

**RECOGNITION OF
DRIVING SITUATIONS
AND ROAD LEGIBILITY**

SUMMARY

The road user in traffic faces many conflict situations which are problems he has to solve. The process involved is then generally based on the recognition of the precise situation thanks to a pattern of clues which lead to the activation of an ad-hoc procedure of resolution. Incoherence in the traffic system - considered as a whole - can therefore lead to difficulties in recognition and sometimes misunderstandings.

In-depth accident investigations show importance of these dysfunctions, especially because driving is performed in a very high level of time constraint: an accident occurs in a few seconds which is a very short time for adequate recognition and for choosing the right action by the driver.

Improving road safety necessitates being alert to those cognitive processes and the structuration of knowledge on roads in the driver's head, whose integration makes possible a better "Legibility" of the space the driver is moving in.

1. INTRODUCTION

What are the main reasons for risk? To this question the workshop is trying to answer, I do not think we will be able to find very new answers, because for so many years, so much research has been done and 50 many papers written about road safety. However, and because we have nowadays a lot of experience and knowledge behind us, I will try to look at this precise question not really through the concept of risk but more precisely in the idea of prevention, in other words, in the way of designing a system with a better level of safety.

In this way I am not avoiding the topic of the workshop but on the contrary focusing on Ralf RISSER's recommendations in his invitation when he writes: "Imagine you have to tell authorities what they really should do to make traffic safer".

As a civil engineer I am interested in the designing of roads. When I work with people locally responsible for the road networks, I talk to people who are used to improving them through accident investigation and through a good common sense - these words are not derogative for me -. In Aeronautics industry this is called the three F approach: "fly - fix - fly". Build an aircraft and fly it. If it crashes, investigate that accident, find the causal factors, fix them, and fly again. Road accidents are more spread out, less spectacular and severe, even if globally they lead to a higher risk. Even so, with different procedures of investigation road improvement is made with a similar retrospective or backward-looking goal and conceptual framework.

However we can learn, through the experience gained that way, that unsafety comes from dysfunctions which result generally from a lack of consistency in the traffic system. Therefore integrated safety can be improved while looking at this system at different levels of analysis and paying attention to the consistency of the decisions and actions, taken at each of these levels.

2. SAFETY OF THE TRAFFIC SYSTEM

Looking at road network as a whole is not an obvious task even for a researcher. It is however much more easy to develop that point of view locally – in a town, a Department – that for designing a National safety policy. This is one of the reasons for the governments to develop incentive programs like the "minus 10%" type operating in France, Holland, Austria.

National safety problems can be seen as the sum of what takes place at a local level; thus, the list of black-spots in France is the sum of those observed in each "department" (French administrative area).

From this standpoint, local activities serve as a relay for national policy which, without them, would not in many cases become a reality. It therefore reproduces what is implemented on a national level: information campaigns, the application of road building and planning norms....

Because of taking into account risk calculation instead of processes and interactions analysis, measures planned on a national level are of ten based on monocausal road unsafety analysis. Thus, alcohol-related measures are not linked with measures directed towards the technical control of vehicles. However, on a local, and therefore less remote level, it is easier to consider a smaller-scale reality in a more "systemic" way. Viewed from this angle it becomes possible to incorporate geographical components, the spatial distribution of activity, town planning, population movements, road network history, into a more in-depth insecurity analysis.

This analysis is based on the commonly accepted idea that the driver is regulating a system (so called elementary) comprising three components: man, vehicle and environment. By referring to a system such as this, it is possible to stress the interaction between the different components, i.e.:

- collecting and processing information,
- driver's actions on the vehicle,
- dynamic behaviour of the car on the road.

It is important to analyse these mechanisms so as to understand the accident sequence and to explain the origin of the malfunction(s).

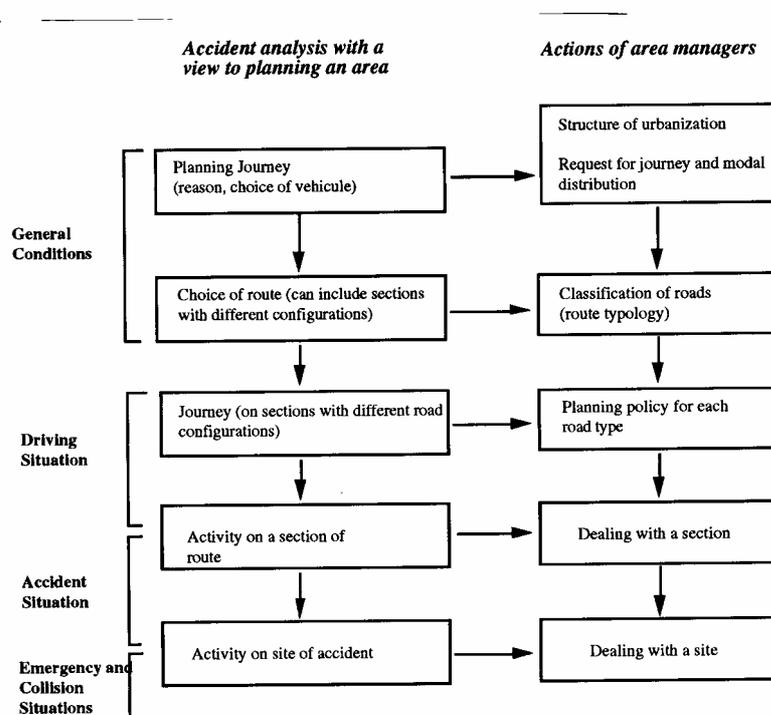
The accident-factors, related to the components are therefore independent from the occurrence of this specific accident. It is possible - and in my opinion it is part of the definition of the

word "factor" – to have an action on them in order to prevent these unsafety conditions from reappearing.

There is a great wealth of literature dealing with analysis models, giving preference in one way or another to functional sequences such as: information acquisition, processing, decision, action. This type of model can be said to be functional as it is focussed on the description of the relevant mechanisms and is aimed at understanding the malfunctions.

Another type of model is built up using the description of the different events as they occur (phase model). This description is based firstly on the kinematic reconstruction of the accident, so as to observe, at each instant, the speed co-ordinates for each vehicle, analyse each successive event and reveal the causal logic behind the way these different phases are linked together (see figure 1).

Figure 1: Conclusions drawn from accident analysis with a view to local measures



During the In-depth Accident Investigation "EDA" which took place at Salon-de-Provence in 1980, a phase model such as this was used to describe the accident as a succession of situations: General Journey Conditions, Driving, Accident (encounter), Emergency and Collision Situations.

It is obvious that these aspects should be complementary. If accident analysis based on a functional model can be used to determine the relevant mechanisms and the malfunctions, a phase model can be of use in "staging" the drivers/pedestrians throughout the sequence. It is therefore possible to go as far back as possible when analysing the unsafety determinants, and apply measures well before this unsafety occurs. More precisely, accident-factors such as home location, urban planification can be investigated whereas the in-depth investigations only referring to a functional model cannot think of them as relevant for safety analysis.

These models refer therefore to the analysis of a traffic system in different hierarchically-linked levels (see figure 1), which is an operational formalisation for both the analysis and the measures taken. Thus, the analysis of accidents using a phase model can reveal the extent of urban systems and the distribution of activity centres. Vehicle choice and usage are also affected by physical and geographical constraints, the hierarchy of the existing road network and public transport facilities. The processing of infrastructures, in physical and statutory terms, can also explain the behaviour observed.

Asmussen some time ago presented such a parallel between the phase model of the transport and traffic process and the consequences of this model for collective control. It was therefore possible to draw a parallel between the driver's regulation of the elementary system and the one made by the managers of the traffic system, what Asmussen called the micro-regulation and the macro-regulation. An important way to reach safety goals and for a safety program to be successful, is for the government decision-maker to take the wishes of individuals into account.

3. ROAD LEGIBILITY

Coming back to road and environment improvement, great attention is nowadays taken to the meaning of the space the driver is moving in. Road legibility is in connection with the physical characteristics of the road operating into the cognitive processes involved in the driving task.

As it is possible to see different levels in the analysis of an accident and the same parallel levels in the regulation of the whole traffic system, different levels of space legibility can be recognised. These different levels are generally studied separately. Roughly, the first level refers to the legibility of the city (see Lynch). Our present researches bear on the two other levels of representations which refer to other kinds of road legibility. More precisely, the hypothesis is investigated that the representations of road sections and of traffic

situations are structured into classes corresponding to different patterns of characteristics and procedures. The second hypothesis is the dependency of the representations of traffic problems upon the representations of the environment at the higher level.

Many technical improvement of roads and streets can be seen as a change in the section legibility, which lead the driver to an other interpretation of the space he is moving in. These kinds of operation first took place in town, changing a road into a street; they are nowadays more generally used.

4. TIME CONSTRAINT

The road user in traffic faces many conflict situations which are problems he has to solve. The process involved is then generally based on the recognition of the precise situation thanks to a pattern of clues which lead to the activation of an ad-hoc procedure of resolution.

In-depth accident investigations show the importance of dysfunctions in these processes, especially because driving is performed in a very high level of time constraint: an accident occurs in a few seconds which is a very short time for adequate recognition and for choosing the right action by the driver.

In most cases, an accident can be seen as the result of a lack of coherence in urban development, the road and overall planning which produce a discrepancy between driver activity and the situation actually encountered. This lack of coherence can lead to difficulties in recognition and sometime misunderstandings and therefore prevents the driver from anticipating what is going to happen. A general principle for improving safety could be to improve overall traffic system coherence, not only from a technical point of view but also as a social space.

Going farther in the analysis of the road system management shows that many lacks of coherence come from history, from land ownership and from a lack of pluridisciplinary work when different jobs are involved. But it also comes from the fact that technical actions take years to be implemented. The idea of setting a charter seems to be a safety tool useful as a guarantee to assure the coherence of the laying out of a public space during time.

5. RESEARCH PROGRAM ON ROAD LEGIBILITY

As a conclusion I would like to present briefly the co-operative programme on road legibility developed since four years by INRETS, the National Centre for Scientific Research (D. DUBOIS) and other research centres in France. The starting point of this programme was the implicit hypothesis regarding the categorisation of the urban and rural environment resulting from accident analysis, which had become an argument for the evaluation of the relevance of the theoretical framework elaborated on simple objects, applied to these complex environments.

Thus the questions to be investigated were the following:

- What is the cognitive categorial knowledge of the "common driver"? What is the hierarchical cognitive organisation of the environment elaborated through the driving behaviour?
- What sets of properties of the environment appear to be relevant for the categorial organisation and finally what clues (or patterns of clues) of the environment are associated as predictors of different types of problems or patterns of behaviour?
- What categories of the environment can be identified at the "basic level", adjusted to driving behaviour?
- Can "typical" representations be identified for the different categories of environments?

5.1. Study 1

A pilot study has been carried out to explore the semantic content of a set of words referring to the urban and road environment in order to accede to the representations associated to these verbal inductors. Subjects were presented with words such as "city", "urban area", "village"... belonging to 3 types of environment (urban environment, roads and streets, intersections). Then, they were asked to "activate" an image of the object or scene the word referred to, and finally, to name the properties of the object they "see in their mind".

5.2. Study 2

The second experiment follows the same line of arguments as the previous study but goes one step closer to the "real" ecological situation of driving, by using photographs of urban scenes, instead of words. Furthermore these analogical representations of the "real world" are processed through a non verbal method of investigation of categorial knowledge: a classification task. Subjects were thus required to classify sets of photographs showing approaches to intersections and their contextual road section, according to two different instructions. The first one stressed the morphological properties of the environment as a classifying feature, whereas the second one focused the subject's activity on the behavioural adjustment he would have had within the scene.

5.3. Study 3

The same set of slides as previously used in study 2 was implemented on a laser-video disk and subjects were required to react as fast as possible when they had identified a scene which induced a modification of their driving behaviour, and then to point out directly on the TV-screen (with a light pen) what property of the picture led them to the decision. The identification time was recorded and considered as an indicator of the legibility of the environment: the more legible it is, the faster the identification and the decision is.

5.4. Study 4

This study can be viewed as a revision of study 2, regarding the methods used but the questions concerned another set of photographs related to road sections discarding punctual environment events such as intersections, curves and also the traffic. This selection refers to the question of the categorisation of sections as the critical level for the generation of provisional frames and scenarios (in contrast with intersections which could be viewed as the level of problem identification and solving). The instructions required the subjects to estimate the "potential problems" they could meet and to classify the photographs according to this criterion. Nowadays 4 experimentations have been made with different sets of photographs in urban and rural areas.

5.5. Study 5

A new regulation in December 1990 reduced the speed limit in towns from 60 to 50 km/h. There were also introduced 30 km/h speed limit zones in certain areas, and also a maximum 70 km/h speed on certain road sections. An experimentation was set up to examine how categories of urban roads, according to these 3 speed limits would be divided into subcategories for driving activity. This experimentation consisted in having experienced subjects class pictures of urban sites, and in questioning traffic engineers on the speed limits in these sites. By using hypotheses of psychology, the results make clear the criteria the subjects used in structuring their representations as well as the order they used in taking into account pertinent clues.

5.6. Study 6

Drawings are much easier representations to deal with than photographs because it is possible to build different scenes according to any combination of characteristics. Different sets of drawings have therefore been made and experiments done according to the same procedure as experiments 4. It was discovered that moving the drawing from simplicity to complexity, lead to a change in the treatment from analytic to family resemblance. Further developments are prepared, to study inter-personal differences, and especially the influence of experience on the structuration of the knowledge. Video disk presentations should be emphasised as it allows the study of the coherence between the type of section which has already been specified by other experiments, the different kinds of conflict situations and the equipments which help the drivers to solve them. This system is also convenient for studying the dynamic sequential process involving these recognition and decision tasks.

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