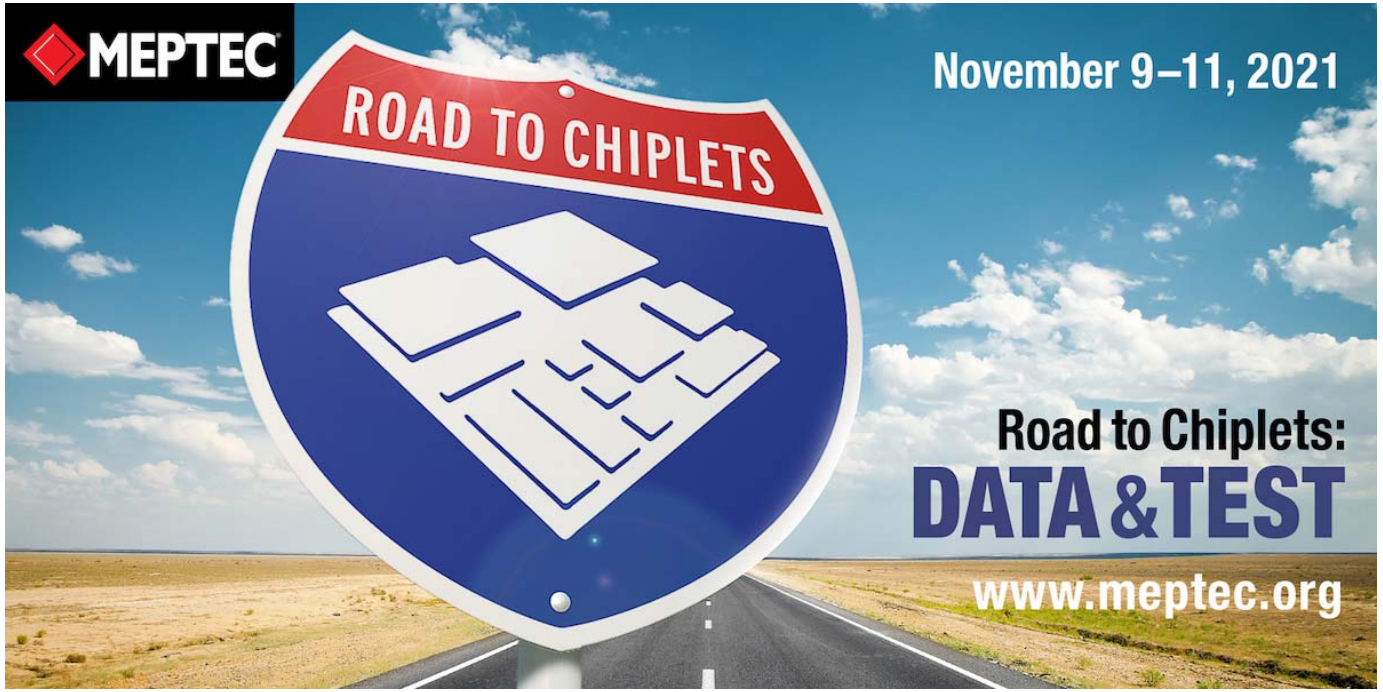

Road to Chiplets: Data & Test

November 9 - 11, 2021

MEPTEC
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Quality Protection for Chiplet-based Modules

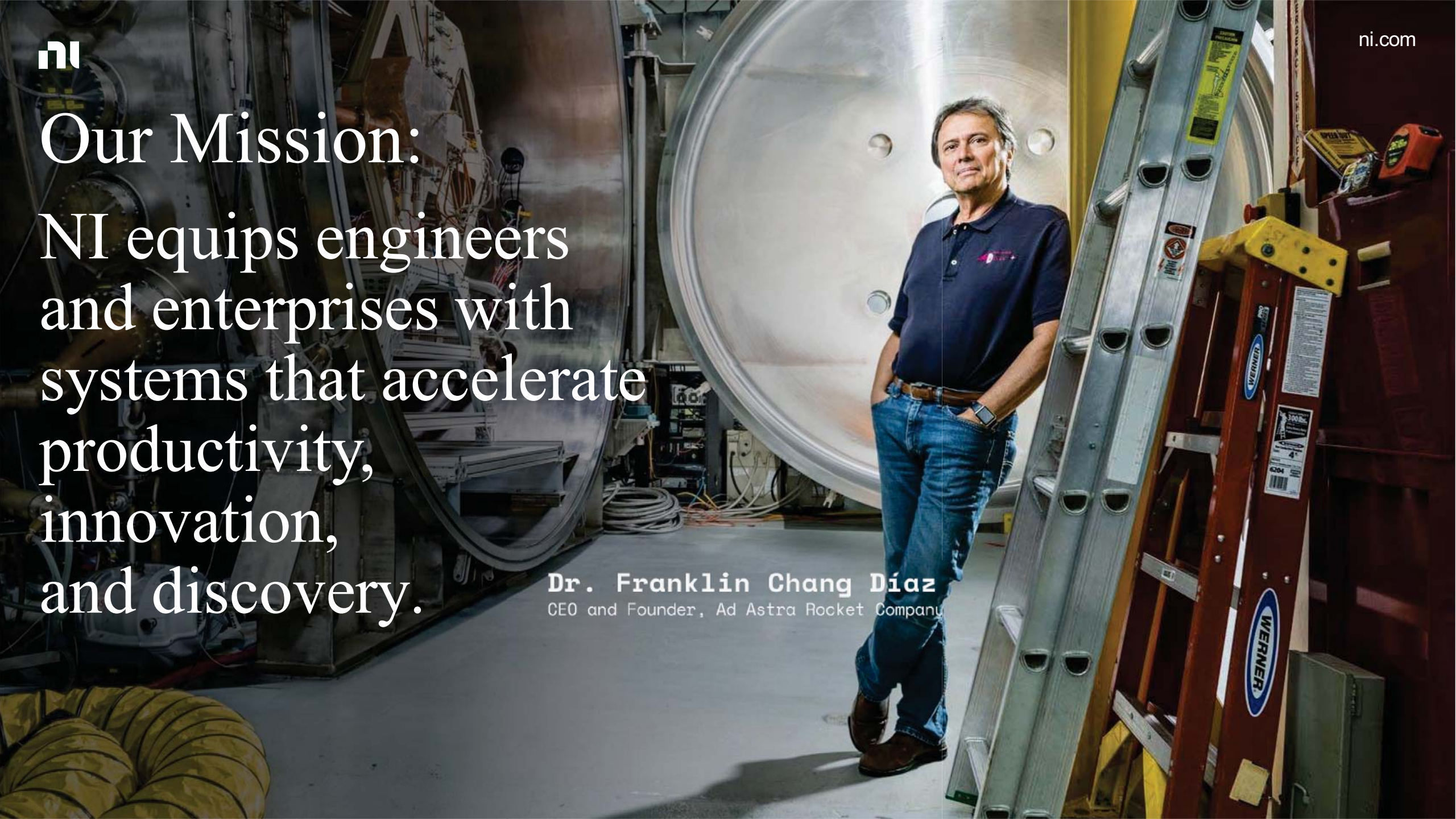
A Practical Approach

Michael Schuldenfrei

NI Fellow

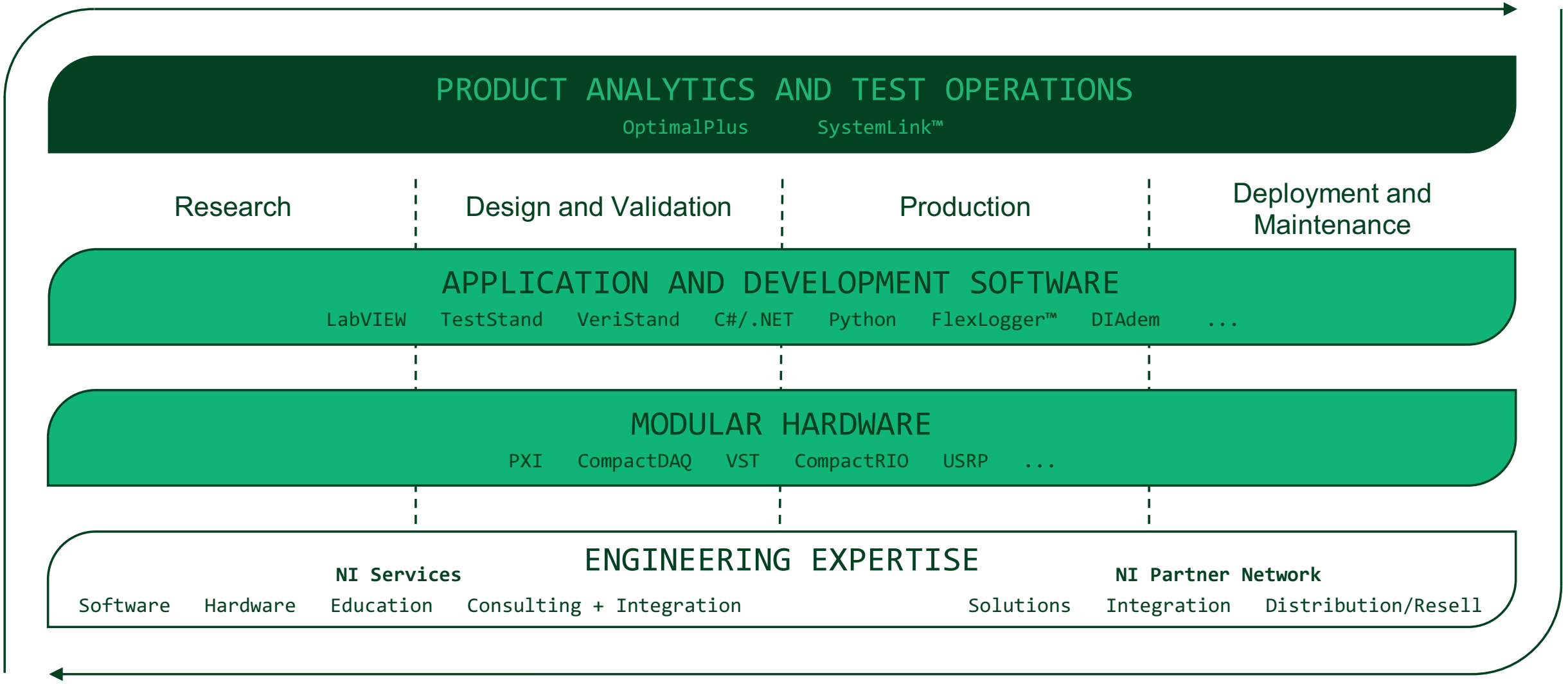
Our Mission:

NI equips engineers and enterprises with systems that accelerate productivity, innovation, and discovery.



NI SOFTWARE-CONNECTED SOLUTIONS

ENABLING INNOVATION AND PRODUCTIVITY ACROSS THE PRODUCT DEVELOPMENT CYCLE

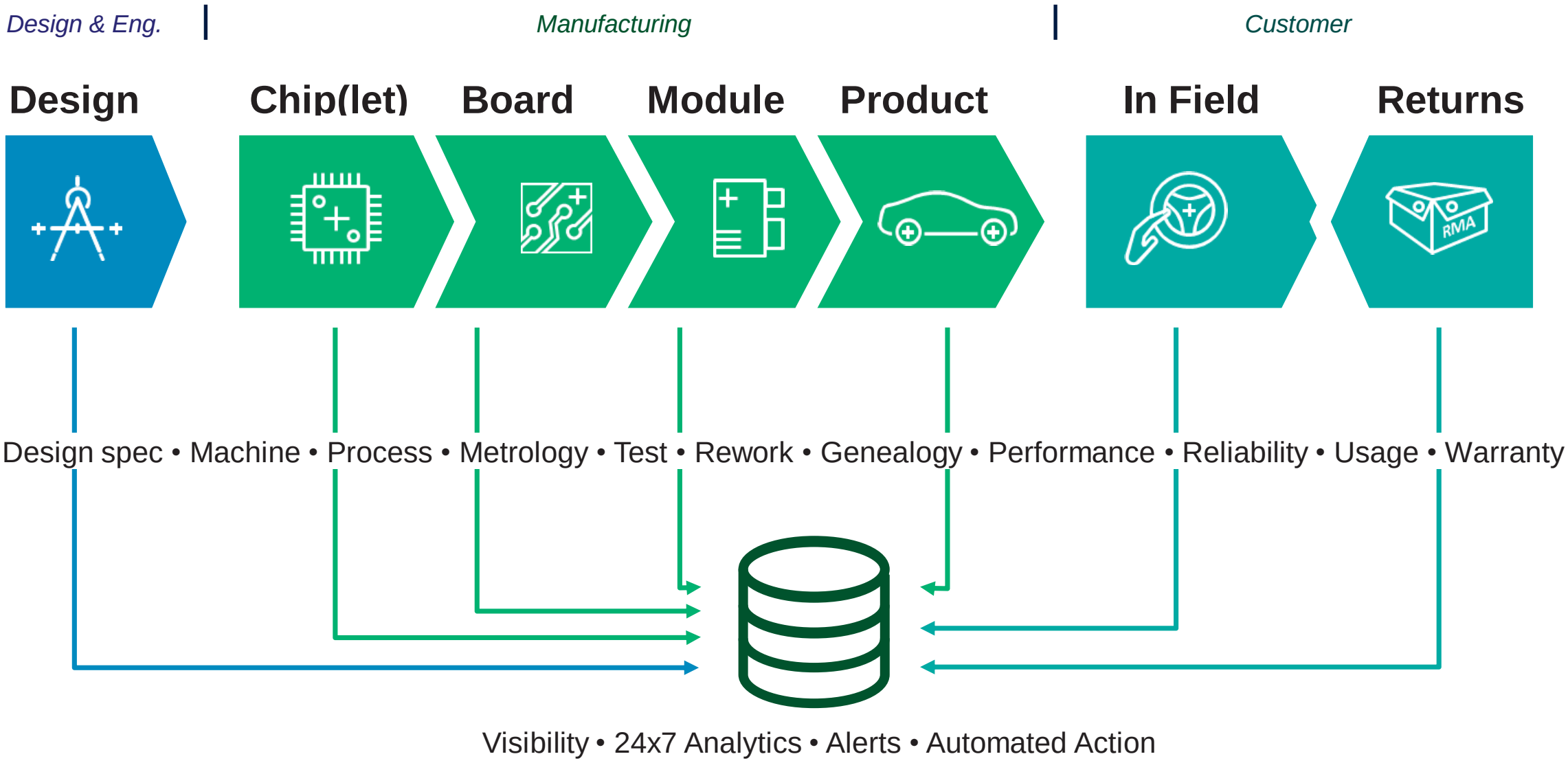


Chiplet Quality Challenges

- 3nm sweet spot for Chiplets
- Highly customized chips / Heterogenous integration
- Complex chiplet-system susceptible to use-conditions
- End-to-end collaboration on design/manufacturing/test and use

- Unprecedented sensitivity to process variability
- Performance and interoperability variances – compound yield
- In-field testing, repair and tuning
- Open business model to enable feedback loop via test

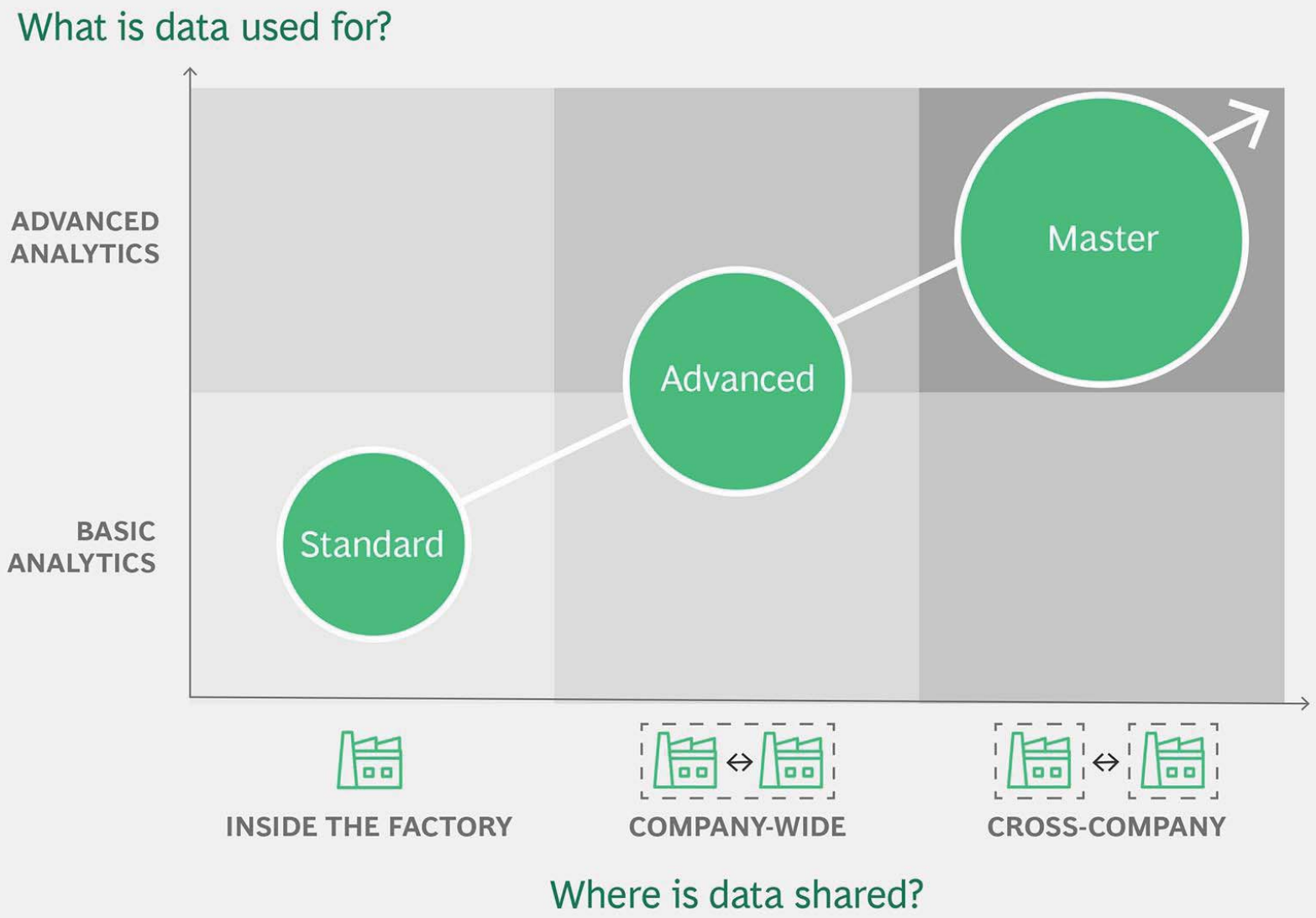
Going Broader and Connecting the Value Chain



The level of data sharing across the value chain impacts the ability to solve key industry challenges

- The need to improve quality FAST
- Consistent Performance
- Warranty Costs
- Recalls
- Liability

Data Sharing Enables Largely Self-Controlled Factories



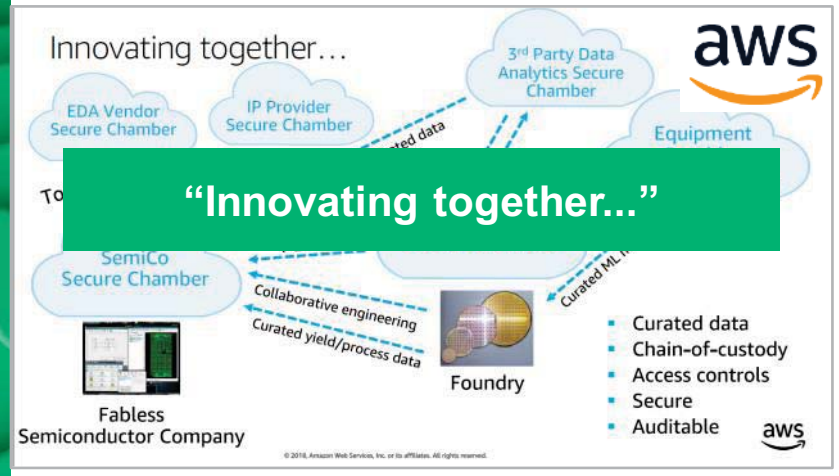
5
application domains that clearly demonstrate the value proposition

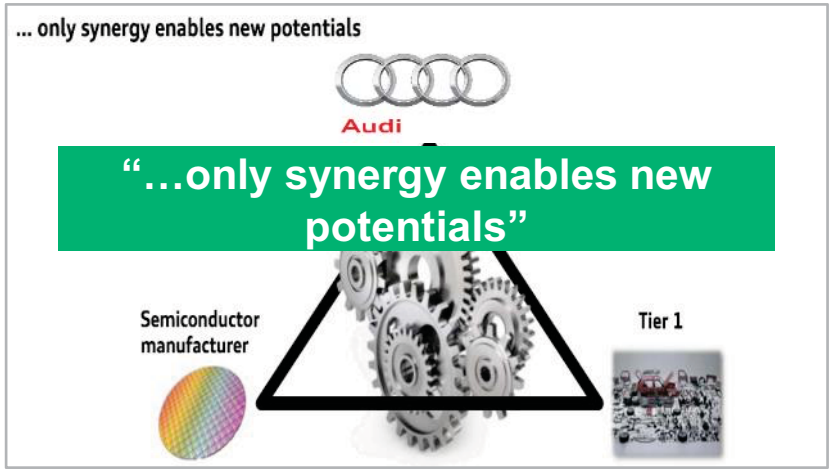
72%
of managers surveyed say they are considering data sharing to improve operations

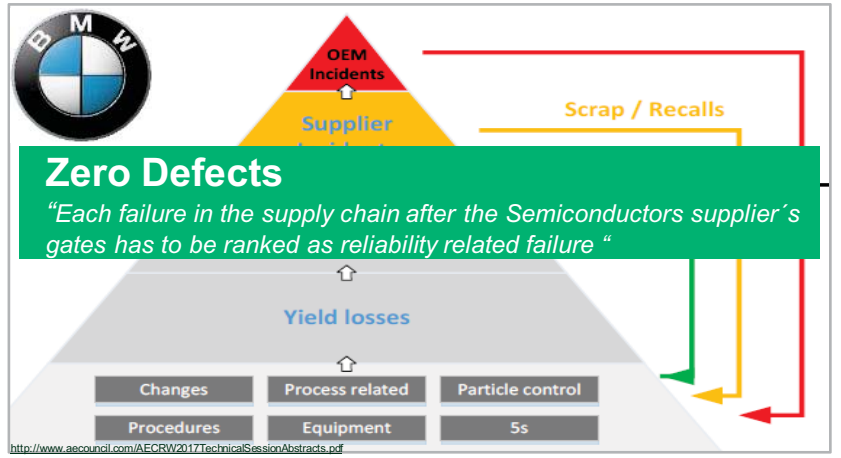
$100B+
in value can be unlocked through manufacturing-process optimization alone

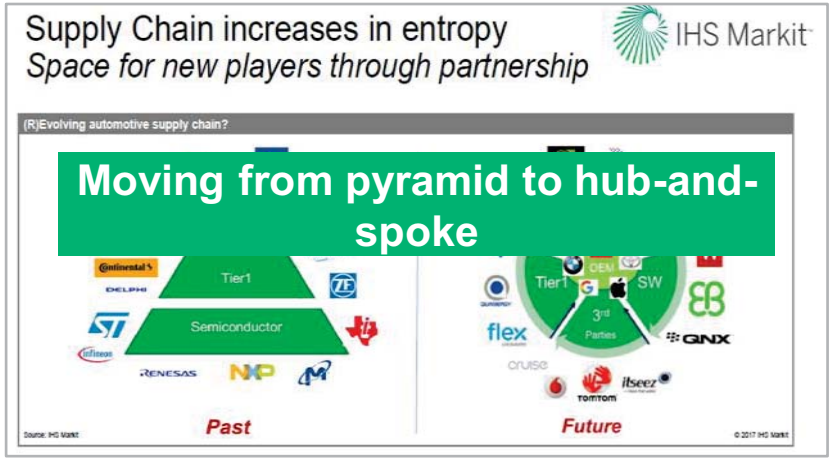
Sources: World Economic Forum; BCG.
Note: Based on a global BCG survey of 996 manufacturing managers.

Voices Across the Industry

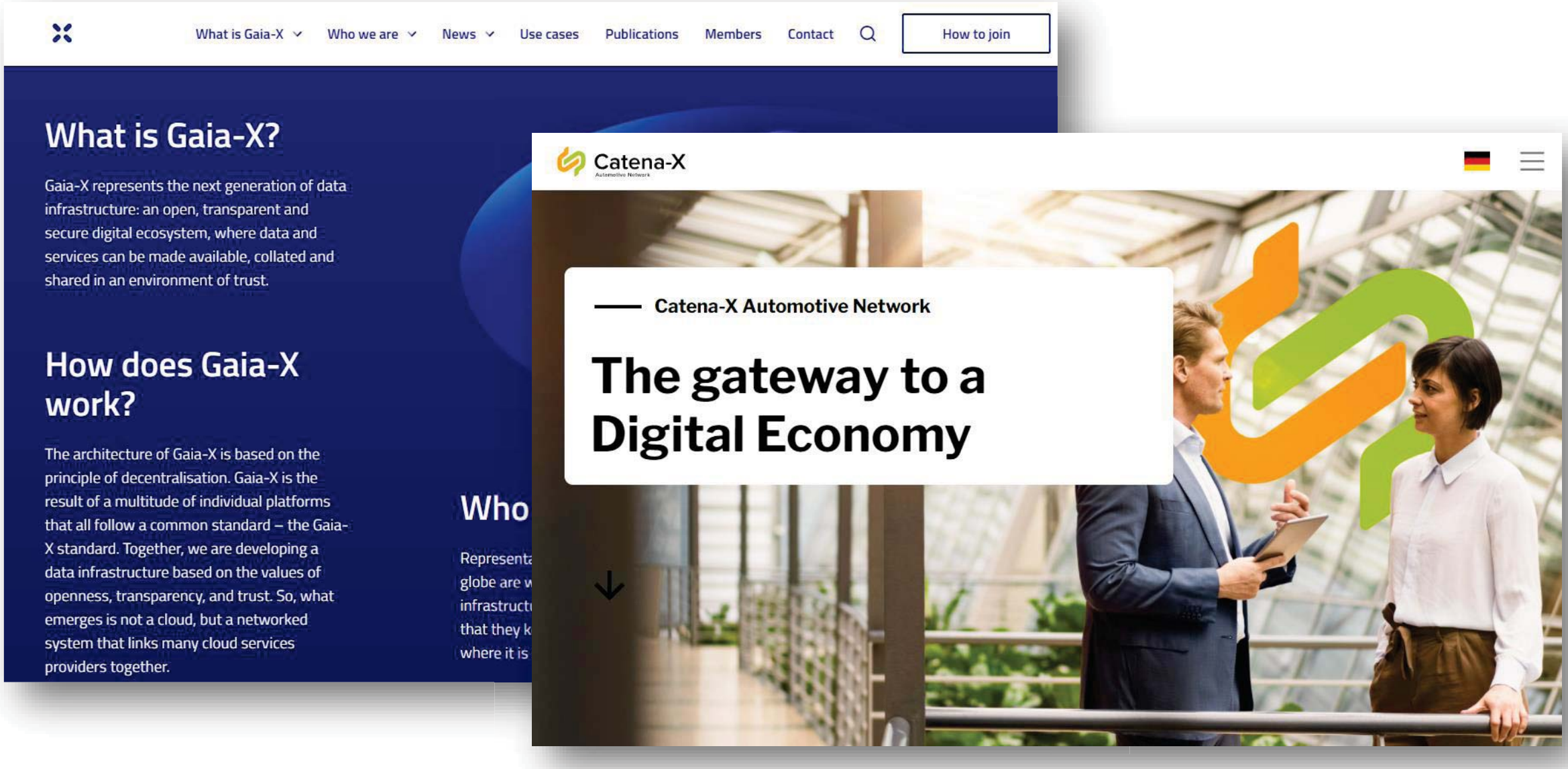


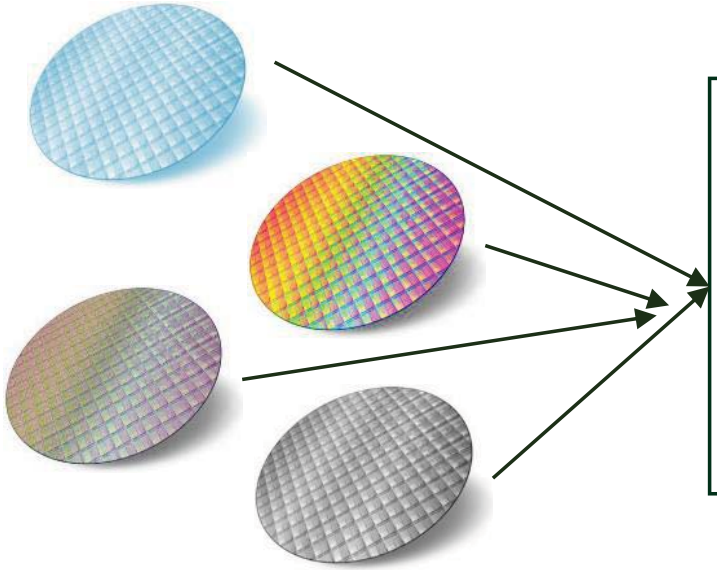


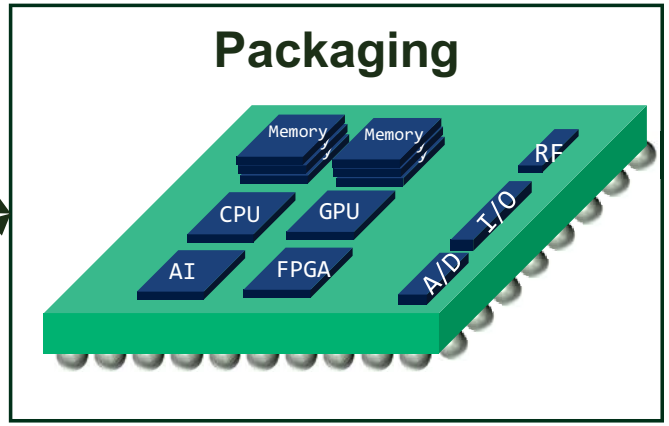


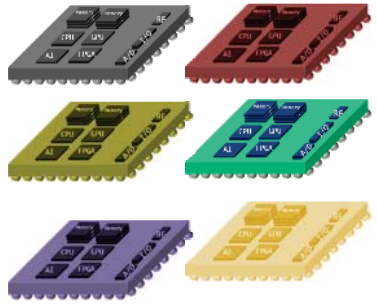


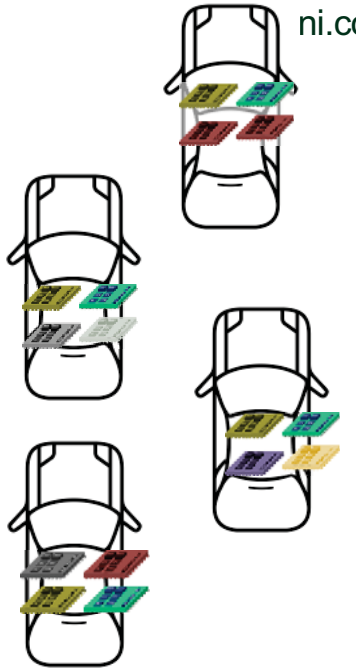
Europe is Leading the Charge…











Wafer Test	Final Test	System Test	In-Field Test
10s of suppliers	10s die types 100s of dies	10s-100s System vendors	100s OEMs Different config.

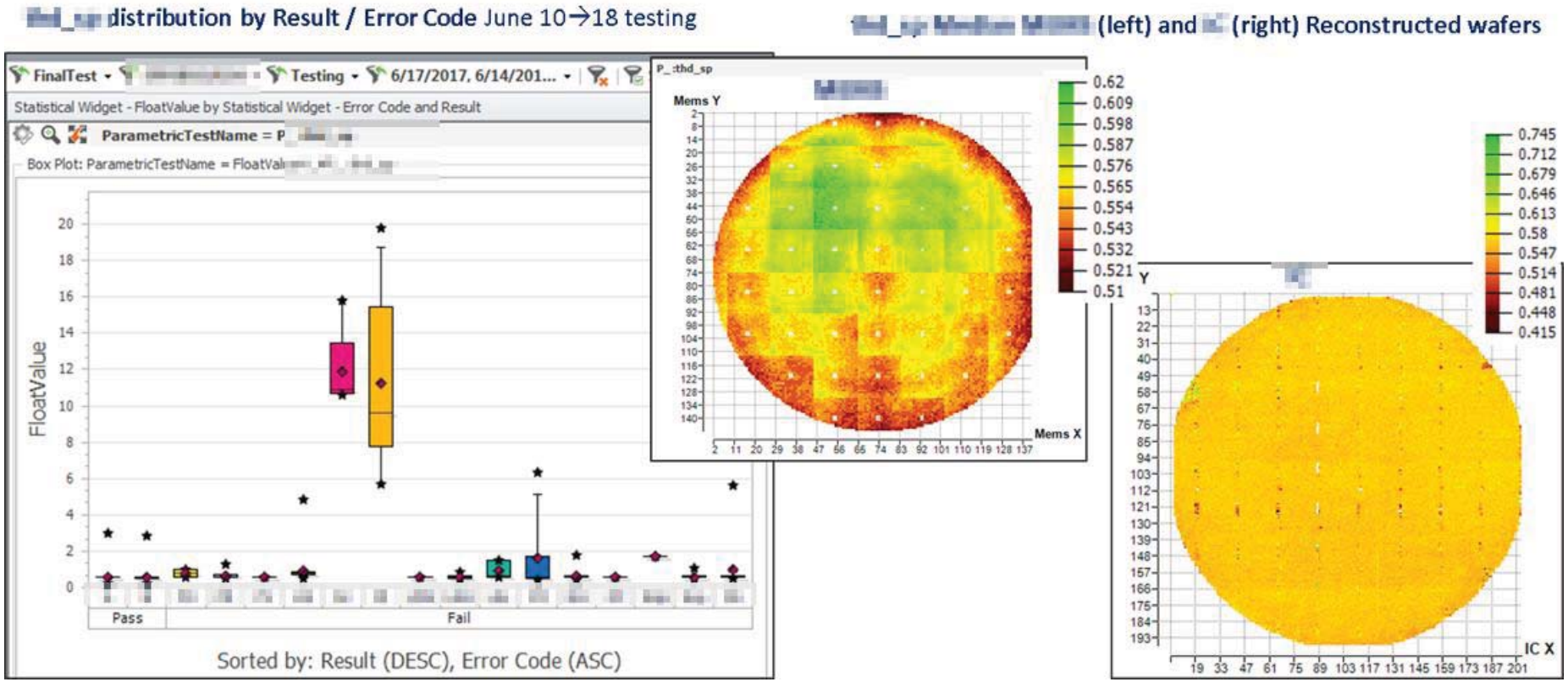
How do we enable Chiplet test-data-driven insights across supply-chain?

Example 1: Connected Value Chain Analytics Hub for Chiplets

Box plot shows the statistical distribution of a single package test result split by bin

Cumulative reconstructed wafer maps of chiplets show:

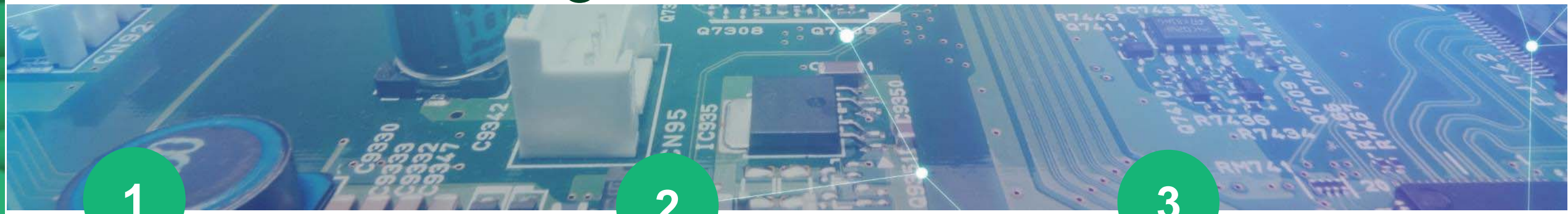
- A wafer from one component with a clear pattern (looks mfg. related)
- A wafer from a second component with a random distribution



Example 2: Improving Quality and Yield for Suppliers and Customers

	Without Hub	With Hub	
Customer	No information shared with IC Supplier	Find highest correlating tests (Chiplet test / Package test)	
Chiplet Supplier	"Blind" outlier detection on 100 tests (6 σ, Outliers)	Outlier detection only on 10 tests (highest correlating tests) (6 σ)	Outlier detection with tighter Control Limits on the 10 tests (4 σ)
Supplier yield loss:	**0.7%**	**0.4%**	**0.5%**
Customer yield loss:	**1.0%**	1.0%	**0.5%**
Customer quality:	**10 DPPM**	10 DPPM	**1 DPPM**

Concerns with Sharing Data



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IP Protection/Commercial

- **Exposing IP** to potential competitors
- Data can be **leveraged against the other party**
- **"Win-Lose:"** Benefit for customer is clear, but what about the supplier?
- **Liability / legal / compliance / sovereignty** risks

2

Technical

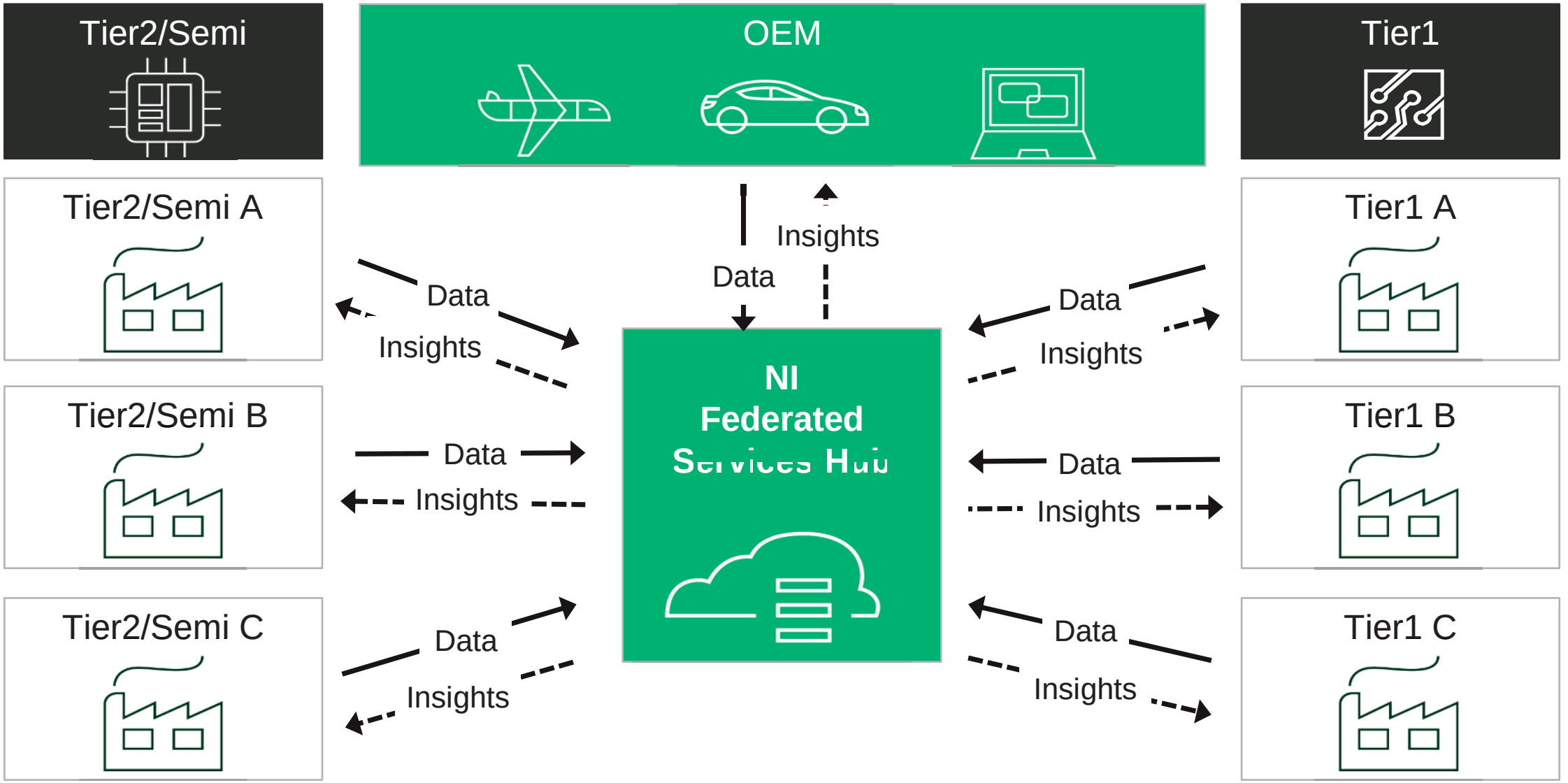
- Data flow / management
- **Security**
- Integration
- Complex many-to-many scenarios
- Lack of traceability
- Cost of doing it yourself

3

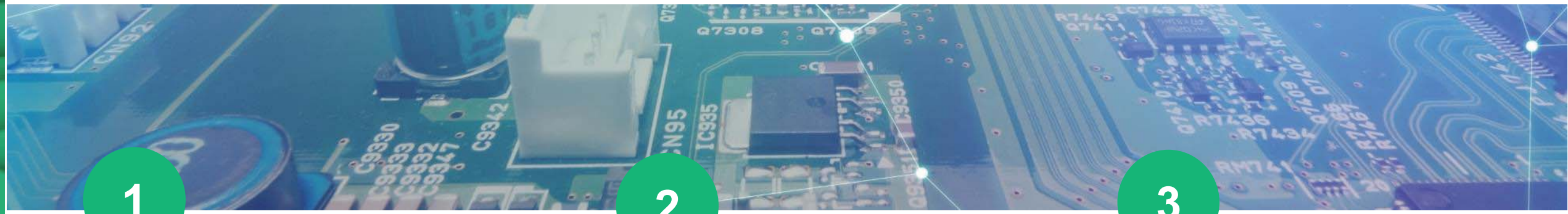
Expertise

- Complex correlations and analytics
- Cross-domain expertise is required

Trusted Quality Assurance Hub



How the Hub Addresses the Concerns



1

IP Protection/Commercial

- **Data owner** has **full control** over exposed data
- **Only data relevant** to resolving identified issues is exposed, and **only to the Hub**
- **Data** can be **obfuscated** while enabling analytics
- **Only agreed-upon Insights** are generated and shared
- All data movement is tracked on a **distributed block-chain ledger**

2

Technical

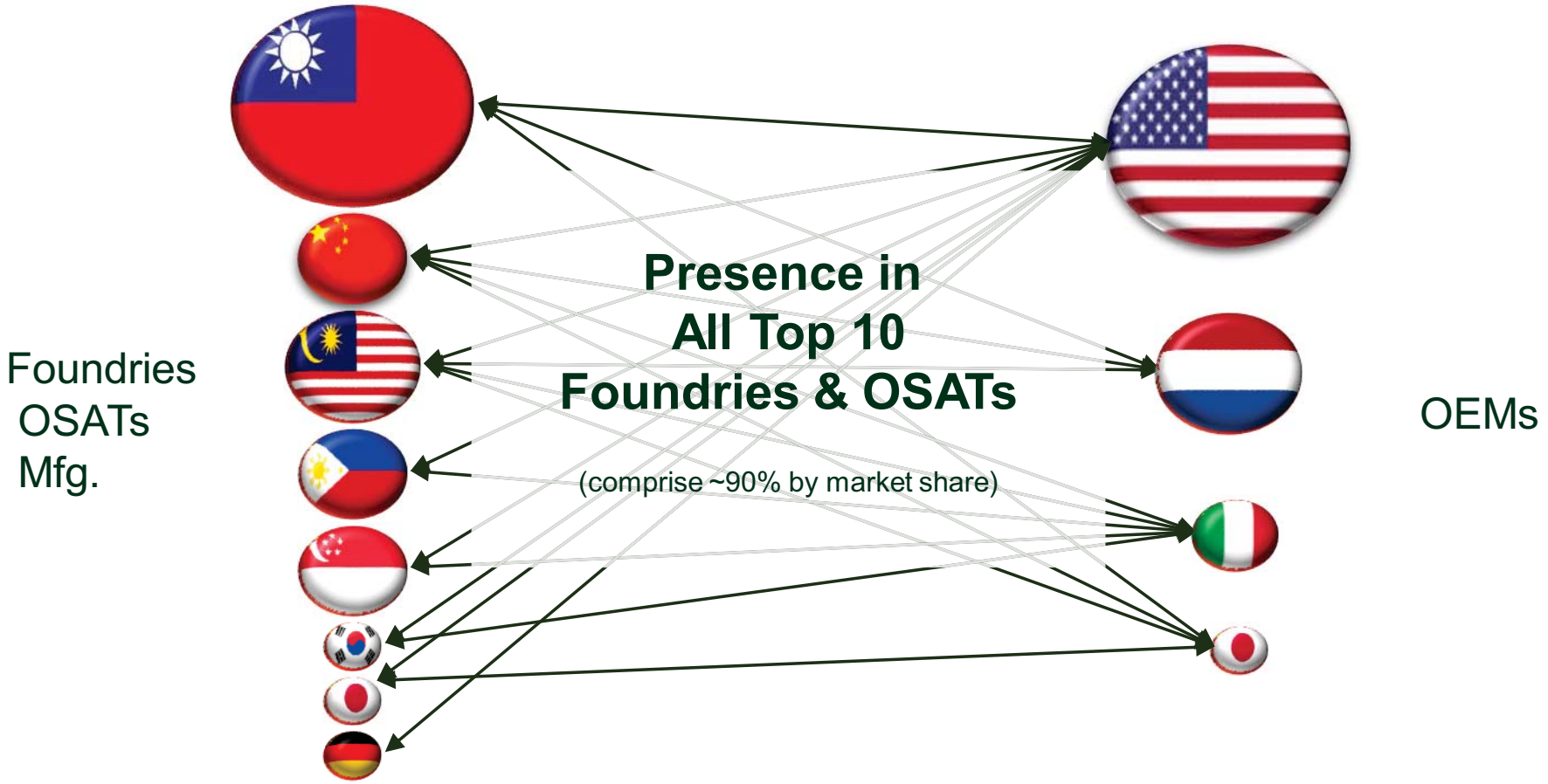
- The hub is **responsible** for the bulk of the **implementation and applications**
- Only one connection to maintain, no matter how many partners
- Consistent solutions for data security
- The hub has **more options** to maintain **traceability**

3

Expertise

- The hub provides the **analytics expertise**
- **Each party leverages its own expertise** when evaluating the issues identified by the hub

Practical to Deploy – Leverages Existing Infrastructure



Note: Size represents proportion of installations

Summary

Chiplets are just one example of an application where **data sharing is inevitable**

The **technical infrastructure** and **business relationships** required are complex

Test is the gatekeeper and thus the key ingredient

The solution HAS to support **many-to-many relationships** between suppliers and customers

A lot of **infrastructure already exists** and **can be re-used**

We're looking for design partners to join us on this journey

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