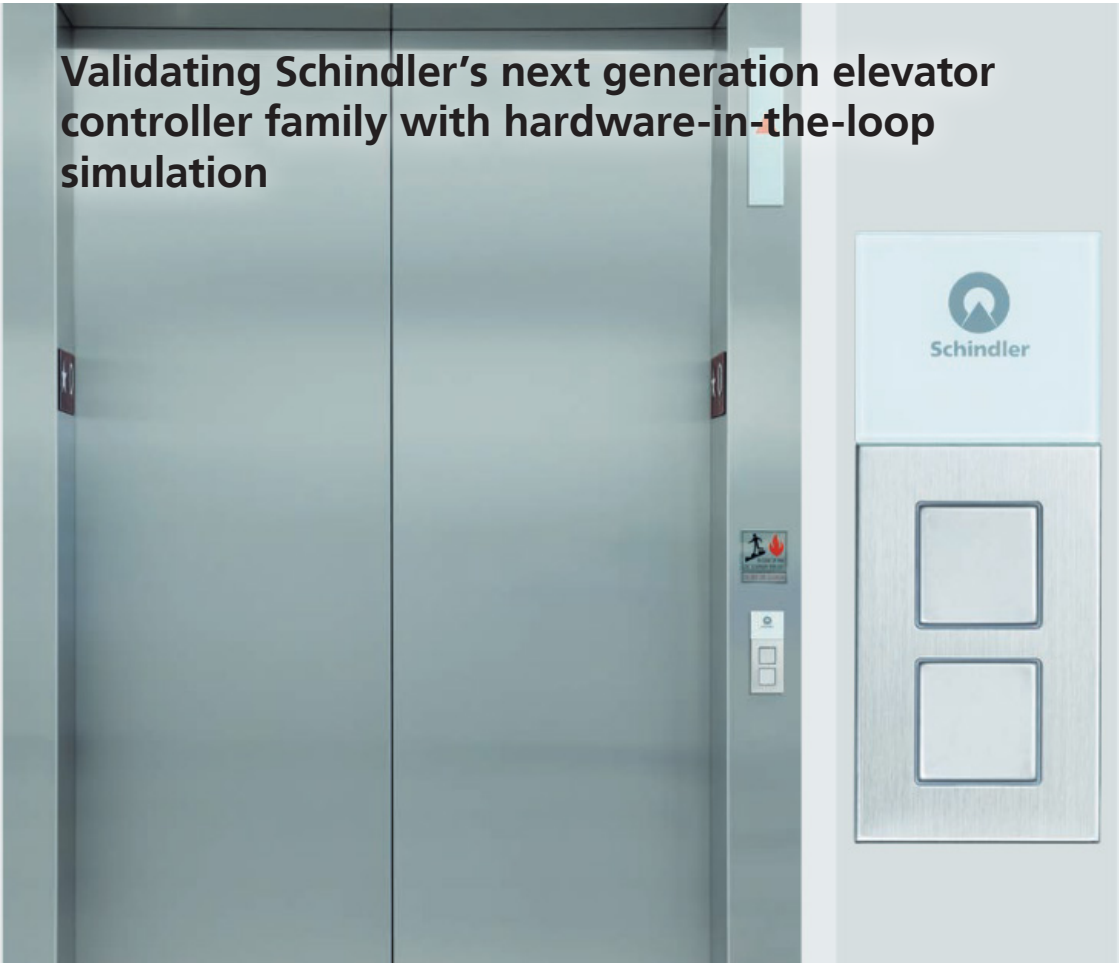
Schindler Elevator Corporation

Validating Schindler's next generation elevator controller family with hardware-in-the-loop simulation



speedgoat
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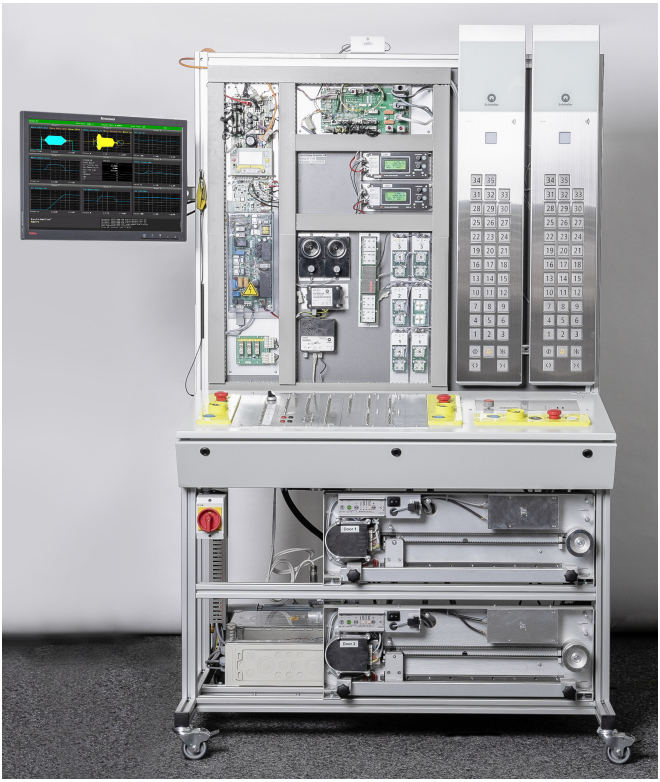


Schindler Elevator Corporation (hereinafter Schindler) are effectively using Speedgoat's robust hardware-in-the-loop (HIL) simulation setup to validate their next generation elevator controller now quicker than ever before

The Digital Transformation department at Schindler in Ebikon, Switzerland are responsible for providing model-based tools for the product development process and focusing on the early integration of the controller into a virtual system and its validation. They are currently working on the Controller HIL project and have developed a lean and mobile simulator for the controller platform with an integrated HIL system using both Speedgoat and MathWorks products.

The elevator controller is the elevator's core system that ensures the safe and efficient operation of the entire elevator system by:

- using an efficient dispatch algorithm to best process elevator calls
- calculating the most efficient trip by taking into account other people calling the elevator to the same floor or different floors or in different trip directions
- coordinating subsystems for the proper operation
- monitoring availability of critical components
- running diagnostics
- assisting acceptance tests performed on-site after installation

The objective of the project is to perform an automated Software Release test (SRT) for the elevator controller under different system configurations covering various different test cases. This elevator controller platform will serve as the basis for a real elevator controller.

The Challenge

The main challenge that Schindler faced with the conventional SRT - which had to be performed on a real system - pertained to time. Due to the limited availability of the test infrastructure, there were long waiting times. The SRT could only be executed late in the development process when all the system components were physically ready for the system integration. The SRT itself was also time-consuming.
In addition, very high elevator configurations, such as 400 m, could not be easily tested. A manual execution of a complete SRT usually took up to four weeks.

The Solution

Schindler added a new HIL environment to their controller platform using Speedgoat's Performance real-time target machine and Simulink®-programmable FPGA I/O module, IO334, to run virtual SRTs for an arbitrary elevator configuration overnight at the end of their fingertips and inside their development office.

For the plant modeling, Simscape™ is leveraged as a physical modeling tool to achieve the necessary fast execution in real-time. Parts of the model are executed on the IO334 FPGA I/O module.

The Results

This complete setup allows Schindler to advance projects quicker, focus on the task at hand, and work very efficiently because they are able to identify and eliminate any bugs and errors early in the virtual integration setting before going into the test tower for the final qualification.

The biggest advantage Schindler found in using Speedgoat products were the guaranteed functionality and ease of use with MathWorks products as their chosen modeling software.

One aspect that the SRT tests for is the safety gear. In order to avoid the free fall of the car in a hazardous situation, a safety gear is mechanically engaged to stop

the elevator car. The controller is used to validate this mechanical function through an Assisted Acceptance test which purposely sets the elevator system to a condition where the safety gear has to be engaged.

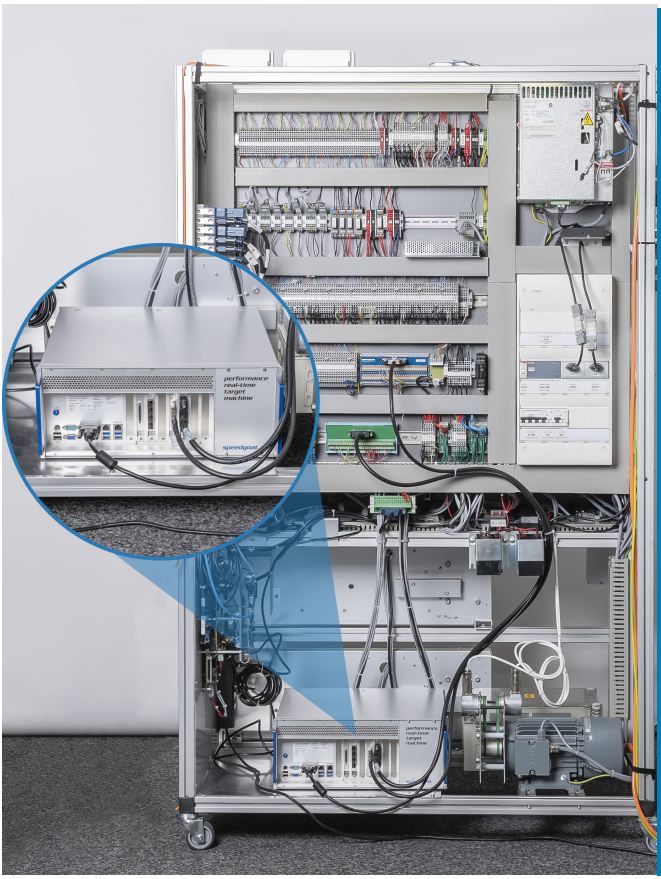
Traditionally, such a test took two to eight hours in the test tower, but now the test for a single system configuration only takes 90 seconds, and the tests can be repeated for different elevator system configurations using the HIL system with the automated test environment.

Schindler is currently integrating the Controller HIL System into the test automation framework in order to automatically execute the test cases on the elevator system configuration.

> “We didn’t want to have issues with the linking of the model and hardware, so we decided to work with Speedgoat.
>
> The integration of the whole system was in the MathWorks environment so it just simply worked.”

> “The main big plus is the integration with MATLAB.”
>
> - Manuel Pijorr, Senior Simulation Engineer, Schindler
> - Titus Bucher, Project Manager Control HIL, Schindler

Top left: front view of the Controller HIL System
Middle right: Manuel Pijorr, Senior Simulation Engineer
Bottom right: back view of the Controller HIL System with the Performance real-time target machine in place



The Key Benefits

- **Reduction of test execution times from up to 4 weeks when done manually to about 12 hours thanks to the HIL system and test automation**
- **Validation of safety gear tests in 90 seconds compared to 2~8 hours**
- **Quicker insight and elimination of errors and bugs at the beginning of the project due to an early virtual system integration**
- **Rigorous automated testing enabled through easily changeable parameters and configurations in the virtual HIL simulation setting**

Utilized Speedgoat products:

» Performance real-time target machine
» IO334 Simulink®-programmable FPGA module providing fast analog input and output
» IO334-21 providing digital input and output
» IO334 HDL Coder Integration Package enabling all the interfaces of the IO334 to be accessible within the HDL Coder™

Utilized MathWorks products:

» MATLAB®
» Simulink®
» Simscape™
» MATLAB Coder™
» Simulink Coder™
» HDL Coder™
» Simulink Real-Time™

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