Perfection through Simulation
BEST Operations and Interlocking Simulation for Practice-oriented Training
Modern interlocking systems and control centres combine technology, operation, and control. This centralisation of safety and control technology places increasingly higher demands on train controllers and dispatchers. Qualified training of operating personnel is the basic requirement for safe, smooth operation. Scheidt & Bachmann System Technik together with their partner Trans-SYS Kft. offer the BEST operations and interlocking simulation, a system which fulfils these constantly increasing training requirements on a long-term basis. Furthermore, thanks to its realistic simulations, BEST is also used for planning of line sections and interlockings as well as for specification of new systems.

Successful Training Programmes
For over 20 years BEST has been used with great success by many European railway and metro operators. Every year, more than 7,500 train controllers take part in training courses on the simulator. BEST reproduces the user interface of the original systems including all the necessary operating menus. The simulation of the interlocking technology with all external installations and train movements provides a realistic impression. Up to 400 different failures can be simulated to help the operator learn the correct course of action in malfunction situations so that smooth operation is ensured.

Forward-looking Planning
BEST can also be used to set up the planning process for new line sections and interlockings on a more cost-effective basis. Weaknesses become obvious before development of the original systems begins thanks to the manufacturer-independent simulation of different interlocking types and operations control systems. This means that costly additions or changes to projects can already be avoided at the planning stage. The high planning quality ensures smooth commissioning later on and thus saves time and cuts costs. The BEST simulation has already been used to support the specification and testing under realistic conditions of new control and safety systems. Simulated prototypes ensure user acceptance of new developments. The integrated approach of the BEST system means that the data prepared in the planning process can be used immediately to start personnel training at an early stage.

Networking and Information Exchange
Scheidt & Bachmann System Technik 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.
Smooth and safe railway operations – that is the responsible task for the staff in interlockings and operations control centres. They are supported by complex control and safety systems. But how to react if the technical safety devices fail and appropriate countermeasures have to be taken very quickly? To ensure that train controllers and dispatchers always react with handling confidence, intensive training in all conceivable situations is necessary. The BEST operations and interlocking simulation provides a cost-effective solution for this purpose – practice-oriented, manufacturer-neutral, and suitable for all interlocking types.

Fulfilling Tomorrow’s Directives Today
European directives now demand consistent simulator training in all transport sectors. Many European railways and metros already 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 is used in all areas of training, both for basic training of new staff as well as further training courses for experienced staff. Even experienced train controllers need training for the commissioning of new interlockings or for changes in operations programmes. Furthermore, train controllers are required to take part in periodic refresher courses and tests in order to keep their authorisation for interlocking operation. A BEST simulator is the ideal, flexible medium for all of these training purposes.

References
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- Österreichische Bundesbahnen
- Schweizerische Bundesbahnen
- BLS AG (Switzerland)
- Rhätische Bahn (Switzerland)
- CFL (Luxembourg)
- Infrabel (Belgium)
- MÁV (Hungary)
- Hochbahn AG (Hamburg)
- Stuttgarter Straßenbahnen
- Stadtwerke München
- Berliner Verkehrsbetriebe
- üstra Hannover
- Wiener Linien
- SMRT (Singapore)
Practical Experience during Basic Training

New operating staff 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 future train controllers can practise correct solution behaviour until they fully master each situation with confidence. Any influence on actual rail 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 by up to 30%.

Smooth Commissioning by Simulation Training

Commissionings and modifications of interlockings place high demands even on experienced operational personnel. With centralising operations in large-area control centres, train controllers must gain both local site knowledge and operating the new control system. The background to this scenario is that when the interlocking is commissioned railway operations must run perfectly from the very first day and there is no more time for familiarisation with the system.

With BEST, training of 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. As a result, functioning solutions are already available before any problems arise.

Handling Confidence in Case of Malfunctions

Due to the routine of trouble-free operations in interlockings and control centres, the knowledge of special operating procedures 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 practise these situations during actual rail operations at any time and in any place, but most importantly, without endangering passengers, freight or rolling stock. Handling of standardised test scenarios on the simulator is accepted as proof for a train controller’s authorisation to operate interlockings. Overall, BEST offers clear advantages over exclusively theoretical further training programmes.
The BEST simulation system is based on a tried and tested simulation platform which can reproduce any interlocking. The system simulates many different interlocking technologies (mechanical, electro-mechanical, relay, electronic) by different manufacturers. The specific functions and user interfaces required by each user are reproduced in detail.

The simulation system is based completely on PC components (both hardware and software). No components from the original systems are used which makes implementation and maintenance of the system relatively uncomplicated. Integration of the system into existing IT structures is not usually necessary, but possible in order to supply the simulation system with data from production systems (infrastructure and timetable).

The simulation software fulfils the requirements for all training levels and is implemented in different configurations. Full-Scope simulators reproduce every detail of modern control centre workplaces and enable training of realistic scenarios. The training units are controlled and monitored by training supervisors.

Part-Task simulators are also being increasingly used as a training method so that trainees can pursue their further training through self-learning or prepare for important training programmes. Trainees operate these simulators themselves and work on specific, prepared practice scenarios.

The operations and interlocking simulation is configured specifically for each individual customer. The major advantage of this is that one consistent simulation software package fulfils all the tasks required by the railway company. Separate software solutions for different applications are not necessary. BEST fulfils all requirements - from stationary simulation installation to web-based training. The web solution is platform-independent and compatible with all standard web browsers and also tablet / PCs.

Always One Step Ahead: BEST

- Training periods are shorter and can be planned more flexibly
- High handling confidence of staff
- Hazard-free malfunction and stress training
- Training of realistic scenarios (incl. timetable and disruptions)
- Training system independent of the manufacturer and type of interlocking
- Can be used as an instructor-controlled multi-user system or web-based single-user system for self-training and further practice
- Training for new installations is separated from commissioning
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 control area can be simulated with real topography. The system takes the special features of the interlocking logics into account as well as the manufacturer-specific differences with regard to the user 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. In the simulation with BEST, any number of trains can travel based on the original timetable. Interfaces to external timetable systems provide the operating programme which can be further processed using an editor, if necessary. Furthermore, the trainer can start any desired number of train trips and shunting movements with realistic vehicle parameters and appropriate running dynamics at any time online. This also enables the training of special transport operations and trips of emergency trains in the case of infrastructure and vehicle damage.

Simulation of Technical and Operational Failures
All operationally important external installations can be provided with detailed malfunctions which produce realistic effects on railway operations. The correct reaction of the operators to the malfunction is made possible by simulation of the technically permissible auxiliary commands. 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 reality can be easily reproduced.

Multi-User Simulation
A railway network is usually controlled by several interlockings. During normal operations and especially in the case of faults, operators must coordinate their activities in order to maintain train operations. This applies not only to dispatching measures but also to safety-relevant actions extending beyond the interlocking limits. In order to train the interaction of several interlockings with different operators, BEST can combine various interlocking sections – even if controlled by means of different interlocking technologies – for multi-user simulation. The operators take on different roles in the operation procedure just as they would in a real situation.

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. In addition, operating actions and non-compliance with regulations can be documented and evaluated.

The BEST Planning System
- Functional and operational testing of interlocking planning processes
- Integration of the human factor into interlocking planning
- Specification and prototyping in a realistic operational environment
- Redundancy-free data storage and quality assurance in the planning process
- Import and export of data
- Electronic interlocking data handed over to the manufacturer
- Statistical evaluations
A large number of responsible persons are involved in the planning of control and safety technology and numerous changes are made during this process. During commissioning, planning deficiencies are revealed (as undetected errors) in delay minutes to the customer. Any necessary corrections result in considerable additional costs for a project.

The BEST operations and interlocking simulation supports an integrated data management system and accelerates the planning process by markedly reducing the work and expenditure involved in the input of data.

Simulated Planning Reduces Effort and Expenditure
With BEST operations and interlocking simulation, the interlocking is simulated in detail already in the 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 in a manufacturer-independent test environment. As soon as planning is completed the operations sequence is simulated and assessed – independently from the original interlocking.

Tested, Uniform Data Improves the Quality
In addition, BEST offers the advantages of an integrated, electronic data management system which enables integration of interfaces to existing database systems and planning tools. Following completion of the planning work, all the data is exported in a defined format. If necessary, the interlocking manufacturer can import the electronic data and receives the draft of the monitor images produced during the planning process. At the end of the planning stage, verified and validated plans of tested and confirmed quality are available.

User-friendly Implementation of New Systems
The main challenge in the development of new control and safety technology lies in adapting highly complex and automated processes to the users’ requirements. The BEST simulation system has already been used in several new developments for specification and prototyping. The future users are confronted in the simulator with the new system in a realistic operational environment. In this way, user-oriented improvements flow into the design process before the system is implemented.

Beginning Training Earlier
The planning system for interlockings is based on the same platform as the training system. This means that the data prepared in the planning process can be used for training purposes. No additional work or expenditure is necessary for the creation of training software. With the BEST simulator training for a new interlocking can begin in good time before commissioning.
Scheidt & Bachmann System Technik GmbH
Edisonstraße 3 - 24145 Kiel - Germany
Tel. +49 431 2481-488
Fax +49 431 2481-501
office.kiel@scheidt-bachmann-st.de

Scheidt & Bachmann Österreich GmbH
A-4030 Linz - Straubing Straße 4
Tel. +43 732 321177-0
Fax +43 732 321177-99
office.linz@scheidt-bachmann.at

Scheidt & Bachmann Polska Spolka z.o.o.
ul. Wąska 15 - 62-030 Luboń - Poland
Tel. +48 61 8306637
Fax +48 61 8633823
sbp@scheidt-bachmann.pl

Scheidt & Bachmann Slovensko s.r.o.
Priemyselná 14 / P.O.Box B-143 - 012 32 Žilina - Slovakia
Tel. +421 41 5060 111
Fax +421 41 5060 118
sb@scheidt-bachmann.sk

Scheidt & Bachmann Israel Ltd.
Air Port city / P.O.Box 204 - 70150 Ben Gurion - Israel
Tel. +972 3 9792365
Fax +972 3 9730330
office@sbparking.co.il

Verkehrs- und Industrietechnik AG
Industriestraße 11 - 5432 Neuenhof - Switzerland
Tel. +41 56 4163434
Fax +41 56 4163435
info@vtag.ch

Dunántúli Távközlési és
Biztosítóbérendezési Építő´ Kft.
Vasút u. 22 - 9700 Szombathely - Hungary
Tel. +36 94 324-221/107 m
+36 94 512-553
Fax +36 94 512-580
tbef@dtb.hu

Scheidt & Bachmann Sverige AB
Stadionsgatan 65 - SE-217 62 Malmö - Sweden
Tel. +46 40 6716 600
office.malmo@scheidt-bachmann.se

Scheidt & Bachmann GmbH
Signalling Systems / Systeme für Signaltechnik
Breite Straße 132 - 41238 Mönchengladbach
Germany
Tel. +49 2166 266-628
Fax +49 2166 266-475
www.scheidt-bachmann.de
signaltechnik@scheidt-bachmann.de