LEADER – driver advisory systems and the human factor

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Addressed topics of interest:

- Usability of advisory and assistance systems
- Mental workload
- Human Factors Integration

Abstract:

LEADER is a modern driver advisory system for rail operation of Knorr-Bremse. It has a history of next to 20 years of successful operation at railway operators mainly in North and South America, Australia and Europe. It targeted significant reduction of energy consumption as well as wear and tear of brakes, couplers and bogies.

It was from the very beginning designed as an advisory system, meaning that the system uses mainly a display screen to give advises to the train driver rather than doing automatic train operations. So the train driver stays in charge of driving, but in order to improve his driving performance he has to follow as closely as possible the recommendations without distracting him significantly from his standard tasks.

So throughout the development process challenges regarding the topics usability of advisory systems, mental workload, risk and situation awareness, human reliability and incident investigation had to be mastered. This problem solving was done with a couple of methods: Theoretical analysis, support of ergonomic experts, test drives and workshops with drivers and their mangers.

As a result LEADER supports the driver by providing foresight of the coming line infrastructure with an optimal speed profile to achieve for the section. It displays relevant information and driving advice messages on a touchscreen in an ergonomic and intuitive way, helping the driver to anticipate the track ahead and to operate the train more efficiently. Remarkable effects on energy efficiency, punctuality, and brake work reduction were achieved. In addition to that, the wear and tear of couplers and braking systems can be minimised. It is very important to get a high acceptance level at the drivers, otherwise they will not use it and the whole effort is in vain. Therefore it is a good achievement that “our” drivers reported that LEADER helped them to be more relaxed throughout the runs, and were able to pay more attention to safety issues.

Since LEADER is implemented subsequently as an external system most of the times, it is very important to find the right fit between being accepted by the driver and not disturbing him from the other tools and the driving itself. The principles of showing information just in the right time, not duplicating any information already available in the cab and the minimisation of the need to extensively interact with the system, were discovered as key-factors to the solution of these problems.

It is also important, that the driver can use LEADER intuitively and fast. That was achieved by providing a touchscreen unit, with a simple but informative interface that can be customised in many different ways, assuring that demands of the drivers and operators are perfectly fulfilled.
Since a train can operate during the day, at night (and is not allowed to use bright head lights in most operations), and also in tunnels, LEADER had to be designed for operation for both, sunlight and close to absolute darkness. The definition of colours and brightness of the driver-machine interface is designed individually to meet customer’s demands and to operate in perfect harmony with internal and external brightness conditions.

The LEADER system includes a Back Office, which logs all the data both automatically and manually collected, allowing detailed analysis of all operational data like clusters of delays or other incidents.

Concerning all those issues intensive tests have been made prior to the official usage of the system. The efficiency of the system and the user friendliness was well proven.

The presentation will explain how different the interfaces between LEADER and the drivers have to be according to local preferences around the globe using some real life examples. But besides the more technical aspects it also will focus on emotional issues and will show how drivers can be motivated to use such systems – and easy ways to demotivate them as well!