# User-centred System Design

Optimum interaction between humans and systems requires appropriate consideration of users' capabilities and skills during system development. This also applies to the railway sector.

User requirements regarding function, design and operation of respective interfaces must therefore be analysed and reviewed by interim results.

The RailSET® laboratory makes a substantial contribution to all levels of such a human-centred development process.

**Understanding Users**
User requirements should be paramount in the development process when designing concepts for new assistance and information systems or seeking improvement of existing systems.

At this stage conducting simulation studies enables data collection on actual user behaviour within completely controllable and reproducible scenarios. It also allows for studies of rare and hazardous operational events.

Fig.: Simulated approach to a level crossing without barriers

An extensive base of behavioural data is thereby obtained from the integration of various measurement systems.

Eye movements for instance, enable inference to sources of information that participants make use of. Driving data such as the braking or acceleration behaviour, or interactions with a train protection system can provide indicators for operating errors. Furthermore, measures of objective stress and perceived strain can be investigated.

Behavioural models and assistance concepts can then be derived, based on a detailed understanding of the tasks and problems of operators.

**Evaluating Systems**
Activities in usability testing of established interactive systems are increasing. Such analyses are commonly based on the principles of dialogue design as specified in DIN EN ISO 9241-110, such as conformity with user expectations, self-descriptiveness and suitability for the task.

Fig.: Simulated interface of the control centre operator workplace

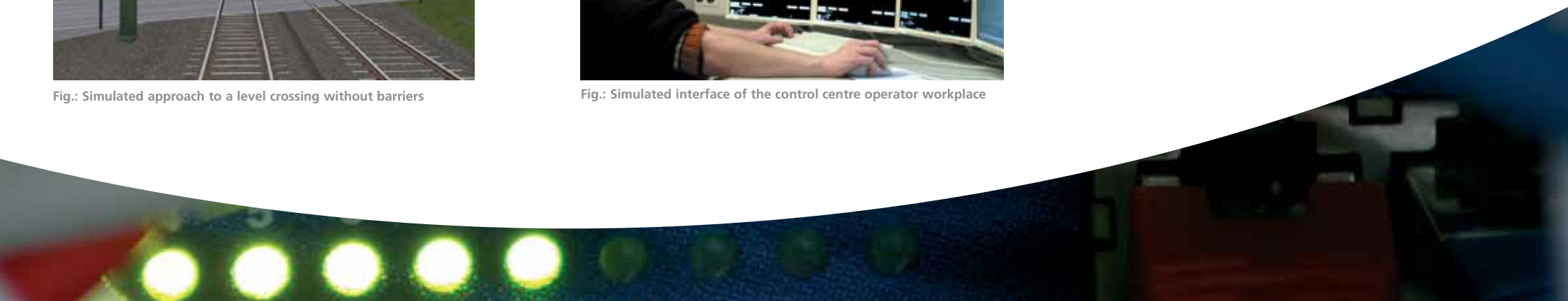
Here, simulator studies contribute particularly to a sophisticated analysis of the suitability for the task-criterion.

Objective measures such as error frequency or processing times within specified use cases, can be used to determine how effectively and efficiently users perform their work tasks with the system studied. Such scenarios also make it possible to gather users' subjective acceptance ratings for each task and help avoiding biases in judgment arising from the time delay between an event and its assessment.

**Testing Concepts**
The adjustable setup of the simulation environment facilitates the integration of prototype concepts for new information and assistance systems into the context of use. They can be implemented either as an extension to or as a replacement for existing systems. Compared to field operational tests, less time and cost is required for system integration and data collection.

Innovative approaches developed from requirements analyses or usability recommendations can thus be evaluated and developed further with support of actual users in realistic working conditions.

Moreover, as the scenarios in the simulator are controllable and flexibly manipulable, systematic comparative analyses between new and existing system configurations are made possible. Comparisons of respective effects on the users' experience and behaviour support the assessment of risks and advantages of new assistance and information concepts.



# Profile

As part of their functions as train drivers, control centre operators or rail traffic managers, humans in the railway system interact with several technical interfaces – both on board the train and in the control centres.

The effectiveness, efficiency and satisfaction with which employees perform their tasks affect the safety and efficiency of the railway system and are in turn affected by various factors related to the interactions between human, machine and environment.

RailSET® – Railway Simulation Environment for Train Drivers and Operators, enables a realistic representation of the context of use found in the workplaces of train drivers and control centre operators through a railway-specific simulation environment. Hereby, influencing factors can be modified as required and their subsequent effects on humans examined.

The train driver workplace for study participants is equipped with an original control desk from a railcar which is integrated into a closed cab. Subjects in the driver's seat experience a fully simulated route ahead, as well as the landscape passing by the side windows.

Trackside elements (such as signals and level crossings) are visualised along the track. Simulation according to the underlying control command signalling and safety technology can depict both regular and failure modes, enabling to study different operational scenarios without affecting real rail traffic or creating hazards.

These scenarios also allow for evaluations of new or existing information and assistance systems or design options for interactive systems at the train driver's workplace, as well as influences wielded by different protection systems.

Experimental facilities are complemented by a simulated workplace for control centre operators.

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## DLR at a glance

DLR is Germany's national research centre for aeronautics and space. Its extensive research and development work in Aeronautics, Space, Energy, Transport and Security is integrated into national and international cooperative ventures. As Germany's space agency, DLR has been given responsibility for the forward planning and the implementation of the German space programme by the German federal government as well as for the international representation of German interests. Furthermore, Germany's largest project management agency is also part of DLR.

Approximately 7000 people are employed at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen and Weilheim. DLR also operates offices in Brussels, Paris, and Washington D.C.

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