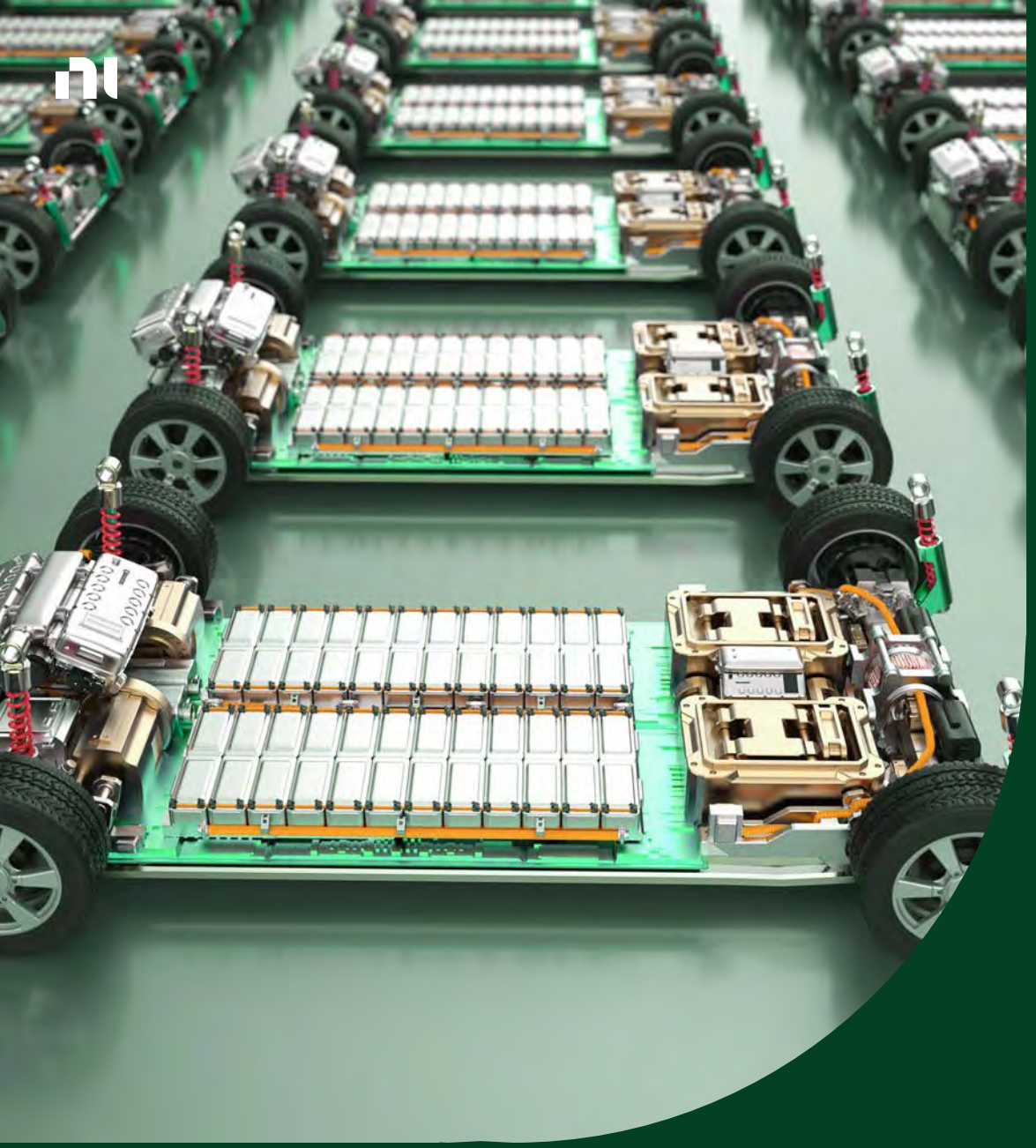


Key Considerations for Designing an Efficient EV Battery Lab

Martin Weiss

Chief Systems Architect, Transportation, NI

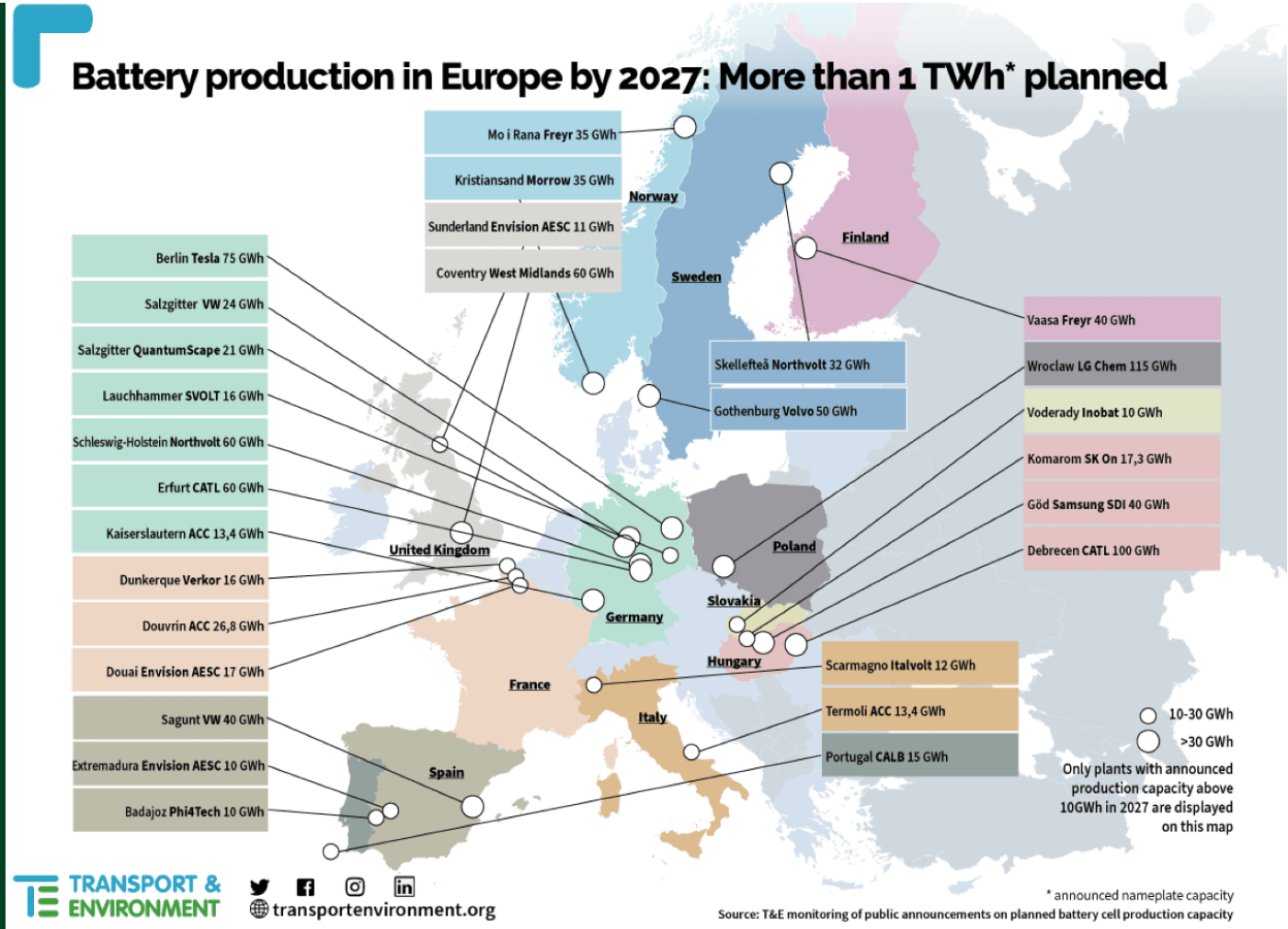
Presenter: Martin Weiss

Martin has over 25 years of experience developing automated test systems for evaluating power electronics and battery systems.

As the Chief Systems Architect at NI Transportation, Martin is responsible for the technical development and launch of new, industry-driven hardware and software test solutions. Previously, he worked as a Principal Design Engineer for high-tech companies including Vocollect, Marconi Communications, and Telxon.

The Growth of Battery Validation Labs and Gigafactories

The development of EVs are increasing and so are the batteries that power them.

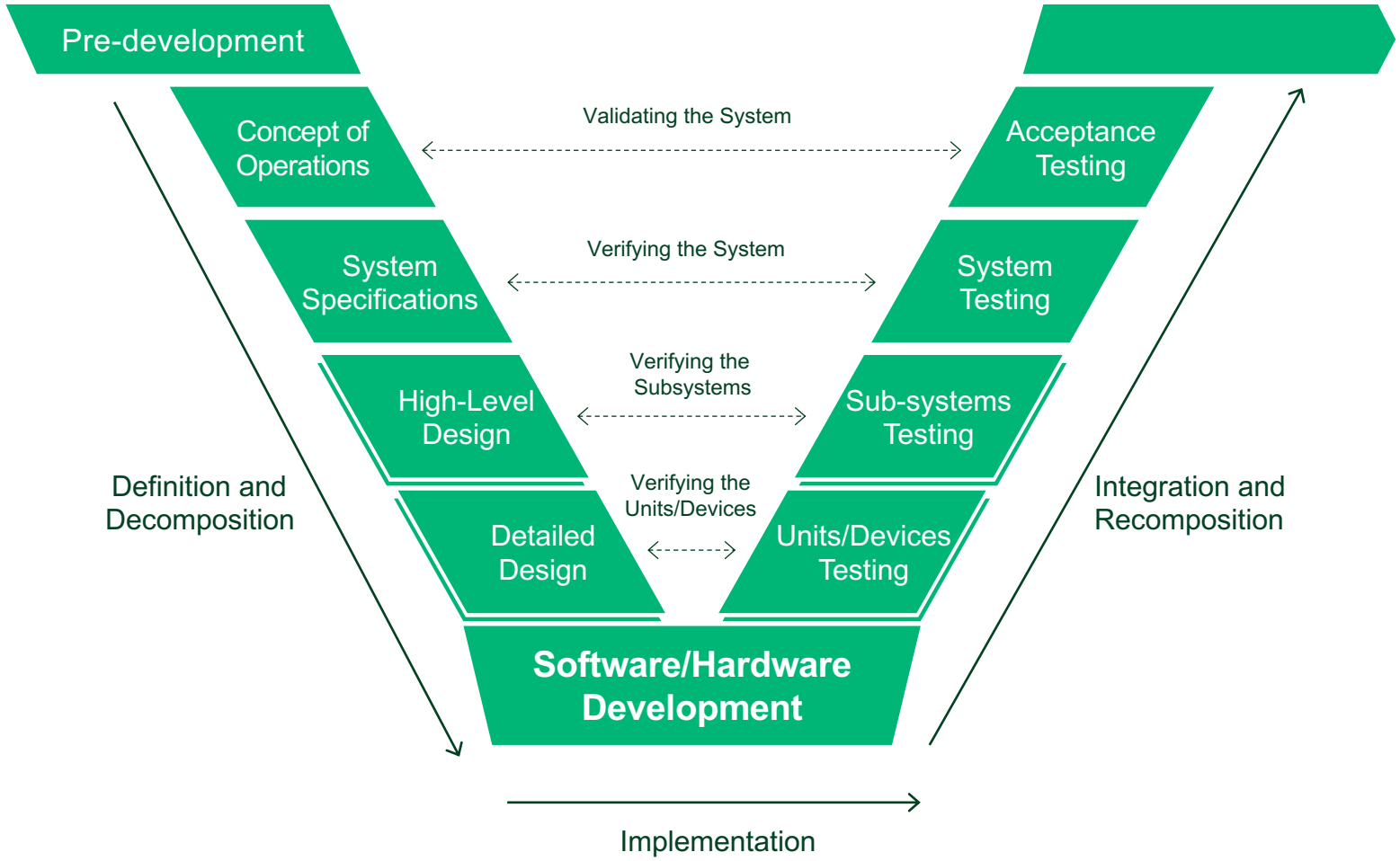


Battery Test Challenges

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

- **Time-to-Market**
- **Battery Performance**
- **Total Cost of Test**

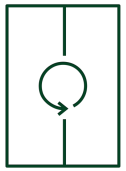
What is Your Stage of Implementation?



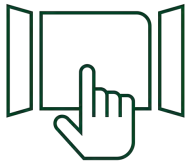
Designing and Managing an Efficient EV Battery Lab

Key Planning Considerations

PHYSICAL TEST ENVIRONMENT



BATTERY CYCLER HARDWARE CAPABILITIES



REQUIRED INTERFACES

SAFETY CONSIDERATIONS

SOFTWARE-DEFINED APPROACH

The Right Approach to Control Your Test Strategy

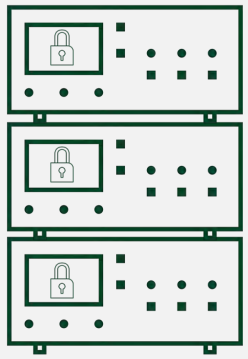
Closed System

"Vendor Knows Best"

Fixed Functionality

Closed Ecosystem

Customer Pays



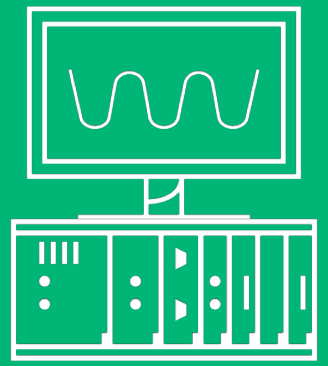
Open Connected Approach

"Customer Knows Best"

Customizable Solution

Open, Vibrant Ecosystem

Customer Designs



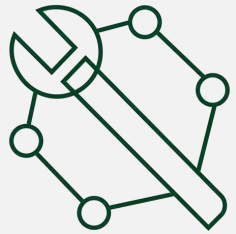
Fully Custom System

"Customer Does Everything"

Ground-Up System

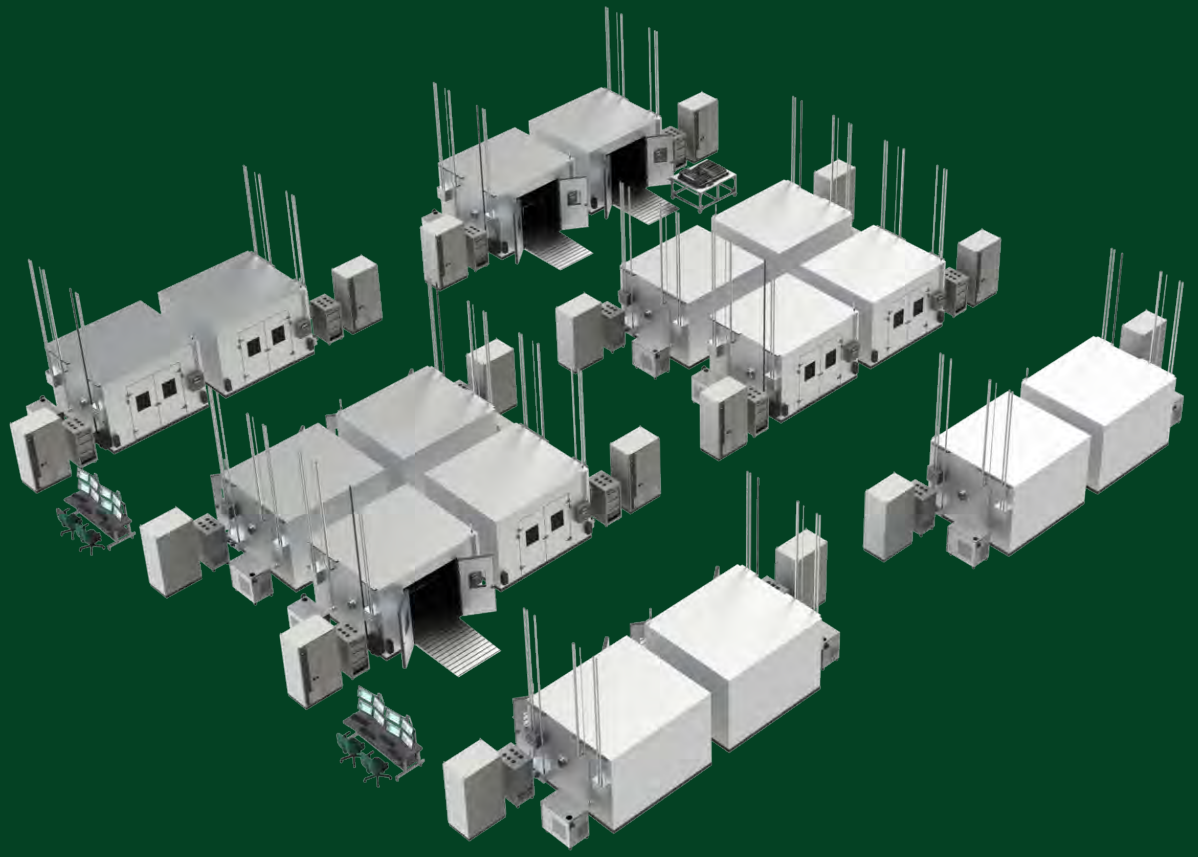
No Ecosystem

Customer Maintains



Designing Your Battery Validation Lab

from One Test Cell to Multiple



Battery Test Cell Considerations

An Open, Software-Defined Approach to Transform the 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

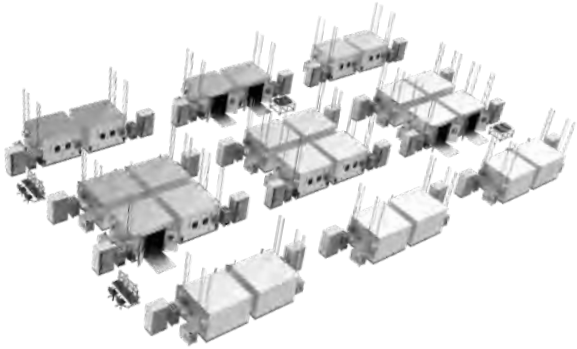
Single Validation Workbench Customizable Test

SOFTWARE

+

DATA

Global Validation Labs



SOFTWARE THAT ENABLEES SCALABILITY AND REUSE

Battery Validation Workbench

Battery Cycler Capabilities

BATTERY CYCLER

Power Conversion Technology

Technology	Advantages	Considerations
MOSFET	Good for low resistance and low cost	Limited on maximum voltage
IGBT	Mature technology for higher voltages	Lower switching frequency (larger components)
SiC or GaN	Modern wide-band gap technology	Current supply-chain constraints

BATTERY CYCLER

Water and Air-Cooled Technology

Water-Cooled Advantages

Less AC / local heating into room
(2% vs.10-100% heat dissipation on average)

- Less air-flow requirements means easier for IP-enclosure and less noise

BEST FOR

- Environments that require IP rating (production)
- Airflow restricted environments with access to water-cooling
- Fixed power or high-power applications

Air-Cooled Advantages

- Limited infrastructure required
- Simplified installation, convenience, easier to expand
- Flexibility in cell configurations

BEST FOR

- Test labs that benefit from modularity (no-water connections)
- Complex environments prohibiting water-cooling installation
- Variable power with mobile configurations

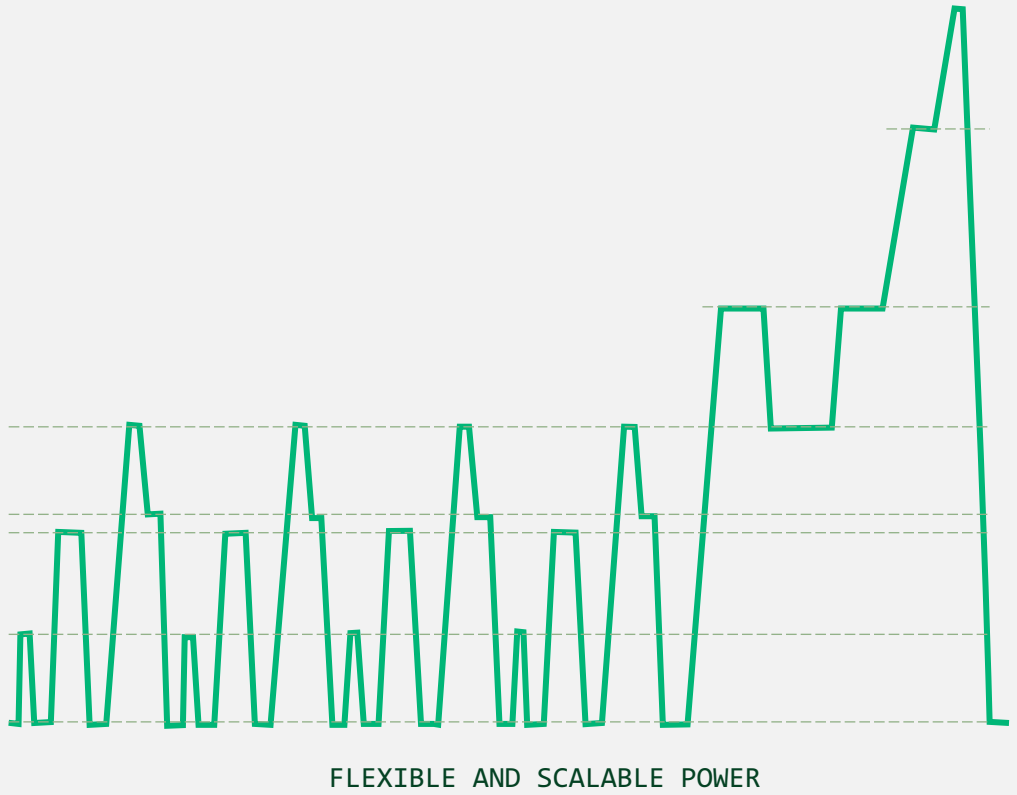
Sizing and Future-Proofing

Power Flexibility

- Overload capability – dimension of power flexibility
- Mobility power and flexible configurations
- Clustering and paralleling

Balance of Systems

- High frequency signals
- Easy integration with hardware and software tools
- Mixed laboratory



Required Interfaces

Measurement Capabilities and Testing Methodologies

Common Measurements

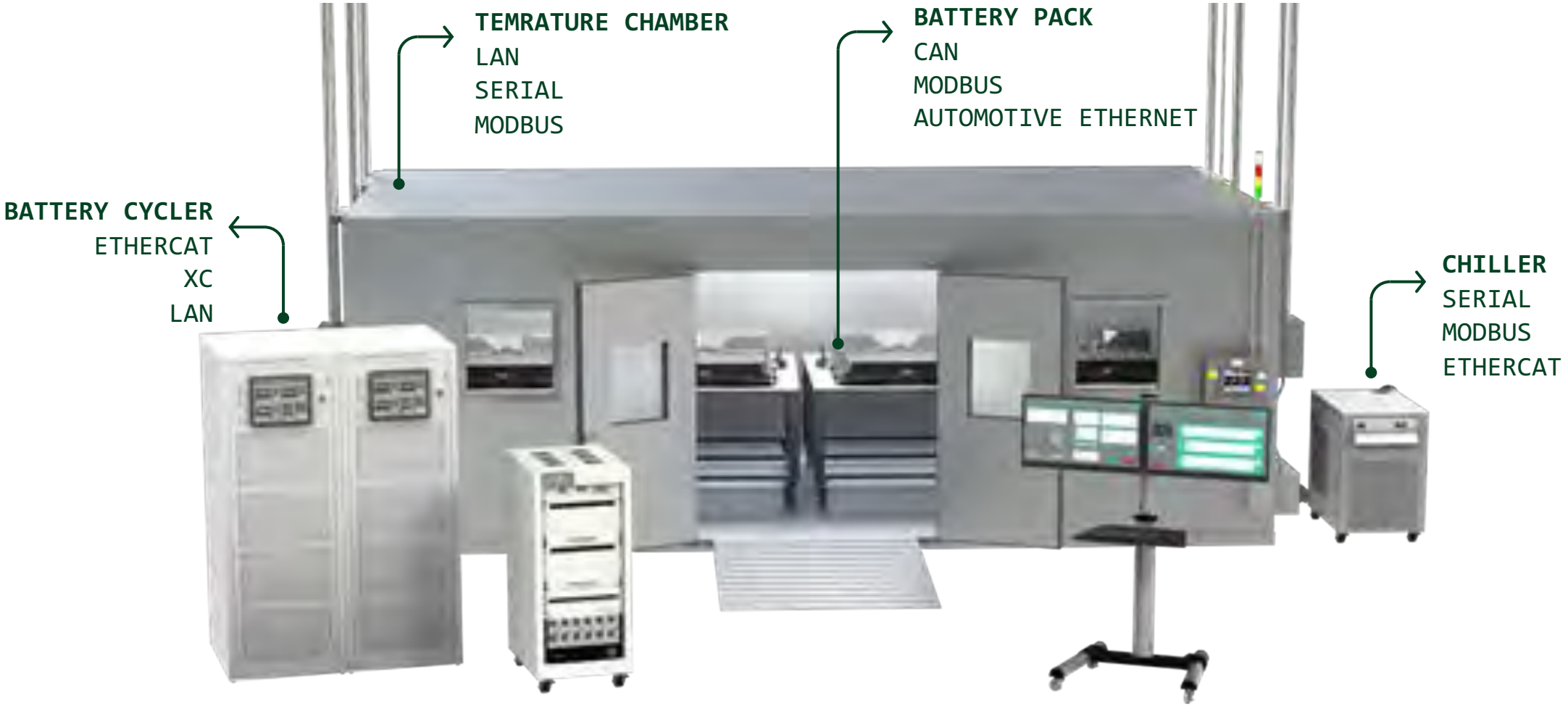
- Voltage
- Current
- Temperature
- Pressure
- Shock Force
- Digital Signals

Test Specific Measurement Methodologies

- EIS
- AC-IR
- OCV

Synchronous Measurements

Device Control and Communication



Control Physical Environment for the Battery Pack

Simulating the Vehicle and Pack Cooling System

Device Control for Battery Cycler Integration

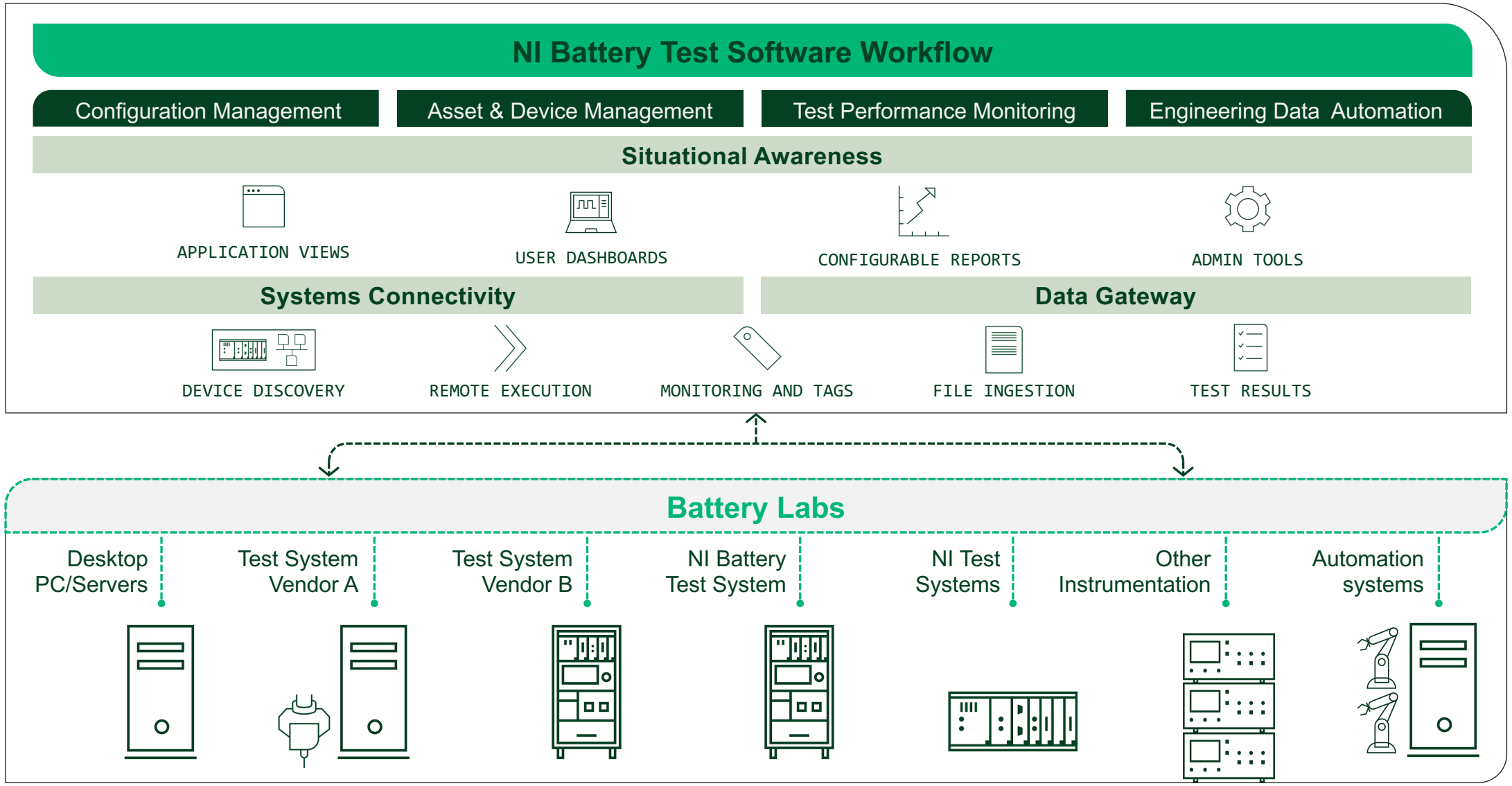
Third-Party

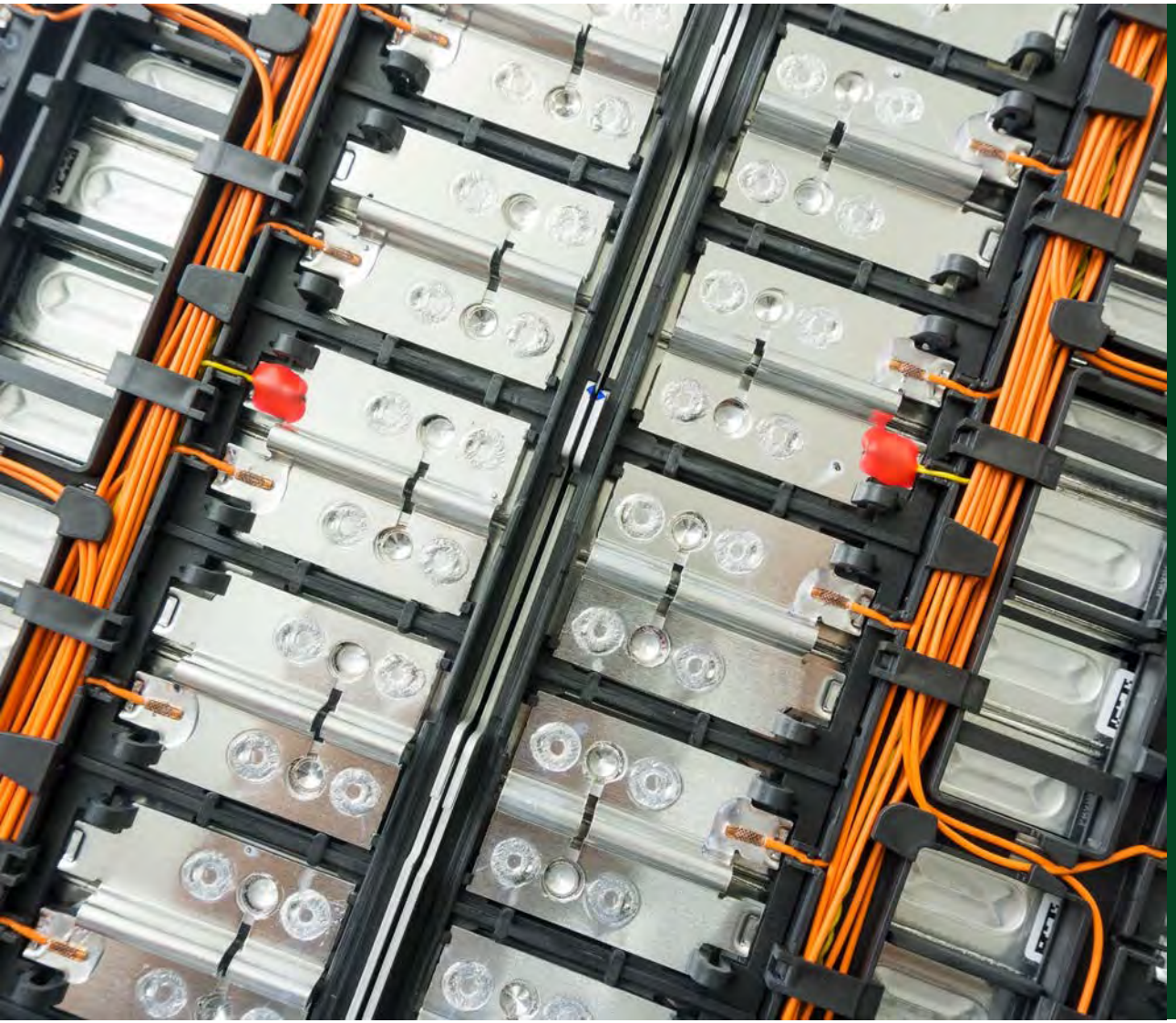
Native Cyclers

Physical Hardware Considerations

1. **Future-Proof Design** with modular and scalable power.
2. **Designed for Battery Test** with built in safety features: safety isolation contactor, polarity checker, pre-charge circuit, and more.
3. **Reliability & Serviceability** maximizes up-time through modular design.
4. **Flexible, Open Test Software Platform** to evolve with your future battery test requirements.
5. **Management & Analytics** to manage test stations, workflows and data efficiently and effectively.
6. **Extensive Partner Network** provides battery and system experts to solve your system test requirements.

Mapping NI Battery Test Software Workflow to Your Needs





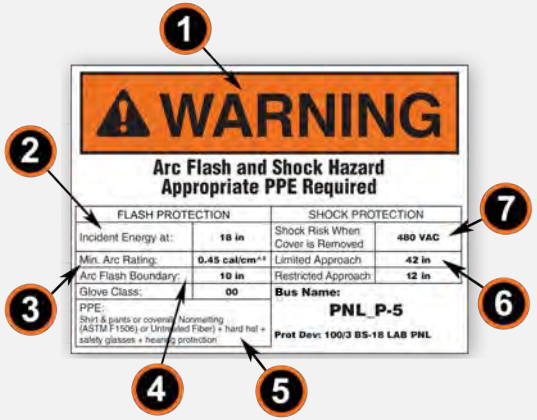
Safety Considerations

Preparation for Safety Hazards Mitigation

Safety Preparation and Hazard Mitigation

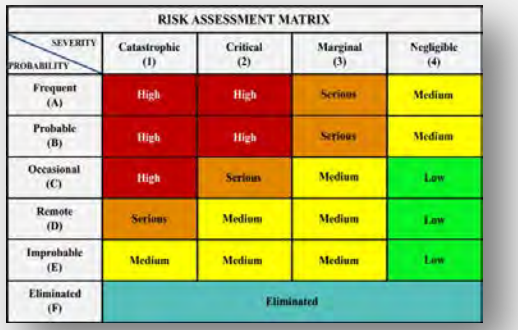
Arc Flash

Managing Unintentional Electrical Power Flows



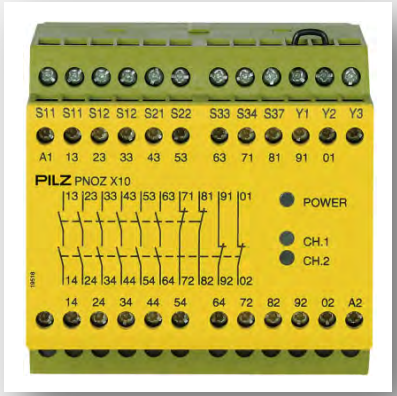
Hazard Levels

Containment & Operator Certification / Training



Safety PLC

Detection that Leads to a Coordinated Set of Actions



Safety Procedures

Personnel Protection & Behavior Coordination

Software Considerations

Optimize Workflows with the NI Battery Test System

Workflow

Team

IMPROVE THE PRODUCT	RUN THE LAB	RUN THE TEST
Battery Design	Lab Management	Battery Test & Execution
PRODUCT OWNER DESIGN ENGINEER TEST ENGINEER IT INTEGRATOR	LAB MANAGER MAINTENANCE ENGINEER	DESIGN ENGINEER LAB MANAGER OPERATOR

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Closed System

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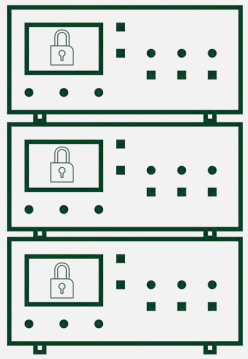
Fixed Functionality

Closed Ecosystem

Customer Pays



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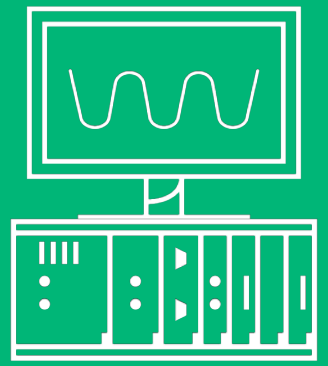

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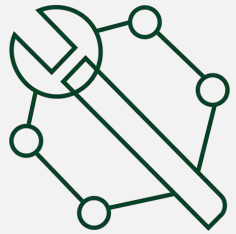


Battery Test Software Workflow

HARDWARE-LEVEL

Test Station Configuration
Equipment Integration
Device Under Test Specification

APPLICATION-LEVEL

Test Sequencing
Data Analysis

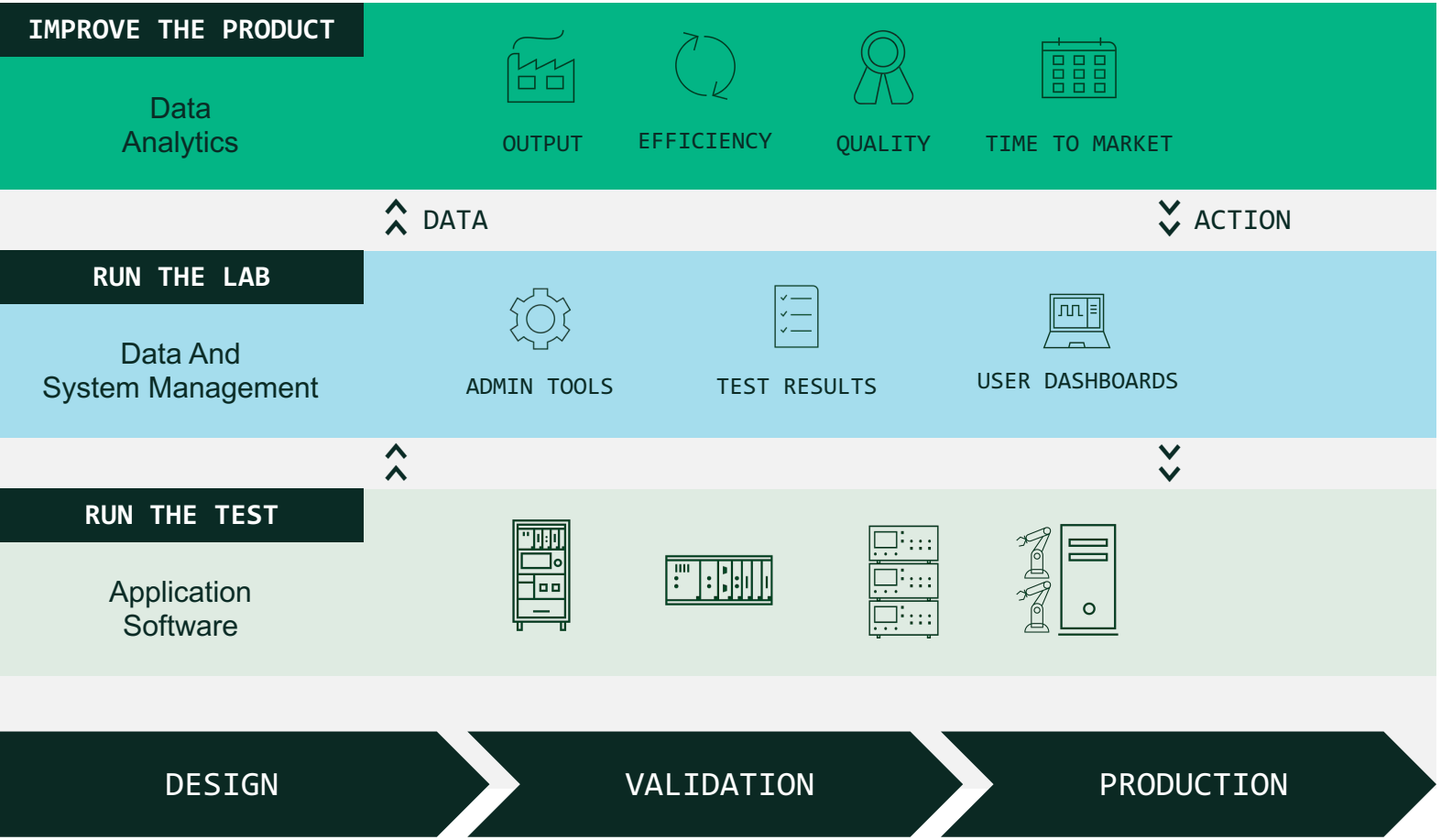
USER-LEVEL

Test Execution/ Monitoring

FACILITY-LEVEL

Asset Utilization
Power Management

The Software-Defined Battery Lab



Automate and Streamline Workflows

Connect and Increase Utilization of Test Systems

Enhance Data Management and Analysis

Make Test Strategy a Differentiator for Your Business

AUTOMATION

Increase test coverage with software-connected and model-based test methodologies.

STANDARDIZATION

Drive organizational consistency in test processes, systems, software, and data.

DIGITAL TRANSFORMATION

Deploy and connect enterprise-wide tools for asset and data management and analytics.

BUSINESS PERFORMANCE

Realize the benefits of an intentional test strategy.

- Reduce time to market
- Deliver customer satisfaction
- Improve the bottom line
- Prepare for the future

Battery Data Analytics

"We're working with NI on a long-term sustainable solution that allows us to connect all the battery test data to quickly develop the insights that we need to improve battery performance. NI's lifecycle analytics platform is fully compatible with GM's IT infrastructure, allowing us to leverage IT Professionals to maintain sustainability, compliance, vendor independence"

Steve Tarnowsky

DIRECTOR – GLOBAL BATTERY CELL ENGINEERING GENERAL MOTORS

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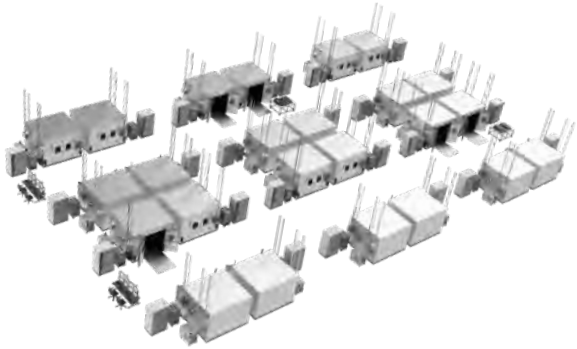

SOFTWARE THAT ENABLEES SCALABILITY AND REUSE

Battery Validation Workbench

Thank you for attending!

Download EV Battery Test Brochure

Learn More

Contact Us

Engineer Ambitiously.