



## Perfection through Simulation

BEST operations and interlocking simulation  
for practice-oriented training purposes

Connecting IT and Transport

**funkwerk**   
information technologies

# BEST – The Solution for Increasing Challenges

Modern interlocking systems and control centres combine technology, operation, and control. As a result of this centralisation of safety and control technology the requirements for the train controllers and dispatchers increase. Qualified training of the operating personnel is the basic requirement for safe, smooth operations. With BEST operations and interlocking simulation, Funkwerk Information Technologies (Funkwerk IT) offers a system that effectively fulfils the increasing requirements on a long-term basis. Furthermore, thanks to its realistic simulations, BEST also optimises the quality of interlocking planning activities.

## Successful Training Programmes

For over 15 years, BEST has been used by many European railway and metro operators. The BEST interlocking simulator reproduces the user interface including all the necessary operating menus. The simulation of the interlocking technology with all external installations and train movements provides a realistic impression. For example, up to 400 different failures can

be simulated to help the operator learn correct behaviour in malfunction situations and to ensure smooth operation.

## Forward-looking Planning Activities

BEST can also be used to set up the planning process of interlockings on a more cost-effective basis. Weak points become quite clear well in advance thanks to the manufacturer-independent simulation of different interlocking types and operations control systems. This means that consequences such as delays and annoyed customers can be avoided – the high planning quality ensures smooth operation later on and thus saves time and cuts costs. BEST is an integrated system. The data prepared in the planning process can be used immediately afterwards for early training purposes.

## Periodic User Group Meetings

Funkwerk IT organises conferences and workshops at regular intervals for users of the BEST operations and interlocking simulation system. These events offer users an effective platform for exchanging information on the efficiency of BEST. The direct feedback from customers influences the further development of BEST.



# Better Training with BEST



Smooth and safe railway operations – that is the responsible task for the staff in signal boxes and operations control centres. At the same time, the staff are supported by complex control and safety systems. But how to react if the technical safety devices fail? What are the appropriate countermeasures if deviations from normal operation suddenly occur? Because of the high train density in railway networks, the right decisions must be made very quickly. To ensure that train controllers and dispatchers always react with handling confidence, intensive training in all conceivable situations is necessary. BEST operations and interlocking simulation provides a cost-effective solution for that purpose – practice-oriented, manufacturer-neutral, and suitable for all interlocking types.

## Fulfilling Tomorrow's Directives Today

From now on, European directives will demand consistent simulator training in all transport sectors. Already today, many European railways and metros use BEST operations and interlocking simulation to secure the safety and quality of their railway operations by means of the integrated training of their train controllers and dispatchers on the simulator.

## For Basic and Further Training

BEST can be used in all areas of training. A clear distinction is made between a basic training programme for new staff and continuing training measures for experienced staff. Experienced train controllers must be trained for the commissioning of new interlockings or for changed operations programmes. Beyond that, recurring training measures and tests are required for the purpose of maintaining operator authorisation for an interlocking.

## References

- Deutsche Bahn AG
- Österreichische Bundesbahnen
- BLS AG (Schweiz)
- CFL (Luxemburg)
- Infrabel (Belgien)
- Hochbahn AG (Hamburg)
- Stuttgarter Straßenbahnen
- Stadtwerke München
- Berliner Verkehrsbetriebe

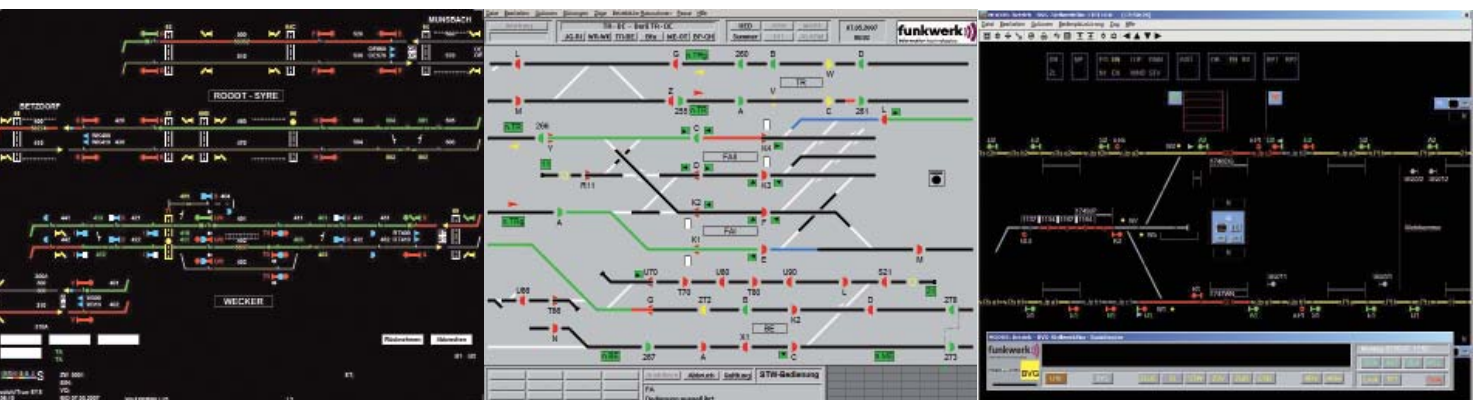
# Simulation Technology Catches On



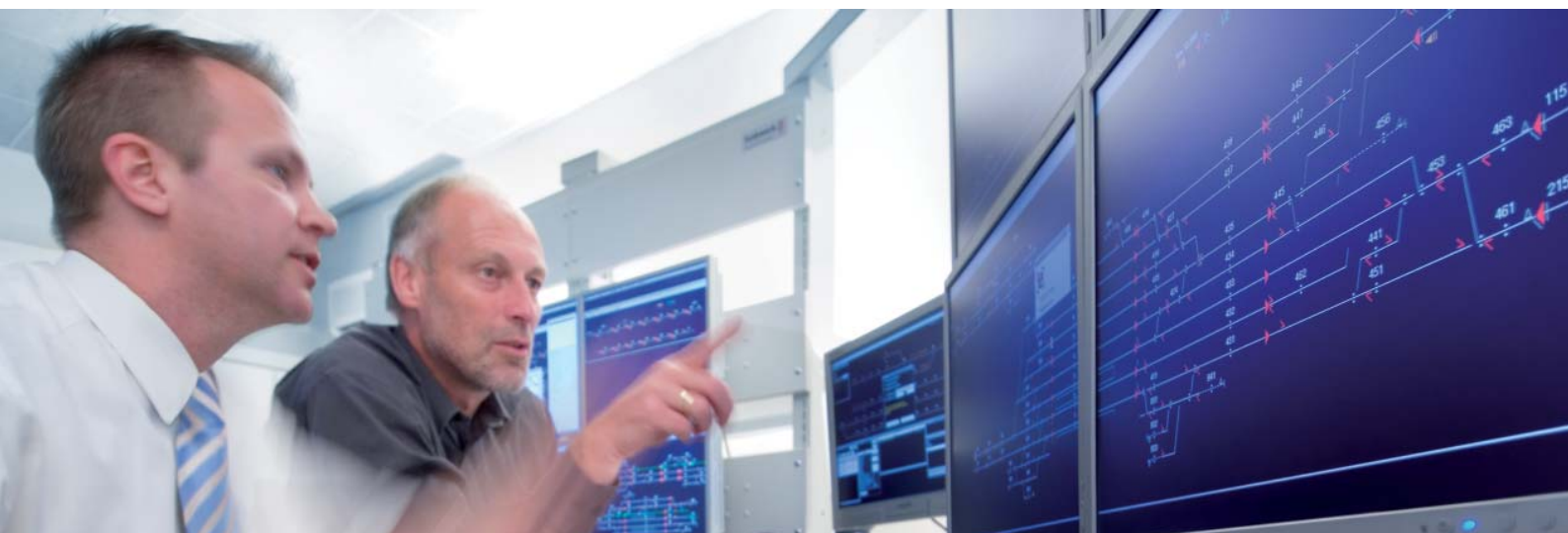
## Practical Experience for the Basic Training Programme

New staff in the operations department face the challenges of learning both the operation of highly complex systems and the safety-relevant operating regulations in a very short period of time. Theory and practice must complement each other perfectly. The practical application of knowledge can be excellently trained using the BEST simulations. No other training medium is able to make technology, regulations, and operational

processes „experienceable“ in the true sense of the word. BEST is able to simulate all conceivable cases of malfunction so that the future train controllers can practise correct solution behaviour right up to confident command. Any influence on running operations as a result of training measures is ruled out from the start. In comparison with other training methods, simulation with BEST shortens the training period.



# Always One Step Ahead: BEST



## Smooth Commissionings through Simulation Training

Commissionings and modifications of interlockings make high demands even for experienced operating personnel. During the process of centralising the interlockings in operations control centres, train controllers with local knowledge must be in complete command of the new systems and operating regulations or train controllers from the control centre must acquire the necessary local knowledge. That must all be provided against the background that the railway operations must be completed perfectly starting from the first day of commissioning and that no more time is available for familiarisation purposes. With BEST, the training of the interlocking operators begins a long time before the commissioning of the actual interlocking. Due to the previous simulation of the interlocking with all vehicle dynamics processes, the timetable, and all conceivable technical and operational malfunctions, the commissioning then runs smoothly – as documented by many examples in practice. Even the effects of future construction measures or major events on railway operations can be tried out on the simulator. In preparation for

EXPO 2000 and the Football World Championship 2006, those kinds of malfunction scenarios were drawn up and the handling strategies tested on the simulator. As a result, functioning solutions were already available before any problems came up.

## Handling Confidence in Cases of Malfunction

Due to the routine of trouble-free operations in interlockings and control centres, the knowledge of special operating activities during failures and malfunctions of system components is no longer readily available in the minds of most of the staff. The simulations provided by BEST make it possible to train these situations during running railway operations at any time, at any place and, most importantly, without exposing passengers, freights, and rolling stock to any hazards. Standardised test scenarios that serve as proof of maintenance of a train controller's operating authorisation can be trained on the simulator. All in all, BEST offers clear advantages over exclusively theoretical re-training programmes.

## Advantages of the BEST Training System:

- Shorter, freely plannable training periods
- High handling confidence of the staff
- Hazard-free malfunction and stress training
- Training of realistic scenarios
- Training system independent of the manufacturer and type of the interlockings
- Acceptance of real timetables
- Separation of commissioning from training in the case of new installations

# Modular Design



## Simulation of Interlocking Logics and External Installations

BEST operations and interlocking simulation reproduces reality in lifelike form for training purposes. During a training programme, the operator cannot see any difference to the real system. In BEST, each interlocking section can be simulated with real topography. The special features of the interlocking logics are taken into account in the same way as the manufacturer-specific differences with regard to the operating and display interfaces. The time behaviour of the interlocking and the external installation is reproduced in real-time (e.g. for route settings).

## Simulation of Train and Shunting Movements

Railways operate according to timetables. Every deviation in the form of delay minutes constitutes a loss of quality. In the simulation with BEST, any number of trains can travel with a stored copy of the original timetable. The timetable data can be transferred from external systems and be reedited, if necessary, with an editor. Furthermore, the trainer can start any desired number of train trips and shunting movements with realistic vehicle parameters and

appropriate dynamics at any time online. This also enables the training of special transport operations and trips of breakdown trains in the case of infrastructure and vehicle damage.

## Simulation of Technical and Operational Malfunctions

All operationally important external installations can be provided with malfunctions in detail and produce realistic effects on railway operations. The correct reaction of the operators to the malfunction is made possible with the simulation of the technically permissible auxiliary operating activities. Further operational disruptions like delays, stopping time extensions, train malfunctions, re-routings, etc. are also simulated. This means that disruption scenarios that have occurred in practice can be easily reproduced.

## Line and Network Simulation

A railway network is usually controlled by several interlockings. In normal operation and especially in the case of faults, the operators must coordinate their activities in order to maintain the train operations. This applies to dispatching measures and to safety-relevant actions extending beyond the

interlocking limits. In order to train the interaction of the several interlockings with different operators, various interlocking sections – including different equipment systems – can be combined to form one line or network simulation. This is supported by a convenient configuration tool.

## Evaluation of the Simulation

The quality of railway operations is measured in delay minutes. The same standard of quality is also specified for train controllers in training programmes. On the basis of the simulation with timetable operations, the delay minutes can be evaluated in every operational situation. This means that comparisons with optimum solutions can also be carried out in standardised test scenarios for faults.

# BEST Planning and Cost-effective Implementation

A large number of responsible persons are involved in the planning of control and safety technology. During the commissioning, undetected errors are then revealed in delay minutes to the customer. Necessary corrections result in considerable additional costs for a project.

The BEST operations and interlocking simulation from Funkwerk Information Technologies supports an integrated data management system and accelerates the planning process by drastically reducing the effort and expenditure for the input of data.

## Simulated Planning Activities Reduce the Effort and Expenditure

With BEST operations and interlocking simulation, the interlocking is simulated in detail already in early planning phases. All the interlocking functions, engineering variants, monitor images, and the entire timetable are displayed with the realistic running behaviour of trains. The operating interface is identical to the impression that the operators will find in their daily work. This provides the basis for a functional and operational verification presented in very clear form. Already upon completion of the planning activities, the simulation of the operational sequence is assessed – independent of the original interlocking.

## Tested, Uniform Data Improves the Quality

In addition, BEST offers the advantages of an integrated, electronic data management system. Interfaces to existing database systems and planning tools can be integrated. Following completion of the planning work, all the data is exported in a defined format. If necessary, the interlocking manufacturer can work with the electronic data and will receive the draft of the monitor

images already as the result of the planning process. At the end of the planning activity, verified and validated plans are therefore available with repeatedly tested quality.

## Beginning the Concrete Training Earlier

Due to the fact that the planning system for interlockings is based on the same platform as the training system, the data prepared in the planning process can be used immediately afterwards for training purposes. No additional effort and expenditure is required in order to be able to use the simulation system for training purposes prior to the commissioning of the new interlocking.

## Advantages of the BEST Planning System:

- Functional, operational testing of interlocking planning activities
- Reduction of extra costs from operationally required supplementary work
- Integration of the human factor of operators into the interlocking planning activity
- Redundancy-free data storage and quality assurance in the planning process
- Import and export of data, such as route and signal tables or XML tables
- Handing over electronic interlocking data to the manufacturer
- Statistical evaluations





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