CONNECT

20
22
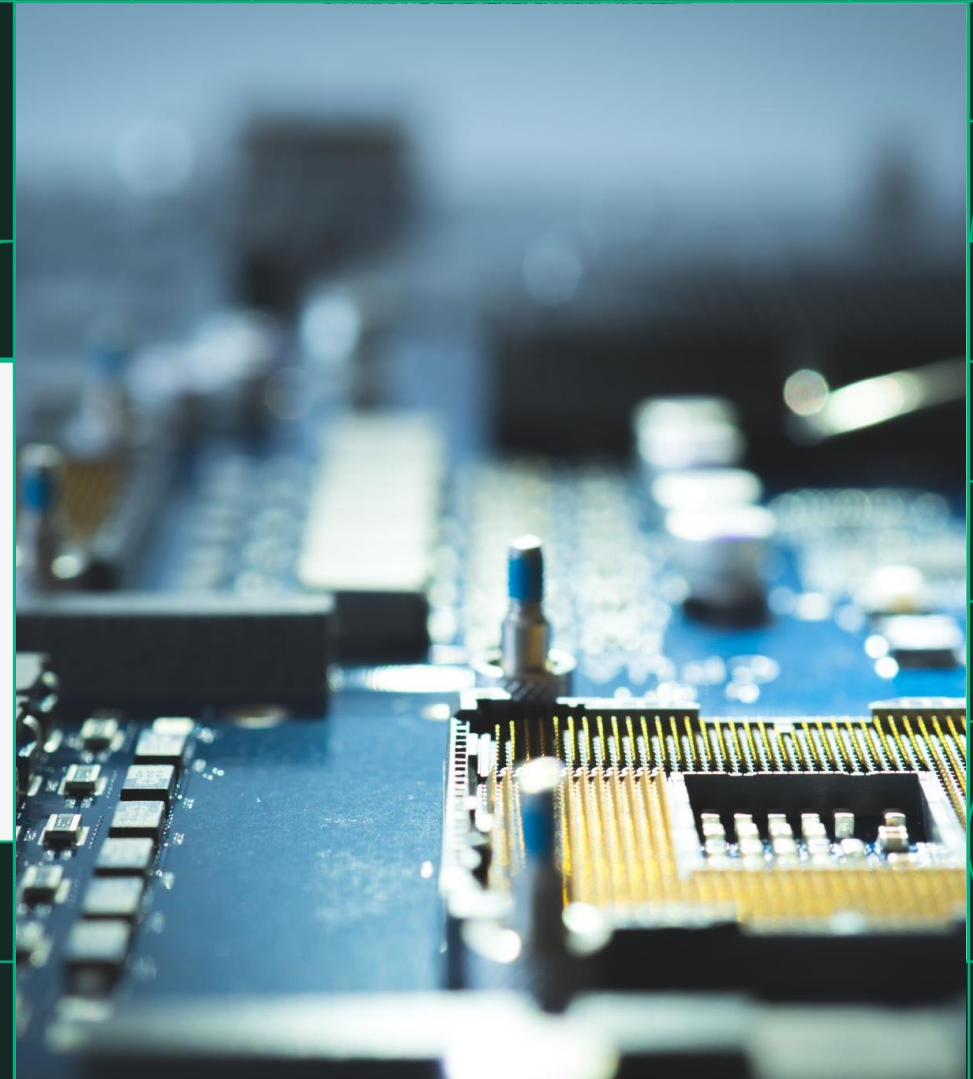
Turning Data into Actions with NI Lifecycle Solutions
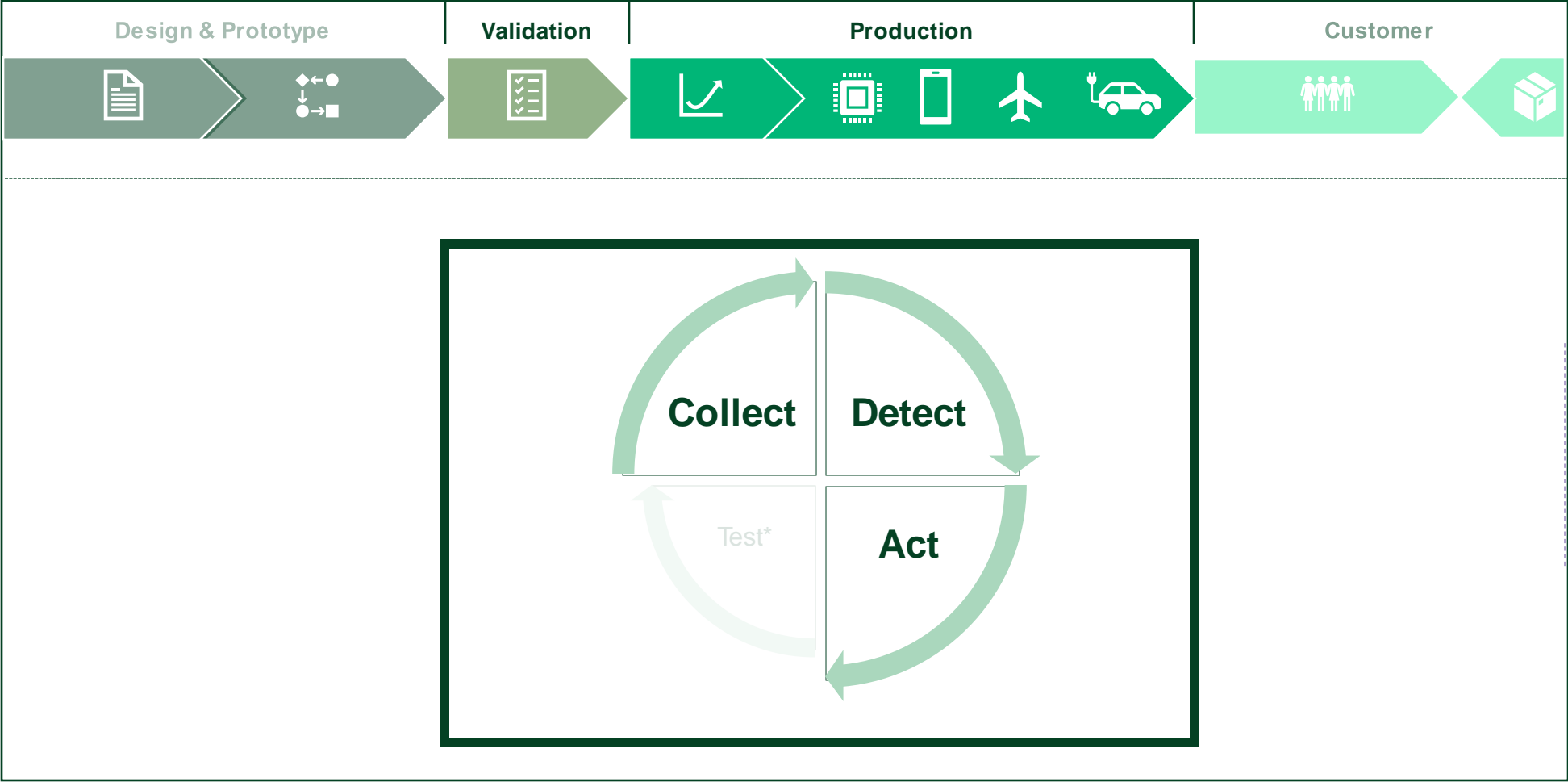
Peter Hodgins

NI Lifecycle Solutions

Design & Prototype **Validation** **Production** **In-Use**

Standardized and Connected Data

Orchestrating, connecting, and analyzing data to solve problems within and across product lifecycle stages

Design & Prototype	Validation	Production	In-Use
Spec management and test-data alignment	Test system orchestration and data reporting	Product-centric analytics to drive improvement	Train analytics models with in-field data to improve design & mfg.

From Data to Insights and Actions

Lifecycle Solutions

Design & Prototype	Validation	Production	Customer

Collect   **Detect**

Test   **Act**

*Compatible with Test HW and Systems from **any Vendor**

Solution Stages

1. Data Harmonization

- Identify and connect to any data source
- Unified data model provides clean harmonized data
- Product-centric data for product-driven results

Lifecycle Collect

2. Analytics Toolset

- **Start with the problem**, not the solution
- Insights on KPIs deliver results
- Open platform is a baseline for custom apps or ML/AI

Lifecycle Detect

3. Insights into Actions

- Rules deploy guided actions directly to the source
- Holistic view of process, product and supply chain
- Supports evolution toward proactive management

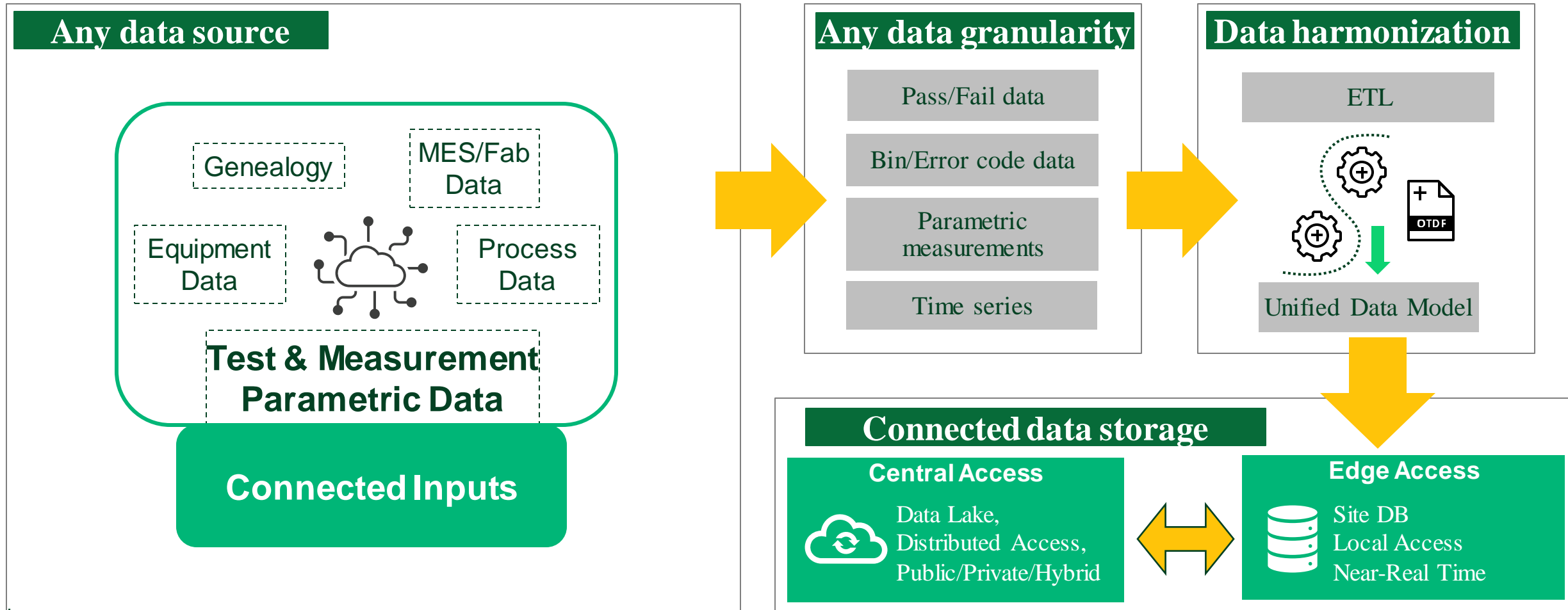**Lifecycle Act**

NI Support Across the Journey Ensures Meaningful Results

Data Pipeline Objectives

Harmonize test data with other sources into a consistent and accessible model

Any data source

Genealogy

MES/Fab Data

Equipment Data

Process Data

Test & Measurement Parametric Data

Connected Inputs

Any data granularity

- Pass/Fail data
- Bin/Error code data
- Parametric measurements
- Time series

Data harmonization

- ETL
- OTDF
- Unified Data Model

Connected data storage

Central Access

Data Lake, Distributed Access, Public/Private/Hybrid

Edge Access

Site DB
Local Access
Near-Real Time

Component Traceability Tools

Genealogy connects the hierarchy of products and components

Product SN	Board SN	PCBA SN	Component ID

Product

Board 1

Board 2

PCBA 1

PCBA 2

PCBA 3

U1
Lot Code, ECID

R1
Lot Code, Reel ID

C12
Lot Code, Reel ID
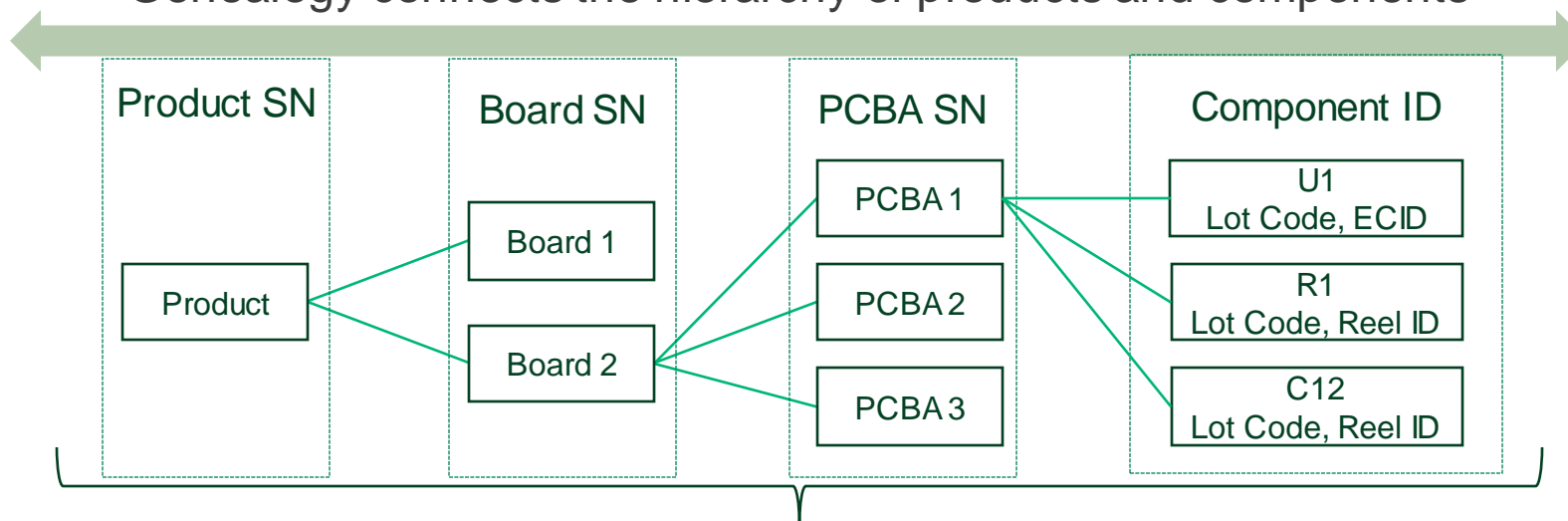
Component Traceability connects that hierarchy to all related data for deeper investigations

Process Data

Screen printer · SPI · Pick & Place · Reflow oven · AOI

AOI · Reflow oven · Pick & Place · SPI · Screen printer

ICT · FCT

In-line or Off-line

Test Data

Parametric Data   Pass/Fail Results   Tagging and Metadata

Supplier Info

Batch/Delivery Info

Supplier Provided Data
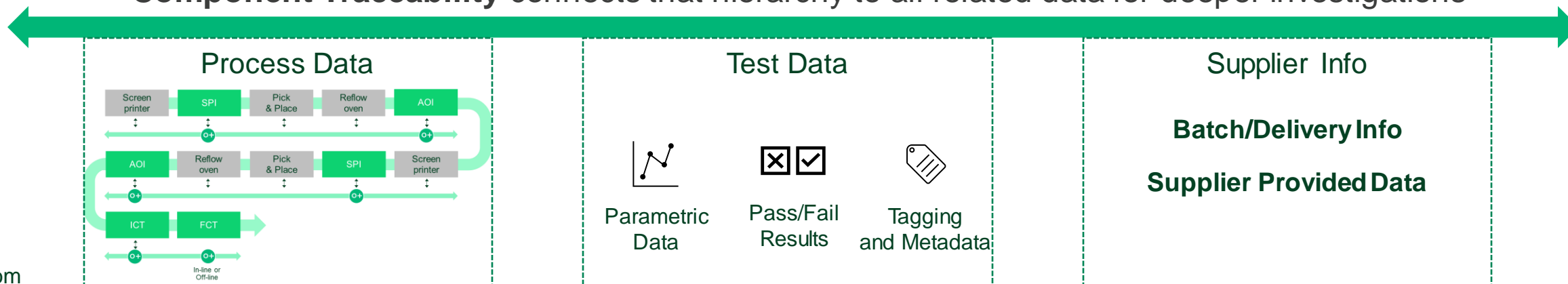
Analytics that Matches Your Needs

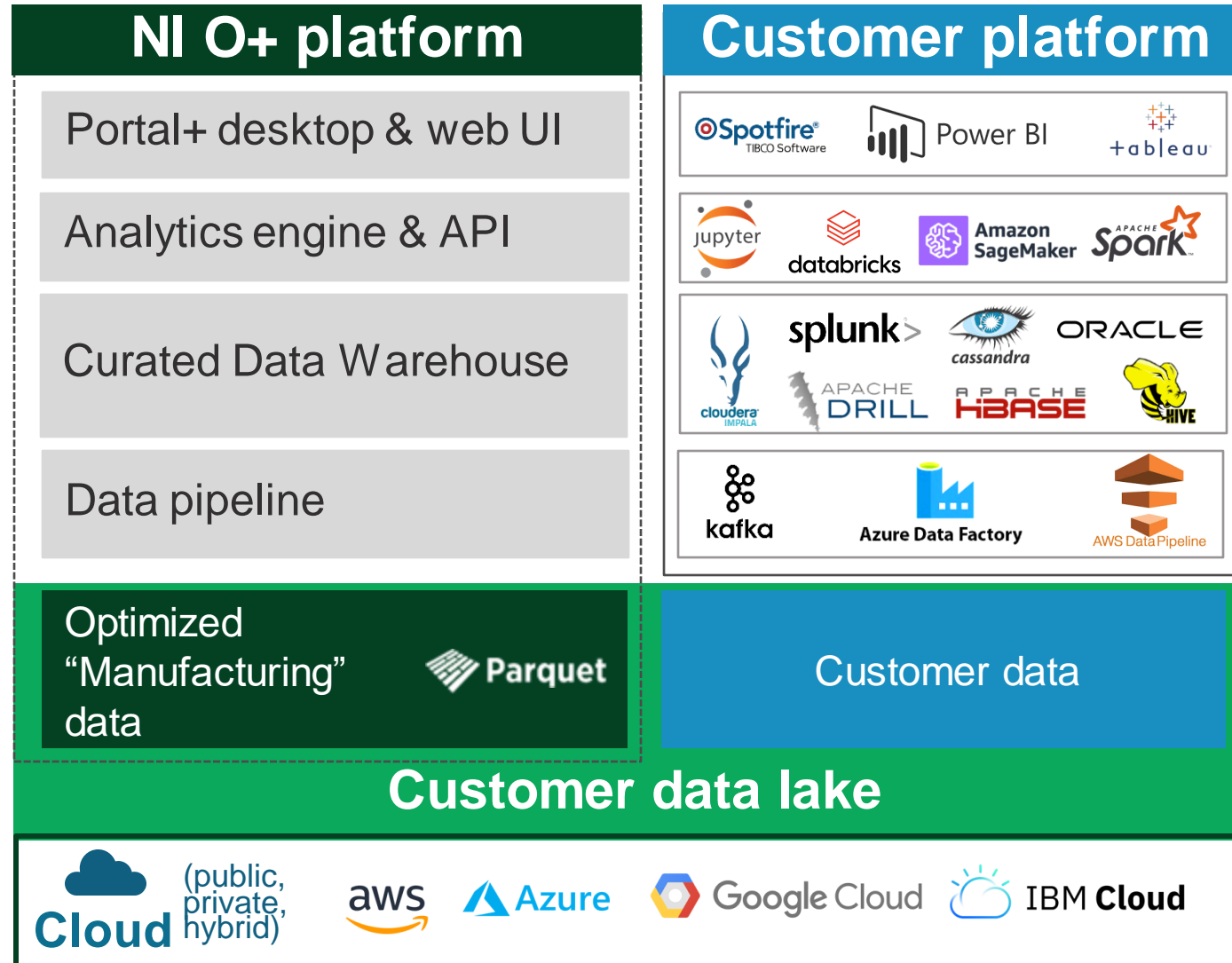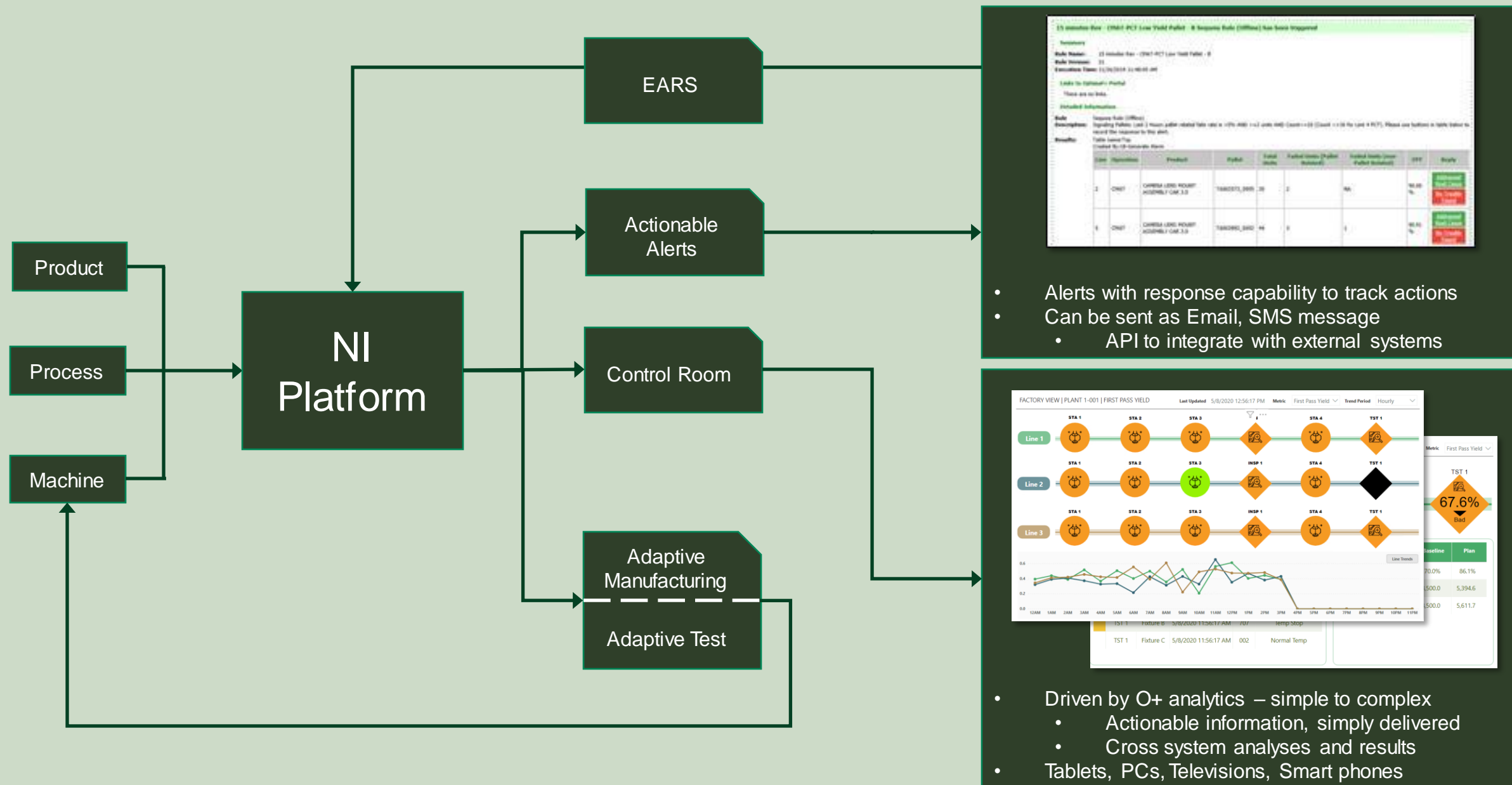| Root-Cause/Drill-down	Custom Detection	Packaged Tools	AI / ML
• Enable Proactive process/factory management • Investigate process and quality issues and recall risks	• Easily build your own detection scripts • Leverage 3rd party tools with API access to data warehouse	• Leverage NI built detection tools and features • Add tools via licensing as needed	• Simplified AI/ML lifecycle • Build, deploy and retrain at the Edge

NI Open Platform

NI O+ platform

Portal+ desktop & web UI

Analytics engine & API

Curated Data Warehouse

Data pipeline

Optimized "Manufacturing" data — **Parquet**

Customer platform

Spotfire (TIBCO Software) · Power BI · tableau

jupyter · databricks · Amazon SageMaker · Spark

splunk> · cassandra · ORACLE
cloudera IMPALA · APACHE DRILL · APACHE HBASE · HIVE

kafka · Azure Data Factory · AWS Data Pipeline

Customer data

Customer data lake

Cloud (public, private, hybrid) · aws · Azure · Google Cloud · IBM Cloud

Operations efficiency – Taking Action

Product

Process

Machine

NI
Platform

EARS

Actionable
Alerts

Control Room

Adaptive
Manufacturing

Adaptive Test

- • Alerts with response capability to track actions
- • Can be sent as Email, SMS message
  - • API to integrate with external systems

- • Driven by O+ analytics – simple to complex
  - • Actionable information, simply delivered
  - • Cross system analyses and results
- • Tablets, PCs, Televisions, Smart phones

Collect & Detect with Analog Devices

Roger Huntley, ADI Wireless Product Group

Transceiver Block Diagram (2nd Gen)

Supplies

Synthesizers

External LO Inputs

Receiver

Transmitter

Observation Receiver

Clock Input

SPI Interface

General Purpose and Auxiliary Converters

Control Interface

Data Interface
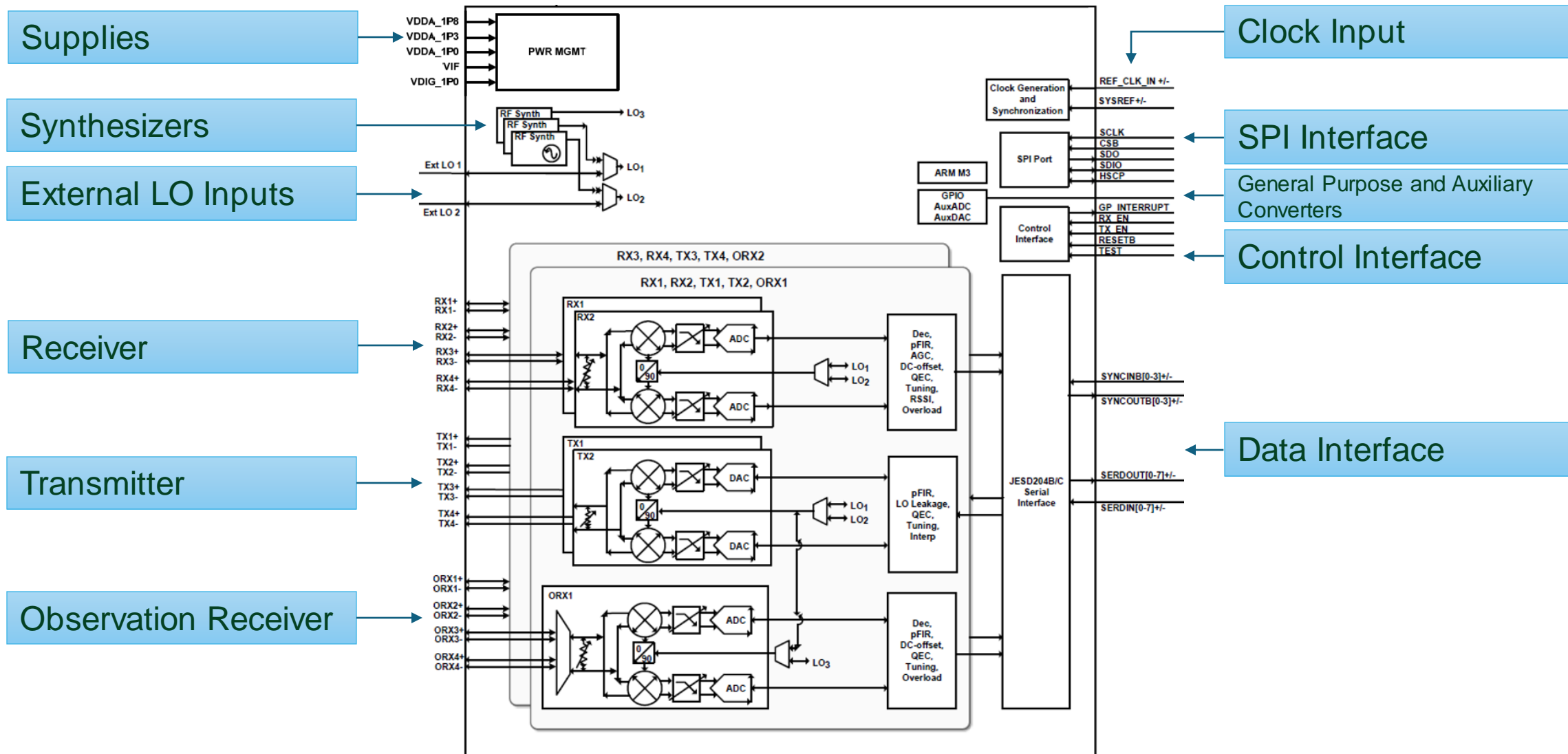
IC Complexity Drives Data Analytics Requirements

PROGRESSION OF TRANSCEIVER COMPLEXITY
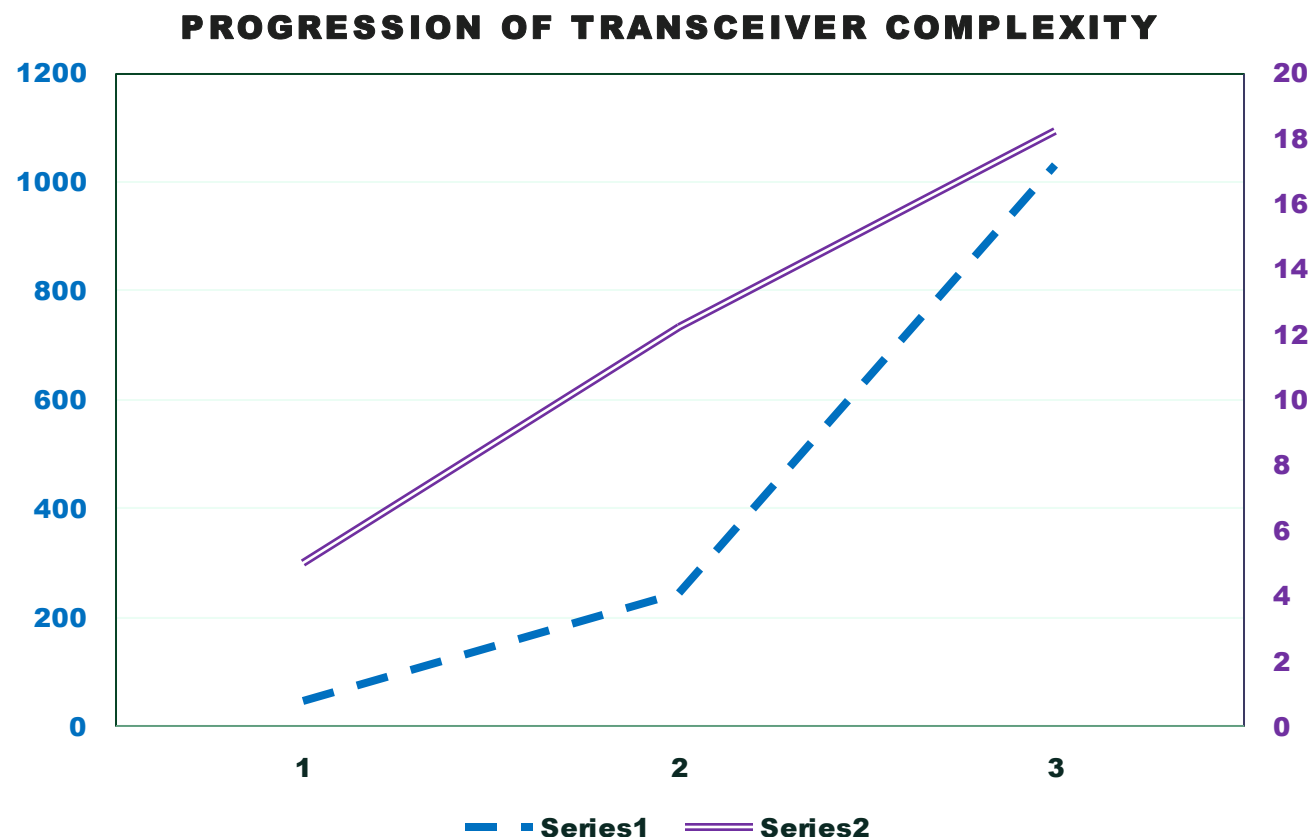
- ❖ Cloud and/or server deployed
- ❖ Ability to process different data formats
- ❖ Automate the analysis of various statistical capabilities

Series1 — — Series2

ni.com

ADI Managing NPI Cycles with OptimalPlus

Qualification of Designs

Scope:

- ❖ Long ATE measurement list
- ❖ Second sourcing causes additional qual cycles
- ❖ Intense "time to market" pressure

Solution:

O+ automated analysis of large volumes of data

Benefit:

Faster & more accurate qual cycles to meet increasing demands on product releases

From Design to HVM

Scope:

- ❖ Ramp from 1st silicon to final tape-out
- ❖ Quickly find design issues and resolutions
- ❖ Make recommendations for design

Solutions:

O+ wafer visualization and correlation analyses to accelerate NPI evaluation

Benefit:

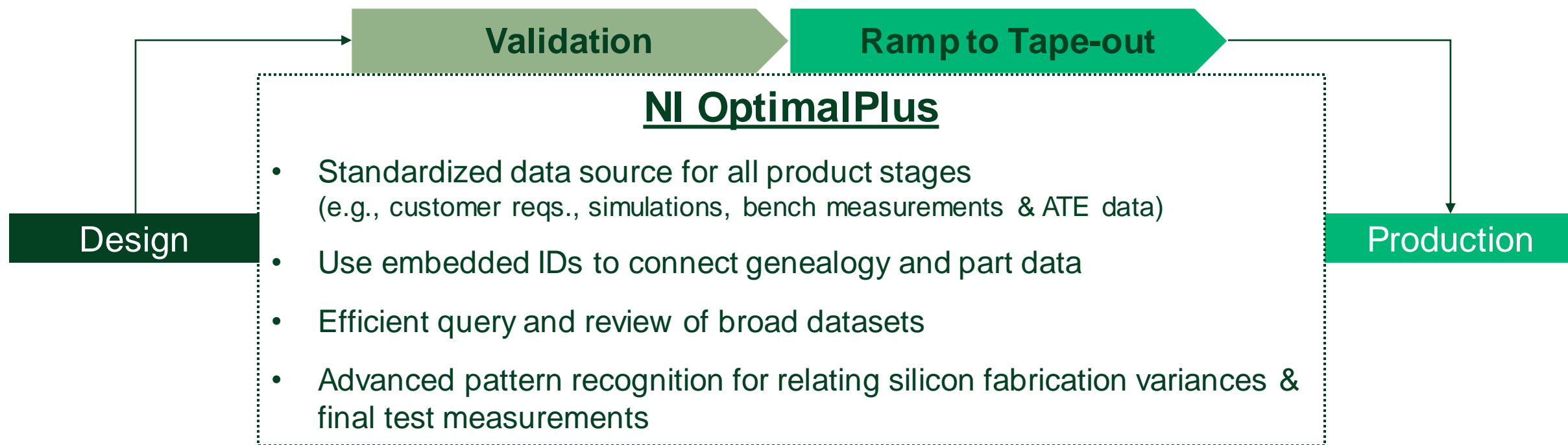Add automation into ramp cycles to meet tape-out timelines and improve final product quality

Validation

Ramp to Tape-out

NI OptimalPlus

ADI: Broader Transformation Opportunities

Validation | **Ramp to Tape-out**

Design | **Production**

NI OptimalPlus

- Standardized data source for all product stages
  (e.g., customer reqs., simulations, bench measurements & ATE data)

- Use embedded IDs to connect genealogy and part data

- Efficient query and review of broad datasets

- Advanced pattern recognition for relating silicon fabrication variances & final test measurements

Additional Data Requirements to Support Transformation

Embedded electronic ID

Embedded wafer x-y coordinates

File and Test name standards

Structured DB's for all data sources

Standard ATE STDF summary/header sections

NI Detection Models

Light Touch for Complex Supply Chain Management
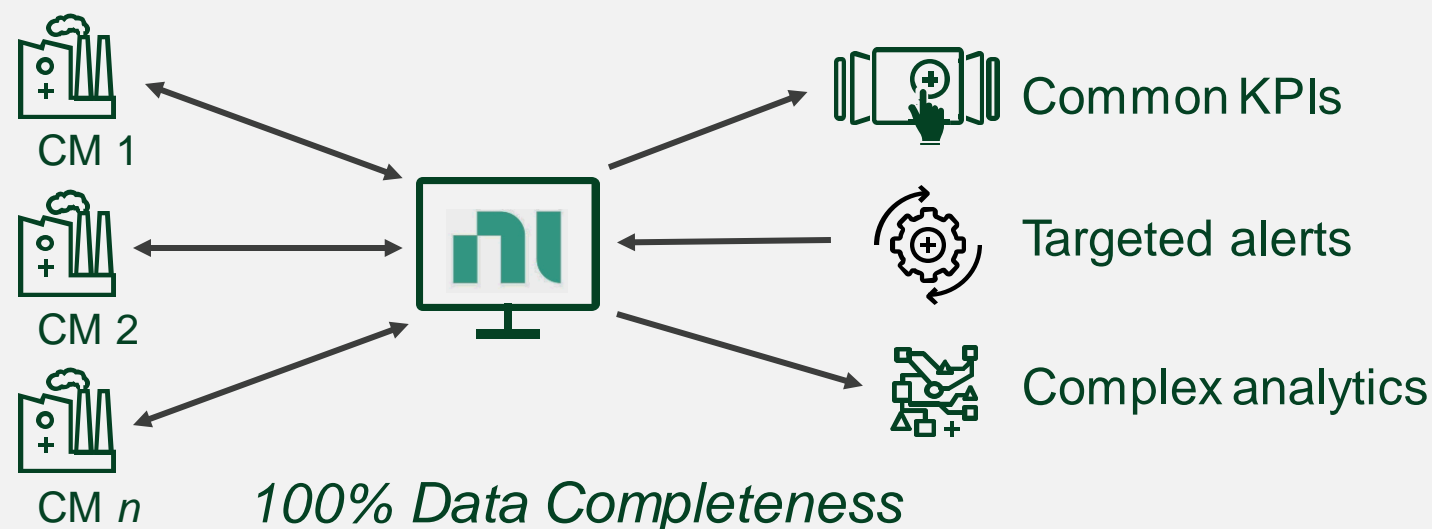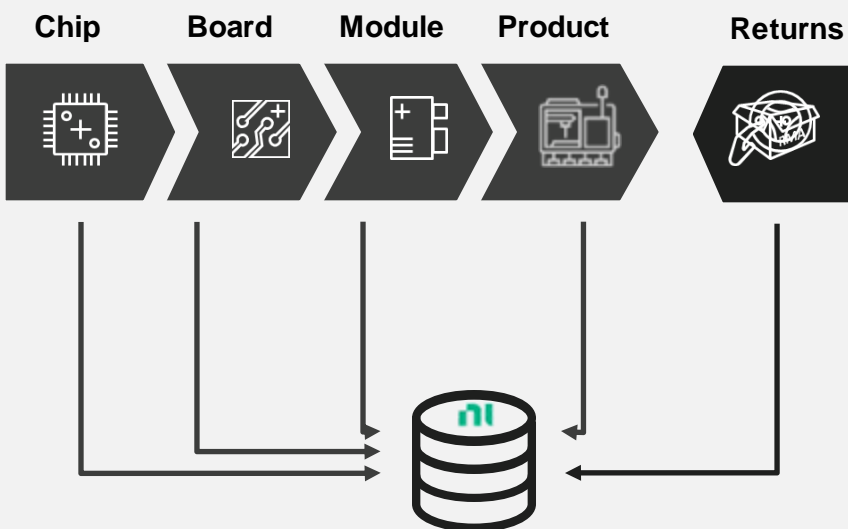
The Challenge

- Too many resources spent managing issues at CMs

Deployment Summary

- Common, aligned visibility and KPIs across multiple contract manufacturers (CMs) for SMT through EOL test
- Targeted rules with statistical limits for both product and process to identify most impactful issues – Directly to CM
- Insights report for broader visibility

Benefits

- **~50% reduced resources** needed to manage CMs
- **Common KPIs and visibility** across CMs
- **Complete supply chain visibility**
- **Improved data alignment** across CMs

Chip | Board | Module | Product | Returns

CM 1
CM 2
CM n

Common KPIs
Targeted alerts
Complex analytics

100% Data Completeness

SMT Line OEE Improvement with Predictive Maintenance
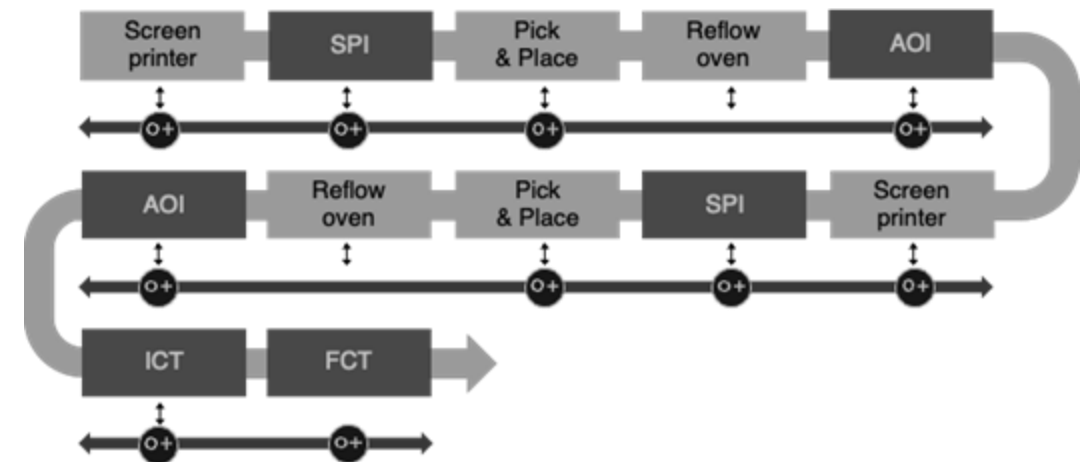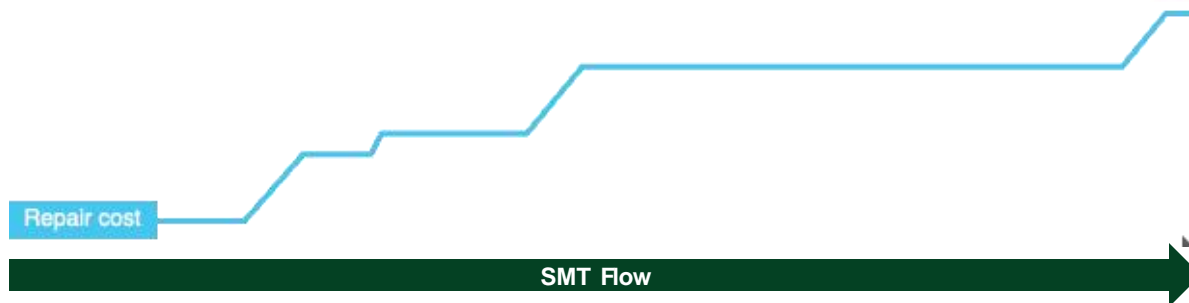
The Challenge

- Multi-step production process is bottlenecked by any single breakpoint

Deployment Summary

- Self-service insights to identify OEE and scrap improvement areas
- Cross-operational analysis enabled through connecting all data sources
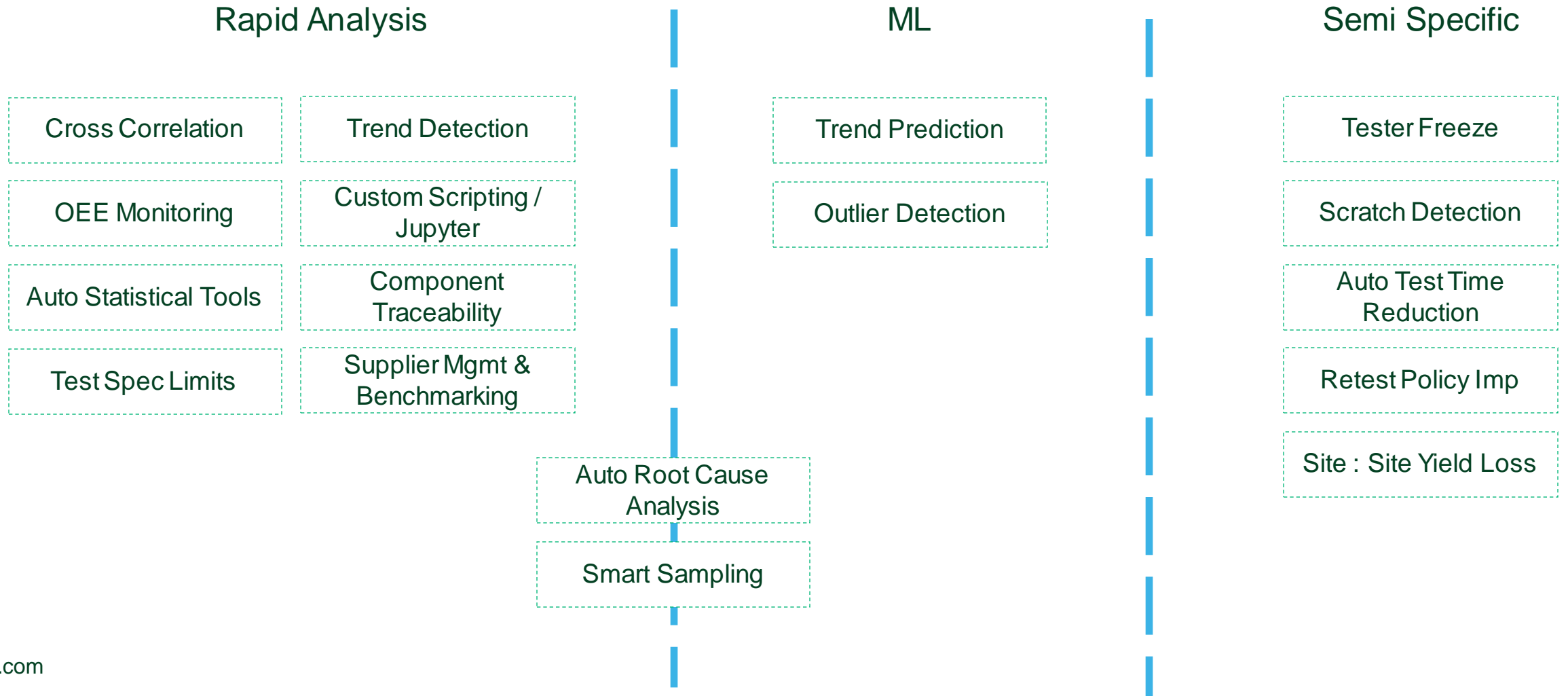- Implemented Predictive Maintenance through advanced algorithms

Realized Benefits

- **Reduced Scrap by ~67%** through Predictive Maintenance
- **Improved process yield by >10%** at SPI
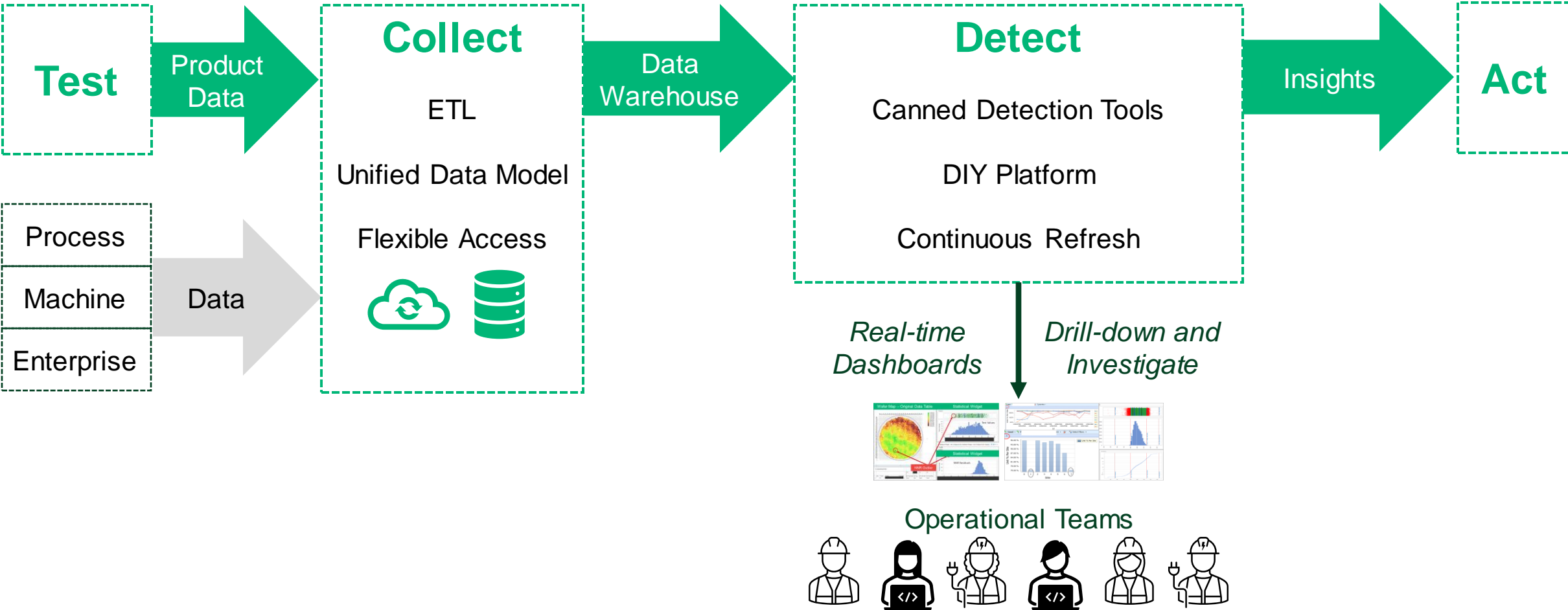- **Cycle time improvement of ~25%**

Repair cost

SMT Flow

Screen printer → SPI → Pick & Place → Reflow oven → AOI

AOI → Reflow oven → Pick & Place → SPI → Screen printer

ICT → FCT

Detection Tools & Features

Rapid Analysis

Cross Correlation	Trend Detection
OEE Monitoring	Custom Scripting / Jupyter
Auto Statistical Tools	Component Traceability
Test Spec Limits	Supplier Mgmt & Benchmarking

Auto Root Cause Analysis

Smart Sampling

ML

Trend Prediction

Outlier Detection

Semi Specific

Tester Freeze

Scratch Detection

Auto Test Time Reduction

Retest Policy Imp

Site : Site Yield Loss

The Democratization of Analytics

NI Lifecycle Solutions empower engineers to analyze and improve

Test

Product Data →

| Process |
| Machine |
| Enterprise |

Data →

Collect

ETL

Unified Data Model

Flexible Access

Data Warehouse →

Detect

Canned Detection Tools

DIY Platform

Continuous Refresh

Insights →

Act

Real-time Dashboards   *Drill-down and Investigate*

Operational Teams

Building Intelligence into the Cycle

AI/ML Capabilities

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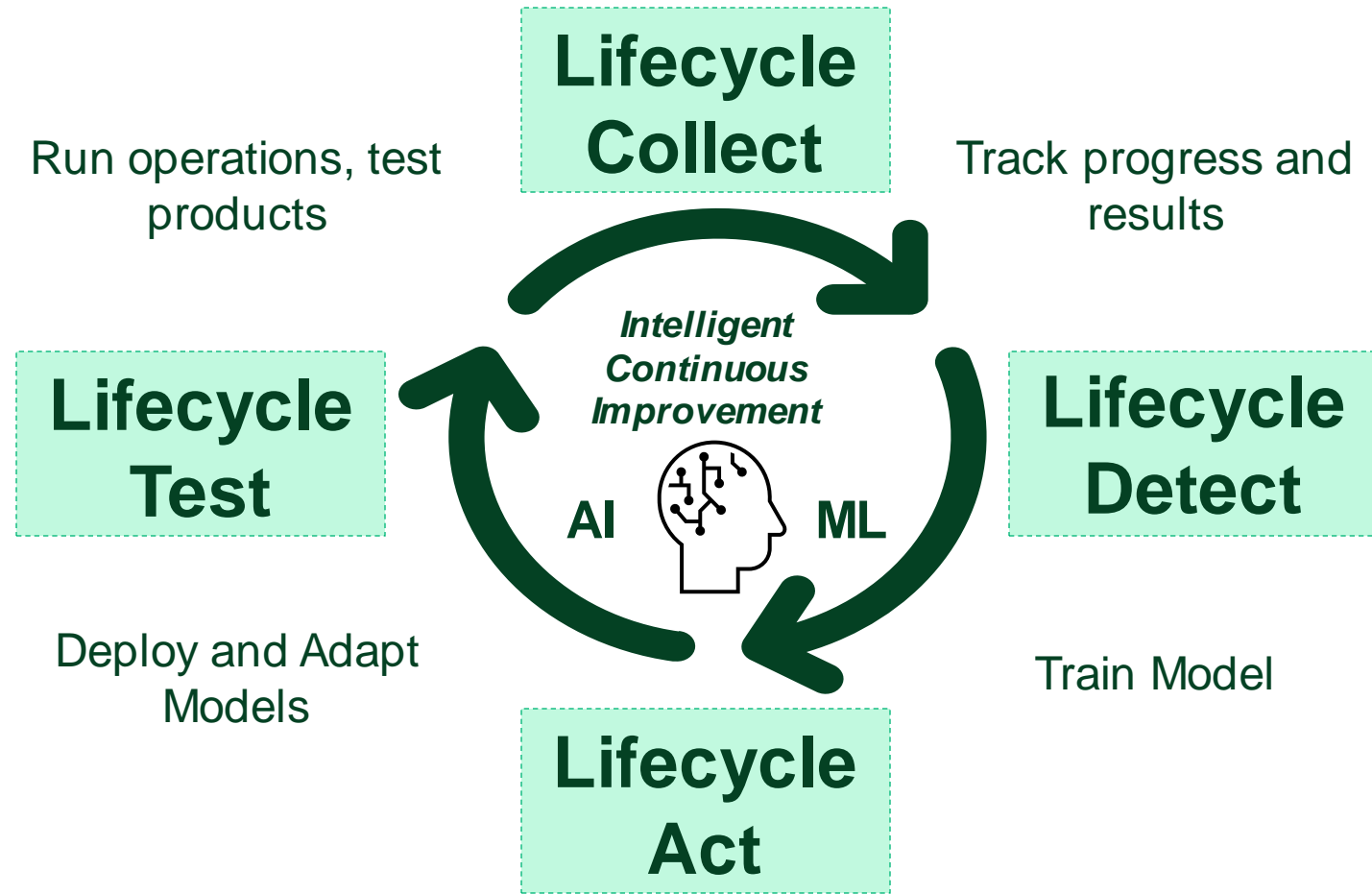
National Instruments
is now NI.