



# ZF Group Optimizes End-of-Line Testing with KNIME

## The challenge of becoming data-driven

The last checkpoint before the product leaves the factory is end-of-line (EOL) testing. These final tests are key to increasing safety and reducing warranty claims, but typically cost manufacturers 4-6% of their revenue.

ZF is a global technology company supplying systems for passenger cars, commercial vehicles and industrial technology. They employ over 157,500 employees worldwide and in 2021 reported sales of €38.3 billion. They produce complex mechatronic and electronic products, such as transmissions or e-axes comprise multiple parts. For electronic parts 100% tests are required at three steps in the production value chain. The effect this amount of testing has on cost is huge.

The people behind the Test Systems Product Line at ZF are specialists for the validation and development of test facilities. Gert Jeckel, Senior Manager Data Analytics at ZF Test Systems, and his team identified the value of using advanced analytics to optimize EOL testing and gain significant savings in time and money.

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## Company

### ZF Friedrichshafen AG

ZF is a global technology company supplying systems for passenger cars, commercial vehicles and Industrial Technology. Their product line, Test Systems, develops, produces, and retrofits test systems for on- and off-road mobility. They are specialists for validation & development test facilities and provide advanced analytics services based on KNIME.

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Automotive

Manufacturing Analytics

## Redundant, expensive EOL testing

Electronic component production is part of ZF's value chain. After an electronic board has been produced in the assembly line, it undergoes three 100% electrical checks while the product receives interfaces like plugs or housing. In-circuit testing checks all the internal electronic functions. Next the board is subjected to a run-in test, where it is exposed to extreme ambient temperatures: -40, +20, and +120 degree Celsius. After final assembly, which involves placing the final covering, plugs, and cables, the board undergoes its third 100% check.

Quality engineers physically carry out 1000 measurements on each and every board. This is not only costly and time consuming, it also has a huge carbon footprint impact because of the energy needed for the extreme temperatures used in conducting these tests. The data analytics team's objective was to optimize the process by reducing the most expensive part of the process: physical testing.

## Physical testing reduced by 95%

Learning from the results of in-circuit testing, a machine learning model is now used to test the parts "virtually". The ML model predicts which parts have anomalies, i.e., are likely to fail, and sends only those parts on to physically undergo the stress tests at extreme temperatures. This solution has reduced physical testing by 95%.

Integration of the anomaly detection model to EOL testing also adds value to ZF's existing traceability data. The results of the anomaly detection model are visualized through a browser-based data app. Quality engineers can check the decisions the model has made and inject their expertise by adding comments, explaining, for example, why a particular decision was made.



## Virtual testing enables 7-digit savings

The new solution of performing virtual testing with KNIME enables significant savings in test equipment costs, manpower, and energy spend.

Test Systems can now avoid physical product testing and no longer need to purchase physical testing equipment. They have achieved 7-digit savings on investments in stress-test equipment.

The extremely high energy costs of the stress tests, which are performed at -40°C, +20, and +120°C have been reduced dramatically. Test Systems expect annual savings in energy in the 7-digit range. This effort marks a milestone in ZF's path to achieving their environmental sustainability goals

## Why KNIME?

When the data analytics team set out to reduce physical EOL testing, they knew they would need a data analytics tool that enables collaboration.

## Agile collaboration

Quality engineers, IT, and data scientists easily inject their knowledge into the new solution, their involvement improving results and raising successive production quality.

“KNIME's visual programming environment is the perfect solution to enabling interdisciplinary teamwork,” says Jeckel. “The analytics platform has enabled agile cooperation of electronic testing expertise, IT integration, and data science expertise to define proper data science solutions. This has been key in transforming existing processes.”

## A scalable solution

After the virtual testing system had proven successful in a single location, ZF wanted to be able to scale the solution to additional factories. Easy deployment of the solution via a browser-based data app means that the solution can be shared easily with multiple locations without infrastructure expertise.

## Easy Python integration

KNIME's Python integration was strategically important to Test Systems' solution. The team uses Python to enhance their solution with custom-designed functionality, maximizing the customer experience. "KNIME is a full system providing tons of lines of quality code. It really helps to know that you can concentrate on your business, but add any custom pieces through the Python integration." said Thomas Nithin, data scientist on the project team.

## Open for (more) integration

Extensibility and flexibility of the analytics platform was a key requirement for ZF Test Systems. KNIME provides access to 300+ data sources and integrations to all relevant tools and environments, enabling ZF to provide future-proof solutions that customers can connect to their 2nd, or 3rd production line and even implement minor process changes by themselves.

"Customers try to avoid being locked into a provider's ecosystem; KNIME's large partner network helps by reducing this risk," said Jeckel.

As a cooperative working platform for IT, data science, and business, the ability to deploy on-premise or in the cloud – all within the visual programming environment, Gert Jeckel confirmed that "KNIME is a perfect fit for our internal and external customers. From prototyping right through to deployment, the end-to-end coverage enables consistent end-to-end work."

