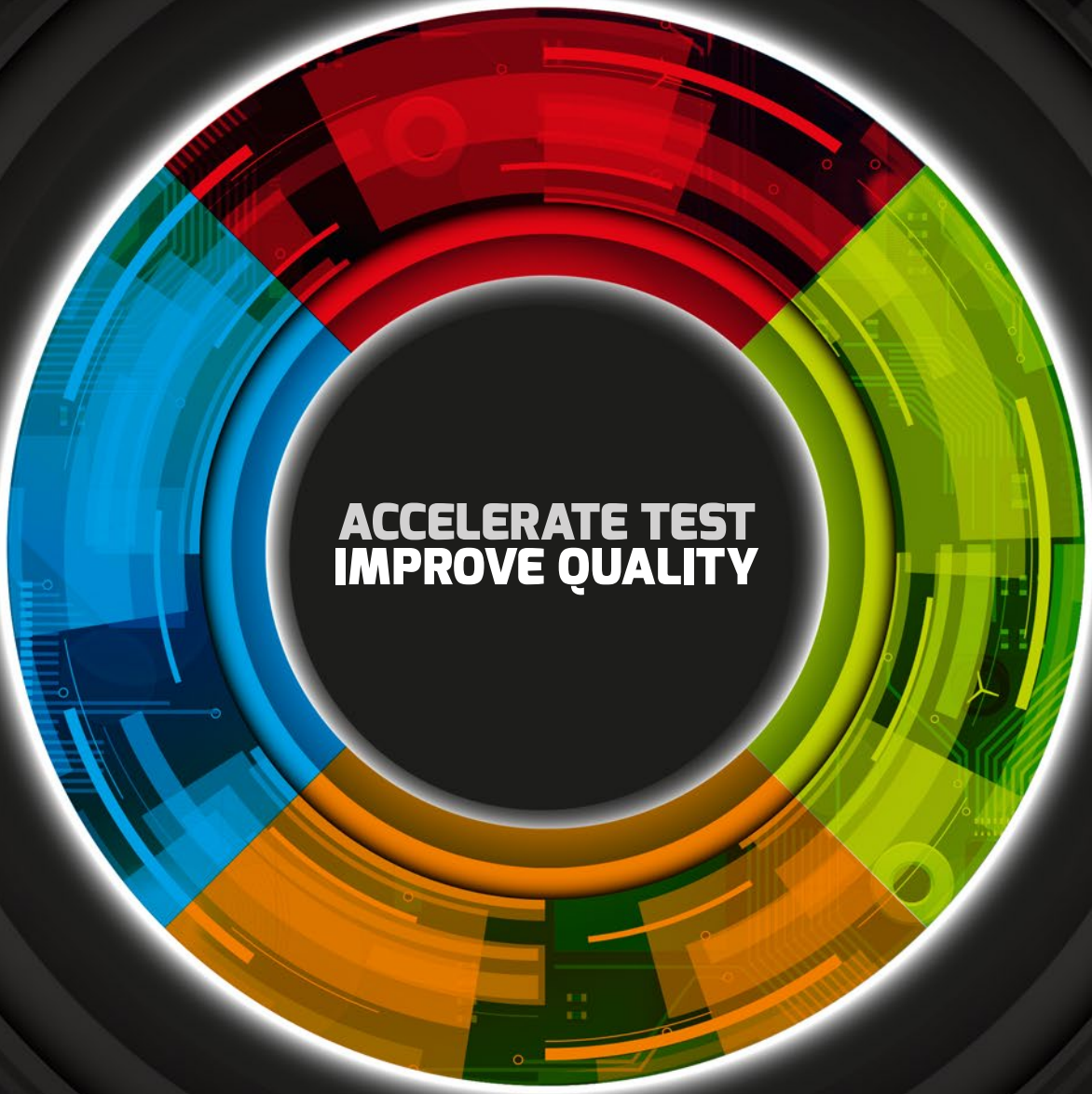
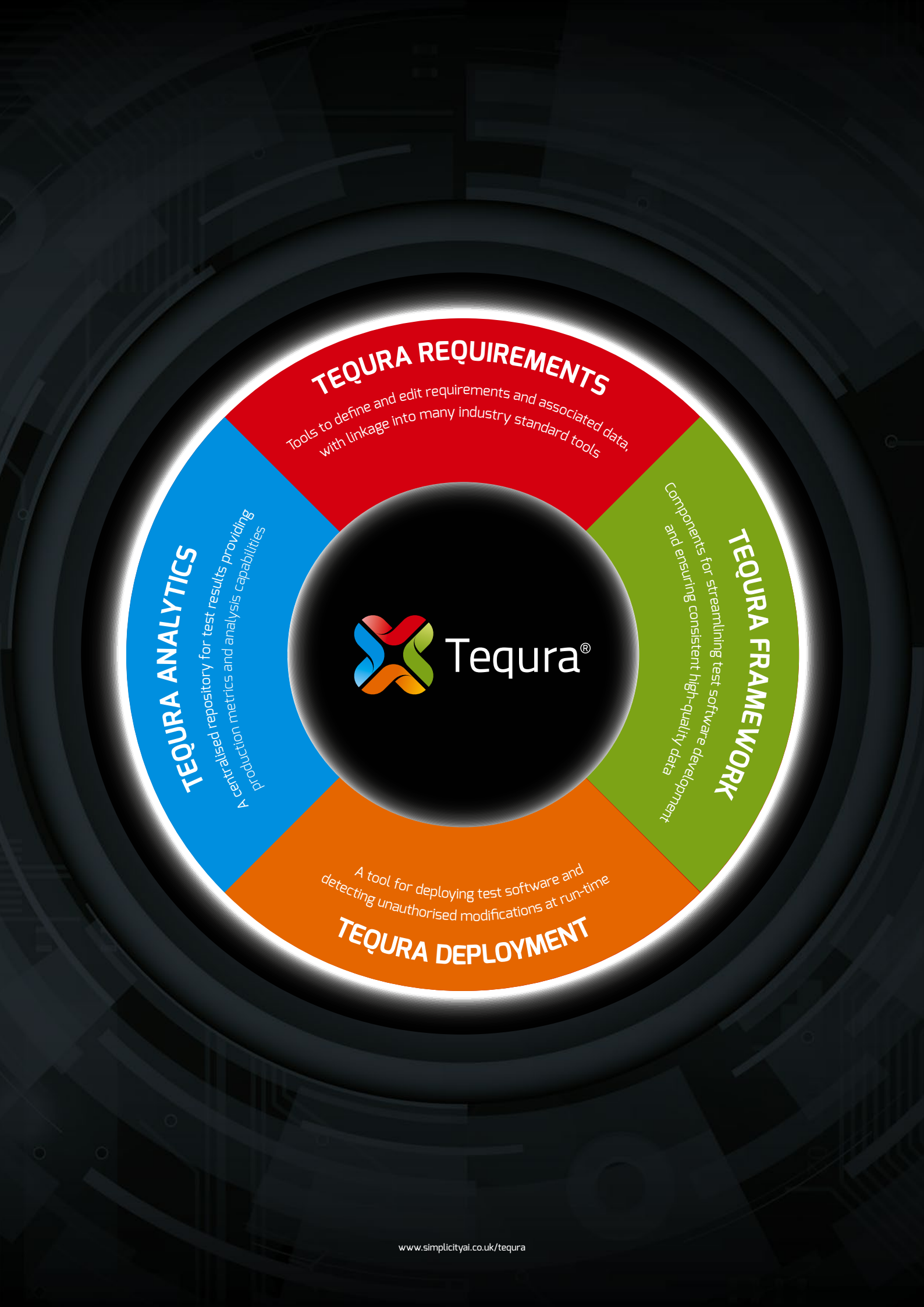
Tequra®



Simplicity ai



www.simplicityai.co.uk/tequra

MAXIMISE TEST VALUE

Tequra is a software suite for test and measurement applications allowing users to develop high-quality software faster, simplify support and maintenance, and facilitate continuous improvement.

The trend in product design and manufacturing is towards increasing product complexity, shorter timescales, squeezed budgets and extended lifecycles. These demands serve to make the task of developing and maintaining test solutions more difficult, putting additional pressure on production managers and test engineers. Tequra was developed to address these challenges, primarily centred around the following areas:

- Streamlining and error-proofing the software development process
- Encouraging software component reuse
- Mitigating equipment obsolescence
- Verifying that software used to test a product is as it should be
- Providing a centralised store of test results which can be used to streamline the manufacturing process and drive product quality improvements

The Tequra platform was developed in order to reduce the cost and risk involved with test software development, deployment and maintenance. Additionally, greater insight into test results allows improvements to be fed-back into the product being tested and into the test development process.

The Tequra suite is split into four main areas:

Tequra® Requirements

Tequra® Framework

Tequra® Deployment

Tequra® Analytics

Within each product grouping, it is possible to purchase only the components required for a particular application. Please contact Simplicity AI to discuss your specific requirements for which a customised solution using off-the-shelf components can be specified.

Tequra®
Requirements

SEAMLESS INTEGRATION

Tequra Requirements bridges the gap between requirements definition, software verification and test code execution.

Requirements can be edited using the intuitive graphical user interface or alternatively loaded from customer–defined or industry-standard requirements management tools.*

The software links in with other tools such as NI Requirements Gateway for coverage analysis, NI TestStand for loading test limits and data at run-time, and Tequra Framework sequence generator for automatic code generation from requirements.
At the core of Tequra Requirements is an XML format file for managing test requirements. This allows test requirements to be specified with associated attribute data including test conditions and pass/fail criteria.

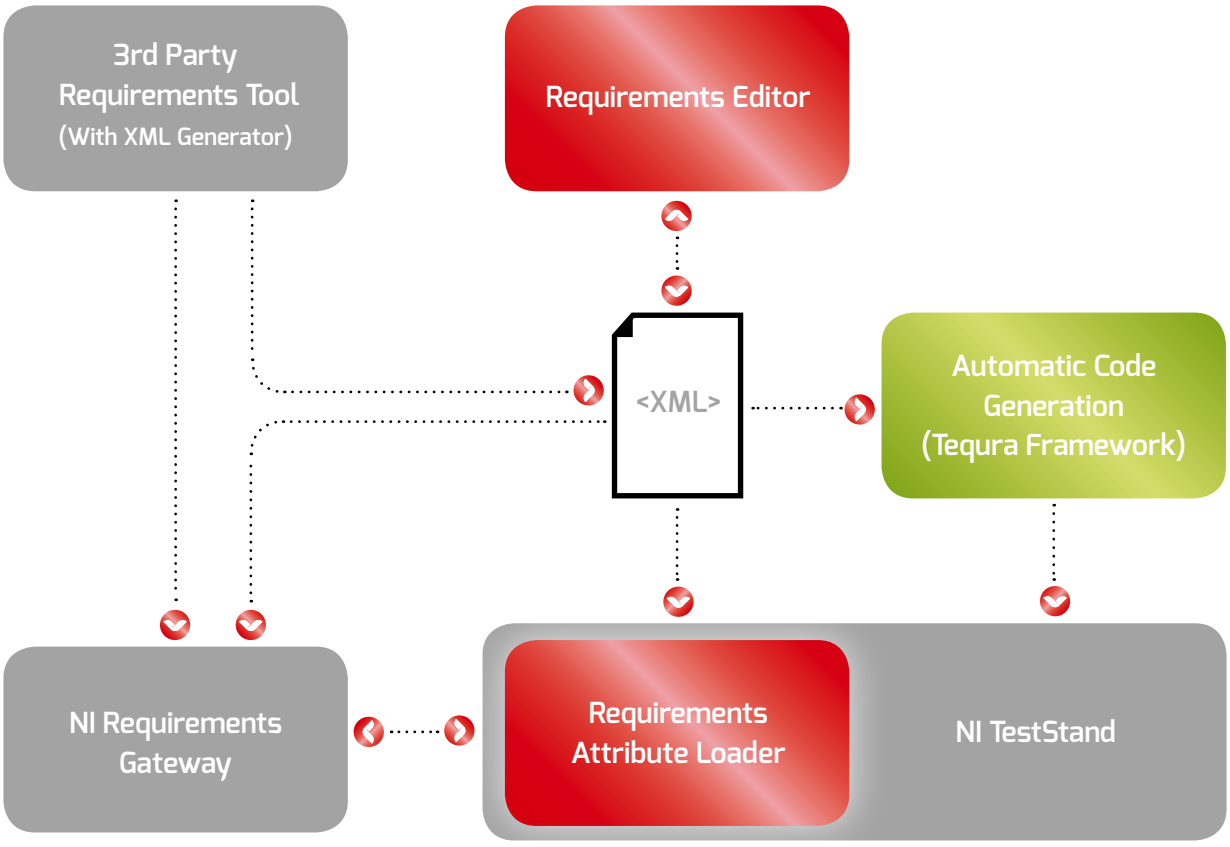
Benefits

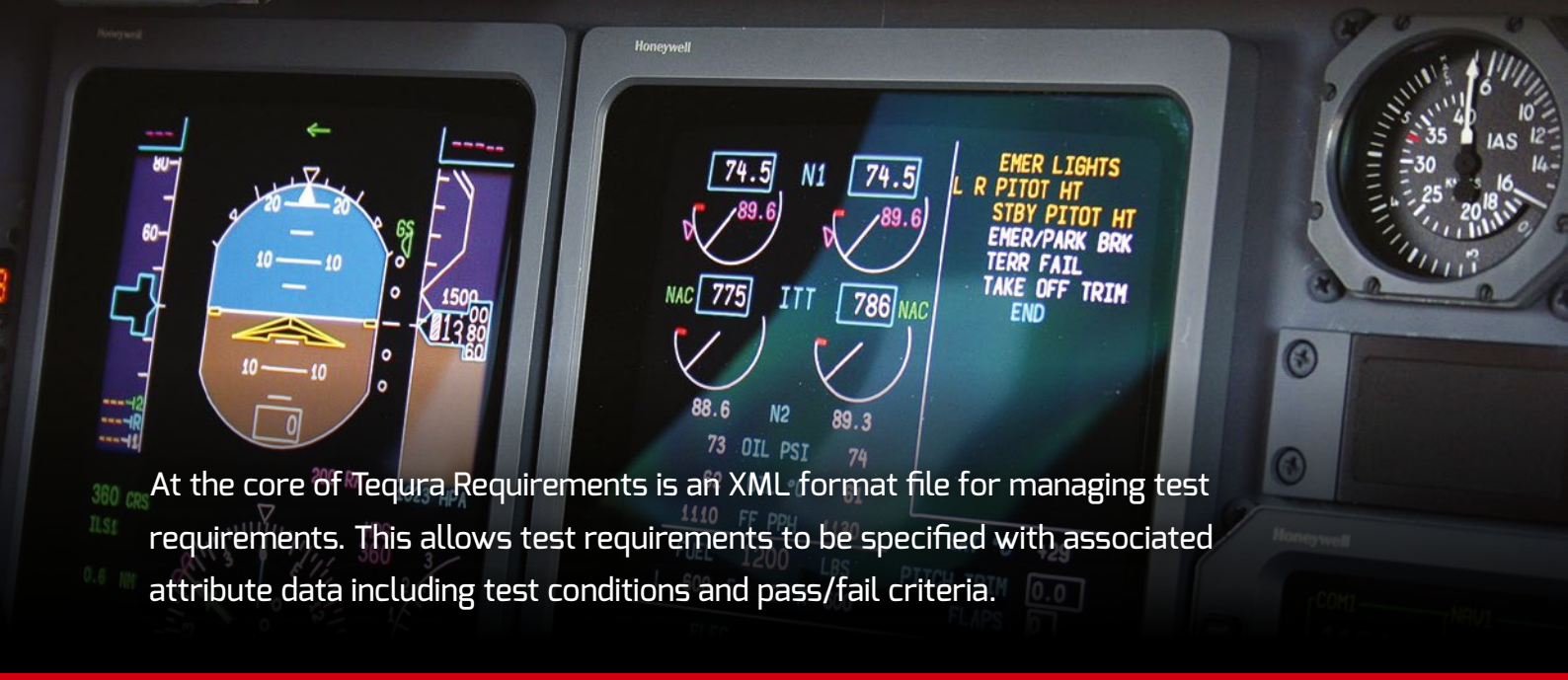
- An easy-to-use environment for specifying test requirements and associated data
- Defines an interface between 3rd Party Requirements Management tools and NI TestStand
- Streamlines the test development process

* Interfacing with customer-defined or third-party requirements management tools is via a defined XML format, please contact Simplicity AI for further details.

Specify and share test requirements and associated data

Relationship between Requirements Management tools





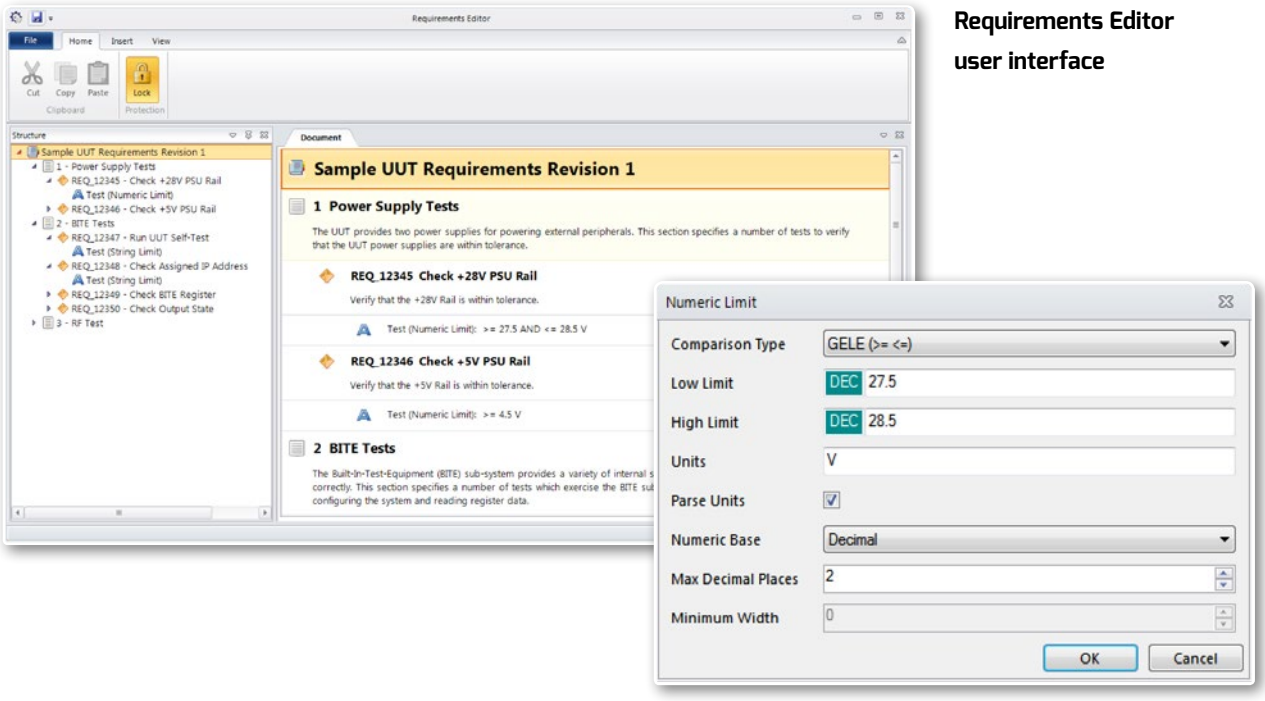
At the core of Tequra Requirements is an XML format file for managing test requirements. This allows test requirements to be specified with associated attribute data including test conditions and pass/fail criteria.

Requirements Editor

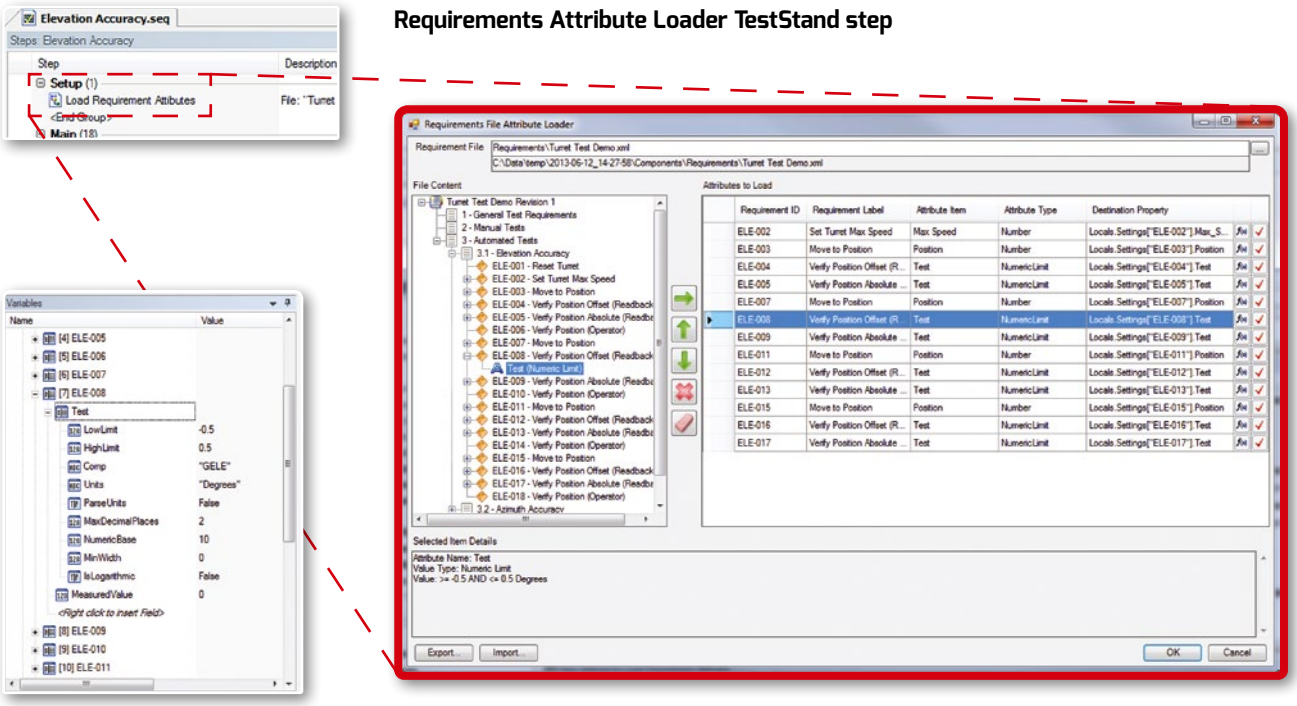
The Requirements Editor application provides a high-level graphical user interface, allowing engineers to specify requirements in a structured way. This enables the requirements to be displayed in a familiar document style and can be exported to standard formats such as PDF and Microsoft Word while providing standard data types for storing test attributes. For example, it is common practice in test applications to compare a measured value against limits; the requirements editor application provides the ability to define a numeric limit test and easily set appropriate parameters through the user interface. By defining the attribute in this way, this data can be easily interpreted by other tools, such as the Requirements attribute loader which is used to load data at runtime into NI TestStand.

Features

- Easy-to-use environment for generating and editing requirements
- Consistent approach for defining test conditions and pass/fail criteria, which allows data to be shared with other tools
- De-duplication of test attribute data, reducing the possibility of translation errors



Requirements Editor user interface

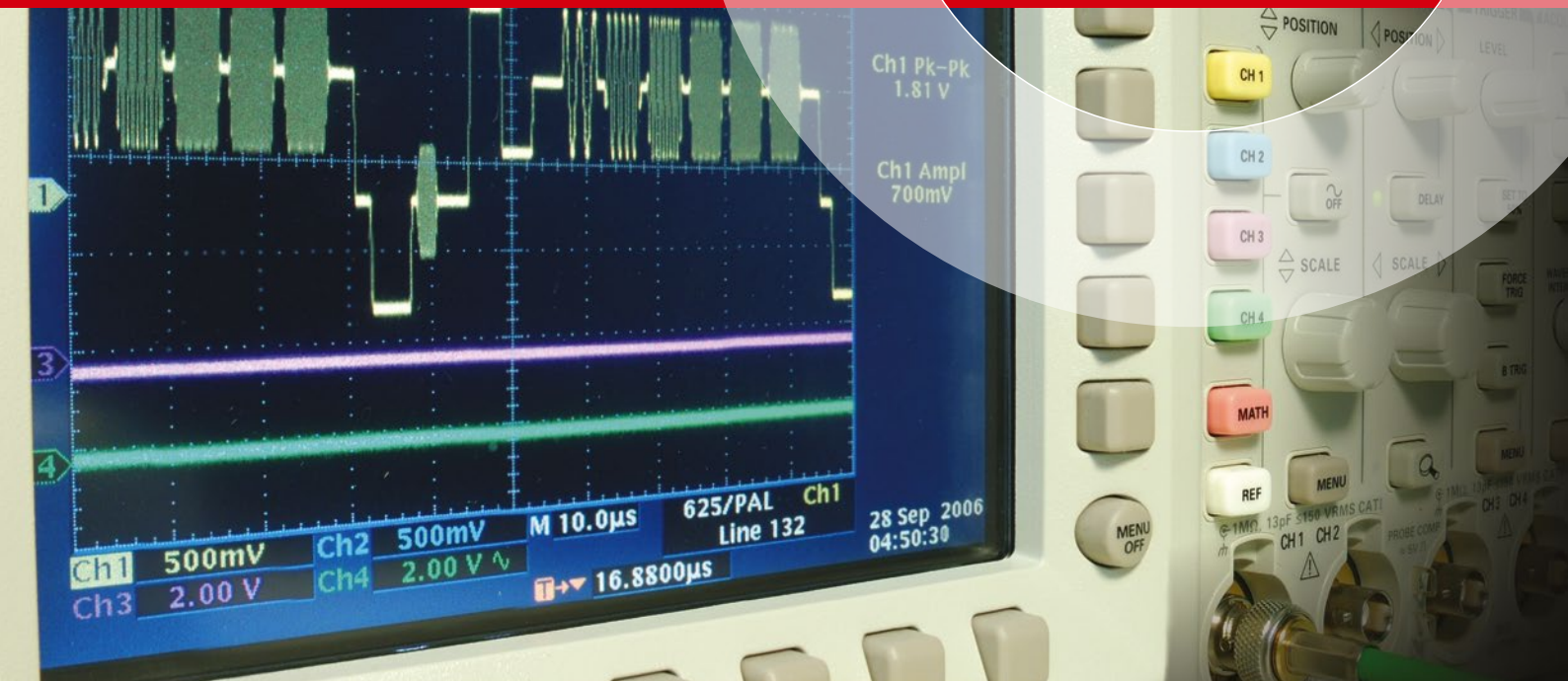


Requirements Attribute Loader TestStand step

Requirements Attribute Loader

The requirements attribute loader is a component for NI TestStand which allows attribute data to be loaded from requirements files during the execution of a test. Test conditions and pass/fail criteria can be stored in the requirements file rather than duplicated in the test code which reduces the chances of translation error and makes the task of updating the test procedure trivial. In the simplest case, an engineer can modify a test limit using the Requirements Editor and deploy the updated requirements file, where the new limit will then be seamlessly used by the test software.

Update test limits without modifying test software



Tequra®
Framework

STREAMLINE TEST DEVELOPMENT

Tequra framework is a set of components for NI TestStand and LabVIEW which enhances the developer and operator experience while providing a bridge to other products within the Tequra suite.

While there are recommended practices for making the best use of the framework, it is not necessary to write TestStand sequences in a specific way to be able to utilise many of the features. The Tequra framework tools are designed to run with existing code without requiring specific modifications.

Benefits

- Reduce development time
- Obsolescence mitigation
- Ensure high-quality data, ready for analysis
- Enhance built-in TestStand functionality
- Improve operator usability

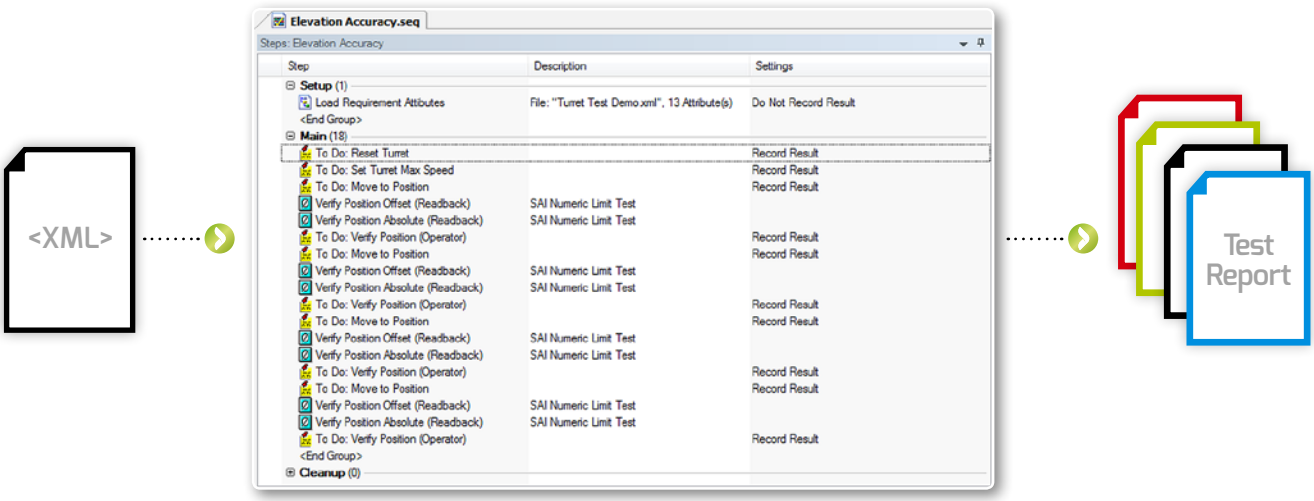
Automatic Code Generation

Tequra Framework can generate ready-to-run skeleton TestStand sequences from Requirements Files defined using Tequra Requirements. When the code is executed, this provides an instant view of how the final test report will be structured, including all test names and test limits applied. This allows for rapid prototyping of the overall structure before test-specific code modules are added. This greatly reduces the initial burden of creating the software structure and ensuring that all data properties are correctly populated.

Features

- Generate ready-to-run skeleton code from requirements files, based on industry best practices
- Utilises enhanced Tequra Framework step types to load requirement data at run-time and provide additional functionality
- Produce a test report immediately after generation, allowing for early stage review of test output

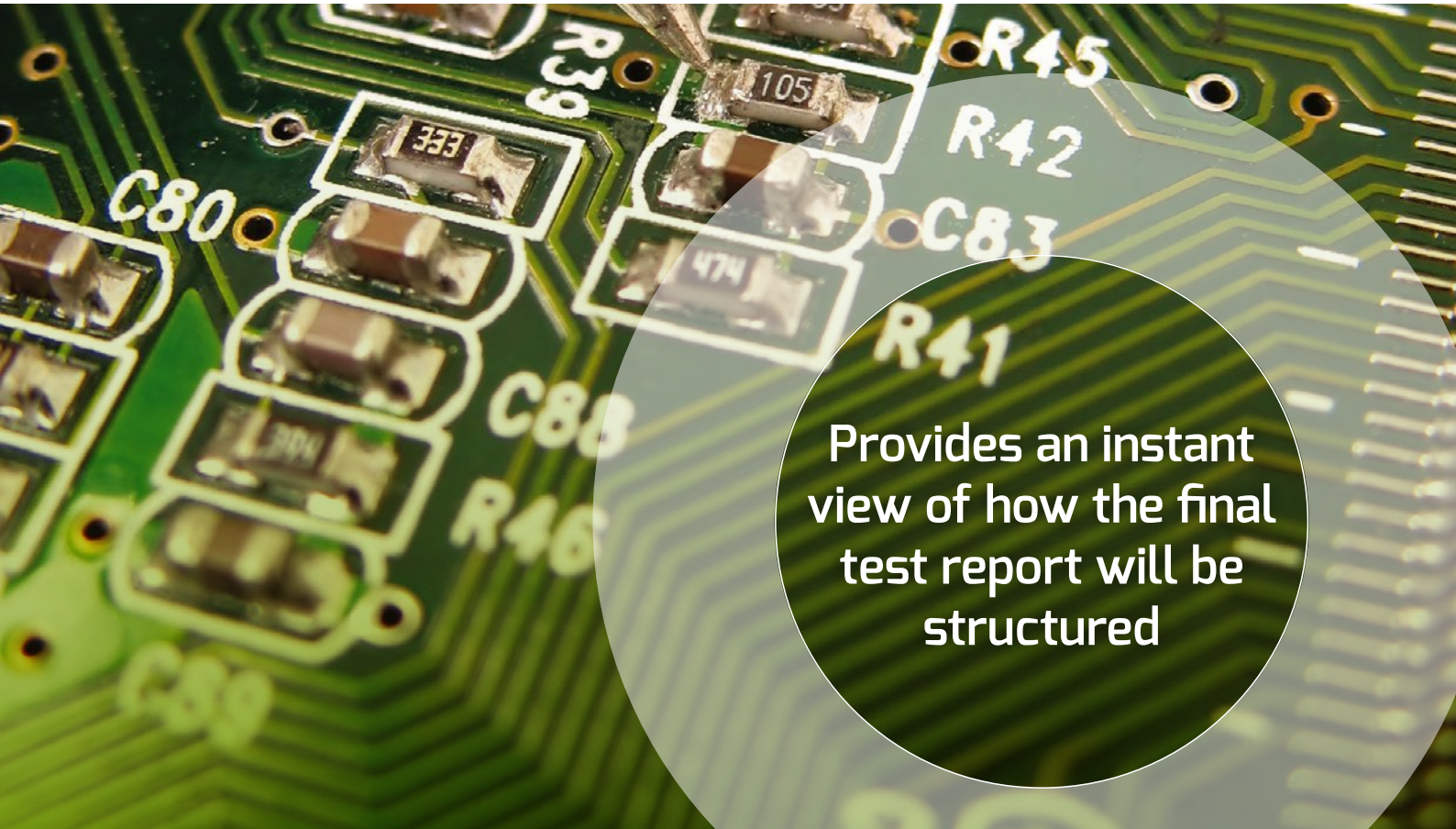
Framework Generator



Elevation Accuracy.seq

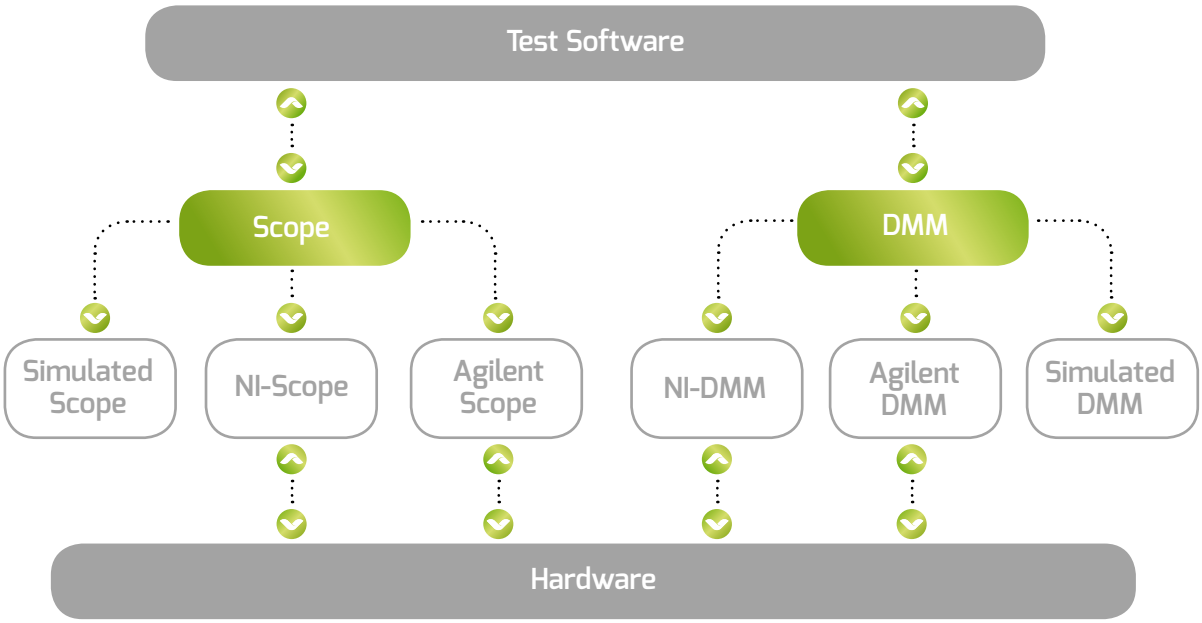
Steps: Elevation Accuracy

Step	Description	Settings
⊟ **Setup** (1)		
Load Requirement Attibutes	File: "Turret Test Demo.xml", 13 Attribute(s)	Do Not Record Result
<End Group>		
⊟ **Main** (18)		
To Do: Reset Turret		Record Result
To Do: Set Turret Max Speed		Record Result
To Do: Move to Position		Record Result
Verify Position Offset (Readback)	SAI Numeric Limit Test	
Verify Position Absolute (Readback)	SAI Numeric Limit Test	
To Do: Verify Position (Operator)		Record Result
To Do: Move to Position		Record Result
Verify Position Offset (Readback)	SAI Numeric Limit Test	
Verify Position Absolute (Readback)	SAI Numeric Limit Test	
To Do: Verify Position (Operator)		Record Result
To Do: Move to Position		Record Result
Verify Position Offset (Readback)	SAI Numeric Limit Test	
Verify Position Absolute (Readback)	SAI Numeric Limit Test	
To Do: Verify Position (Operator)		Record Result
To Do: Move to Position		Record Result
Verify Position Offset (Readback)	SAI Numeric Limit Test	
Verify Position Absolute (Readback)	SAI Numeric Limit Test	
To Do: Verify Position (Operator)		Record Result
<End Group>		
⊞ **Cleanup** (0)		



Provides an instant view of how the final test report will be structured

Hardware Abstraction Layer (HAL)



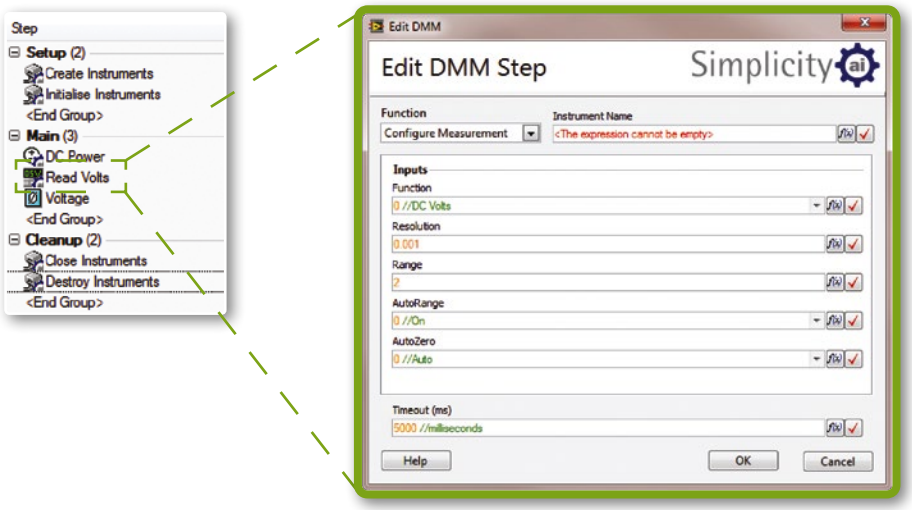
Extensive Instrument Support

Tequra framework provides a set of instrument control modules for LabVIEW and TestStand based on a hardware abstraction layer (HAL), which allows test code to be written that is vendor agnostic. For example, test code can be written to read data from a generic digital multi-meter (DMM) and can seamlessly switch between a National Instruments DMM, an Agilent DMM or a simulated instrument at runtime. This ensures that test solutions may be easily re-hosted onto new hardware and are supportable for decades to come. Tequra Framework's instrument modules come with full documentation to allow end users to add support for additional instruments or customised simulation, without modifying the original test code.

Support is available for most common instruments and many esoteric ones, such as avionics busses. Please see **www.simplicityai.co.uk/tequra** for an up-to-date list.

Accelerate development and mitigate obsolescence

HAL DMM TestStand Step Type



Reporting & Data Integrity

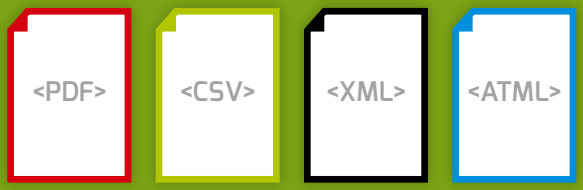
NI TestStand provides a number of out-of-the-box reports; however in many cases these may not be sufficient. Many TestStand users would like a human-readable non-modifiable test report file, such as a Portable Document Format (PDF) file. Others may want to be able to easily analyse results using off-the-shelf tools such as Microsoft Excel. Tequra Framework provides a modular reporting solution with a number of often-requested file formats and the ability to create custom reports in future.

Test results are saved to an intermediate file during an execution, so multiple reports can be generated at the end of a run – or at any point in the future from the same source file. Additionally, this file was designed to allow large amounts of data to be stored, such as all the results from environmental testing which may last for days. Using standard TestStand components would mean that the system would run out of memory or produce reports that could not be loaded in a standard application due to their size.

The Tequra framework also provides a fully-featured data model for logging test results. This includes additional data fields which are valid for production, validation, characterisation and many other types of test. By providing the ability to tag test result data with these additional fields, data analysis becomes more meaningful whether standalone or via Tequra Analytics.

Features

- Out-of-the-box report formats: PDF, CSV, XML, ATML



- Allows extremely large datasets
- Plug-in architecture for custom report formats and future enhancements
- Seamless integration with other Tequra components

Example test reports

MainSequence	Start Time: 30/10/2012 11:52:27	End Time: 30/10/2012 11:54:23		Passed
Step Name	**Limits**	**Result**	**Units**	**Status**
1.1 - Elevation Accuracy				Passed
1.2 - Azimuth Accuracy				Passed
2.1 - Drive Current				Passed

1.1 - Elevation Accuracy	Start Time: 30/10/2012 11:52:32		End Time: 30/10/2012 11:52:53		Passed
Step Name	**Limits**		**Result**	**Units**	**Status**
Measured Elevation	>=9.5	<=10.5	10.16	Degrees	Passed

2.1 - Drive Current	Start Time: 30/10/2012 11:53:50	End Time: 30/10/2012 11:54:21	Passed
Step Name	**Limits**	**Result**	**Units**	**Status**
Drive Current Waveform				Passed

	A	B	C	D	E	F
19						
20	Execution Details:					
21	Project	Super Tank				
22	Process	Turret AIT				
23	Operation	Functional Test				
24	Execution Type	Production				
25	Operator	administrator				
26	Start Time	30/10/2012 11:52				
27	End Time	30/10/2012 11:54				
28	Test Socket	0				
29	Is Partial Execution	FALSE				
30						
31	Results:					
32	Test Group	Result Name	Result Type	Result Value	Units	Comparison Type
33	1.1 - Elevation Accuracy	Measured Elevation	Double	10.16		GELE
34	1.1 - Elevation Accuracy	Operator Verified Elevation (10 Degrees)	Boolean	TRUE		IsTrue
35	1.1 - Elevation Accuracy	Measured Elevation	Double	20.16		GELE
36	1.1 - Elevation Accuracy	Operator Verified Elevation (20 Degrees)	Boolean	TRUE		IsTrue
37	1.1 - Elevation Accuracy	Measured Elevation	Double	29.82		GELE
38	1.1 - Elevation Accuracy	Operator Verified Elevation (30 Degrees)	Boolean	TRUE		IsTrue
39	1.1 - Elevation Accuracy	Measured Elevation	Double	40.16		GELE
40	1.1 - Elevation Accuracy	Operator Verified Elevation (40 Degrees)	Boolean	TRUE		IsTrue
41	MainSequence	1.1 - Elevation Accuracy	TestGroupCall	<Overall Result>		
42	1.2 - Azimuth Accuracy	Measured Azimuth	Double	44.98		GELE

Enhanced Functionality for TestStand

NI TestStand provides a set of Step Types which facilitates many common tasks, such as checking a numeric value against limits. However, there are some limitations making it necessary to write custom code for certain test scenarios. Tequra Framework includes an enhanced set of steps types including waveform testing, enhanced string testing and the ability to add data tags to specific results, which is particularly useful for characterisation testing.

Features:

- Waveform Limit Test
- String Limit Test (including partial matching and regular expressions)
- Test Parameters (Conditions) and Meta Data tagged against results

Improved Usability

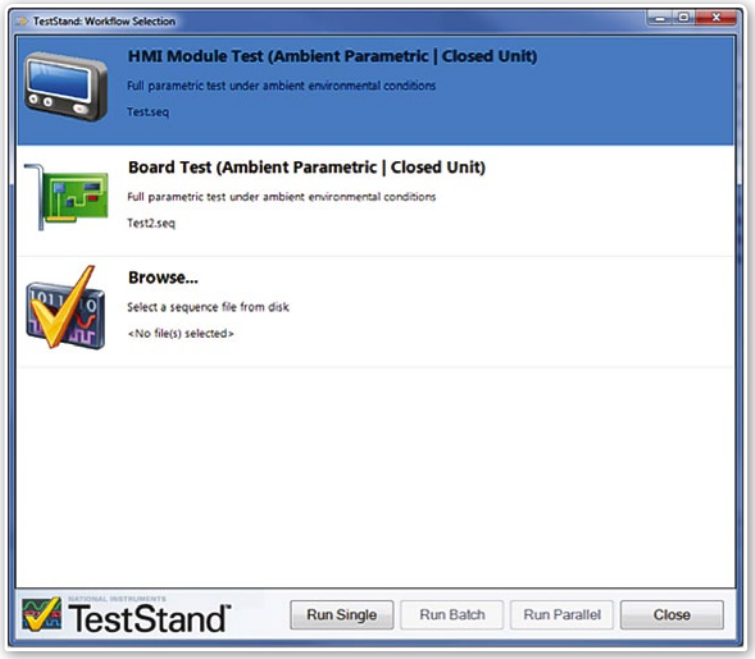
Typically, the TestStand Operator environment is provided through one of the standard NI Operator Interfaces. As source code is provided for these, it is possible to customise the interface to match specific requirements. Tequra Framework adds a number of attractive features missing from the standard interfaces meaning that customers no longer need to make specific modifications.

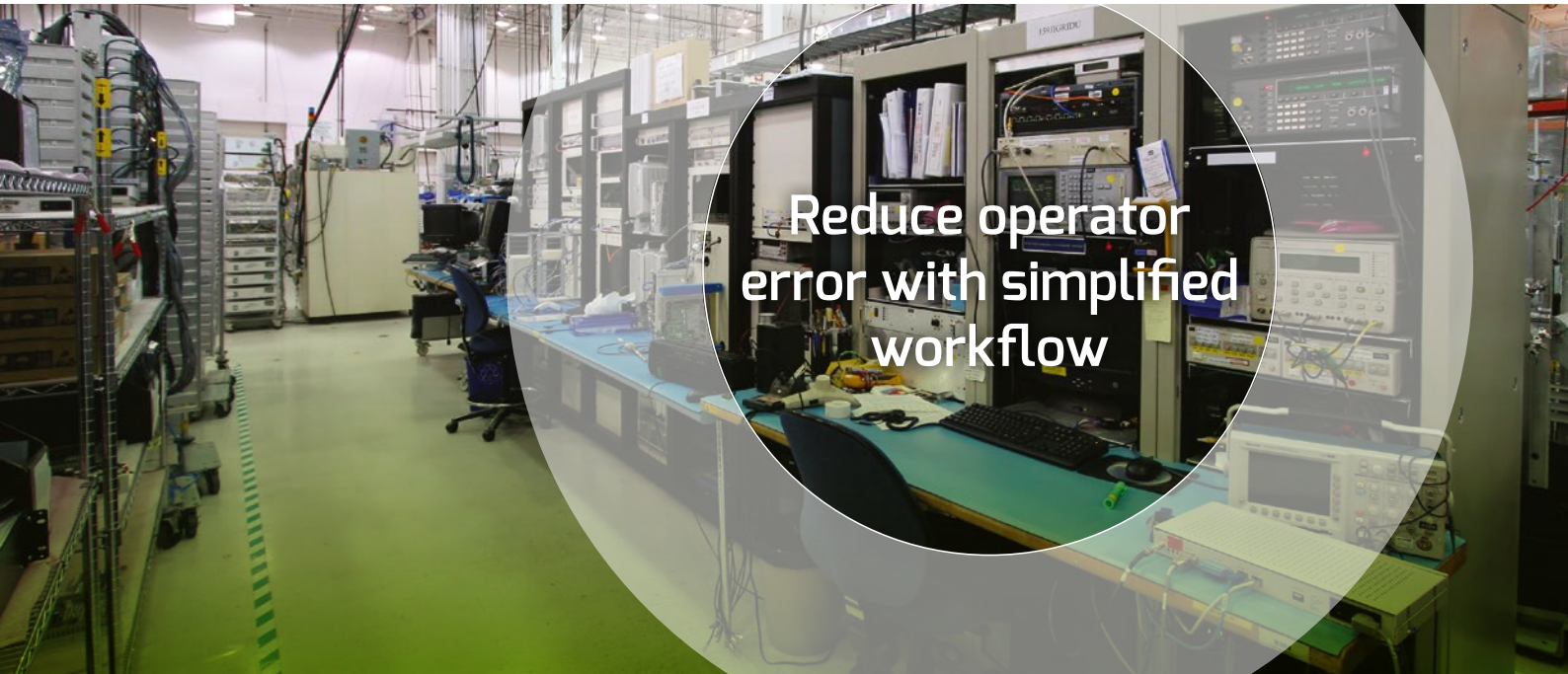
It is also possible to define tests which can be selected from an easy-to-use selection screen, reducing the chances of operator error by loading the wrong sequence file. Additionally, this mode of operation allows multiple sequence files to be chained together and optionally looped such that a complete automated test process can be invoked at a click of a button and produce separate reports for each test stage.

Features:

- Operator Interface Test Results View (Including test limits and measured values)
- Ability to display product specific or test specific information in the Operator Interface
- "Workflow" mode which provides a test selection screen and test looping/chaining
- Test Scheduling

Workflow selection dialogue box





Tequra®
Deployment

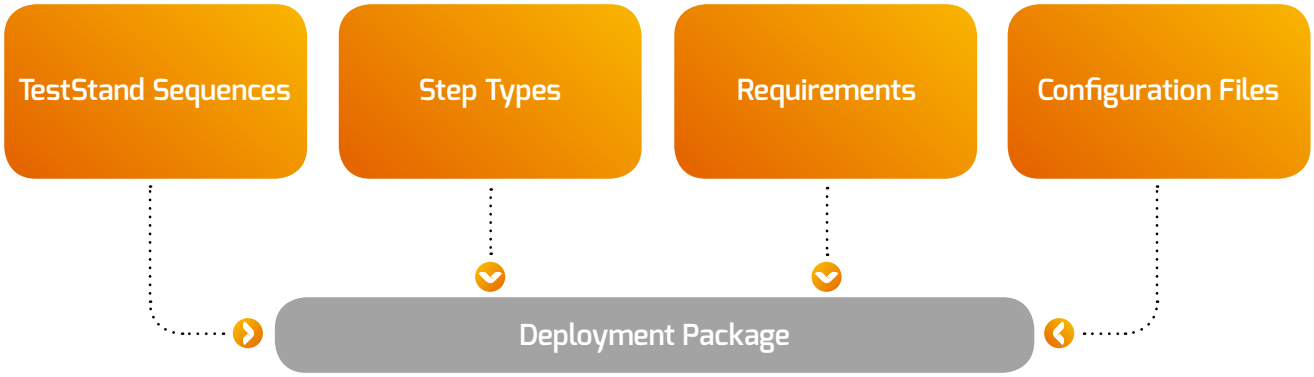
ONE-CLICK DEPLOY & VERIFY

Tequra Deployment allows software components and data files to be packaged for easy distribution and provides a tool to allow these files to be managed on the target system. This includes the ability to deploy, un-deploy and verify that the files have not been modified. This can be automated such that test applications will self-verify before commencing testing.

Benefits

- Simplify test software distribution and installation
- View and manage installed test software
- Verify the integrity of deployed test software

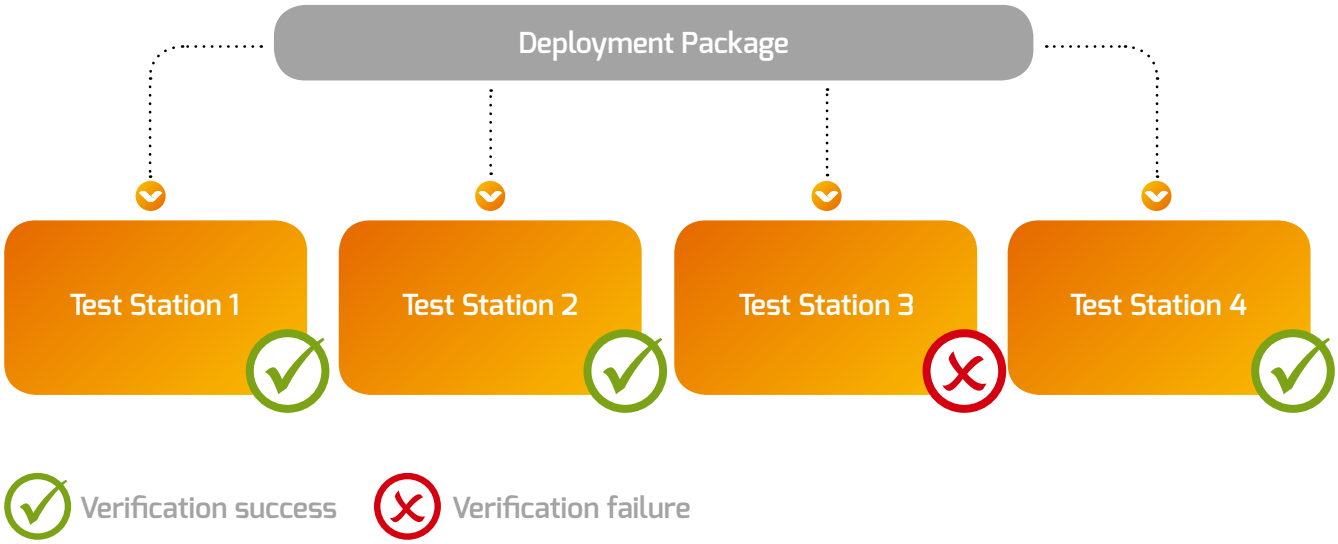
Package creation



In some circumstances it is possible to build a software package into a single executable file, making the process of updating test stations as simple as copying over the updated file. However modern test solutions, such as those based around NI TestStand, often require multiple files which need to be copied to specific locations. If the software is constructed in such a way to promote reuse, there may be dependencies on shared components which may require that a specific version of the shared component to be used. These challenges have often been overcome by building all required components into an archive file (e.g. zip), then deploying to the target system. The limitation with this approach is that once the software is extracted, it can still be modified on the system and there is no overall indication of what has been installed.

Tequra Deployment seeks to address these challenges by providing the ability to build versioned deployment packages, containing multiple files, which can then be imported onto a system and deployed as required.

Package deployment and verification



Using the management console, it is possible to perform the following actions:

Features

- Determine what has been deployed to the system
- Deploy/un-deploy particular versions of the test program or any dependent common component
- Verify the integrity of deployed files

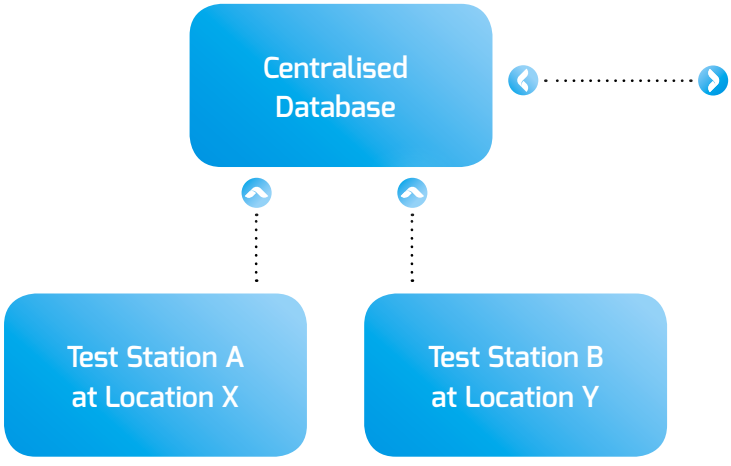
In addition to providing a GUI driven management console, all these operations are available through an application programming interface (API). This allows test applications to verify their integrity at run-time thereby mitigating the risk that crucial files may have been changed prior to the test execution. For example, if test limits are stored in a text file – inadvertent or malicious modifications to this file could allow failing tests to pass effectively meaning that defective product is shipped. By running this check at the start of an execution and changes can be highlighted and automatically reverted if appropriate.

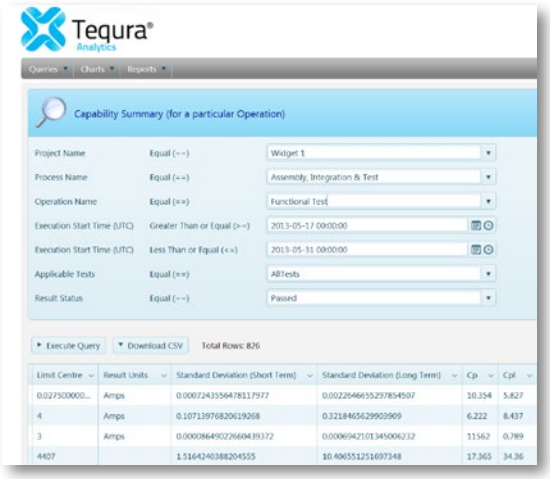
Tequra®
Analytics

DATA DRIVEN INSIGHT

Tequra Analytics is a centralised test data management system, incorporating a web-based analysis and reporting front-end. A set of built-in reports covers a wide variety of analysis use cases for both production managers and engineers. Additionally, a powerful graphical query builder allows easy visualisation, analysis and export for ad-hoc analysis requirements. Test data can be imported into Analytics from Tequra Framework, standard NI TestStand report formats or via a custom import tool utilising the Application Programming Interface (API).

Data collation, reporting and analysis





Benefits:

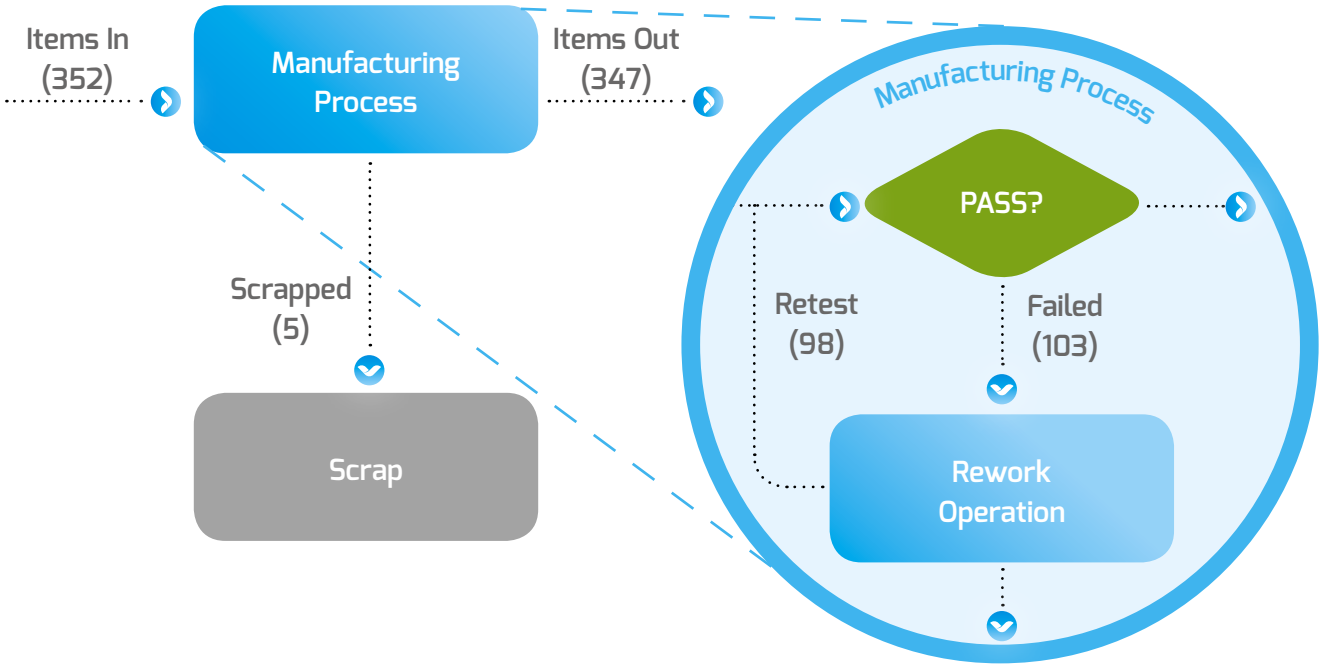
- Provide a centralised repository for all test results
- Data backup and archiving capability
- Utilise the analysis capabilities of Tequra Analytics to:
  - Improve production yield
  - Maintain quality
  - Identify hidden wastes
  - Improve product design

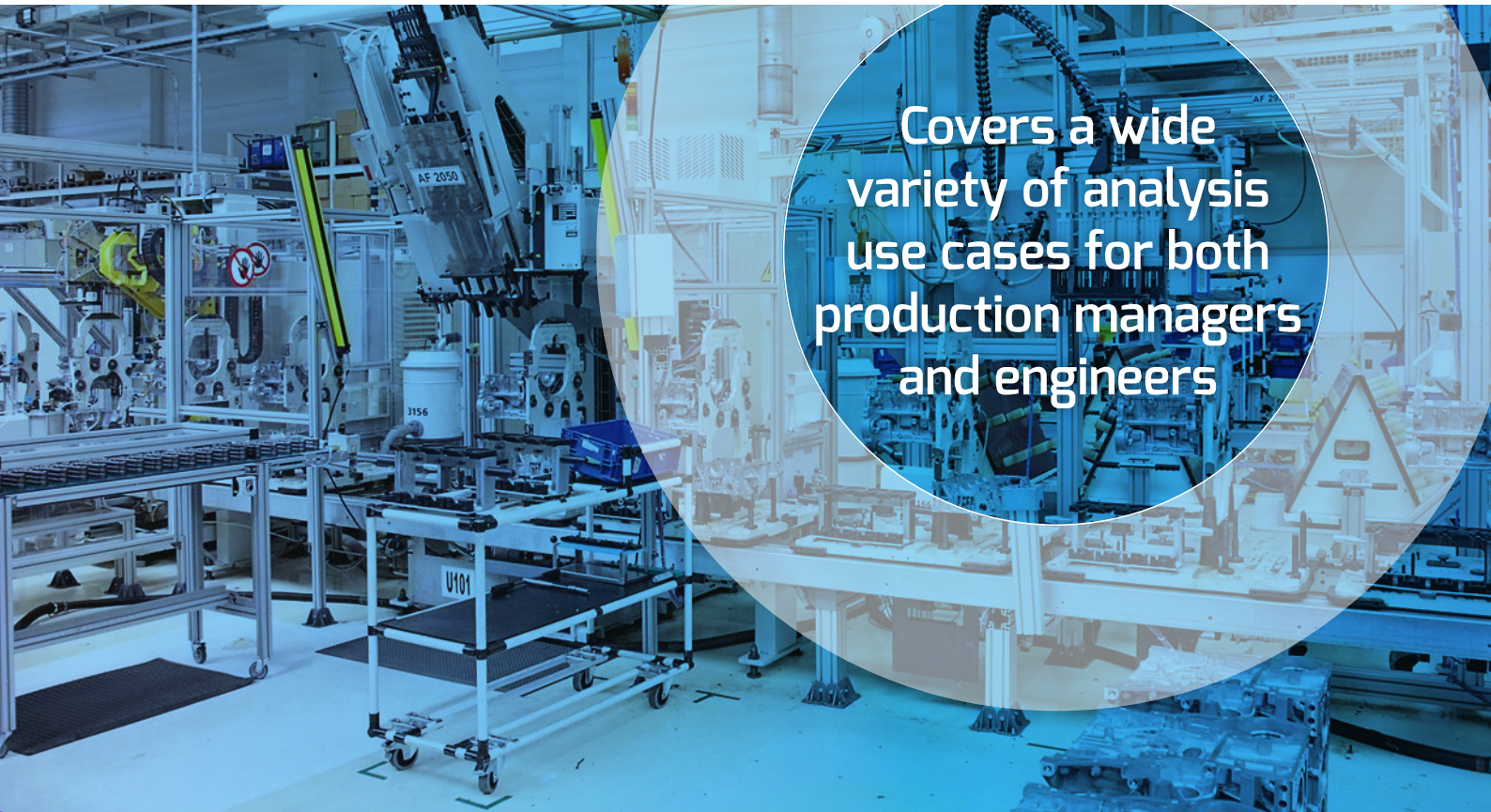
On-Demand Production Metrics

In the context of a manufacturing setting, Tequra Analytics provides quick access to data about the production process; which is of great interest to production managers and quality engineers alike.

Instant visibility of production yields is possible, helping to identify problem areas. By highlighting processes and operations with low test yields, further analysis can be performed to find the root cause. This could be extensive rework, often termed "The hidden factory". Additionally, different views on the data help determine whether particular test stations or operators are the main contributing factor to low yields, or whether the problem is down to a UUT not meeting its test specifications.

The hidden factory





Seamless Results Import

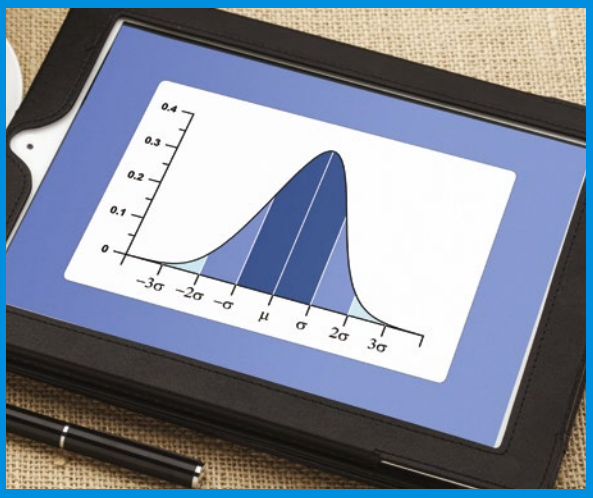
Test results may be imported from a number of sources: if using some elements of Tequra Framework, results are ready to import with no additional configuration required. Additionally, results may be imported from "standard" TestStand report formats or the Tequra Analytics API can be used to import custom formats. Simplicity AI can write these custom import modules if required.

Quality Tools

Tequra Analytics provides standard data views which aggregate results across multiple UUTs. For example, it is possible to select a particular test and see a set of statistics across a set of UUTs, test stations, operators or a combination of all three. These statistics include standard measures such as minimum, average and maximum values as well as capability statistics such as Cp and Cpk. Additionally standard reports also indicate which tests are failing most often and which are statistically likely to fail in future given the current test criteria.

Custom Query Builder

Tequra Analytics contains an easy-to-use query engine, allowing engineers to construct ad-hoc queries to answer specific questions about test results. For example, it would be trivial to extract the "Measured voltage @ TP12" for "Product X" to provide a trend across all units (or a particular subset). Extending this further, if the measurement is parameterised with temperature information, it would be possible to plot the same trend split into separate series/lines on a chart for each environmental chamber setting. Using this information, the effect of temperature on a particular voltage measurement can be established. Extracting this kind of engineering data from a database takes minutes, whereas manually aggregating data from hundreds or thousands of result files can take hours or days – and this must be repeated for each measurement that requires analysis.



Simplicity ai

ABOUT SIMPLICITY AI

Simplicity AI provides a range of advanced technical products and engineering services for test, measurement, control and automation. Solutions span across a wide range of industry areas including, aerospace, defence, electronics, telecoms and medical devices.

Solutions

By applying the latest measurement and automation technology Simplicity AI have created a diverse range of solutions to enable customers to meet their business and technical objectives.

Simplicity AI solutions have allowed customers to:

- Ensure manufactured products consistently meet exacting quality standards
- Verify complex safety critical aerospace & medical components
- Accelerate & standardise internal test engineering processes
- Increase automation & monitoring of large scale experimental science facilities
- Rapidly analyse large production test datasets and report key performance indicators
- Protect against obsolescence and reduce down-time of key equipment assets

Services

Simplicity AI provide a range of technical services that can be tailored to fit the needs of customers. The scale of offering can range from short training and consulting activities, through to large turn-key system delivery and long term partnering relationships.

Services Include:

- Full Turn-Key System Delivery
- Custom Test/Measurement Platform Design
- Tool/Component Development
- Technical Training
- Support Services
- Engineering Consulting

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