EMERSON

NI CONNECT

2024 AUSTIN

Automated Lab Validation is a Journey. Are You Ready?

Anna Pedale - NI
Principal Solution Marketing Manager

David McDaniel – Infinitum
Senior Manager, Test & Integration

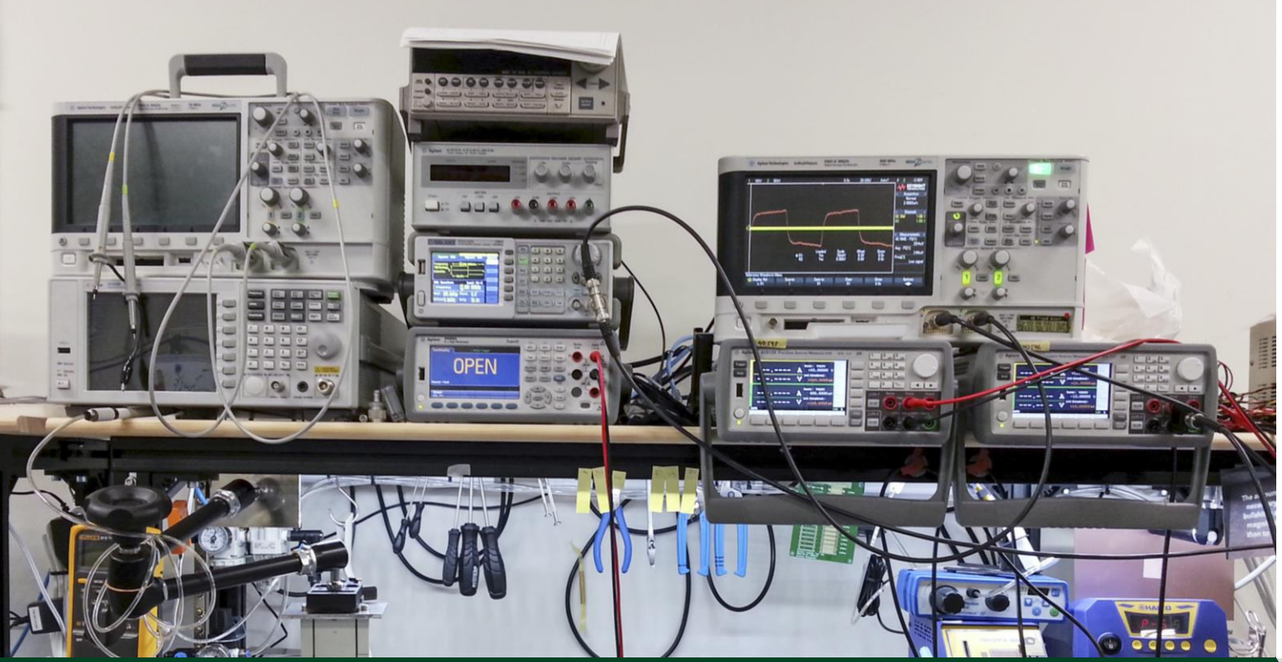
Agenda

1 Traditional Lab Approach

2 Modernizing the Lab is a Critical Strategic Differentiator

3 NI Test Capabilities for Validation Applications

4 Infinitium: How They Modernize Their Validation Laboratory



Your Current Validation Approach Isn’t Helping You

TRADITIONAL LAB APPROACH

- Inconsistent Data Storage Practices
- Manual Asset Management
- Inconsistent Software Approach
- Too Many Instrument Models
- Limited Automation
- Inconsistent Measurement Methodology

CHALLENGES

- Limited Product Insight
- High Engineering Cost
- Slower Development Time

Traditional Lab Validation Architecture

Approaches range from manual to DIY measurement frameworks and sequencers

Manual Test Bench

100’s of Test Instrument Makes & Models

Manual Data Storage

Other Manual Test Bench

Common Issues

Time Wasted for Duplicate Software Development

Disparate Instruments Complicate Correlation

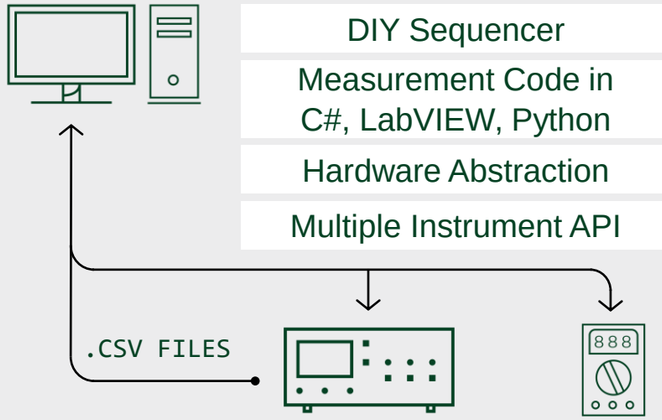
Lack of Automation Slows Measurement Time

Difficulty Finding & Utilizing Test Data

Significant Time Maintaining Test Systems

Difficulty Hiring Broad Range of Hardware & Software Skills

Automated Test Bench



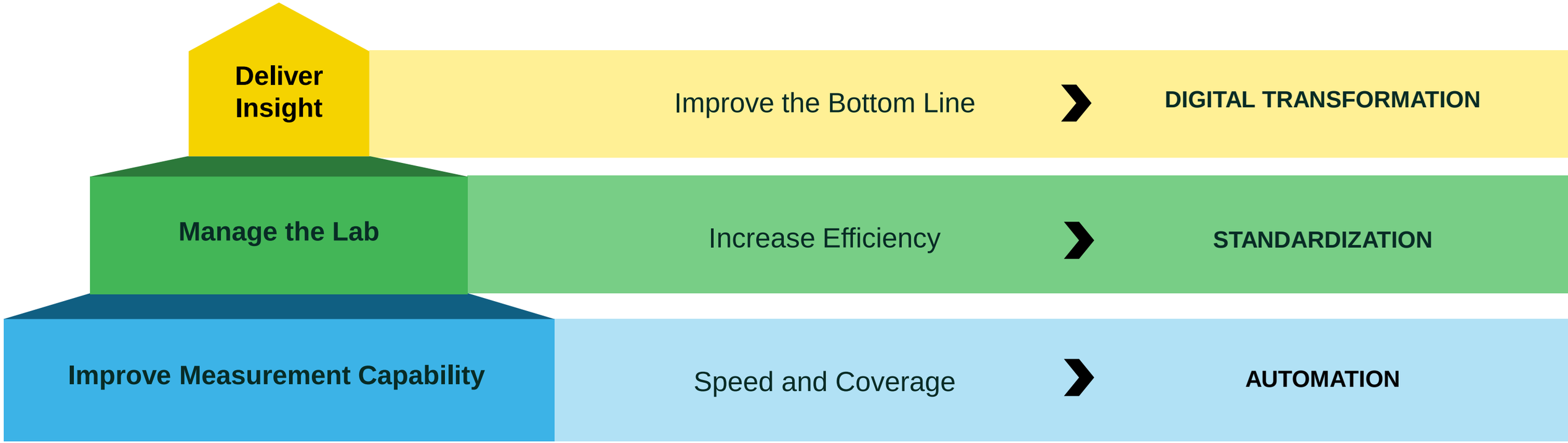
Other Automated Test Bench

Alternate DIY Sequencer

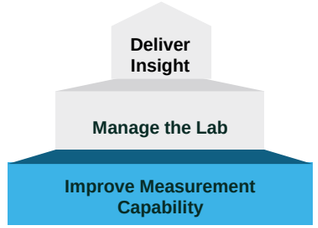
Alternate Measurement Code

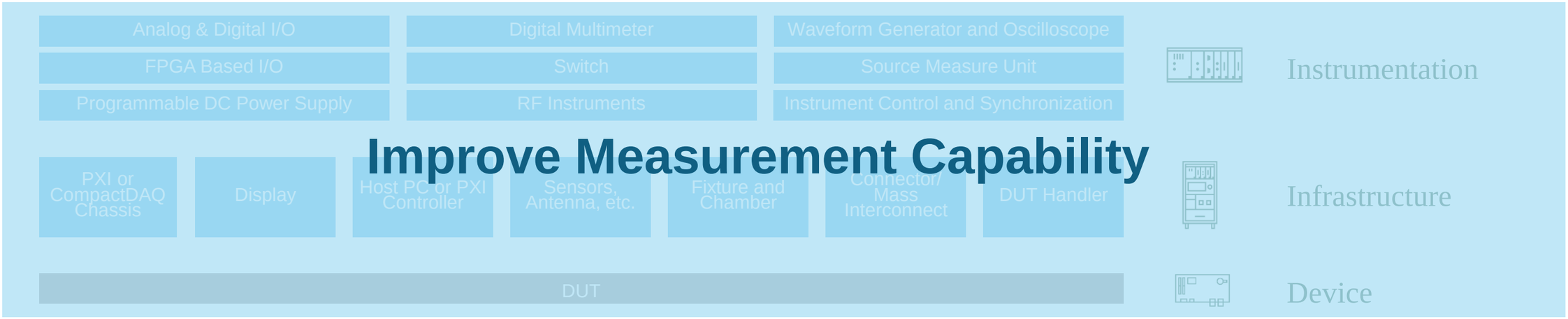
Modernizing the Lab is a Critical Strategic Differentiator

The Value of Test Is More Than Just “**Performing Measurements**”



Standardize Test and Modernize Your Lab





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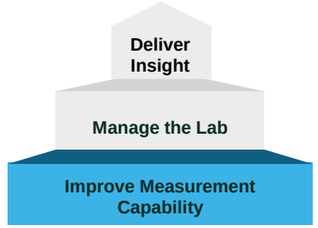
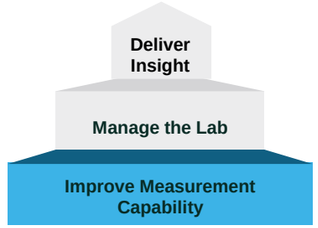


Analog & Digital I/O	Digital Multimeter	Waveform Generator and Oscilloscope	Instrumentation
FPGA Based I/O	Switch	Source Measure Unit	
Programmable DC Power Supply	RF Instruments	Instrument Control and Synchronization	

PXI or CompactDAQ Chassis	Display	Host PC or PXI Controller	Sensors, Antenna, etc.	Fixture and Chamber	Connector/ Mass Interconnect	DUT Handler	Infrastructure

DUT	Device

Standardize Test and Modernize Your Lab



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Instrumentation

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Infrastructure

DUT

Device

Signal Type	Channels	Measurement Types	Sampling Rate Max
Analog Input			
Voltage	4, 8, 16, 32	±200mV, ±500mV, ±1V, ±5V, ±10V, ±60V, 300Vrms, 400Vrms, 800Vrms	1 MS/s/ch
Current	4, 8, 16	±20mA, 5Arms, 20Arms, 50Arms	200 kS/s
Universal	2, 4	V, mA, TC, RTD, strain, IEPE, W	51.2 kS/s/ch
Thermocouple	4, 8, 16	J, K, T, E, N, B, R, S types	95 S/s/ch
RTD	4, 8	100W, 1000W	100 S/s/ch
Strain/Bridge	4, 8	¼, ½, full bridge (120W or 350W)	50 kS/s/ch
Sound & Vibration	2, 3, 4, 8	3 Vrms, ±5V, ±30V	102.4 kS/s/ch
Analog Output			
Voltage	2, 4, 16	3 Vrms, ±10V	100 kS/s/ch
Current	4, 8	0 mA to 20mA	100 kS/s/ch
Digital I/O			
Input	4, 8, 16, 32	LVTTL, 5VTTL, 12V, 24V, 30V, 250 VDC/VAC, sinking and sourcing	55 ns
Output	4, 8, 16, 32	LVTTL, 5VTTL, 12V, 24V, 60V, programmable; sinking & sourcing	55 ns
Input / Output	4, 8, 16, 32	LVTTL, 5VTTL, 12V, 24V	55 ns
Relays	4, 8	30VDC, 60VDC, 250VAC; SPST & SS	1 op/s
Bus			
CAN	1, 2	HS/FD, LS/FT CAN	5 Mb/s
LIN	1, 2	LIN	20kb/s
Counter/Timer			
Counter	8 counters	0V-5V diff, 0-24V single-ended	1 Mhz

CompactDAQ Product Family

Ensure that you never have to compromise the quality, quantity or mix of your measurement

Hit your deadlines by completing your projects faster and more efficiently

Maximize component reuse despite new or evolving requirements

PXI Platform

DAQ and Control	Instrumentation	Interfaces
Multifunction I/O	Oscilloscopes	GPIB, USB, LAN
Counter/Timer/Clock	High-Speed Digital I/O	RS232/RS485
Digital I/O	DMM and SMU	CAN, LIN, DeviceNet
Analog Input/Output	Signal Generators	SCSI, Ethernet
Vision and Motion	Switching	VXI/VME
FPGA/Reconfigurable I/O	RF Analyzers and Generators	Boundary Scan/JTAG

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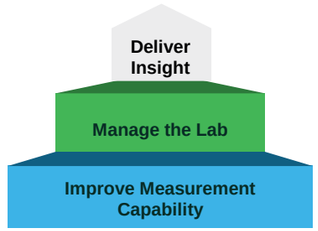
Standardize Test and Modernize Your Lab



Manage the Lab

Test UI
Sequence Editor
Data Connectivity
Test Architecture/Sequence
Test Steps
Debug UI
Abstraction Layers
Instrument Drivers/Configuration Tools
DUT Control Functions
DUT Handler Functions
Station Health and Operation Functions

Application Software

Improve Measurement Capability

Analog & Digital I/O
Digital Multimeter
Waveform Generator and Oscilloscope
FPGA Based I/O
Switch
Source Measure Unit
Programmable DC Power Supply
RF Instruments
Instrument Control and Synchronization

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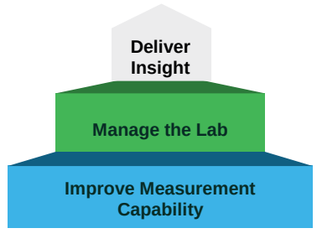

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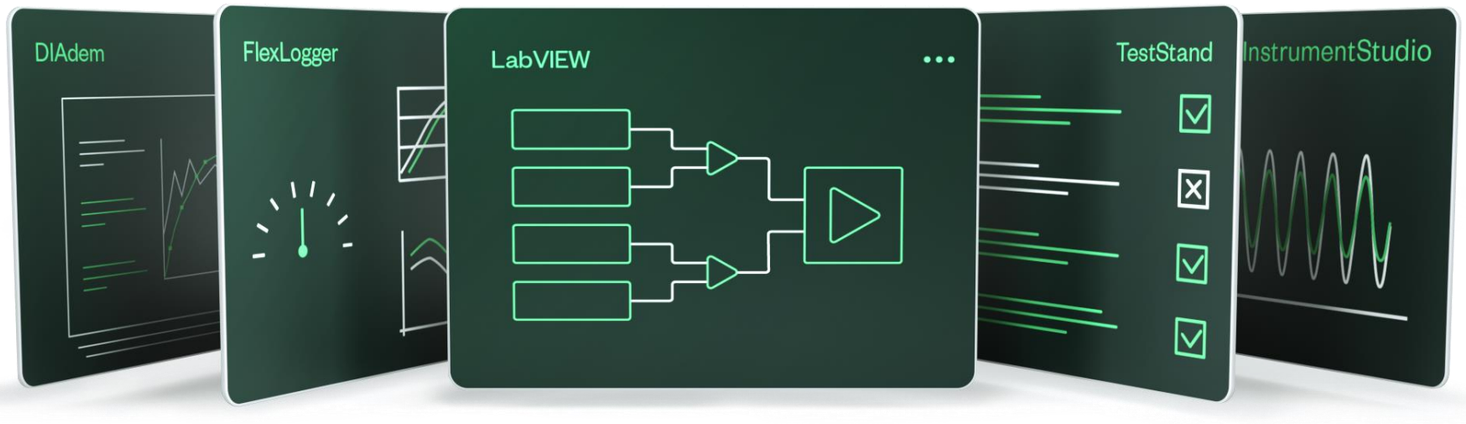
LabVIEW+ Suite

A connected suite of software that makes you more productive across your test workflow



Quick configuration and high-level development of common tasks

Comprehensive development environment for custom tasks

Connectivity across tasks and with other engineers

Open integration to 3rd party software and instruments

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LabVIEW Plus More NI Software

With time and effort, LabVIEW can do anything – but it doesn't need to. The LabVIEW+ Suite brings together NI test software that saves engineers time by optimizing every task in their workflow.

Performing Measurement

FlexLogger
Interactive data acquisition software to get data faster

InstrumentStudio
Interactive measurement and monitoring software

Data Analysis

DIAdem
A data analytics software for visualizing and analyzing data and creating reports

Test Sequencing

TestStand
A test executive software for building validation and production test systems

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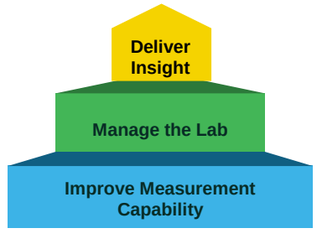
Standardize Test and Modernize Your Lab



Deliver Insight

Manufacturing Execution System (MES)

Systems Management | Test Management | Data Management | Real-Time Dashboards | Operations Modeling

Analytics and Operations

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Test UI | Sequence Editor | Data Connectivity

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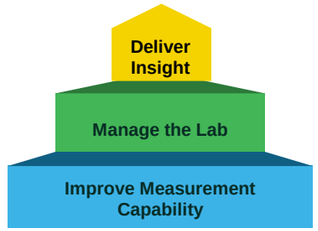
Standardize Test and Modernize Your Lab



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Infrastructure

DUT

Device

SystemLink™

Streamline lab operations and amplify engineering insights in an integrated, scalable, enterprise solution.

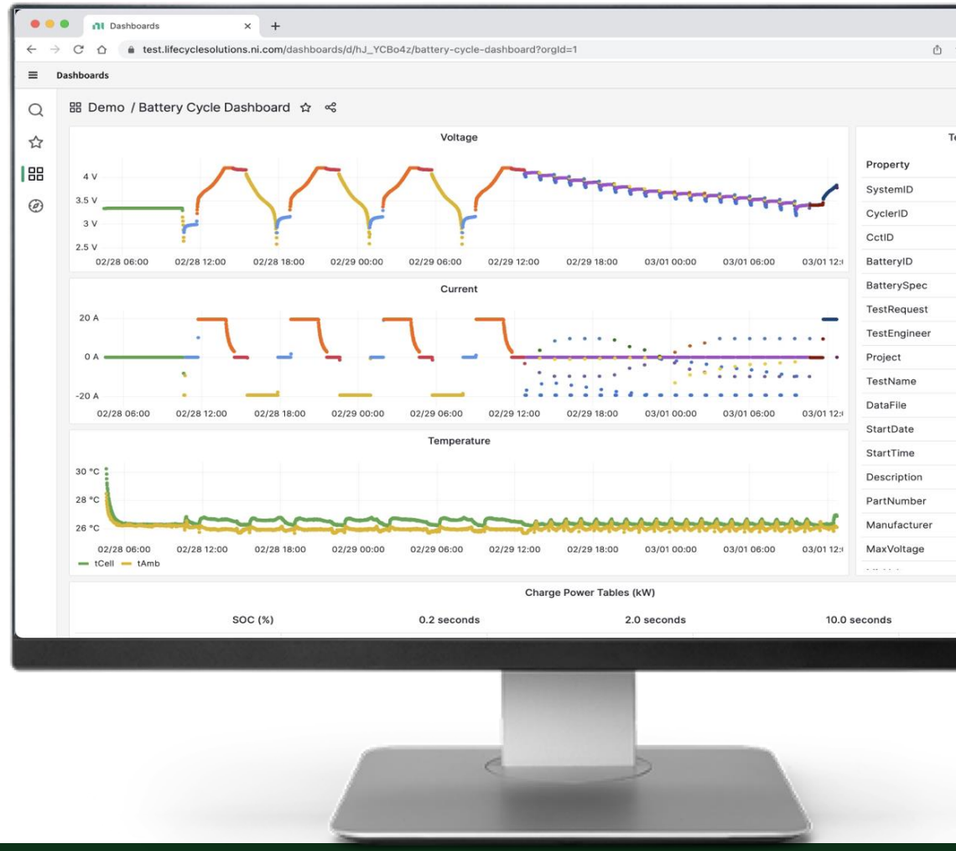
Manage Systems and Assets
Manage and install software for your entire test fleet, monitor test system health, and manage and track NI and 3rd Party instrument utilization

Monitor and Analyze Parametric Tests
Collect and view test results, files and parametric data; filter data for additional insights and track KPIs with dashboards and ad-hoc analysis

Plan Tests and Work Orders
Track incoming test requests, define test requirements, schedule, deploy, and remotely execute tests

Track Product Specification Compliance
Elaborate requirements into engineering specifications to drive test consistency, quickly discover product issues, and track test progress

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



Connect SystemLink

With **TestStand** to complete the loop from specifications to measurement

With **LabVIEW** to centrally manage test data and test system status

With **DIAdem** for further analysis and powerful report generation

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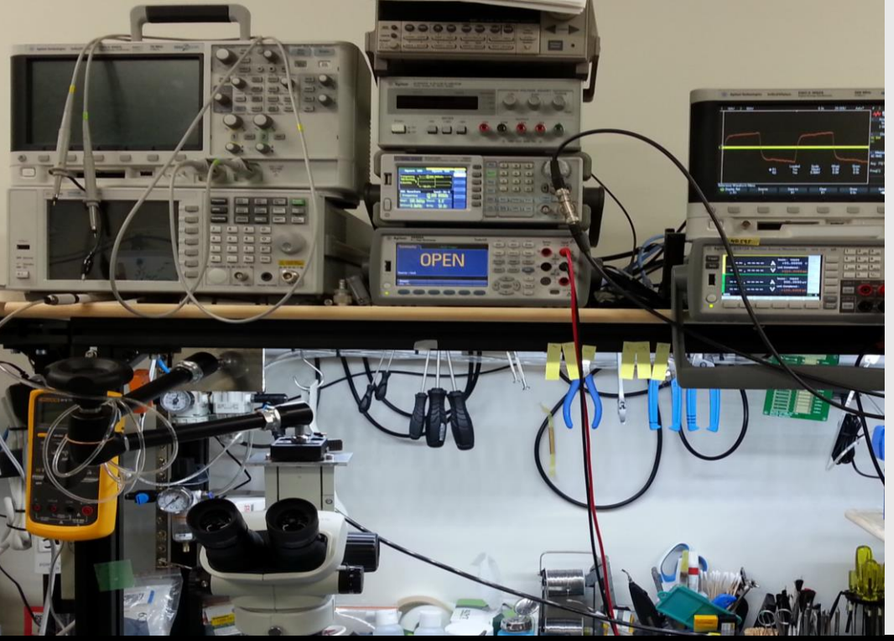

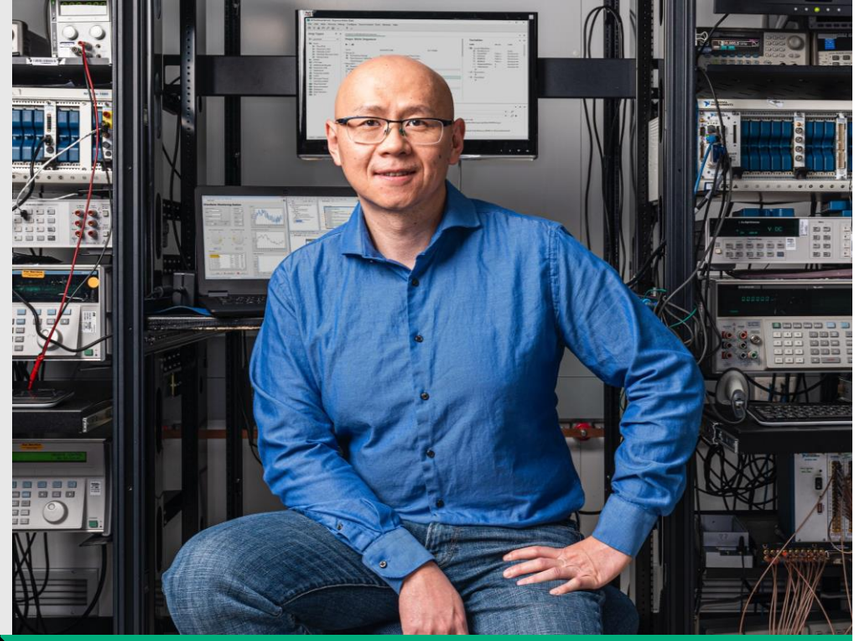

Software is Critical for the Modern Lab.

TRADITIONAL LAB APPROACH

- Slower measurements
- Large footprint
- Difficult to synchronize
- Inconsistent software APIs
- Inefficient measurement correlation
- Inconsistent data management

MODERN LAB APPROACH

- Faster measurements
- Small footprint
- Native synchronization
- Consistent software experience
- Correlation from lab to production
- Consistent and speedy data access

- Software frameworks
- Modular instrumentation
- Automated measurements
- Code re-use across groups and sites
- Fast, data-driven decisions

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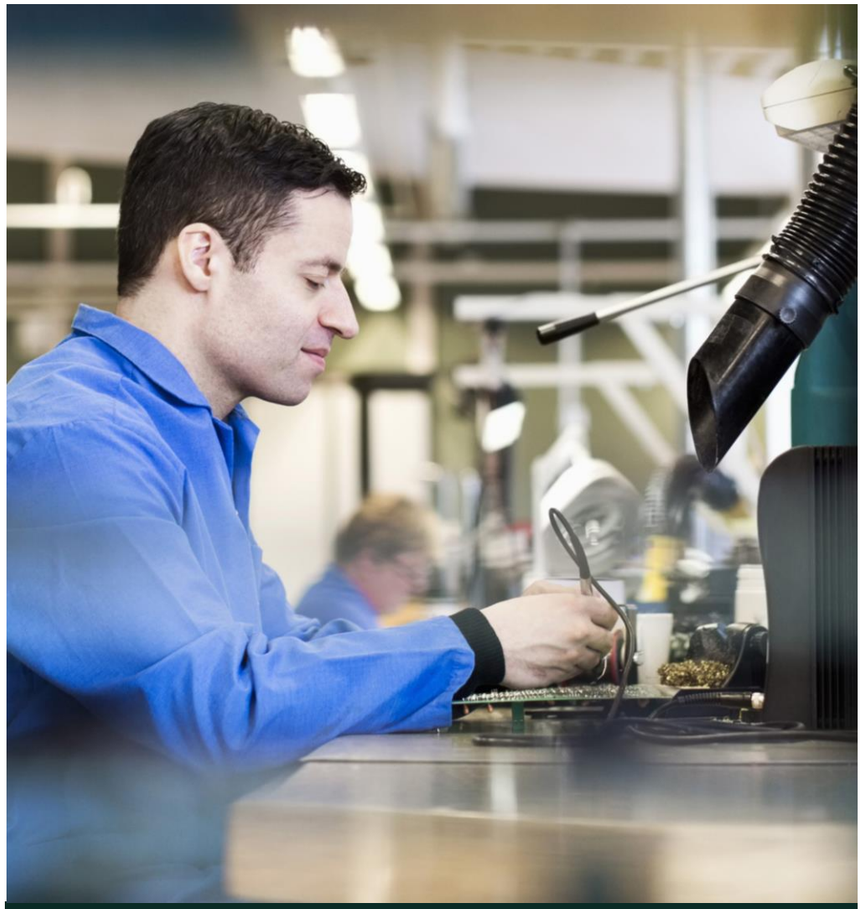
Standardize Your Approach Across Test

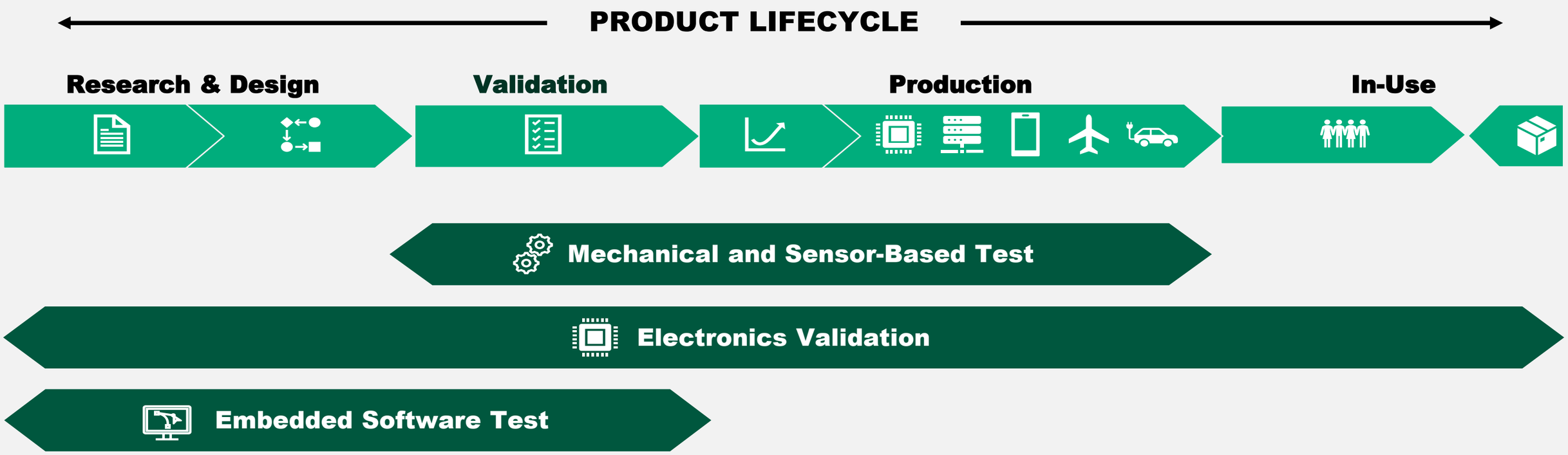
MECHANICAL AND
SENSOR-BASED TEST



ELECTRONICS
VALIDATION

EMBEDDED SOFTWARE
TEST

Standardize Across Engineering “Workflows”



Mechanical and Sensor-Based Test

Measure/Acquire

Measurement Instrumentation

Sound and Vibration modules

Strain/Bridge

Thermocouple

Current I/O

Voltage I/O

IEPE Module

Debugging and Logging Interface

FlexLogger™

Events, Alarms, and Triggers

Custom Plugins

Multi-Chassis Synchronization

Customize/Automate

Automation Environment

TestStand™

Programming Environment

LabVIEW™

python™

Analyze/Present/Insight

Reporting/Analysis Environment

DIAdem™

Reporting/Analysis Environment

SystemLink™

SOFTWARE AND HARDWARE TOOLS

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Electronics Validation

Measure/Acquire

Measurement Instrumentation

Source Measure Unit (SMU)

Data Acquisition Systems (DAQ)

Oscilloscope

Programmable Power Supply

Digital Multimeter (DMM)

Debugging and Logging Interface

Instrument Studio™

Power Validation Add-On

Custom Plugins

Multi-Instrument Support

Customize/Automate

Automation Environment

TestStand™

Programming Environment

LabVIEW™

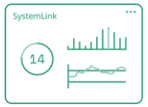
python™

C#

Analyze/Present/Insight

Reporting/Analysis Environment

DIAdem™



Reporting/Analysis Environment

SystemLink™

SOFTWARE AND HARDWARE TOOLS

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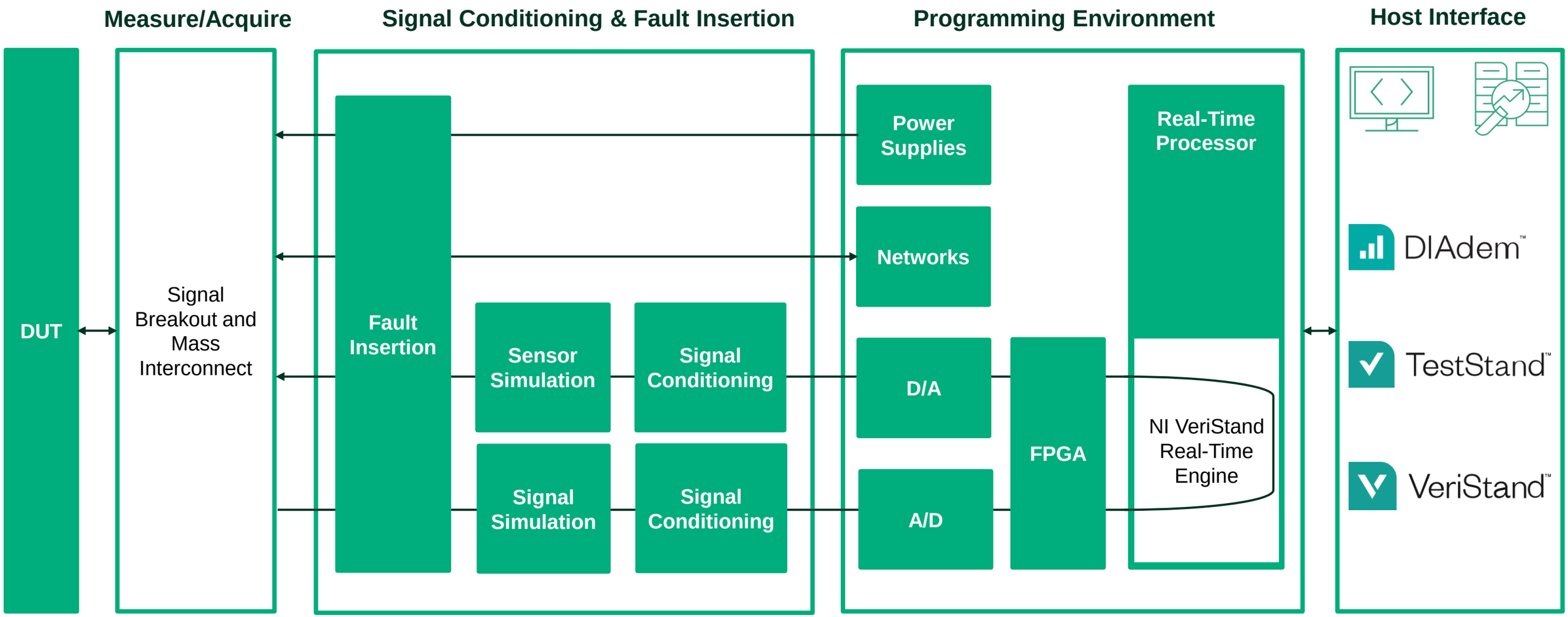
Embedded Software Test



Why NI

Software

Develop, or Don’t.

Free (Python, C/C#)

Opensource data formats

SW for test engineers that scales from free to LabVIEW+

Data management/analysis software/Model Integration

Performance

Speed

Synchronization

Bandwidth

Advanced Computing

Quality

If the datasheet says it, the device can do it

Reliable design/build so things work as expected

A broad range of I/O to meet test requirements and advanced technology

Future Proof

Keep up with change

Open ecosystem of SW

Large catalog of hardware that run off of relatively few drivers

Modular systems to expand/adjust hardware measurements

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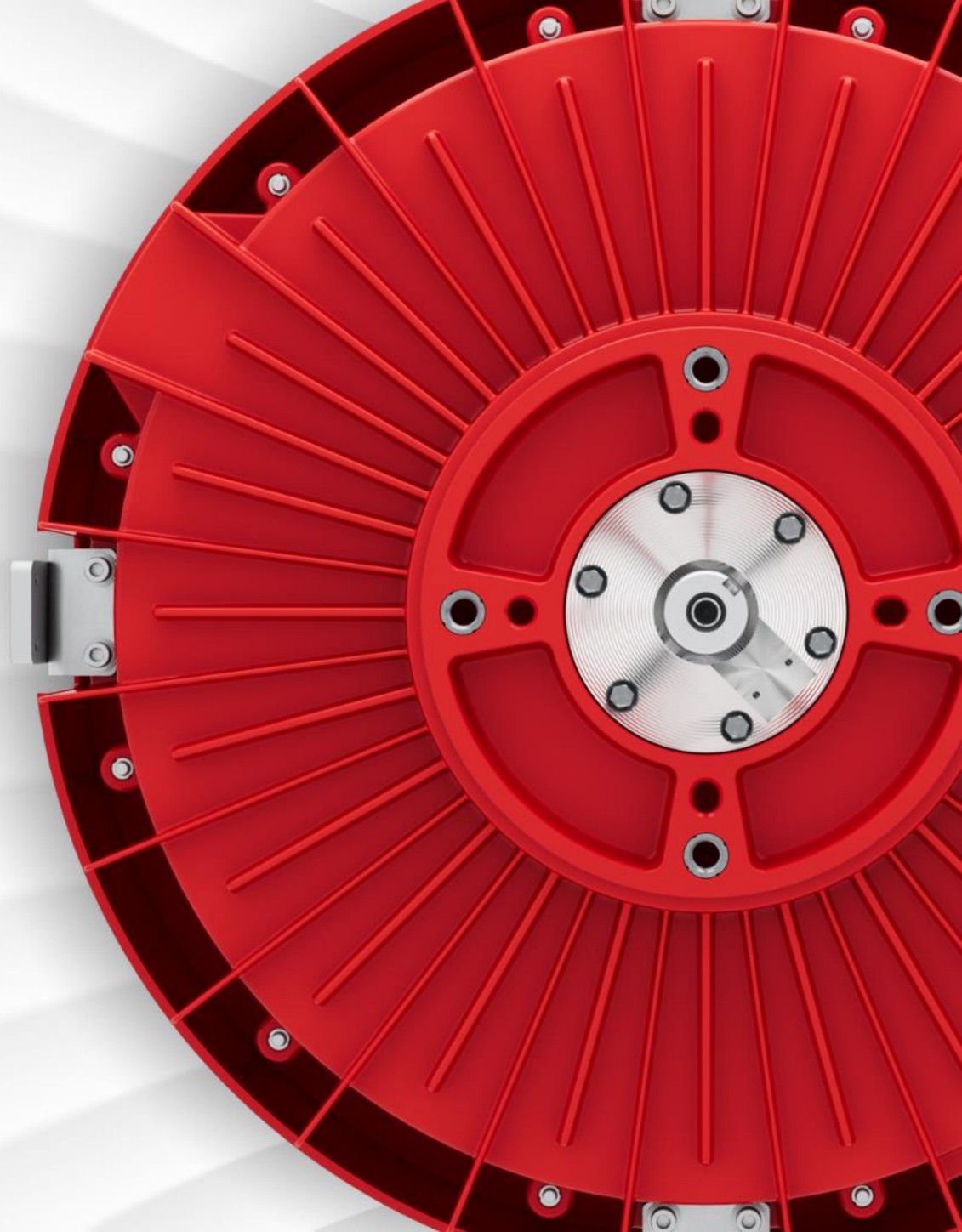
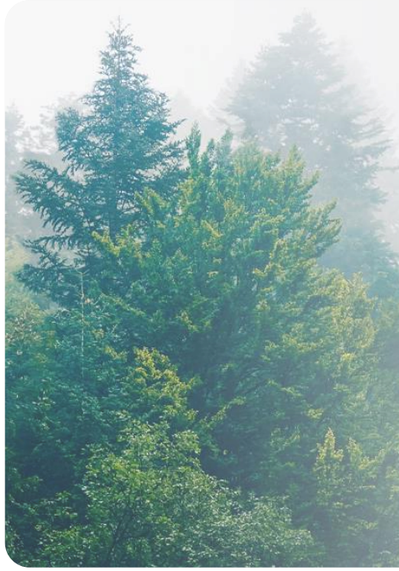
Infinitum

The Next Generation of Lab Validation

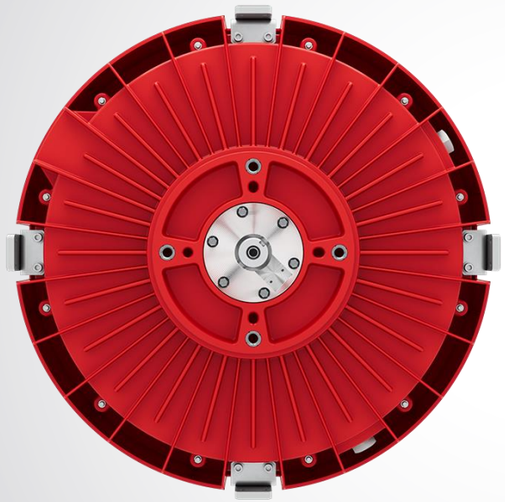
David McDaniel
Senior Manager – Test & Integration
dmcdaniel@goinfinitum.com



Infinitum: to infinity; endless; without limit



Our vision is to go beyond expectations by creating a more efficient motor with less resources that is better for people and the planet.



A next generation motor

66% Less Copper

50% Smaller/Lighter

10% Less Energy

No Iron Core | Circular Design

Headquartered in Round Rock, TX

Patents
108

Employees
200+

Established in 2016

Founder & CEO, Ben Schuler

Sustainable modular design for serviceability and remanufacturing

Over $345m raised to design, develop and scale production of a revolutionary integrated motor and inverter.

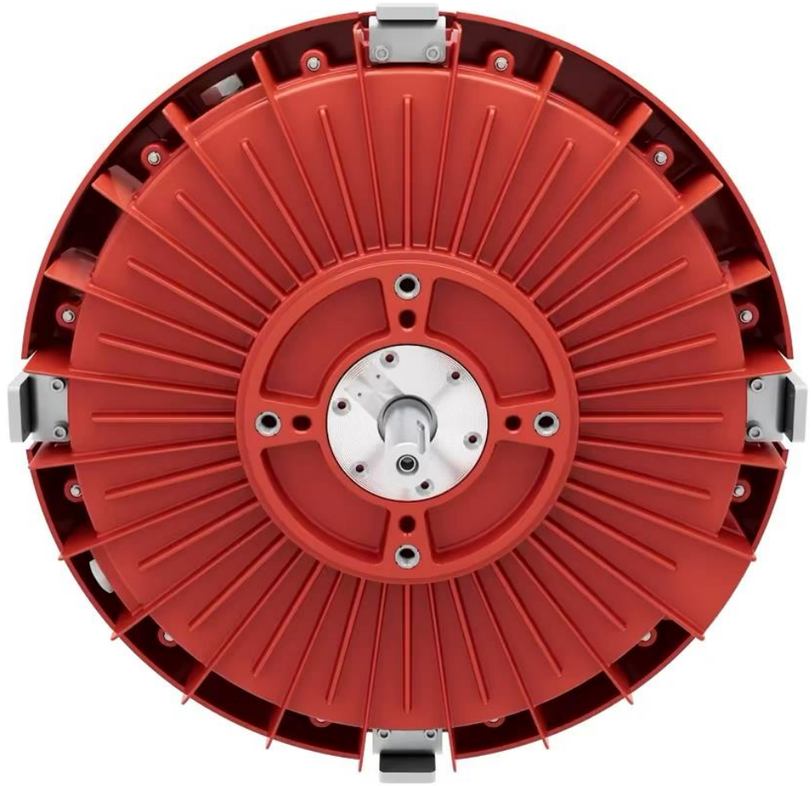
APPLIED Ventures

chevron technology ventures

CATERPILLAR

Rockwell Automation

Motor and Drive in a single compact design.



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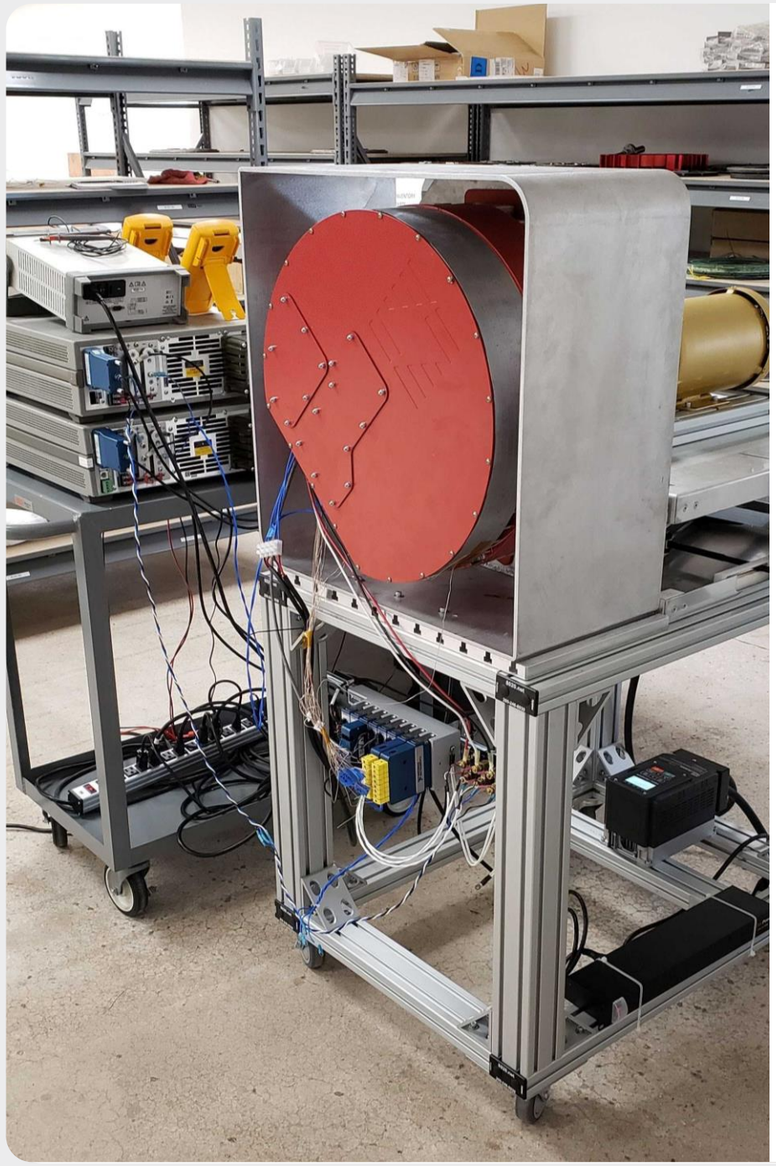
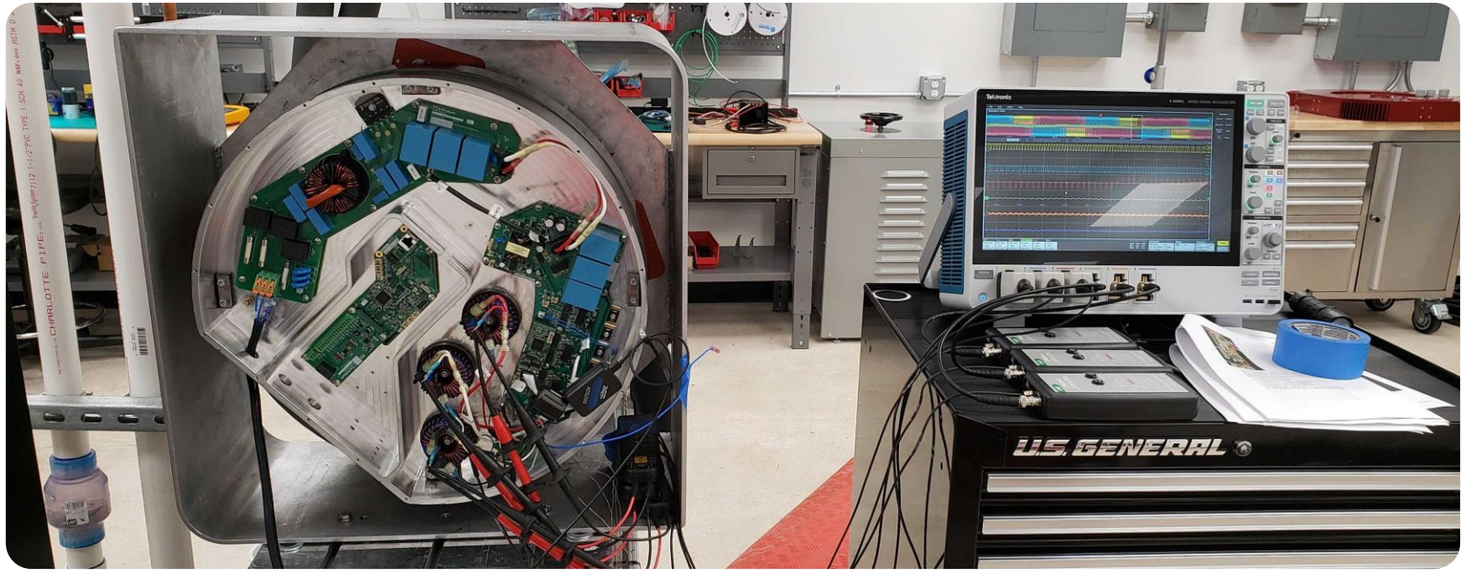
Traditional Measurement Approach





- ✓ Quick Startup
- ✓ Fast Results
- ✓ Manual Measurements
- ✓ Easy Setup
- ✓ Push-button Hardware

- X Not Scalable
- X Inconsistent Results
- X Labor Intensive
- X Not Standardized
- X Human Error

Infinitum’s Automated Test Journey

In the beginning:

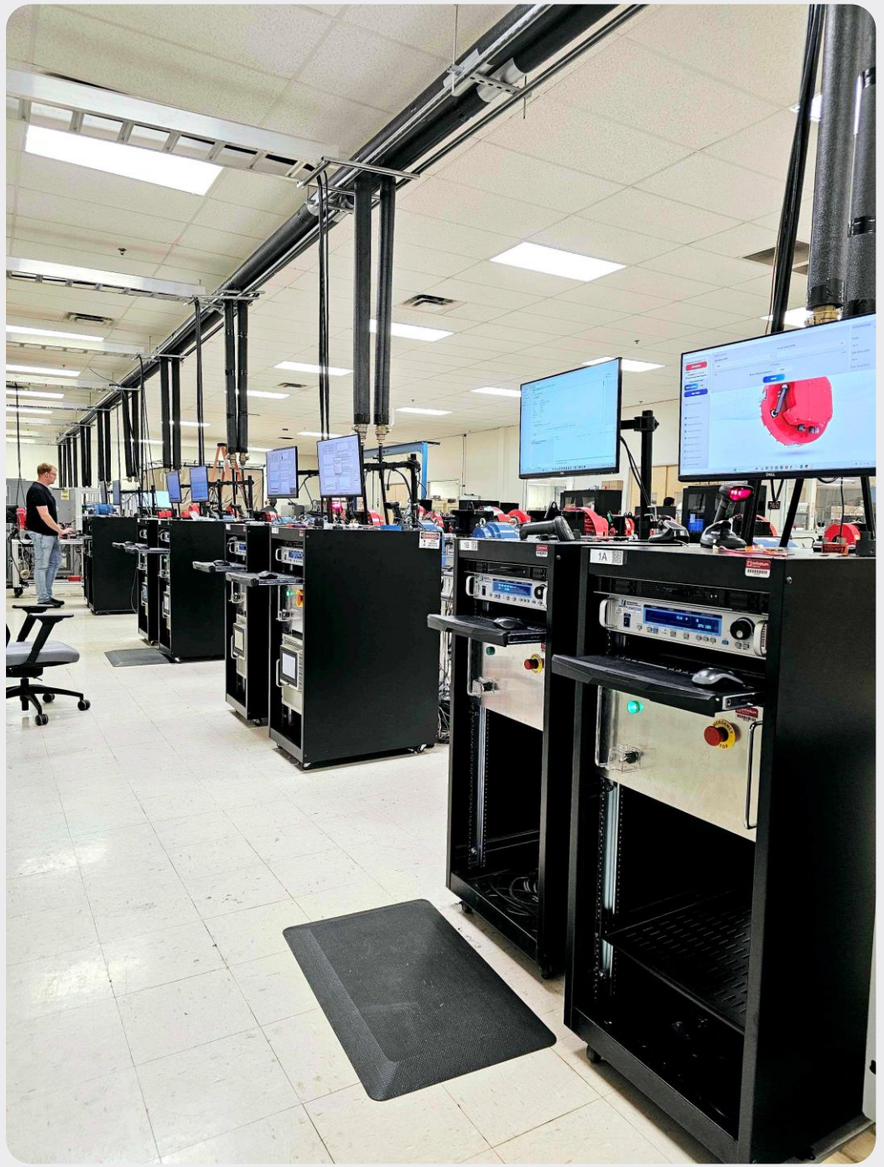
- Single test stand for motor development.
- One lab engineer for all software and hardware development.
- Developed test solutions in parallel with product development testing.
- Manual measurements and reported data in spreadsheets and documents.
- Data inconsistencies.

On our Way:

- 30 Test stands across multiple development sites and factories.
- Multiple standardized platforms of product test.
- Shared software, test code and sequences.
- Consistent, repeatable, logged data and reporting structure.
- Multiple developers, and lab support staff.

How It Started

How It's Going



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How We Got Here

- Define Test Requirements
- Select Automation Tools
- Design Test Architecture
- Develop Test Software
- Implement Test Sequences
- Integrate Hardware and Software
- Validate and Verify
- Continuously Improve

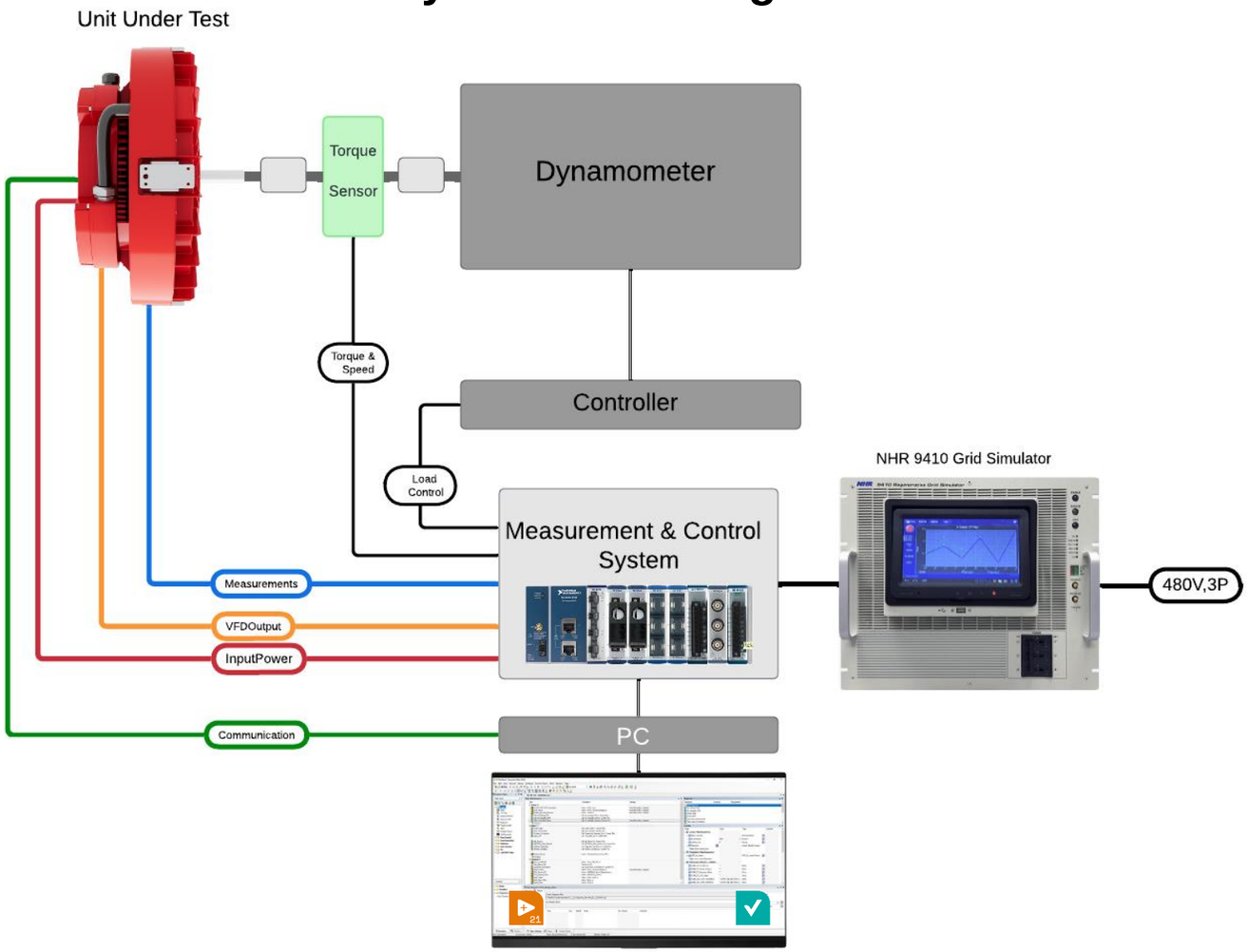
Define a Platform to Meet your Requirements

Software Requirements:

Measurement Capability:

- Voltage (600V) (NI 9244)
- Current (50A) (NI 9247)
- Temperature
  (NI 9210, 9212, 9216, 9219)
- Accelerometer (NI 9230, 9234)
- Microphone (NI 9230, 9234)
- Digital I/O (NI 94xx Series)
- Analog I/O (NI 9223, 9229, 9269)
- NI 9189 Ethernet Chassis

System Test Diagram



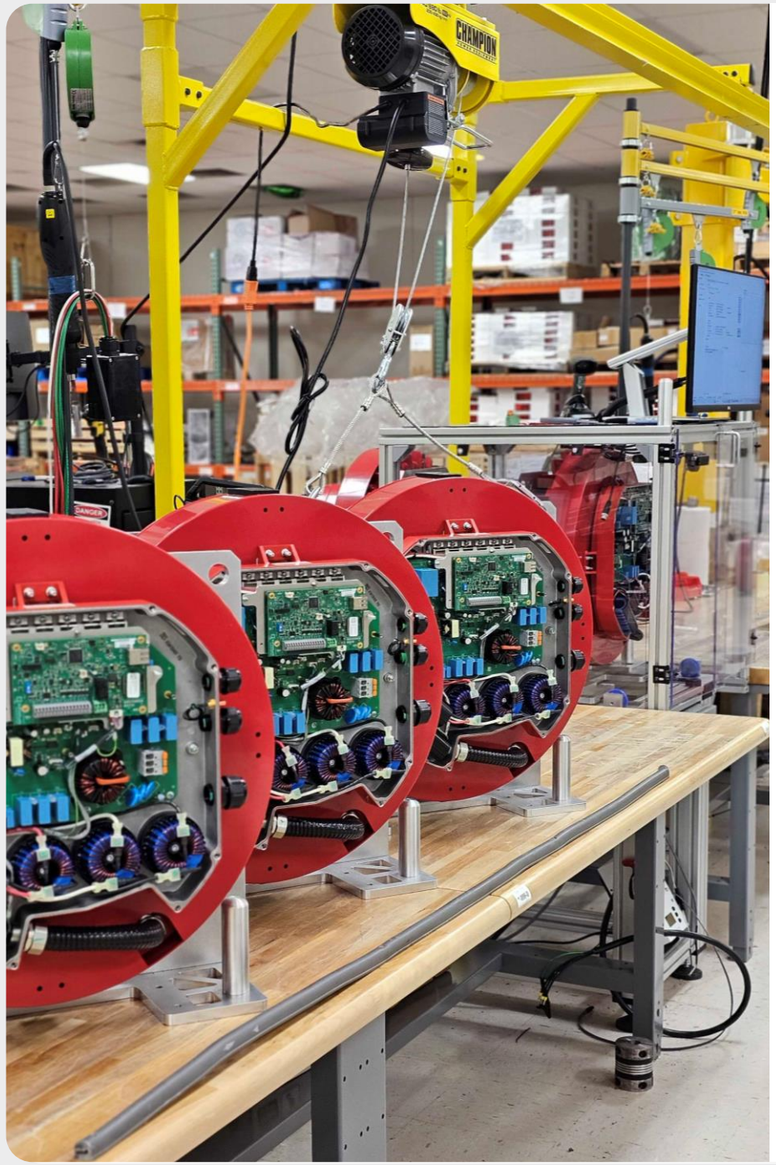
Standardize Across Test Cells

In the Laboratory

On the Test Bench

In the Factory

Lessons Learned Along the Way



- Thorough Planning is Essential
- Invest in Training and Documentation
- Continuous Improvement is Key
- Collaboration is Vital
- Start Small and Scale Gradually
- Address Challenges Proactively

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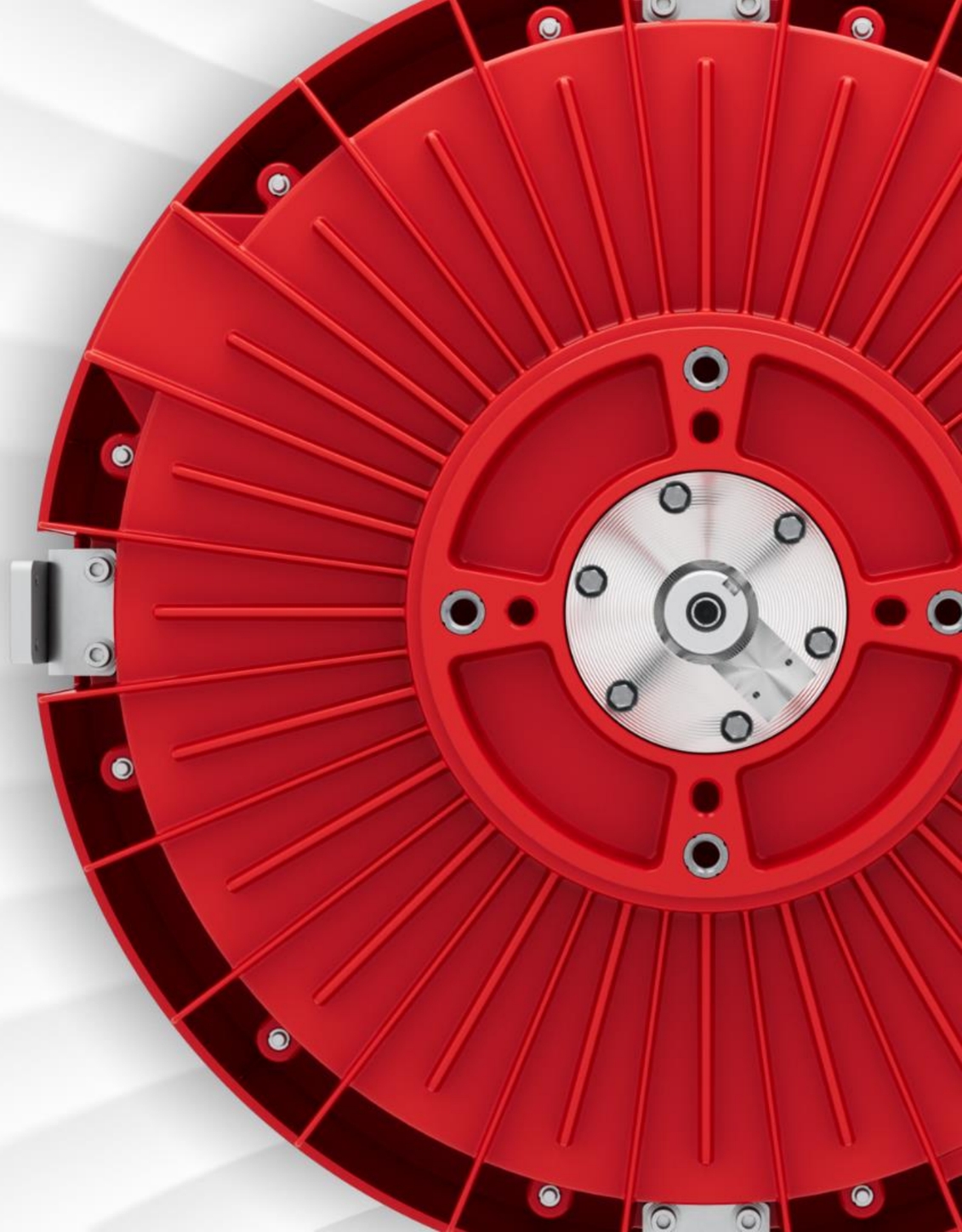
Questions?



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EMERSON

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