



TRi-xiL

VERIFICATION AND VALIDATION
WITH
THE NEXT GENERATION OF XiL

What is?

TRi-XiL

The **Tri-XiL** platform is a modernised version of a classic model/software/hardware-in-the-loop (ASSAM XiL). It is based on our unique ELMo® simulation engine, which is particularly useful for function validation and allows real-time simulation of the behaviour of an electrical system and all buses. Since the model-based solution can vary the system parameters at lightning speed by using CAD data and libraries with the data of all parts and components, it is also ideal for performing regression tests.

Tri-XiL is the central tool of the Tritem solution for digitising and automating tests as part of the development, verification and validation processes of complex high-tech products. With the help of Tri-XiL, all subsystems, as well as the entire system, can be simulated in an unlimited number of parameters and scenarios - starting in the design phase, throughout the entire development process and right up to the commissioning of the finished system.

What is?

TRi-XiL

This creates optimal transparency with regard to the functional interaction of hardware, software as well as buses and I/O systems. In the process, errors can be detected quickly and at an early stage before they can lead to consequential errors that require costly and time-consuming corrective measures. For all development and validation processes, Tri-XiL therefore becomes an effective tool for minimising risk and increasing quality.

Tri-XiL is designed for 24/7 use and is suitable for both automatic and manual test strategies and also allows remote tests directly at supplier companies. Tritem provides its customers with a stand-alone, holistic complete solution that carries out all test and simulation processes in a consistent manner throughout the entire project duration.

Since the Tritem technology is designed to be extremely scalable, it is not only an extremely economical solution for large scale production, but can also be used with the highest efficiency for product variants, small volume production and refittings.

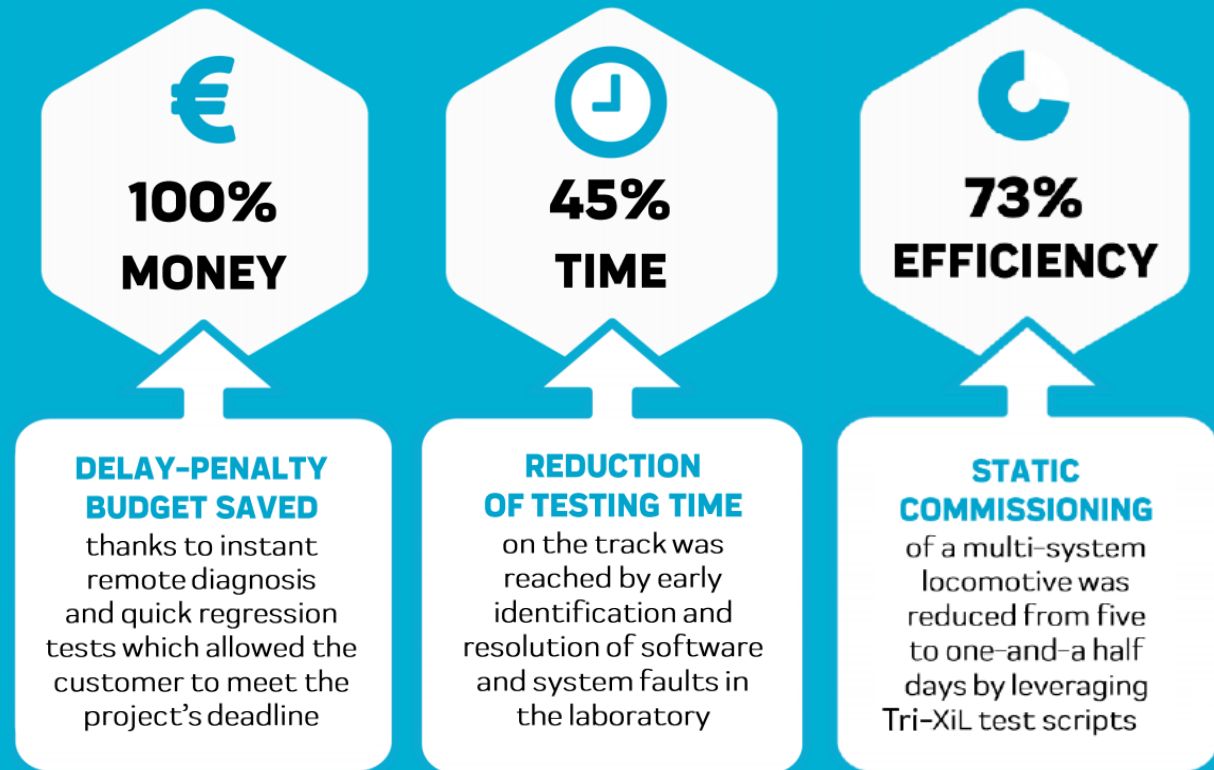
Highest scalability creates solutions for all requirements

Different corporate philosophies, different industries, individual processes - the development, verification and validation of complex systems moves in a very diverse environment.

The scope and type of requirements for tests and simulations are correspondingly varied. This circumstance is taken into account by the outstanding scalability of the Tri-XiL technology.

Depending on the individual requirements for the test and simulation processes, the performance spectrum of Tri-XiL can be roughly divided into three basic application types.

What advantage do our customers* receive?



Scenario 1: **Entry into digitisation with Tri-XiL**

This simplest usage profile is aimed at companies that want to update their current test processes/testing solutions, use their own test scripts or simply want to dive into the world of in-the-loop testing and learn about the advantages that an elegant and fast XiL platform solution such as Tri-XiL offers you.

Here is a brief outline of the technological features of this scenario:

ELMo® Simulation Engine

- Generates the simulated HiL test system automatically
- Automatically reacts to changes in product design and electrical schematics
- Uses the same hardware for quasi-simultaneous testing of different variants or products
- Changes from one test to another within seconds

The test automation framework

- Provides the means and tools for creating test scripts
- Executes scripts for the software under test in a simulated ELMO® driven environment
- Ready for use with MiL and SiL configurations
- No specific hardware or test stand assembly is required.

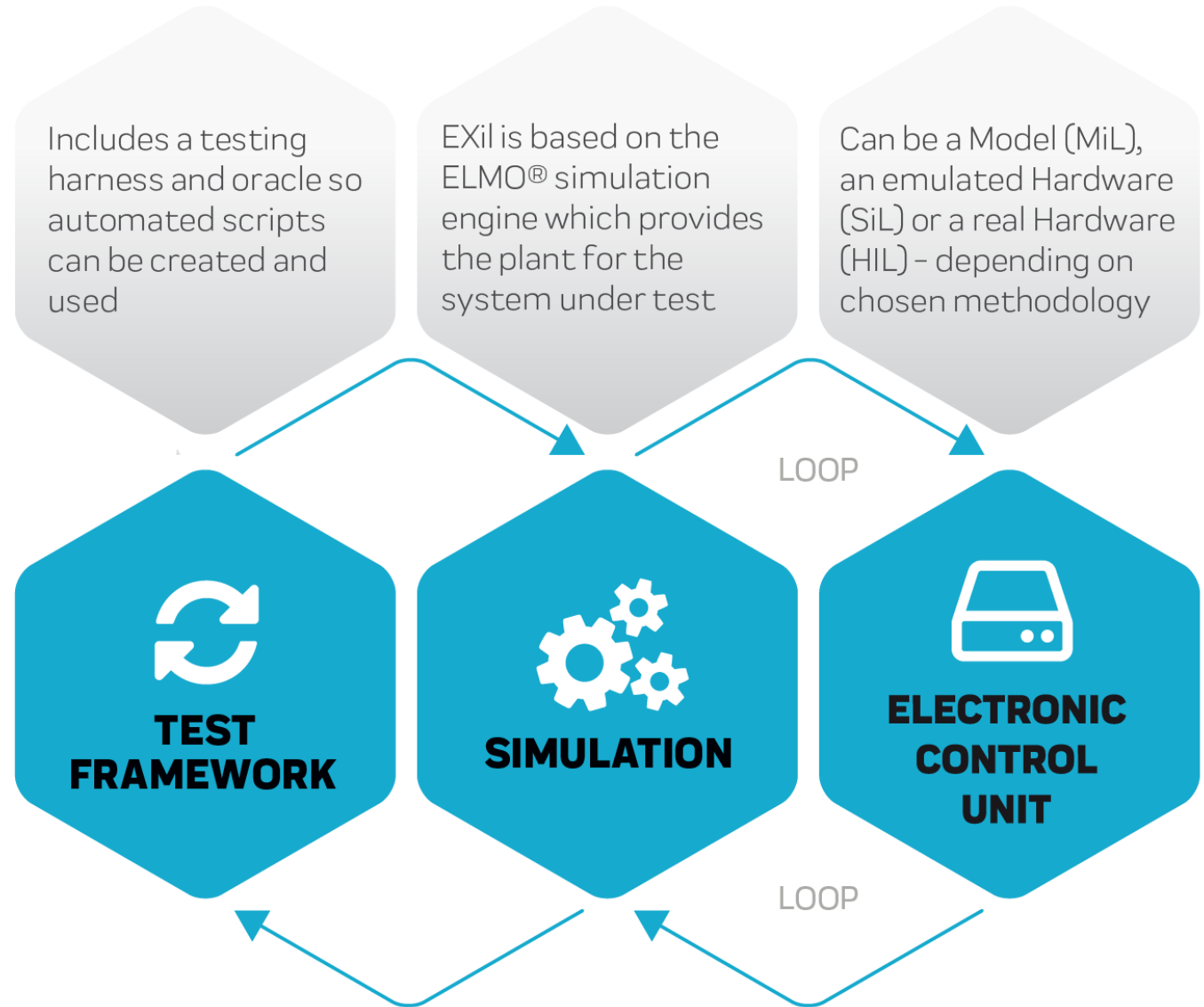
Our solution is based on NI technologies. This also applies to the test framework when NI's TestStand® is used as a flow control and test oracle. If necessary, other types of test sequencing can also be used.

Standardised, optimal test process

Regardless of how mature your current testing process is, our experts are ready to help you define and implement the optimal strategy so you can take advantage of the Tri-XiL platform. We also ensure that the process complies with normative requirements and obligations.

Support with test script creation

No matter which strategy or technique you choose: whether model-based testing, data-driven testing or testing with manually created scripts - at Tritem you will receive support from competent and experienced software test engineers who will help you to make the most of your Tri-XiL configuration.



Scenario 2:

Standard use for Tri-XiL automation technology

This scenario is ideally suited for companies that need to fit the verification and validation of the software of complex products efficiently, flexibly and reliably into their development process, as well as for cases in which control software needs to be formally qualified or validated by external authorities.

This applies to numerous companies in the railroad, shipbuilding and aerospace technology sectors as well as in mechanical and plant engineering. Key features of the Tritem solution for this scenario are:

ELMo® in real time

- Tri-XiL is based on the ELMo® Simulation Engine developed by Tritem.
- Tri-XiL automatically converts the system to be simulated into a simulator, taking into account changes in the product design as well as in the electrical circuit diagrams.
- In its standard version, the Tri-XiL platform supports the use of ELMo® on NI PXI devices in real-time mode.
- Tri-XiL meets the strictest timing criteria.

ASAM XiL 2.0 compatibility

- Tri-XiL complies with the API standard for communication between test automation tools and test benches.
- The Tri-XiL platform provides data acquisition and mapping functionality independent of the test stand hardware and software used.

ALM integration

The Tri-XiL platform integrates with an existing ALM solution: whether it is an off-the-shelf solution (such as IBM Jazz, HP Quality, etc.) or a customised solution specifically for your company, Tri-XiL can work hand-in-hand with all of these solutions and is guaranteed to work for the development process.

Scenario 2:

Standard use for Tri-XiL automation technology

OSLC-compatible Test Executor

- Tri-XiL can be equipped with a dedicated test execution agent that is compatible with the OSLC Automation 2.0 standard.
- The solution can be used with any type of OSLC-compatible test management system, and
- it is compatible with any test execution system or framework, including NI TestStand®.

Platform-Management

- Tri-XiL provides tools for test management of different product variants on the same test platform.
- Tri-XiL ensures that no unnecessary tests are performed.
- Traceability from system requirements to test results is preserved. This is especially important for products that are produced in small quantities and with numerous variants, such as trains, locomotives or ships.

Beyond baseline scenario 1, this usage profile includes:

Support for hardware integration

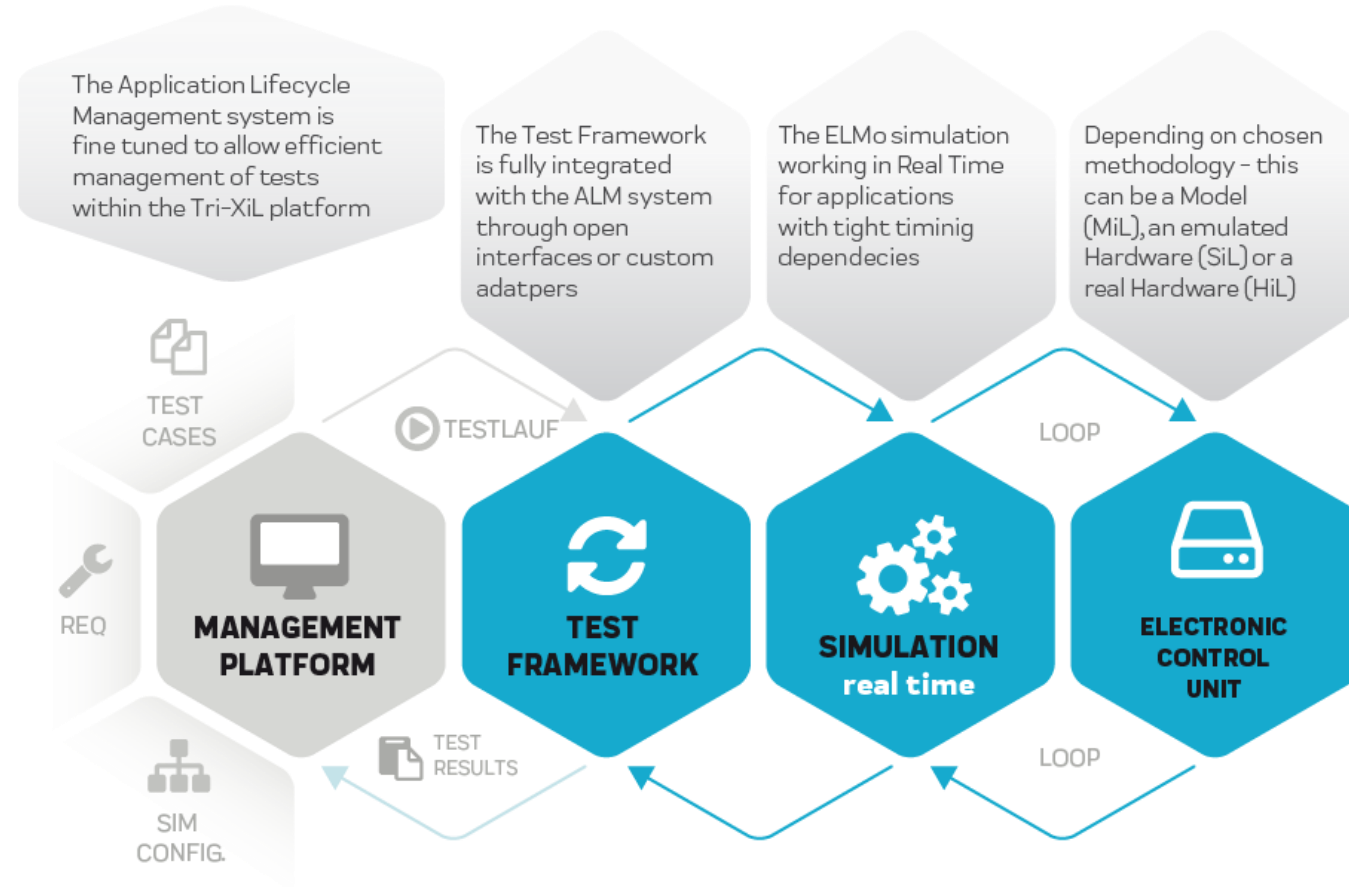
Tritem has extensive experience in designing and assembling solid, stable and standard-compliant test stands that are specifically tailored to the customer's needs for use in test laboratories. We also offer support in defining the required measurement hardware and custom driver development.

Advanced modelling support

This includes advanced modelling techniques that focus on optimisation and efficient use of resources, including for real-time simulation. This includes modelling of the most complex subsystems.

Integration into the existing toolchain

If Tri-XiL is to work within an existing ALM/PLM toolchain, we will support you in seamlessly integrating it and run its operation without any negative impact on the existing configuration.



Scenario 3:

Tri-XiL for the highest technological demands

More and more processes that were described as "technologies of the future" just a few years ago have now matured into important tools for manufacturers of complex systems. These include, for example, artificial intelligence, machine learning/deep learning, cloud computing, big data and the Internet of Things. For companies that want to effectively use these or other highly modern technologies (such as the use of a digital twin) to stay ahead of the competition, this application level of Tri-XiL, expanded with numerous intelligent features, is ideally suited.

Benefit from the full range of advantages and options of our XiL technology. Use the Tri-XiL platform not only during the development phase (verification and validation), but also use your own data during the life phase of your product as a valuable asset to support the market. Below are the key characteristics of the Tritem solution for this deployment scenario.

Suitability as a digital twin

- The Tri-XiL-based test system can act as a digital twin of your system throughout its life cycle.
- Real data can be entered as stimuli.
- The behaviour of each system component can be observed separately.
- The simulated system can be compared with the real one conveniently via remote diagnosis from the laboratory.

Integration into the IoT cloud enables

- data storage in the cloud
- the addition of special applications to the Tri-XiL system
- a whole range of new and expanded uses.

Data collected from both the real and the simulated system provides better insight into actual system operations and indicates options for improvement.

Predictive maintenance

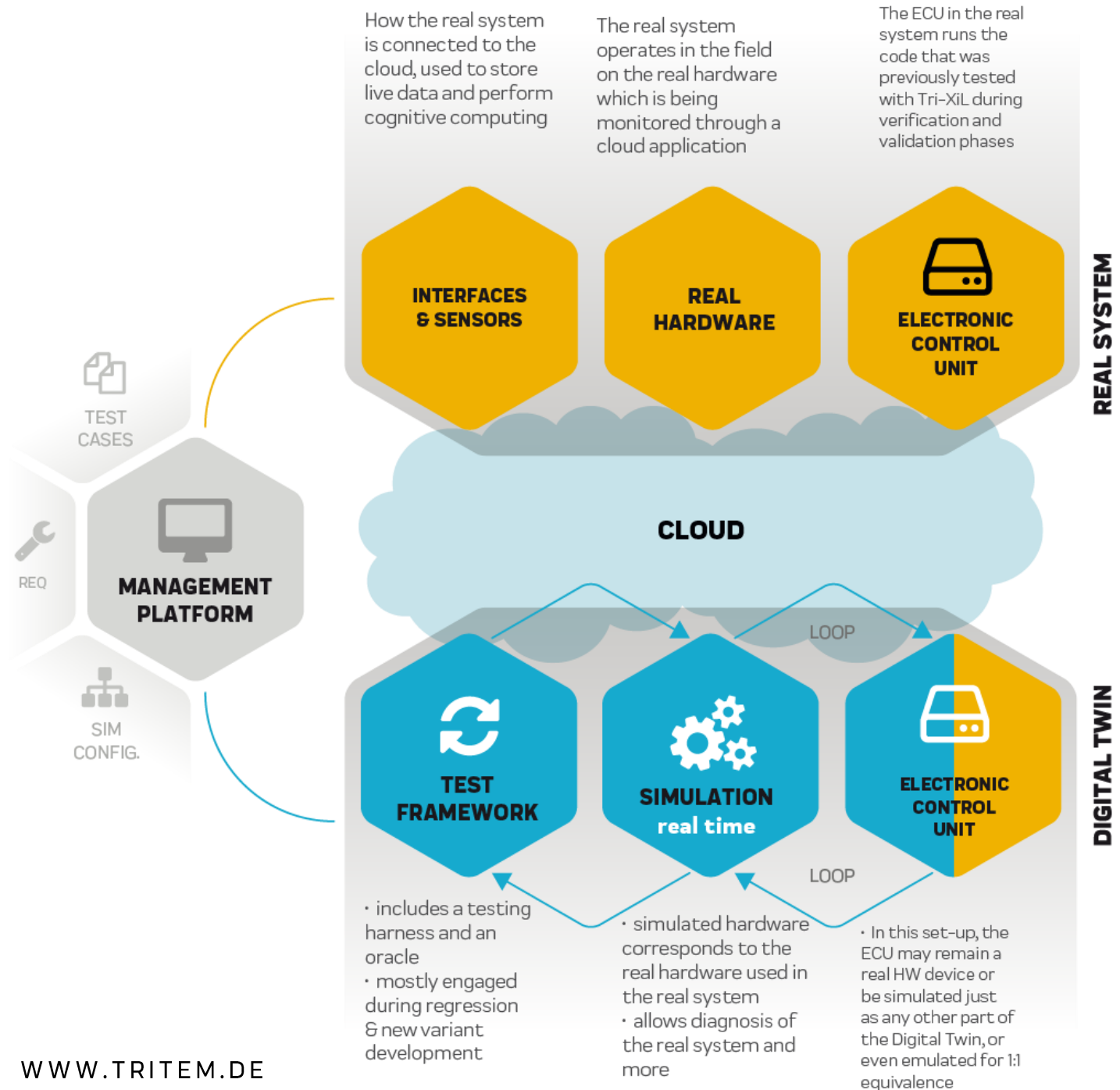
In conjunction with a cloud-based IoT solution, Tri-XiL is able to predict when system maintenance will be required. For this purpose, the reaction of the simulated system is compared with the live data as well as the available historical data.

Remote diagnosis

Tri-XiL allows remote diagnostics of your real system from anywhere in the world. For this purpose, the control code in question is executed and updated on a simulator in your laboratory. The corrected version can then be remotely transmitted to the real system at the desired location.

AI-based test automation

The data obtained from the real system, together with the data analysed by the digital twin, can be used to generate automated tests, for example during a regression or as a basis for new product variants.



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