede the drivers' capacity to take advantage of the functions (e.g. the fact that he was looking behind)

- **Evaluate the Response efficiency of the functions**
  - Their capacity to compensate for the contextual constraints

- **Safety effectiveness of the functions**
  - Capacity to meet the needs x capacity to compensate for the constraints
### Results

An evaluation of safety functions capacity and weaknesses in potentially compensating for actual human failures

A definition of the conditions under which they could be more effective

<table>
<thead>
<tr>
<th>Feature</th>
<th>Capacity to meet driver’s needs</th>
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<tbody>
<tr>
<td>Collision Avoidance</td>
<td>14.10%</td>
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<tr>
<td>Intersection Control</td>
<td>12.30%</td>
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<tr>
<td>Collision Warning</td>
<td>8.90%</td>
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<tr>
<td>Alcolock Key</td>
<td>5.60%</td>
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<tr>
<td>Electronic Stability Program</td>
<td>4.50%</td>
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<tr>
<td>Advanced Adaptive Cruise Control+</td>
<td>3.60%</td>
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<tr>
<td>Vulnerable Road Users Protection</td>
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<tr>
<td>Drowsy Driver Detection System</td>
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<td>Lane Keeping Assistant</td>
<td>2.10%</td>
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<tr>
<td>Night Vision</td>
<td>1.70%</td>
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<tr>
<td>Intelligent Speed Adaption -3</td>
<td>1.70%</td>
</tr>
<tr>
<td>Advanced Adaptive Cruise Control-2</td>
<td>1.70%</td>
</tr>
<tr>
<td>Lane Changing Assistant</td>
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</tr>
<tr>
<td>Blind Spot Detection</td>
<td>1.60%</td>
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<tr>
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<tr>
<td>Intelligent Speed Adaption -2</td>
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<tr>
<td>Cornering Brake Control</td>
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<tr>
<td>Intelligent Speed Adaption 1</td>
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<tr>
<td>Rear Light Brake Force Display</td>
<td>0.30%</td>
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<tr>
<td>Tyre Pressure Monitoring and Warning</td>
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<tr>
<td>Predictive Brake Assist</td>
<td>0.10%</td>
</tr>
<tr>
<td>Dynamic Suspension</td>
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<td>Traffic Sign Recognition</td>
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<tr>
<td>Brake Assist</td>
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<tr>
<td>Advanced Adaptive Cruise Control -3</td>
<td>0.00%</td>
</tr>
<tr>
<td>Advanced Adaptive Front Light System</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

TRACE – eIMPACT - Final Conference

26th June 2008
TRACE impact

A lot of work, a lot of progresses in accident causation analysis

Before

After
Thanks to those who have been attentive
Human Factors and traffic accident
Human Factor - Human Actor

- Road user is a component and a regulator of the driving system
- The very same functions allow him to adapt... and sometimes fail

SYSTEM COMPONENTS

MAN
- Experience
- Motivation
- Intention
- Emotion
- Attention
- Vigilance
-...

ENVIRONMENT
- Visibility
- Conspicuity
- Legibility
- Complexity
-...

VEHICULE
- Tyres
- Braking system
- Steering system
- Shock absorbers
-...

DRIVING ACTIVITY

FONCTIONS and OPERATIONS ENGAGED
- Perceptive
- Cognitive
- Active

OUTPUT

ADJUSTMENT

FUNCTIONAL FAILURE (“ERROR”)

- Accidents are the result of the failure of an usually adaptative function
- These failures are a link in the accident process
Further upstream Human errors

Different levels of intervention of factors along the accident process

- Failure inducers
- Failure triggers
- Defence weaknesses
- Protection blanks

Driving situation → Conflict situation → Emergency situation → Crash situation
Further upstream Human errors

- Some elements intervene further upstream, in the very conception of the driving system

Roads infrastructure generating "road delinquency"?

Vehicles inducing "road crime"?

- Driver's error is also the symptom of (human) errors of conception, management, legislation, organization, maintenance, etc.