Benefit Analysis of Driver Information and Driver Assistance Systems

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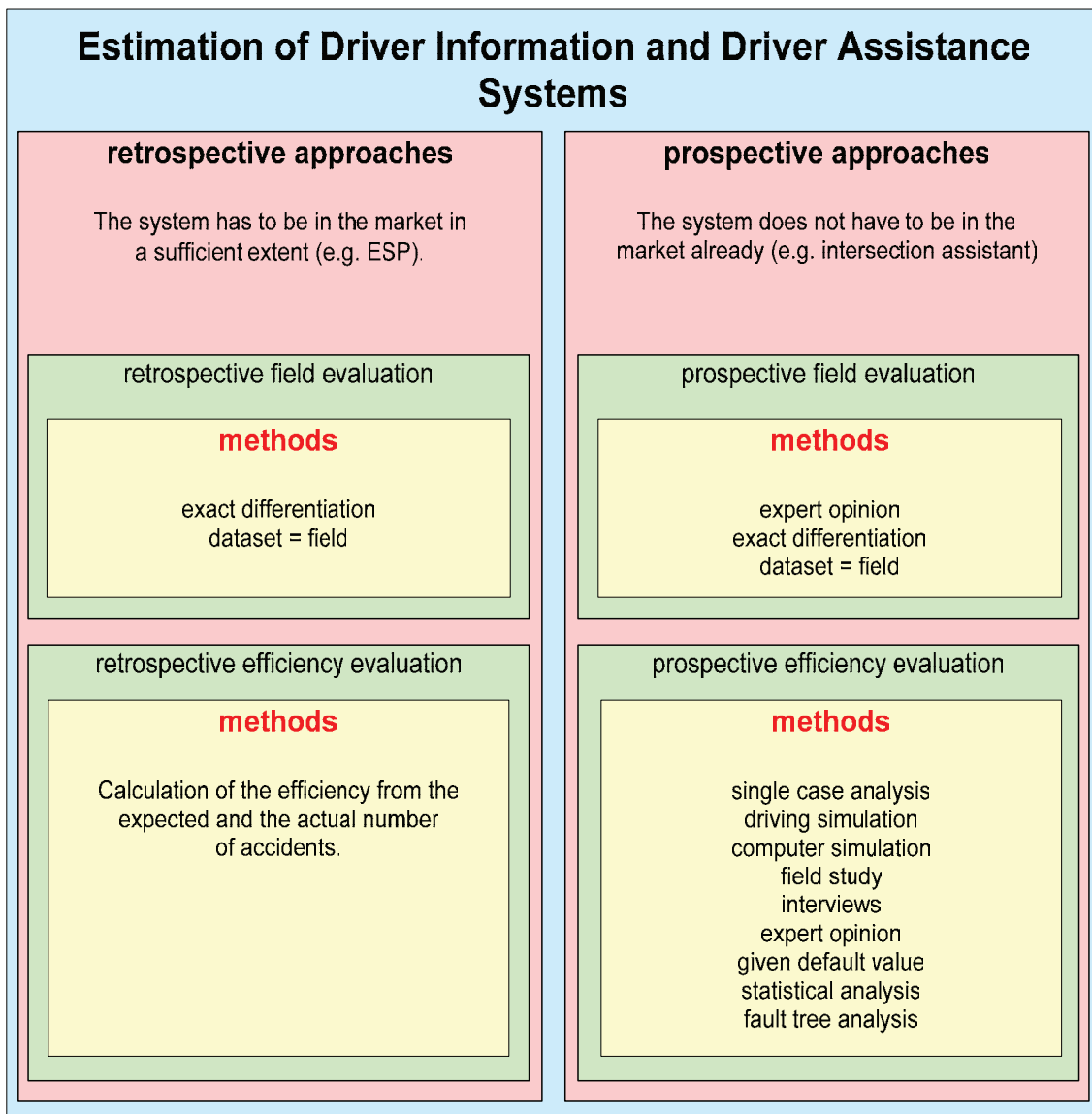*Verkehrsunfallforschung an der TU Dresden GmbH

Introduction

In the last years various new driver information and driver assistance systems made their way into modern vehicles and there are yet countless systems underway. However, expenses for both, the development and the construction of these systems are tremendous. Therefore the interest of evaluating systems keeps growing steadily, not only regarding the results of systems developed in the last years but also regarding system ideas. Only if at least a rough benefit estimation is given, the industry can decide which development should be supported. However, there is still a lack of transparency of possible and useful methods for these kinds of estimations. These were analyses and structured in this study.

Aims and methodology

In a thorough review of 78 national and international studies different approaches for benefit estimations of driver information and driver assistance systems were investigated. The used methods, key elements and results were structured in a toolbox and analyzed in detail. The different approaches were evaluated, further developed and validated for common system examples. The structured toolbox now offers a detailed overview about the possibilities for an evaluation and lists advantages and disadvantages of the different methods. Reference studies that used the specific method can be filtered from the literature database to give examples and detailed explanations.

Classifications of methods and estimations

As the analysis of the different studies showed, the wording and definition of benefit estimation methods varies quite heavily. Thus the different methods were structured in a model of four different levels. Level 1 is the system estimation in general. This estimation can be approached in two different ways: retrospectively and prospectively (Level 2). Within each of these groups there are two basic parts of analyses: the field evaluation and the efficiency evaluation (Level 3). Finally a large group of methods can be used for these evaluations (Level 4).

Estimation of Driver Information and Driver Assistance Systems

retrospective approaches

The system has to be in the market in a sufficient extent (e.g. ESP).

retrospective field evaluation

methods

exact differentiation
dataset = field

retrospective efficiency evaluation

methods

Calculation of the efficiency from the expected and the actual number of accidents.

prospective approaches

The system does not have to be in the market already (e.g. intersection assistant)

prospective field evaluation

methods

expert opinion
exact differentiation
dataset = field

prospective efficiency evaluation

methods

single case analysis
driving simulation
computer simulation
field study
interviews
expert opinion
given default value
statistical analysis
fault tree analysis

Picture 1 - General Structure: Benefit Estimation

Estimation of the field of a system

To estimate the field there are retrospective and prospective approaches. If the system is already present in traffic accident databases, all accident scenarios where the system could possibly have had an effect are considered in a retrospective approach. Possible methods are the exact differentiation of the field or the use of all cases in a dataset as the field.

If however a system idea or a very new system without reliable real world accident data available has to be estimated a prospective approach has to be chosen. Here the field covers all accidents that are theoretically addressable by the system. Thus all accident scenarios where the system could have an effect are addressed, without the evaluation of the extent of this effect. Here useful methods are the expert opinion, the exact differentiation of the field or again the use of all cases in the dataset.

Efficiency evaluation

In a retrospective approach the portion of accidents in the field that could have been mitigated or prevented by the system represents the efficiency within the field. It directly depends on the functional specifications of the system and can cover a maximum of 100%, meaning all accidents in the field. The used approaches all represent the methodology of calculating the efficiency from the expected and the actual number of accidents recorded.

In a prospective approach the portion of accidents in the field that could theoretically be mitigated or prevented by the system represents the efficiency within the field. Here a large list of possible approaches is given: the expensive and time consuming single case analysis, driving or computer simulation that usually need a large apparatus of technical equipment, field studies giving realistic results for a rather small group of users, interview and expert opinions for subjective evaluations and statistical analyses or fault tree analysis to put emphasis on scientific comprehension.

Estimation of system combinations

The benefit of a single system has to be distinguished from the estimation of system combinations. If several systems are used in a vehicle the accident can yet only be prevented once. Every system can have an influence itself but a plain addition of the benefits would lead to an overestimation. Special analyses including this idea become more and more necessary since there will be various different system within one vehicle in the future.