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## 2024 AUSTIN

# Intro to NI Battery Lab Software Suite

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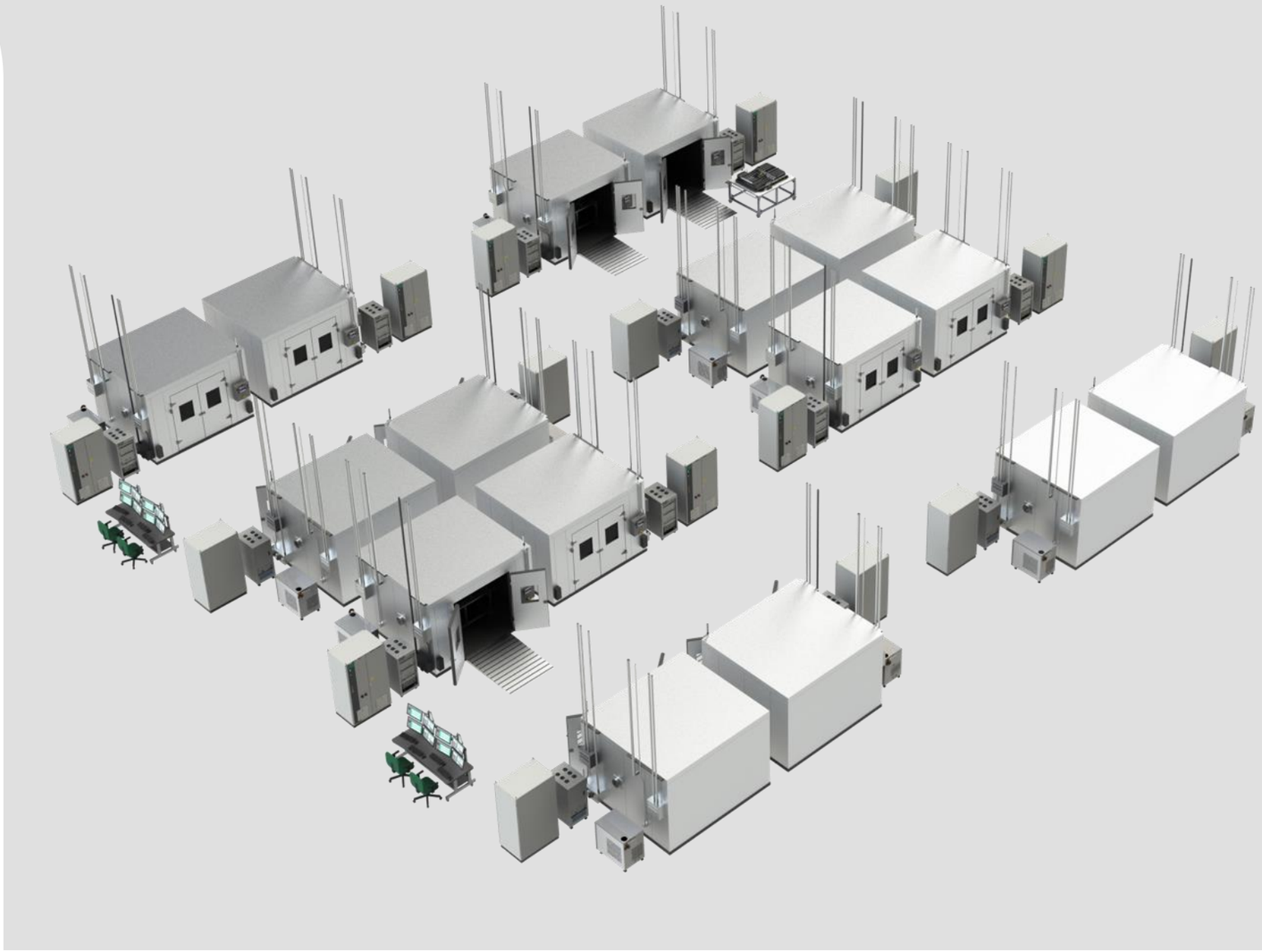
# Battery Test Labs: The Challenge with Scale

- Temperature Dependency
- Long Test Times
- Constant Changes
- High Power Hazard
- Expensive
- Aggressive Program Schedule



# Challenges in Procuring Equipment for Battery Test Validation Facility

### Lack of Standardization

Each supplier may have proprietary technologies, complicating standardization efforts.

### Maintenance Complexity

Managing multiple suppliers can lead to complexities in maintenance schedules and support requirements.

### Training Needs

Specialized training may be required for operators to manage equipment from different suppliers, increasing costs.

### Compatibility Issues

Different equipment may not be fully compatible, leading to integration challenges and inefficiencies.

**Challenges**

### Scalability Challenges

Integrating additional equipment as production needs expand could pose scalability challenges and increase costs.

# Transformation of the Battery Validation Lab

**OPEN AND FLEXIBLE SOLUTION STACK**

**Global Distributed Lab, Connected Lab**
**Product Performance**

**Multi-Test Bench, Connected**
**Lab Product Performance**

**Multi-Test Bench**
**Facility Management**

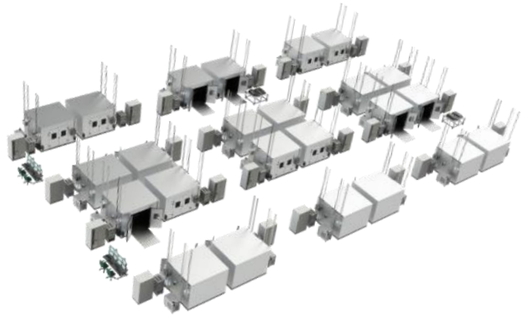
**Single Validation Workbench**
**Customizable Test**

Software

+

Data

**Global Validation Labs**



Scalability with
Software-defined Battery Lab

**Battery Validation Workbench**

# The Right Approach to Control Your Test Strategy

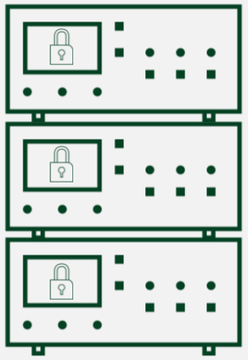
## Closed System

"Vendor Knows Best"

Fixed Functionality

Closed Ecosystem

Customer Pays



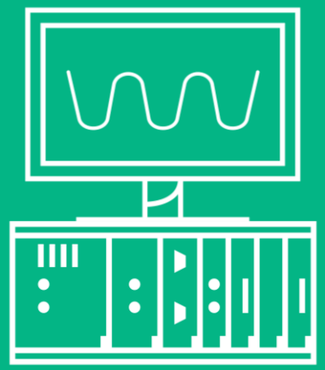
## Open Connected Approach

"Customer Knows Best"

Customizable Solution

Open, Vibrant Ecosystem

Customer Designs



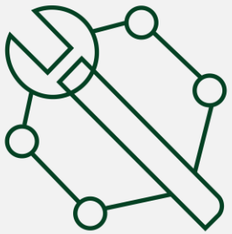
## Fully Custom System

"Customer Does Everything"

Ground-Up System

No Ecosystem

Customer Maintains



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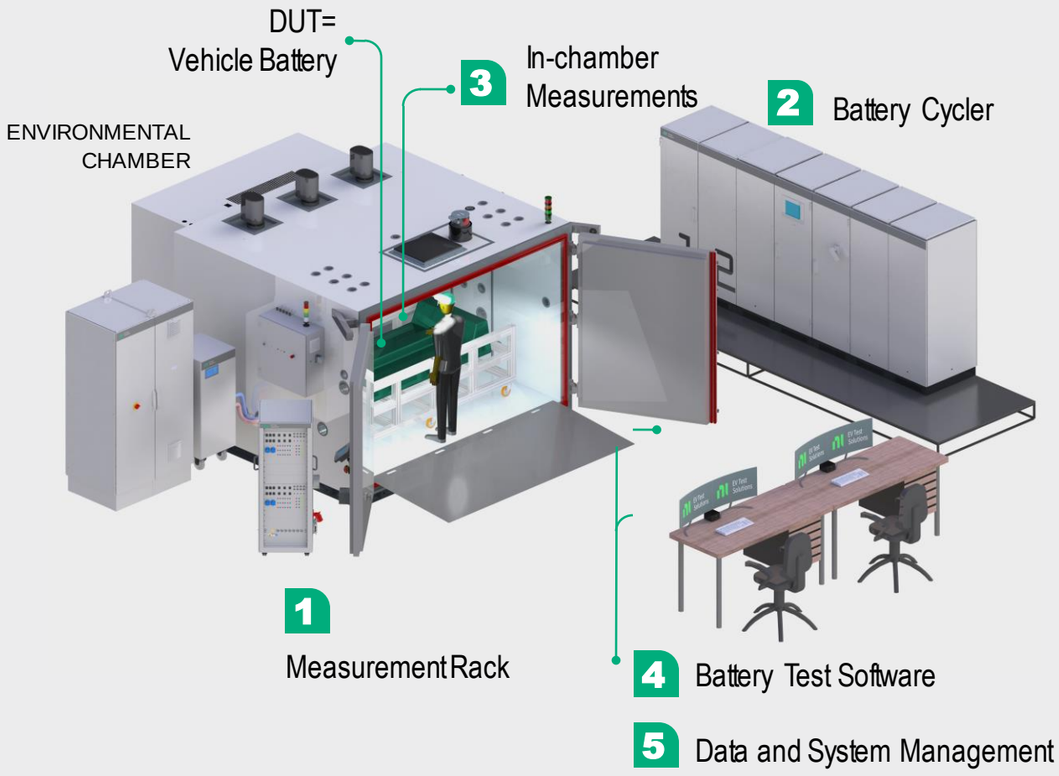
# NI Battery Validation – Test Solution

## Software Connected Workflow

DESIGN ⟵ VALIDATION ⟶ PRODUCTION

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**NI Software Suite**

- Data Analytics
- Data & Systems Management
- Test Software
- Control System
- Power Electronics
- Lab/Line Infrastructure
- Connectivity and Fixturing
- Commissioning, Operation, Maintenance

6 HV Electronics Module And Battery EOL Testers

1. Scalable measurements at low cost per channel
2. Connection to power electronics, less rework
3. Rugged in-chamber measurements
4. Open, out-of-the-box or custom battery test software
5. Customized data dashboards for facility management
6. High voltage module and battery EOL quality in production facilities
7. NI's Software Suite

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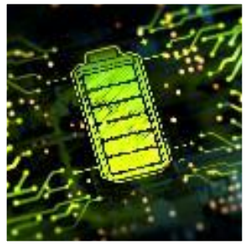
# Benefits of NI's Software-Defined Battery Lab



## Connect to all the most popular Cyclers and Instruments

Minimize retooling time to bring in new instrumentation, cyclers, external software and new DUTs without relying on a third-party vendor.

## Scalable software and open APIs makes your investment future-proof

Server-based systems and data management software that can scale-up and scale-out as your test requirements evolve and expand.

## Quickly create targeted software workflows to boost productivity

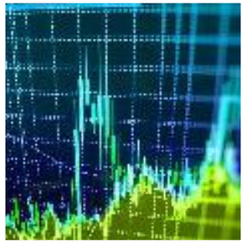
Enable a small team of test engineers to maximize the productivity and efficiency of large groups of different stakeholders with unique expertise.

## Modern, web-based software enables collaboration from anywhere

Open and proven software with a large community of support and partner resources that includes powerful and accessible scripting tools. Modular and flexible hardware that can be easily reconfigured.

## Coordinate and schedule tests to optimize assets and power utilization

Power is an increasingly expensive asset that requires careful consideration and planning for large validation labs.



## Extract critical insights from data across the lifecycle

Organizations are producing large quantifies of data that is either inaccessible or underutilized. Value of data across a product's lifecycle is not maximized.



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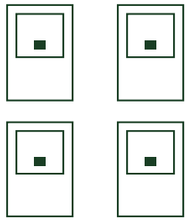
# Solution Advantage

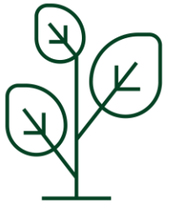
## Requirements Compliance

100% requirement compliance + seamless technology insertion with third-party equipment interoperability



## Minimize Footprint, Maximize Power Density

We cover cell, module, pack and system testing, from 10V to 1500V and up to 1.5MW

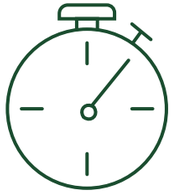


## Energy Efficiency

>90% efficient cyclers with regeneration yield
Double-digit energy savings over competitors

## Cost of Ownership

Access and own your IP, in-house calibration, local support/training, remote asset management



## Responsiveness to Change

Add channels, DUTs, and technology insertion in **hours or days,** not weeks
Modular design reduces downtime with advanced replacement service

## Reduced Supply Chain Risk

Selected suppliers with global footprint and capacity to exceed customer delivery expectations, local support

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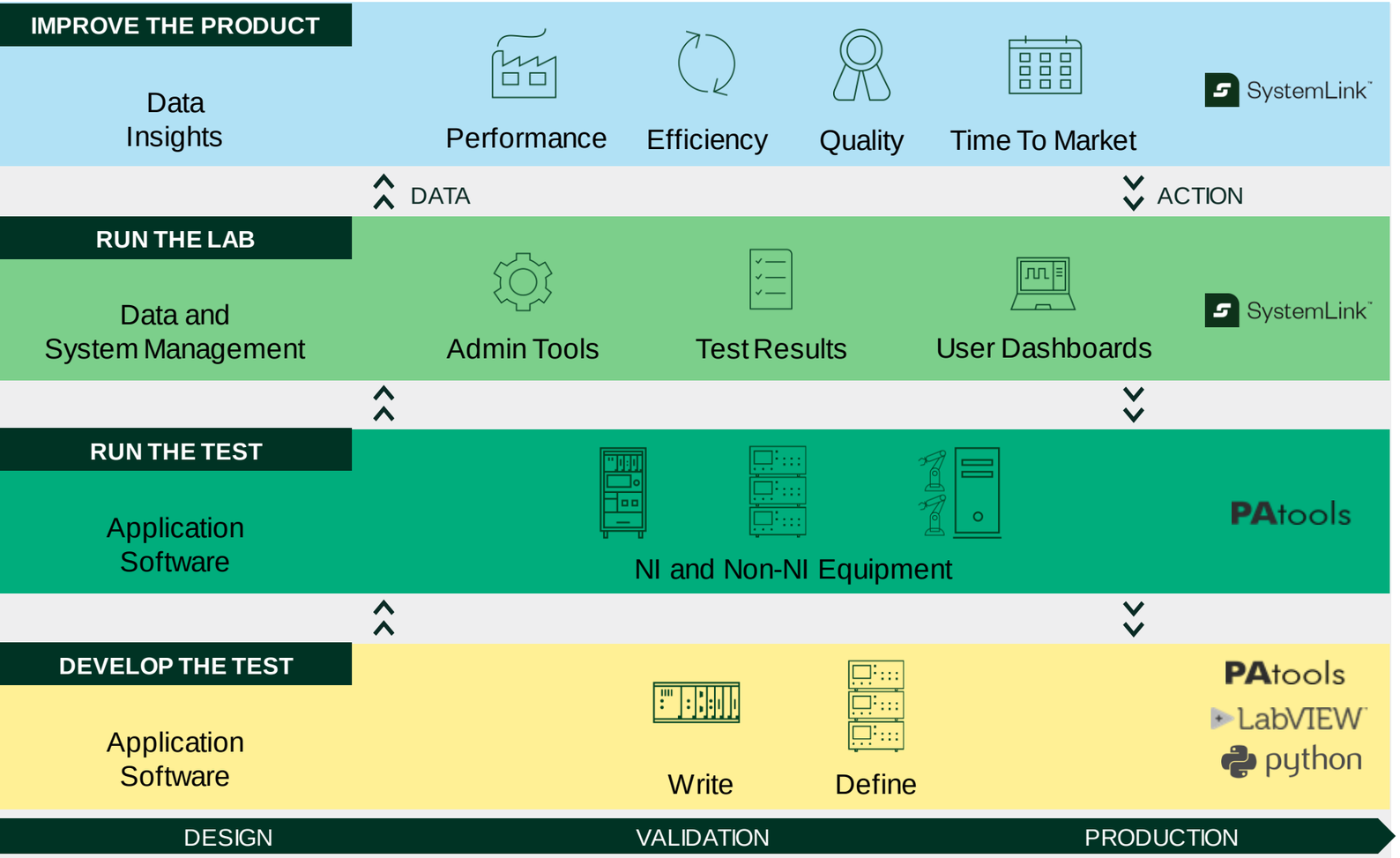
# Battery Lab Software Overview

# Battery Lab Software Architecture

Open, Connected, Software-Defined Approach to Operating Modern Labs




Automate & Streamline Workflows

Connect & Increase Utilization of Test Systems

Enhance Data Management & Analysis

Automated Data Analytics

Integrated Suite with Complete Traceability

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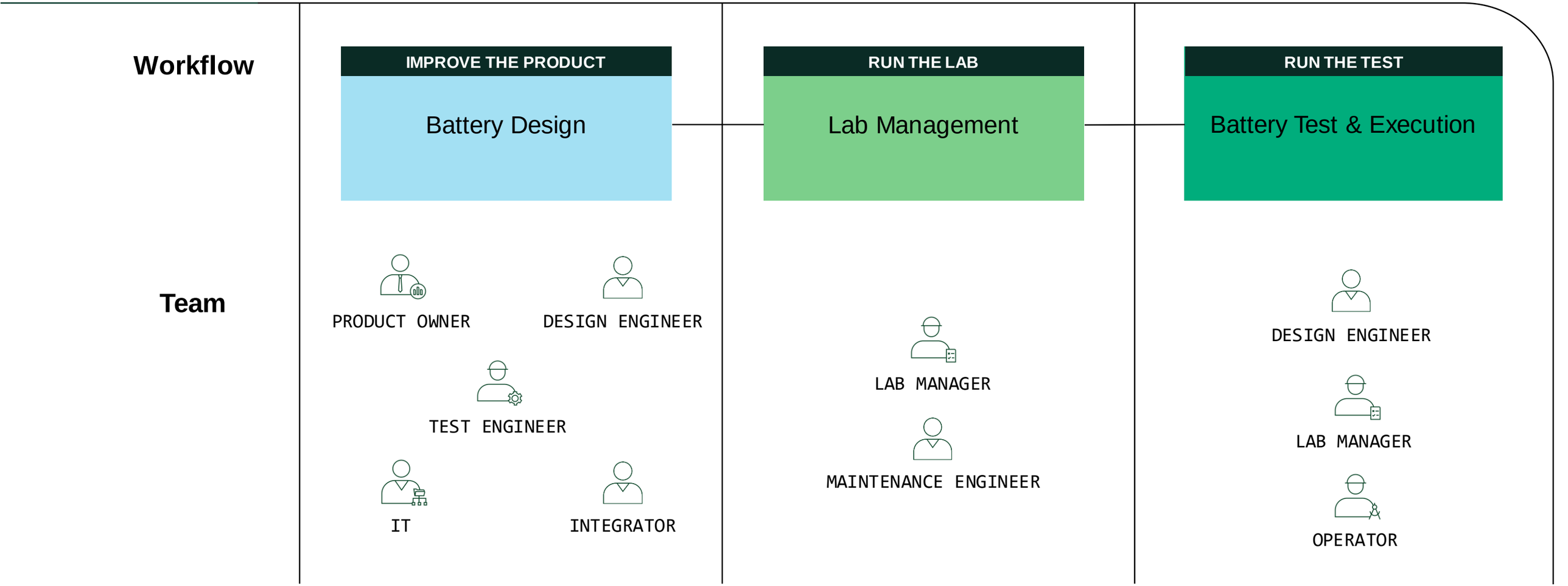
# Optimize Workflows with the NI Battery Test System



# PAtools | Tools for Test Station Automation

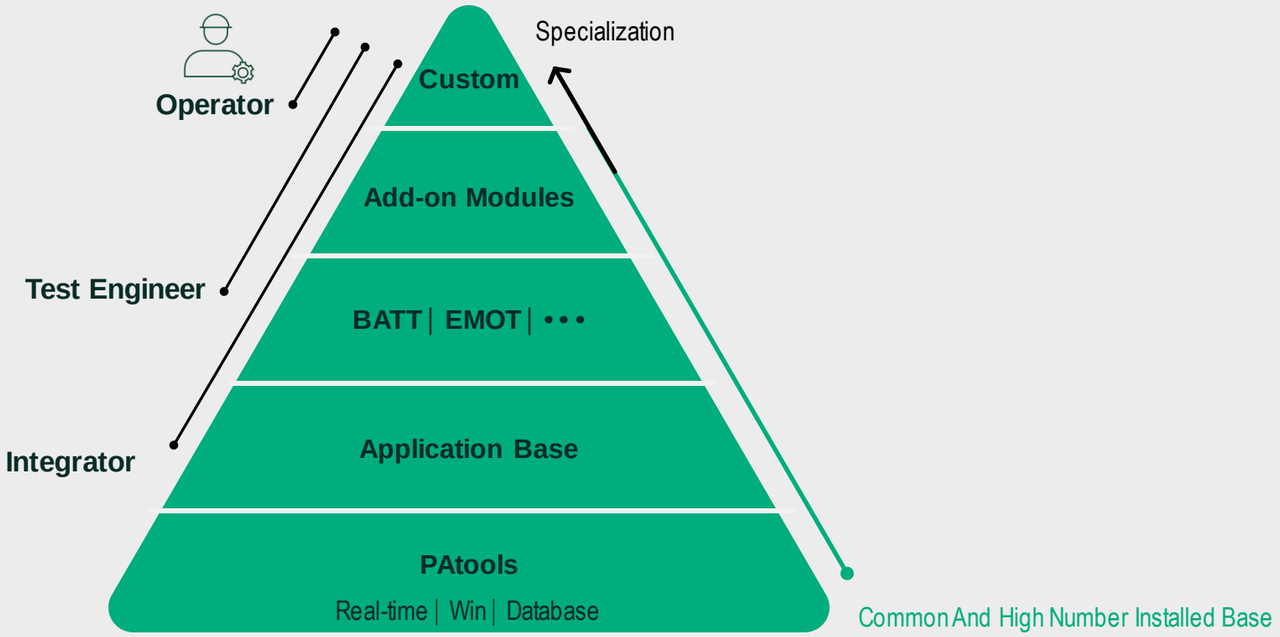
Test Station Automation Software and Test Field + Data Management

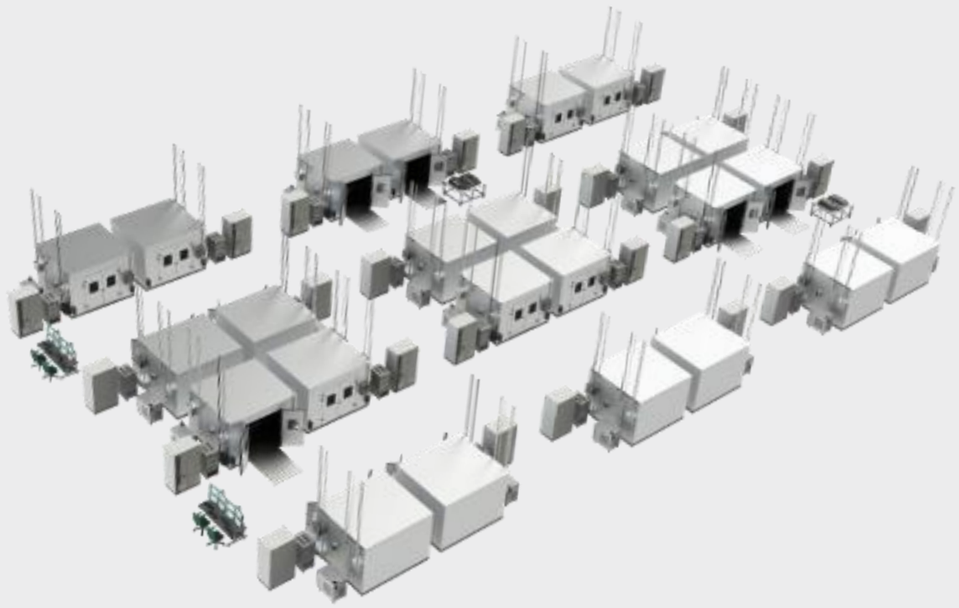
**PAtools Core Software:**

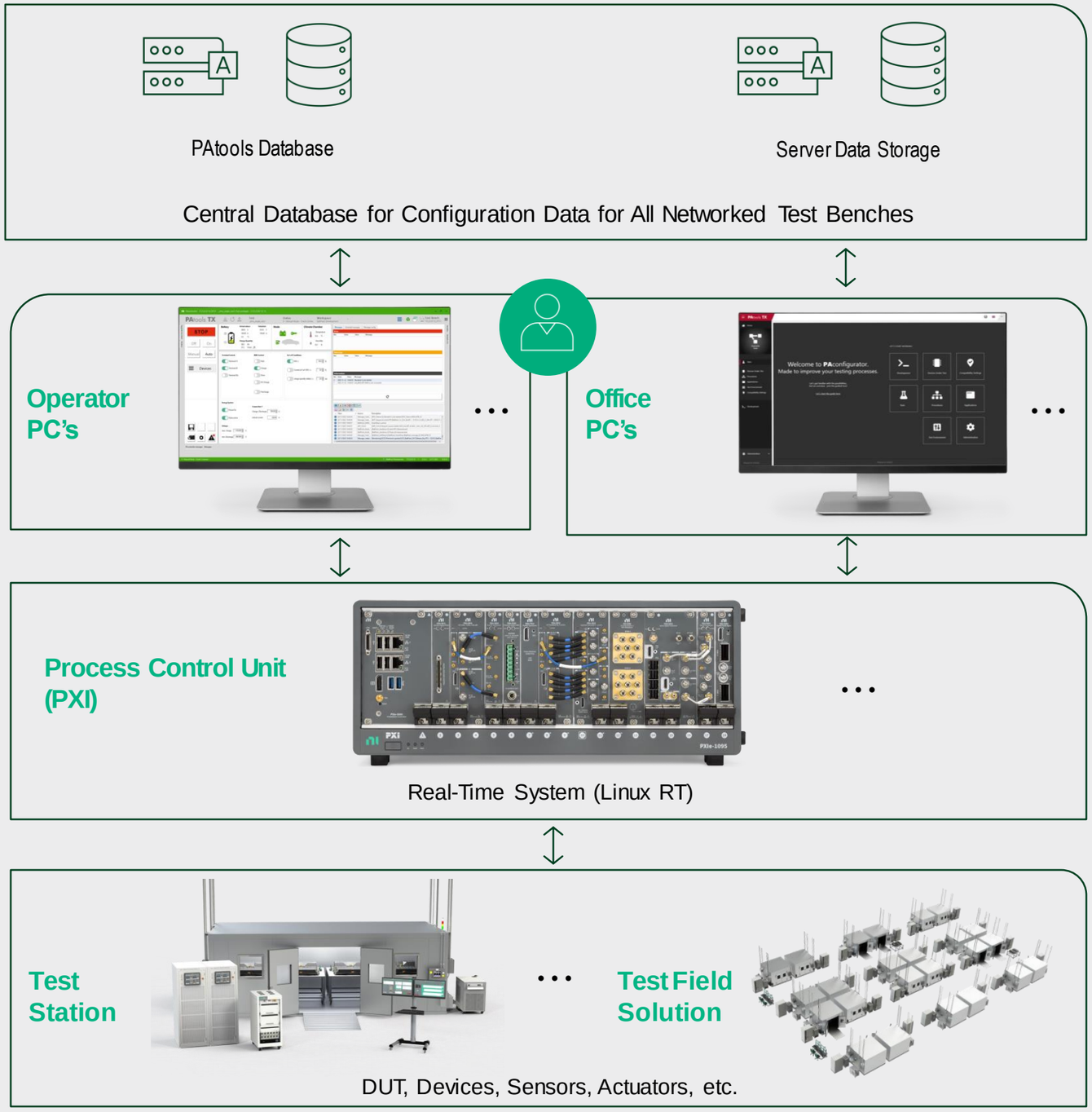
**Segment Specific Applications** = Application Base + Segment (e.g., BATT)

**Customer-Specific Solution:** Done Through Parameterization and Programming of Core System

**Test Field and Test Data Management:** SystemLink Enterprise






# PAtools | Scalability

Centralized PAtools database to easily share and deploy new features to the single test station or the entire test field

2 computer-based system to separate Real-Time Test Station and Windows Environment

Remote Access and Central Data storage
for All Networked Test Stations

# PAtools Benefits

## Unifies Development

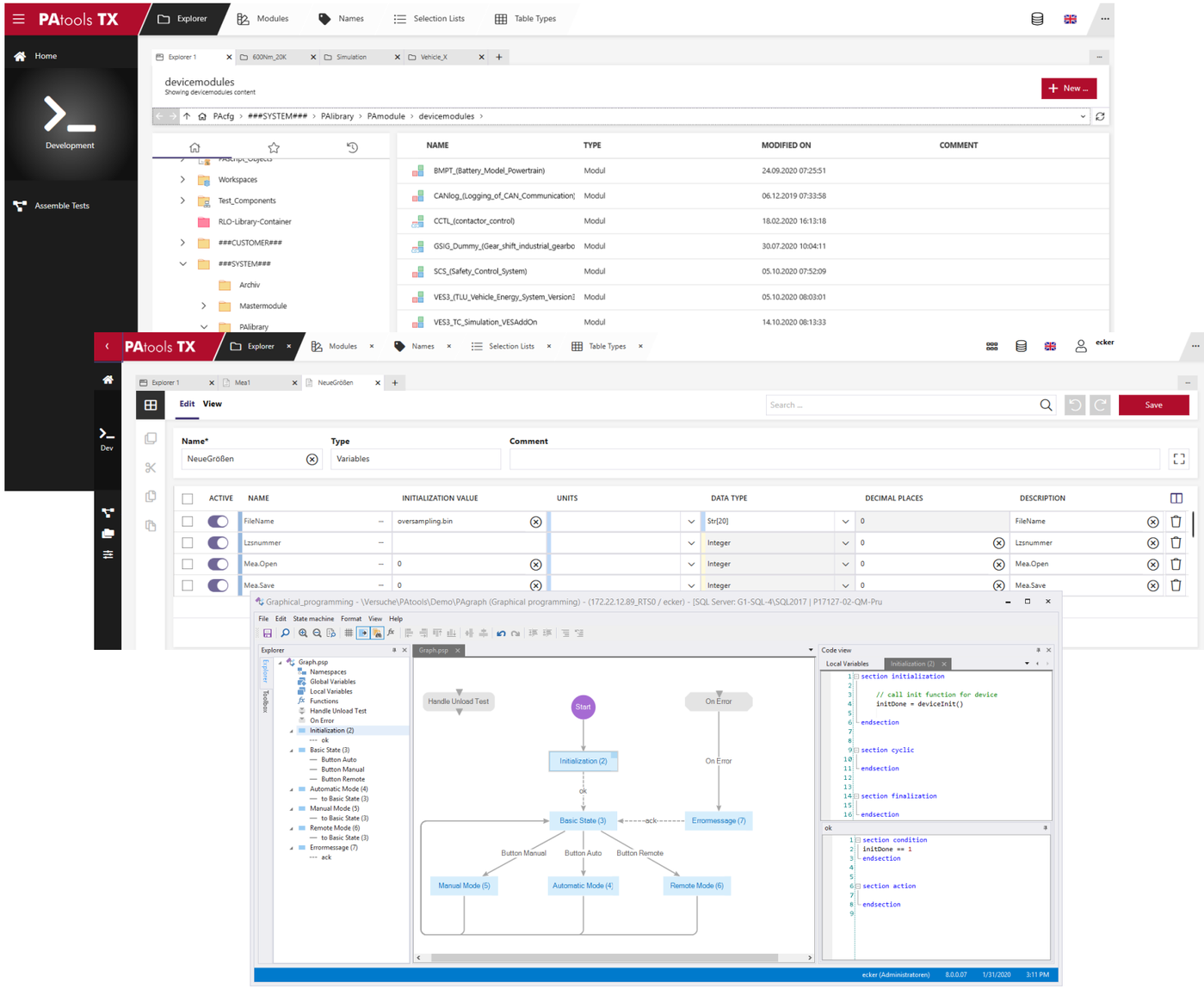
**PAtools** offers a workflow-based and user-centric platform that integrates different components, testing methodologies. Various data analysis and reporting capabilities allow a seamless collaboration and efficiency across the development lifecycle.

## Openness & Scalability

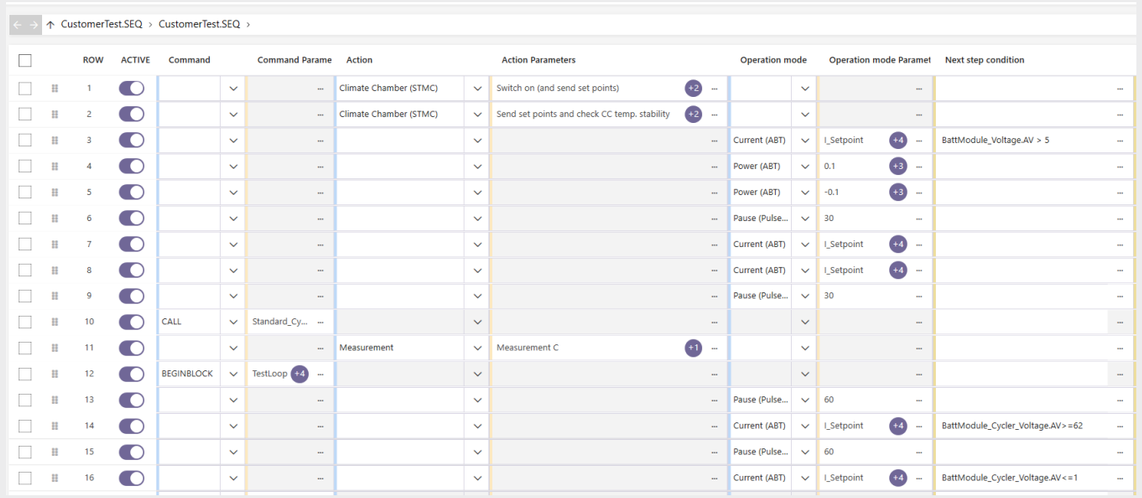
**PAtools** supports individual integration of a wide range of test stations and equipment through hardware and software interfaces, to adapt to customer specific DUT requirements and testing procedures. PAtools currently supports XCP, CCP, EtherCat, CAN, CAN/FD, ISO-TP, UDP, TCP, ProfiNet, Profibus.

## Headless Operation in Real-time

**PAtools** increases with a dedicated Real-Time System utilization and uptime of the Test Station to reduce time to market and better product performance through efficient test processes.



# PAtools Test Automation Workflow Development



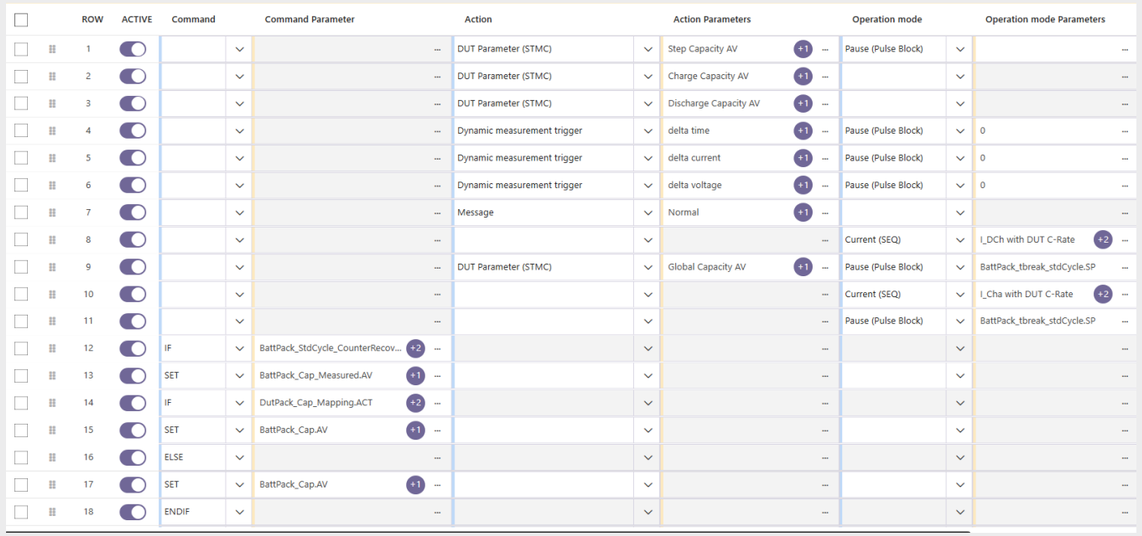




Table-based configuration simplifies authoring and debugging of test scripts.

Automation scripts are DUT and equipment agnostic thanks to abstraction layers

Editor enables advanced control and conditional logic without programming.

Test scripts run on real-time OS, ensuring deterministic response time.

Test-scripts can be edited in external tools like Microsoft Excel.

Test scripts include DUT limits and specifications to ensure compatibility and safety.

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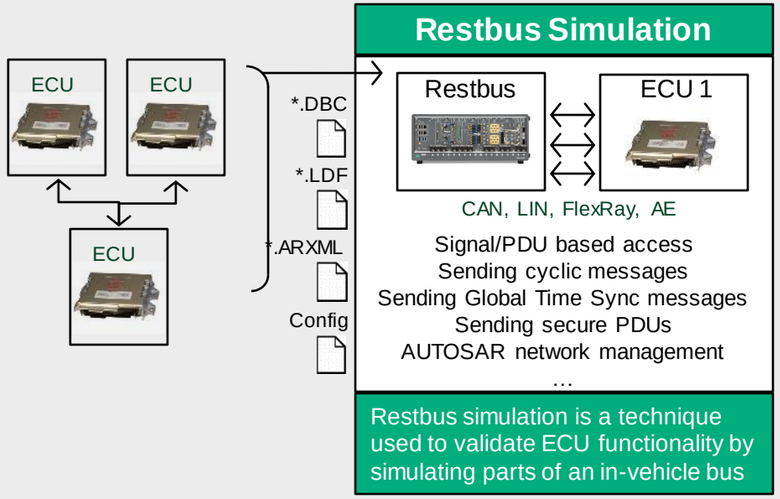
# Automotive Communication Protocols




The Vehicle Communication Software Suite includes the Vehicle Communication Toolkit as well as two optional add-ons: the Vehicle Communication Measurement and Calibration Toolkit and the Vehicle Communication Diagnostic Toolkit.

## Vehicle Communication Toolkit Key Features:

- Restbus simulation on NI-XNET hardware (CAN, LIN, Automotive Ethernet, FlexRay)
- Multiple restbus simulation transmission modes for .dbc and .ldf databases (cyclic, spontaneous, event, etc.)
- Signals to activate channel/node/message/PDU
- Automatic calculation of different cyclic redundancy check (CRC) and counter signals
- Manipulation of auto signals (counter, CRC, etc.)
- Automatic calculation of AUTOSAR End2End communication protection profile
- Network management
- Signal multiplexing (explicit and implicit)
- AUTOSAR multiple-PDU-to-container handling
- AUTOSAR secure onboard communication (SecOC)
- Message disassembly
- SOME/IP support (service discovery, SOME/IP services)

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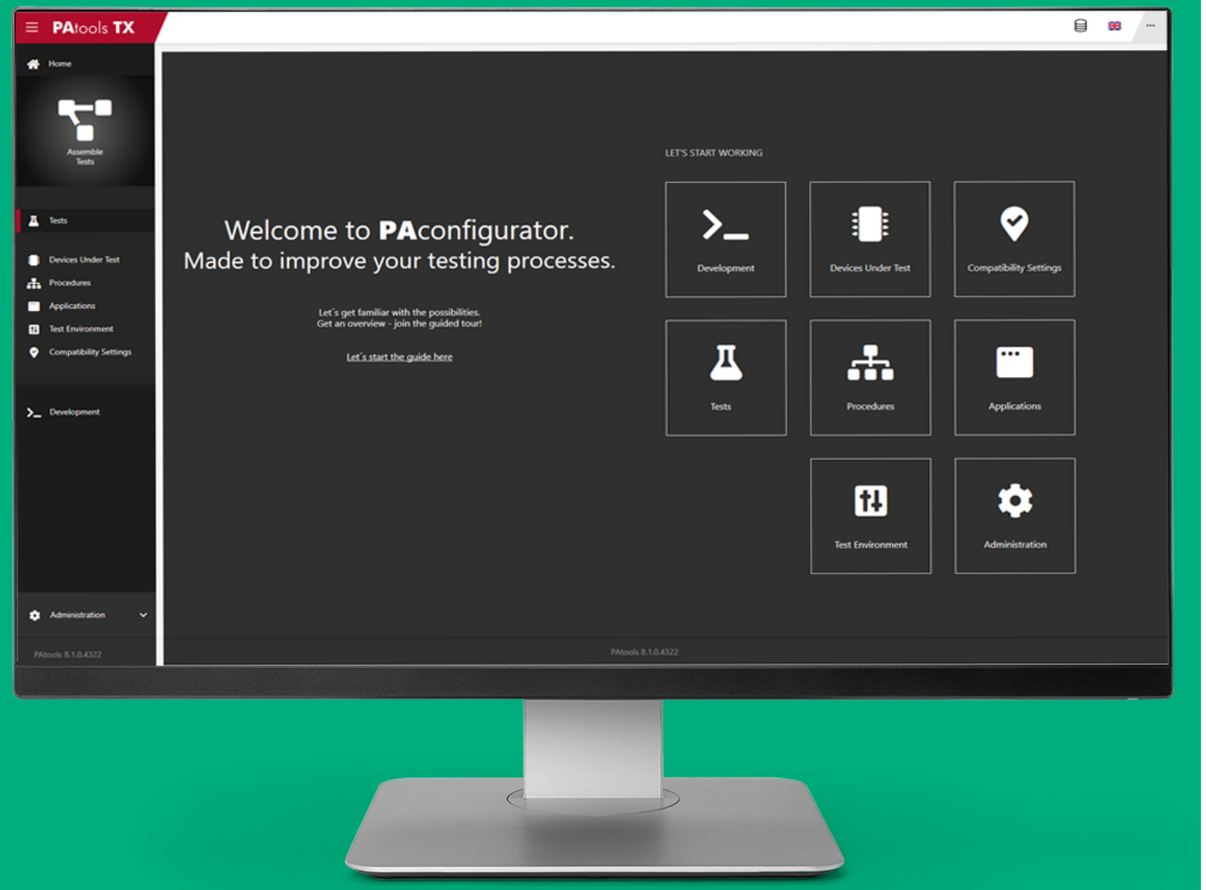
# Battery Lab Software Demo




# PAtools 2024 Q2

**New Features:**

Install PAtools via NI Package Manager

Integrate SystemLink to create test results, publish measurement files to SLE and publish PAtools variables as tags.

Measure multiple temperature sensors on a battery cell

Integrated a power-controlled mode in the Battery Application

New editors for Profibus, component interfaces, measurements, CAN, classifications, results files, Profinet RT, and DSO configurations, buffer types

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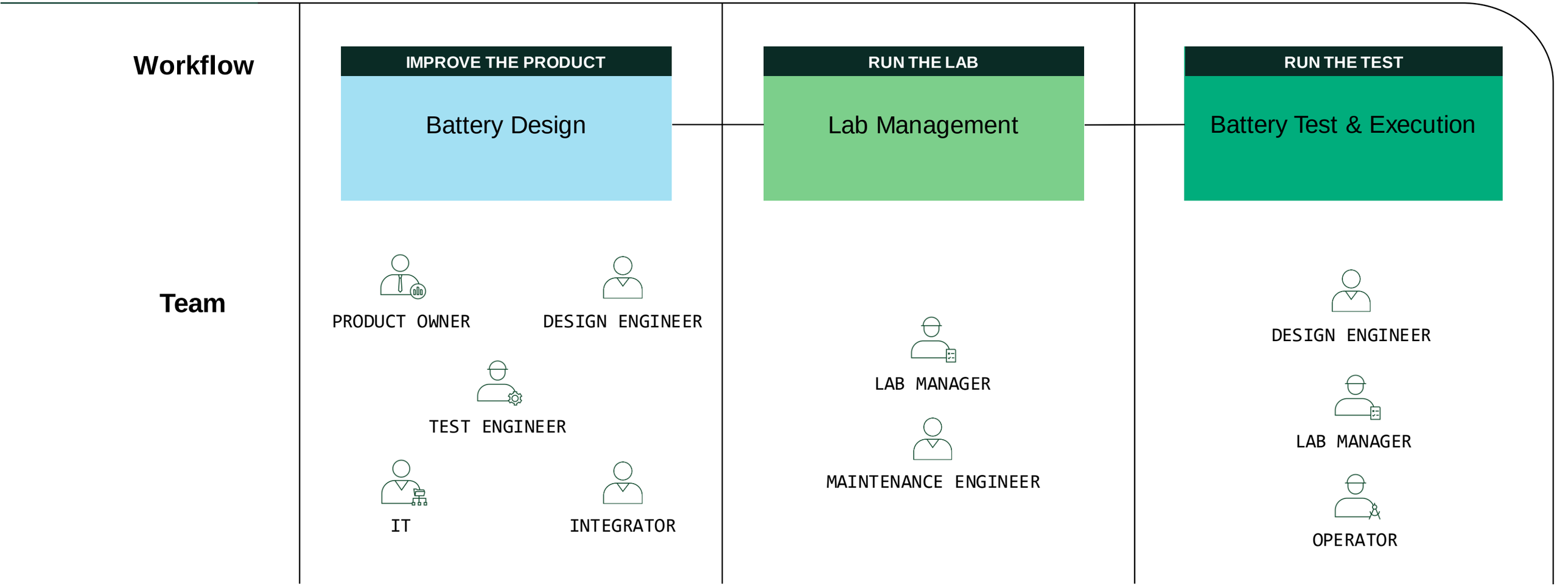
# Lab Operations Overview

# Optimize Workflows with the NI Battery Test System



# Battery Lab Management System

SystemLink™ provides a central infrastructure of asset management, lab orchestration, data management and analysis tools to plan, execute, and deliver results through the entire Lab Workflow.

### Work Order & Test Plan Management

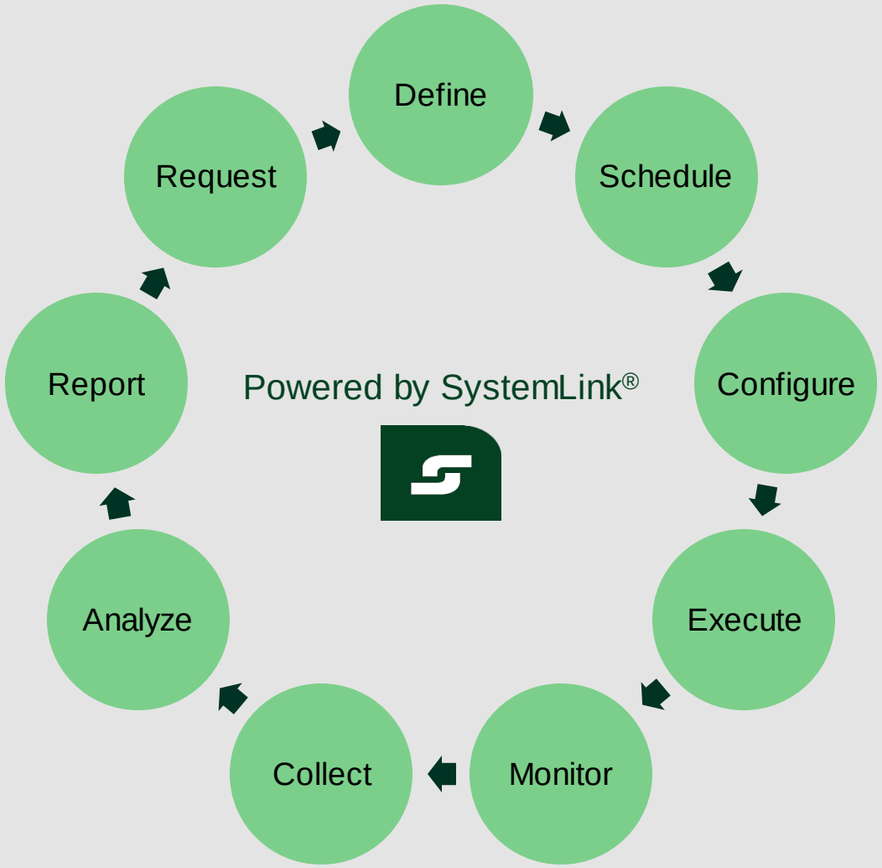
Track incoming test requests, define requirements, assign to test stations, and efficiently return the results to requestor.

### Systems & Asset Management

Manage and install software for your entire test fleet, monitor test system health, and manage and track the assets connected to your test systems.

### Asset Traceability & Utilization

Automatic asset tracking for NI and Third party LXI, USB-TMC, GPIB instruments to maximize utilization and optimize spend.




### Calibration Management

Track calibration status and calibration history.

### Test Monitoring & Insights

Collect and view test results, files and parametric data; filter data for additional insights and track KPIs with dashboards and customizable analytics.

### Analysis Automation & Reporting

Fully integrated Jupyter Notebook development environment to create Python scripts to extract, transform, and analyze data.

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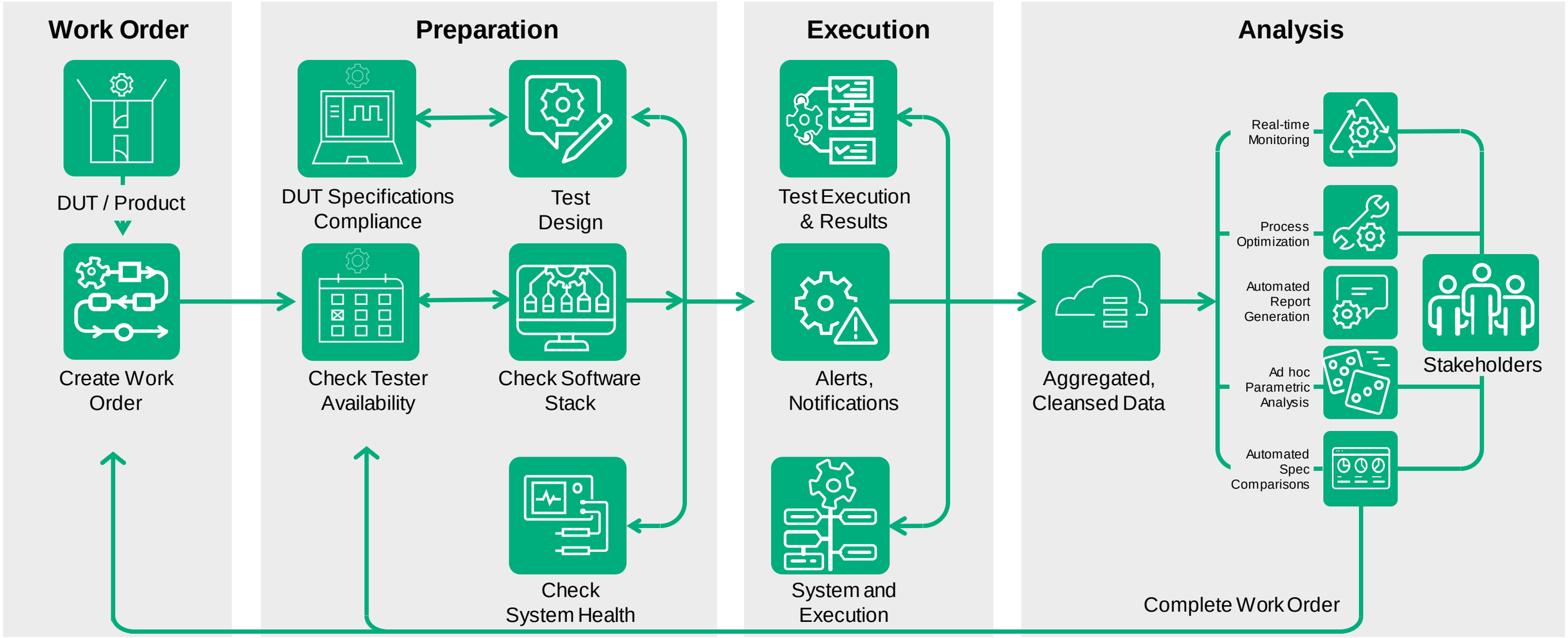
# Closing the Operations Loop

Providing Context Across the Lab Operations Workflow



# Key Highlights

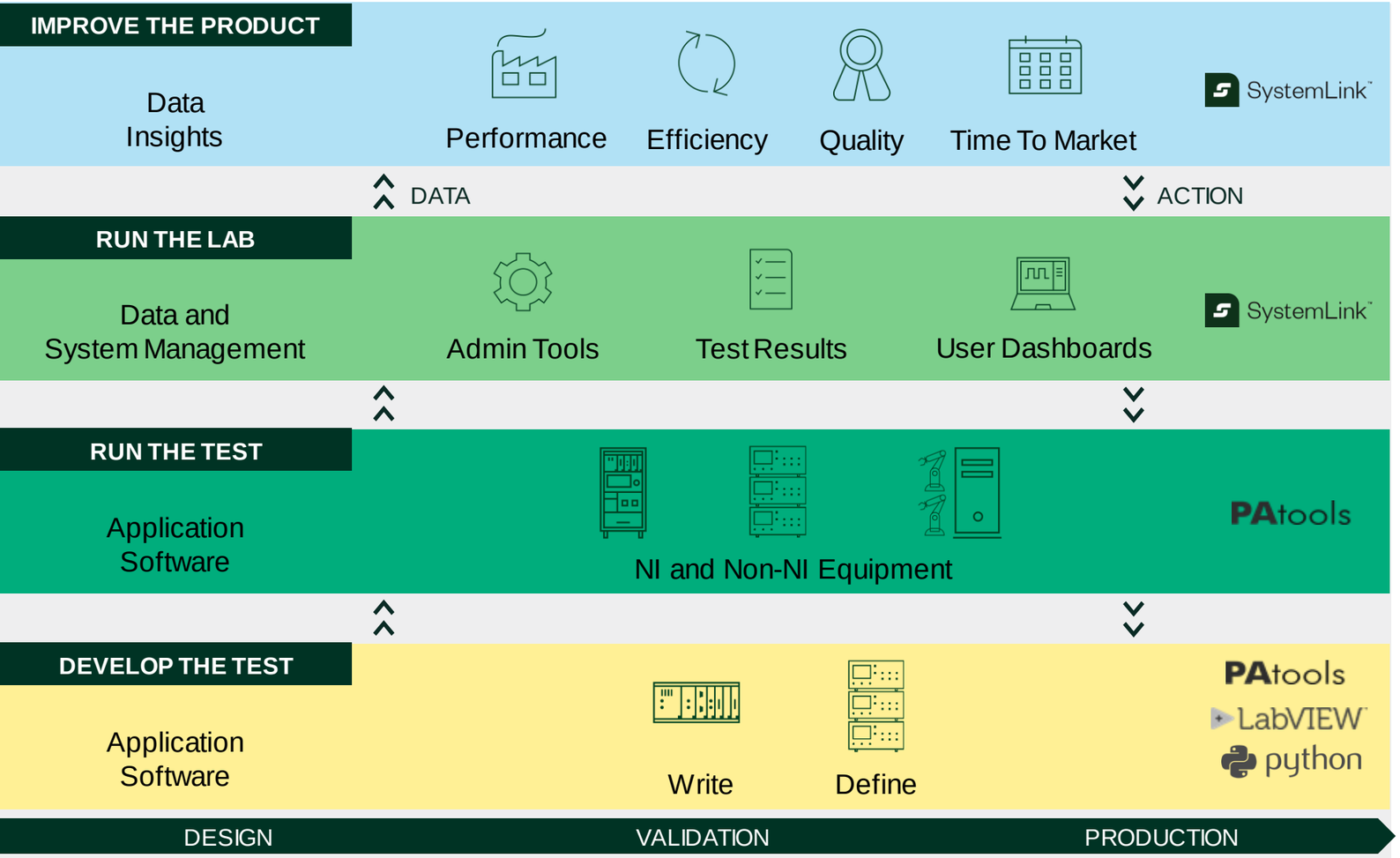
Our unique approach drives down long-term costs by increasing flexibility and ensuring your investment with scale for future capabilities and anticipated growth.

NI's software is designed to cater to the unique needs of specific personas to maximize their effectiveness.

We have significant ongoing investment into further enhancements of the software, including and especially advanced LIMS capabilities such as test scheduling and power management.

# Battery Lab Software Architecture

Open, Connected, Software-Defined Approach to Operating Modern Labs




Automate & Streamline Workflows

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Integrated Suite with Complete Traceability

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