English Summary

Ease-of-use and safety aspects are essential attributes for assessing the quality of in-vehicle information systems (IVIS). Although most accidents due to distraction are related to events outside the vehicle, a significant effect of secondary tasks on driver distraction has been proven. These influences are particularly relevant for liability issues which are of increasing importance in the automobile industry. As a consequence, there have been numerous attempts to provide evaluation routines for IVIS, but "industry-best-practice" methodologies, that are widely accepted, are still missing. In the field of software ergonomics, such tools are already at hand. Usability engineering and human-machine interface (HMI) design guidelines as well as recommendations for dialogue principles have reached a high level of maturity; their underlying principles are widely accepted. In the domain of desktop computer applications, plant and machinery engineering and human-computer interaction for office work with visual display terminals, all levels of requirements according to Hacker's system of ergonomic evaluation (Hacker, 1998) are tackled: practicability (fulfillment of anthropometric requirements), lack of impairment and nuisance (avoidance of short-term stressors, long-term health problems and accidents), and personality enhancement (degree of self-fulfillment). Even so, these aspects also play a relevant role for the human-machine interfaces of IVIS. Regarding aspects of lower ergonomic-relevant levels such as perceptibility, evidence of conformity with existing norms can be proven in a straight line: the size of symbols, text, and color combinations are determinable, therefore compliance with normative rules can be assessed directly. For higher levels of ergonomic criteria, which are associated with higher mental processes, this verification cannot be done in such a straight forward way. First, there is no broadly accepted definition at hand, which mental restrictions are responsible for driver distraction during secondary task performance. Second, if critical parameters are indentified, their quantification can not necessarily be established directly. The latter aspect has been solved in software ergonomics by developing questionnaires which operationalize the postulated dialogue principles. In the field of automotive HMI, the solution was

a) to focus on quantifiable measures such as task duration, or

b) on the decline in performance during the driving task, this is done in a standardized way by the lane change task (LCT; Mattes, 2003).

The goal of the project ‚CarUSE' was to engineer a tool for describing and evaluating the automotive human-machine interface. This measurement inventory (which I called 'CarUSE-MI') is intended to be used as a rapid screening test to give hints about strengths and weaknesses of a certain HMI regarding its influence on driving safety. Overall, four key aspects are addressed: First of all, ease-of-use, intuitive use and cognitive ergonomic criteria of the interface are relevant quality aspects with some impact on driving safety. Based on these criteria, I developed a short usability questionnaire tailored to evaluate the human machine interface of IVIS. This questionnaire addresses psychological aspects, such as intuitive use and hedonic qualities, as well as design principles for screen layout and dialogue figuration. Second, the time to complete a certain task influences driver distraction. This has led to benchmark criteria such as the 15-second rule and similar suggestions regarding task completion time, which have found their way into guidelines and standard-like recommendations. Although static time on task is no perfect predictor of the amount of attention the driver addresses to a secondary task while driving, this rule of thumb is appealing because it allows evaluation results to be assessed and communicated in a straightforward way. Therefore, the CarUSE-MI allows calculating the static time to complete a certain operating task based on a simplified GOMS analysis. Third, operating a driver information system requires visual scanning which leads to a certain eyes-off-the-road time. Even though lane keeping can be accomplished with peripheral vision only, especially the reaction-time to critical incidents depends on focal vision to driving-relevant areas. I used a model developed by Horrey, Wickens and Consalus (2006) to predict visual attention allocation to in-vehicle information systems (IVIS) and the outside world, respectively. Finally, IVIS have to meet certain normative criteria, which are defined by a number of ISO and DIN standards. For IVIS and automotive HMI, critical aspects concern the color, size and shape of symbols, letters and words conveying the relevant information. The latter aspects are considered in the CarUSE-MI by a checklist to assess the conformity with such documents.