

Holistic AIoT in automotive semiconductor value stream

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Bosch

A global network



394,500*
Bosch associates make
these solutions possible



60*
countries –
440 regional
subsidiaries

Four business sectors



Mobility
Solutions



Industrial
Technology



Energy & Building
Technology





Consumer
Goods

✓ Including sales and service partners, Bosch's global manufacturing and sales network covers nearly every country in the world.

* As of 12.20, preliminary figures

Bosch – Corporate presentation

Four business sectors – Key figures 2020*

 Bosch Group	€ 71.6 billion euros Sales revenue	 394,500 associates
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Mobility Solutions

- ▶ One of the world’s leading providers of mobility solutions



Industrial Technology

- ▶ Leading in drive and control technology, packaging, and process technology



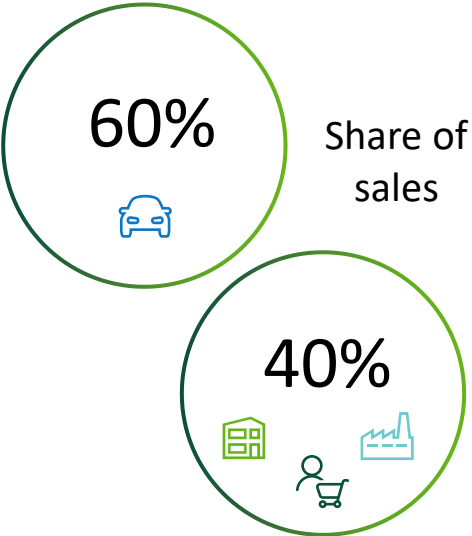
Energy and Building Technology

- ▶ One of the leading manufacturers of security and communication technology
- ▶ Leading manufacturer of energy-efficient heating products and hot-water solutions



Consumer Goods

- ▶ Leading supplier of power tools and accessories
- ▶ Leading supplier of household appliances



* As of 12.20, preliminary figures

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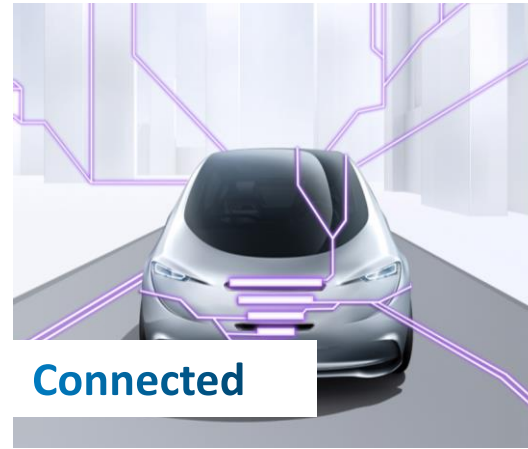
Four Megatrends as Drivers for Bosch



Electrified



Automated



Connected



Intelligent

plug-in costs electric motor
 market ramp-up hybrid
e-bike roaming
range smart charging
 Driving enjoyment battery
 e-scooter charging infrastructure

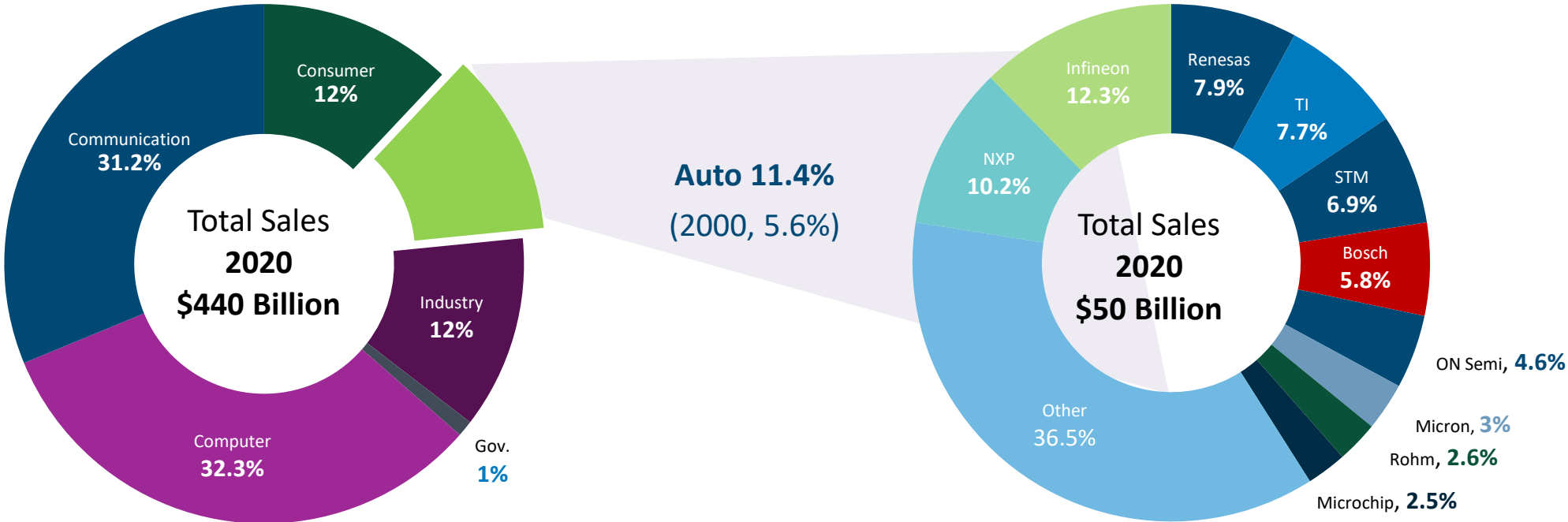
legislation highway pilot valet parking
auto pilot sensors
 emergency braking assistant
 redundancy assistance systems
SoC electric steering
digital environment

cloud augmented reality
 electronic horizon
 smartphone integration
 internet of things
eCall vehicle to vehicle
 vehicle to infrastructure
 fleet management services
 entertainment

scalability autonomous driving
 real-time processing software
artificial intelligence cloud
 Vehicle infrastructure configurability
 interfaces power consumption

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Semiconductor Market shares



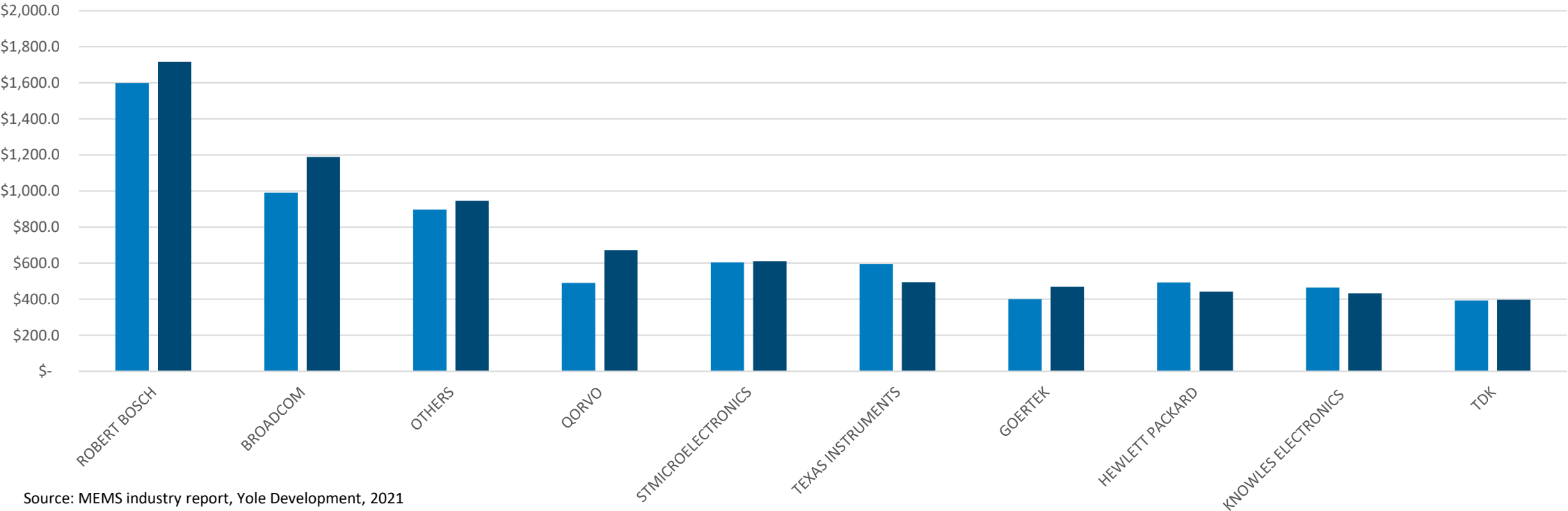
Source: Strategy Analytics, WSTS, Bosch

Automotive represents 11.4% of total Semiconductor Market

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2020 MEMS PLAYER RANKINGS

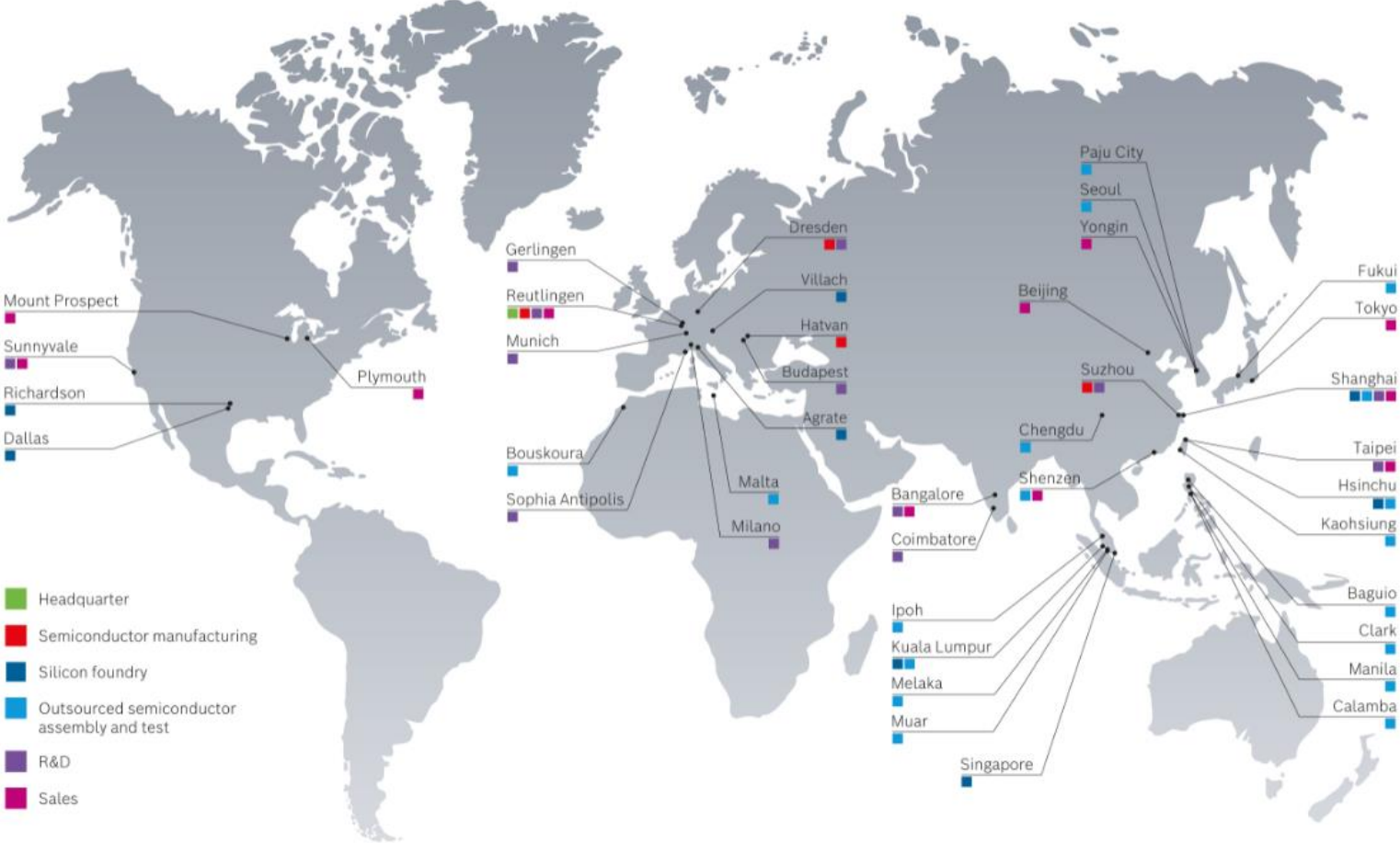
2020 MEMS ranking: Top-10



Source: MEMS industry report, Yole Development, 2021

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A worldwide network



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Inhouse semiconductor plants

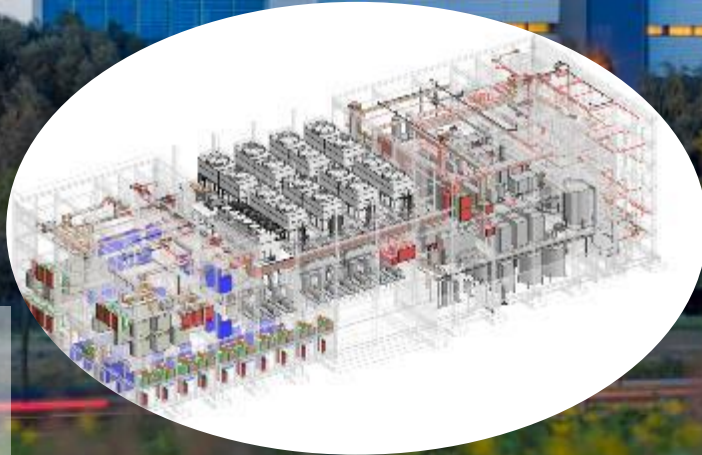


Dresden – a digital AIoT plant

Details in Jens Krause's speech in
„Smart Manufacturing“



Sensors but Eyes:
no direct labor, full automation



Data driven fab release:
Faster production process
stabilization through digitalization



Compensate small(er) Scale:
Smart Data Management as differentiator
against competitors with scale advantage



Digital ecosystem:
AIoT-centric process landscape, AIoT
mindset of employees

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Digitalization Use Case: Remote Assist

Activities in Dresden



- Major equipment suppliers located **outside EU**
- **Covid** related travel restrictions critical during fab commissioning
- Dresden piloted a **proof of concept** (*Safety, Security, Reliability*) for HoloLens application

Use cases at other sites



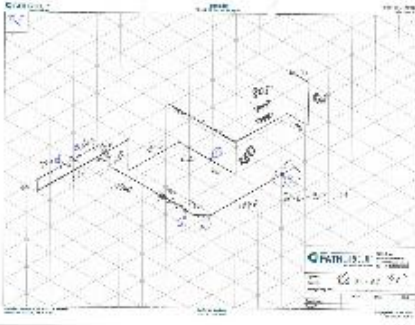
Use case examples in whole value stream: remote commissioning of equipment, remote specialist support in unscheduled down events, conduction of remote training

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Digitalization Use Case: Digital Twin of Building

State of the Art

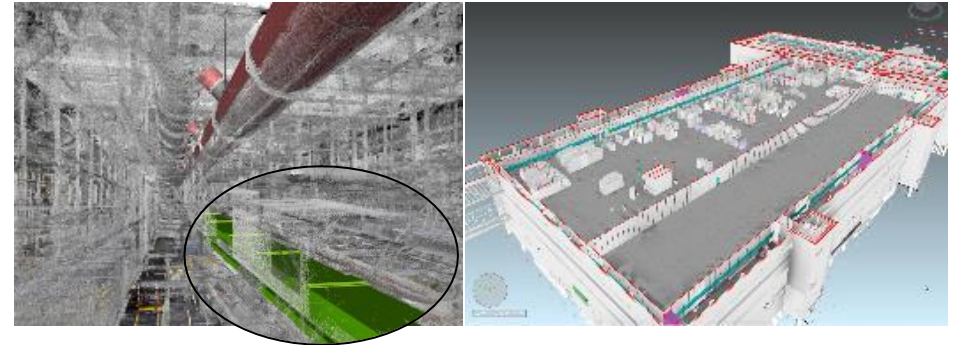
1. As built model based on drawings, images and measurements on site
2. Conversion to Revit @ designer



Challenges: Errors in isometry creation due to incorrect measurements, human errors or poor accessibility

New Standard

1. As built documentation with 3D laser scanning
2. Accuracy of 3 mm at 4m

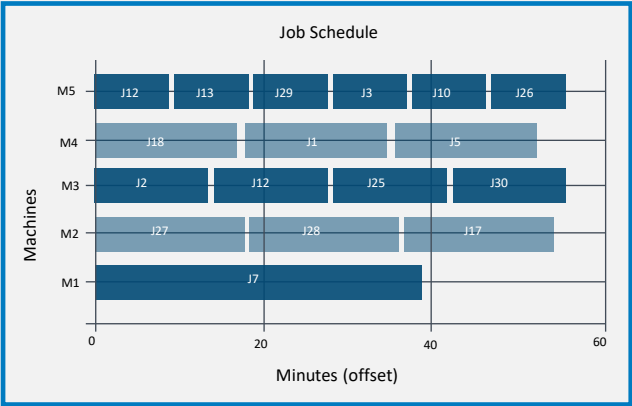


Benefits: Better alignment to installations above and below clean room (sub Fab, plenum)

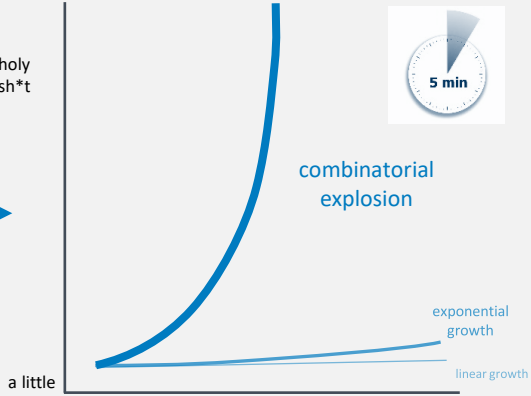
Enables tool hookup with ~20% less cost and 30% time saving during installation* and enables the complete digitalization even down to installation

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AIoT Use Case: Scheduling



holy sh*t



Scheduling with optimization (Solver)
Scheduling solution was implemented in first workcenter after 6 months

KI-system can handle the huge complexity
Scheduling problem has more possible solutions than atoms in the universe



>5% higher throughput with all-time high in first month



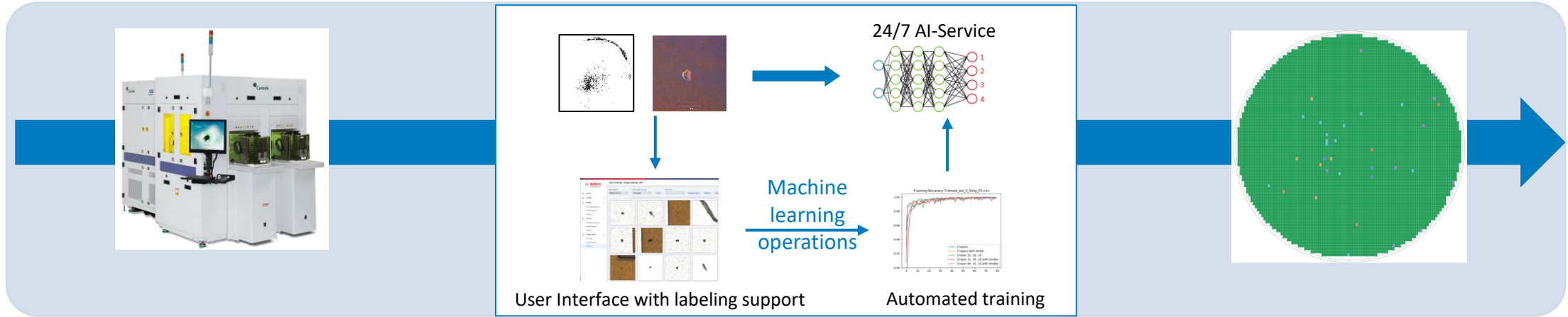
Reduction of "SBY with WIP" by ~45%



"No one would do it like this... but it is better"

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AIoT Use Case: AI-solution for Defect Engineering



Fully automated defect scan

AI-based image classification platform

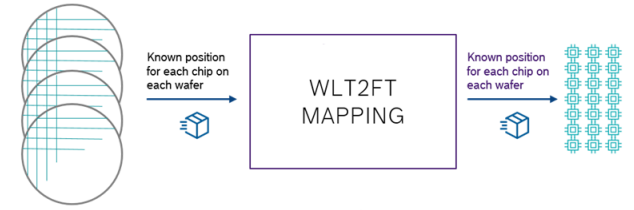
- ✓ Instant classification of all defect images and signatures
- ✓ Specialized AI-models for each product
- ✓ Accurate, reproducible and monitored results
- ✓ Inhouse solution using state-of-the-art classification algorithms

eCAP^(*) and disposition

AI enables defect classification, automatic feedback loops and material disposition

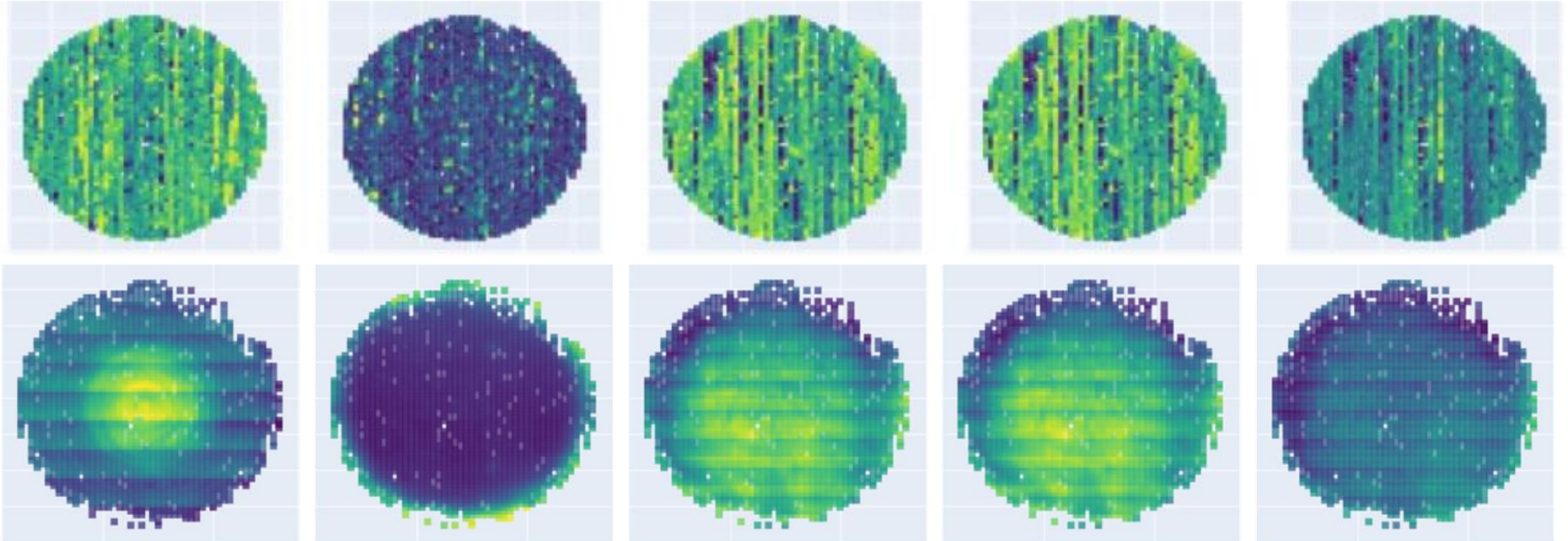
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AIoTT Use Case: Running EWS-FT Mapping



Map @ FT
unsorted

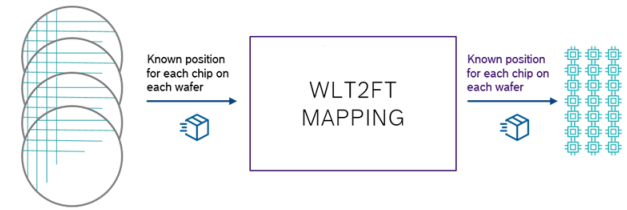
 No tracking
on chip level



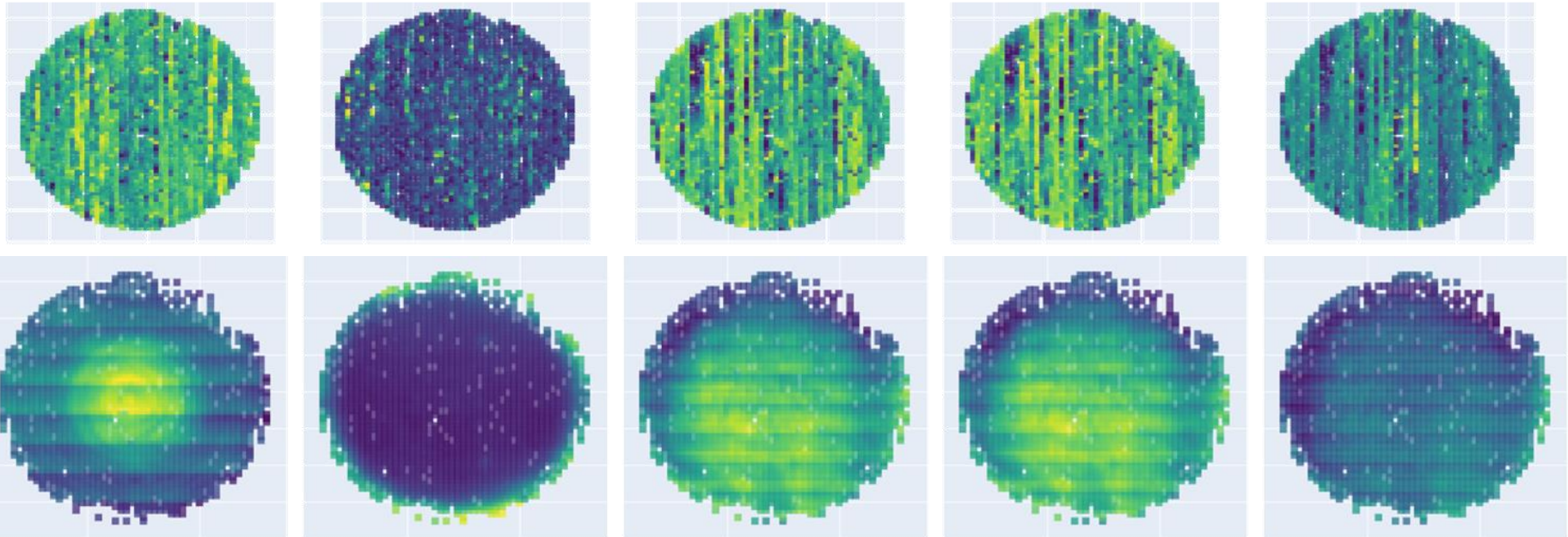
EWS
wafermap

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AIoT Use Case: Running EWS-FT Mapping



KRegress iteration 00



Sorting map
@ FT using AI

Tracking on chip
level by AI

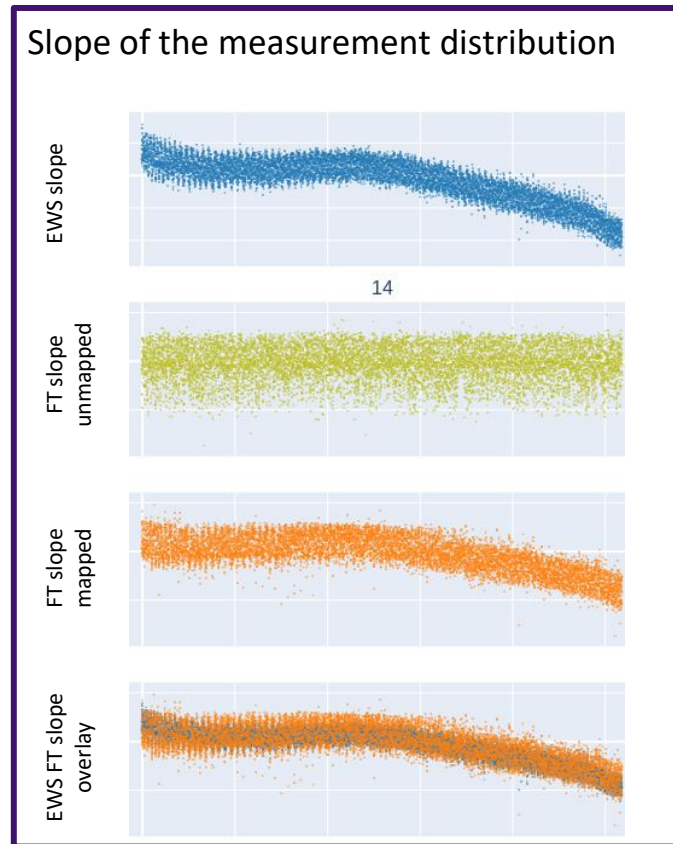
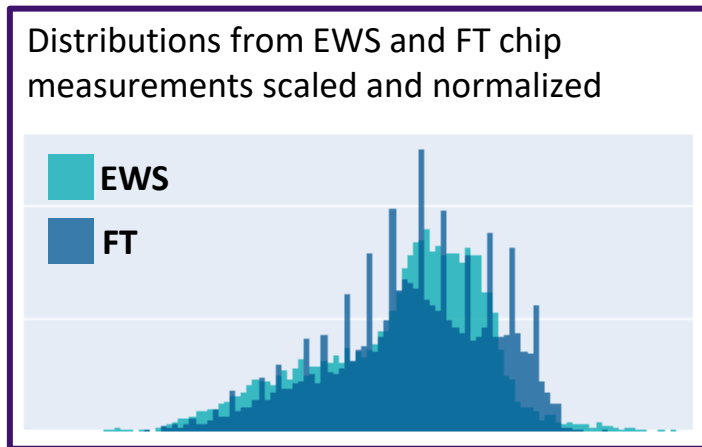
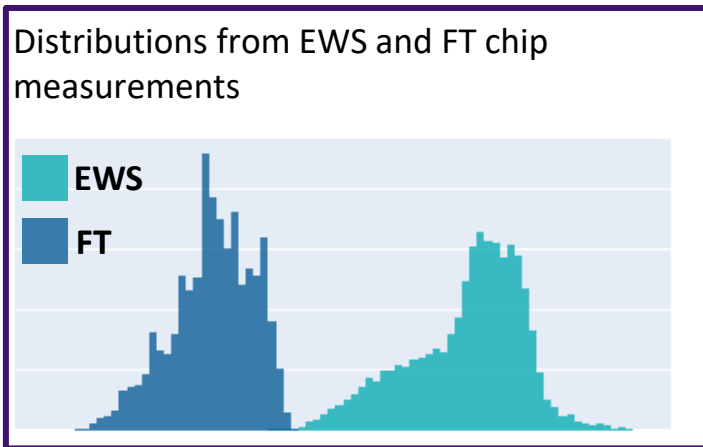
EWS
wafermap

PowerMOS Wafer maps based on sorted FT reproduce EWS pattern

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AIoT Use Case: Concepts for EWS-FT Mapping

Details in Matthias Werner's speech in
„Advanced Packaging Conference“



Strong linear correlations of certain EWS and FT measurements due to:

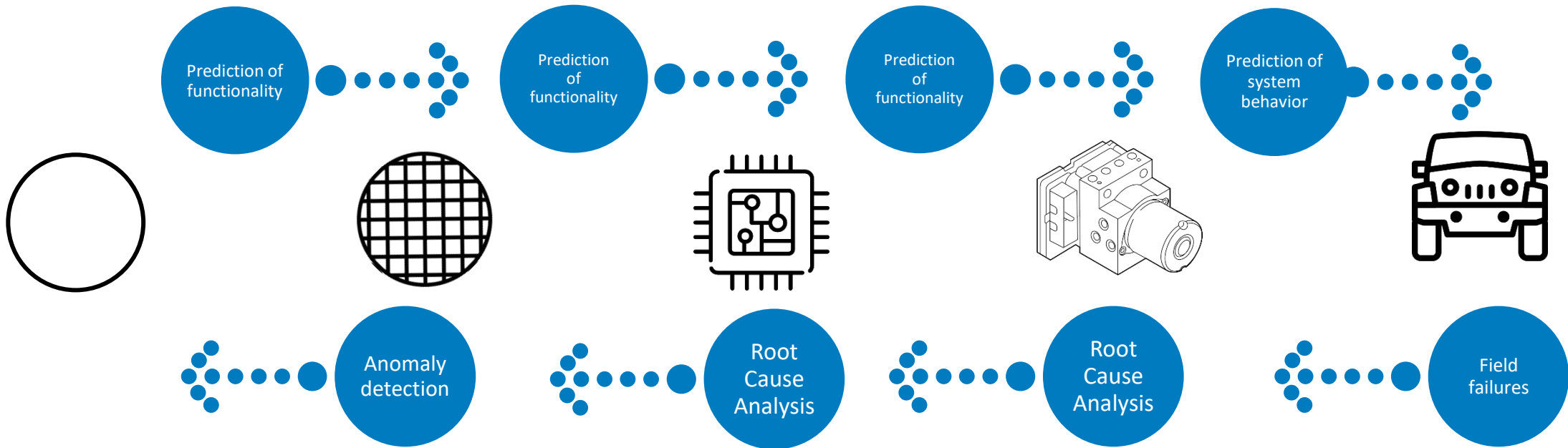
- Physics
- Product design
- Characteristics of the production process
- Test program design
- ...

These tests are utilized to create a ‘fingerprint’ for each chip based on the electrical characteristics on EWS and FT level

Fingerprints identify chips such that traceability is created

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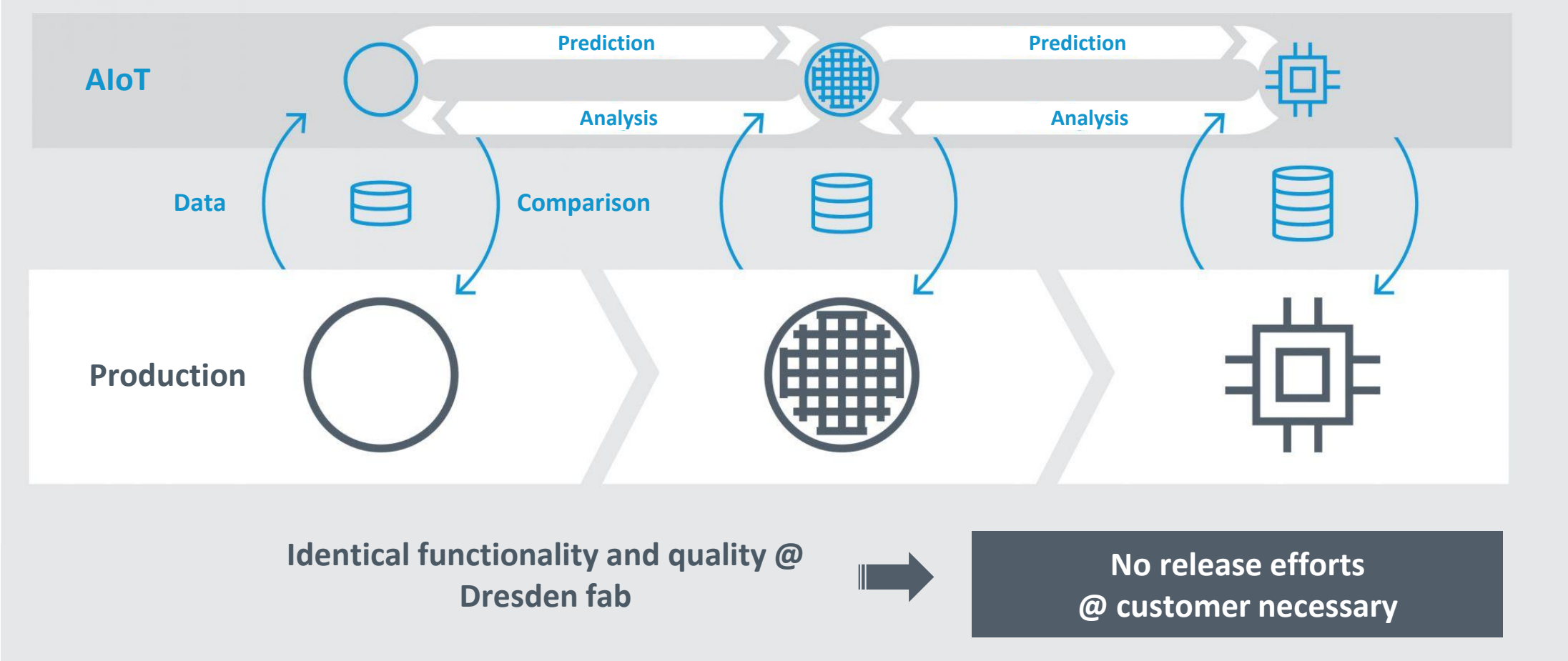
Holistic AIoT in automotive semiconductor value stream



Holistic AIoT approach along the entire value stream allows prediction of product properties and functionality based on smart data

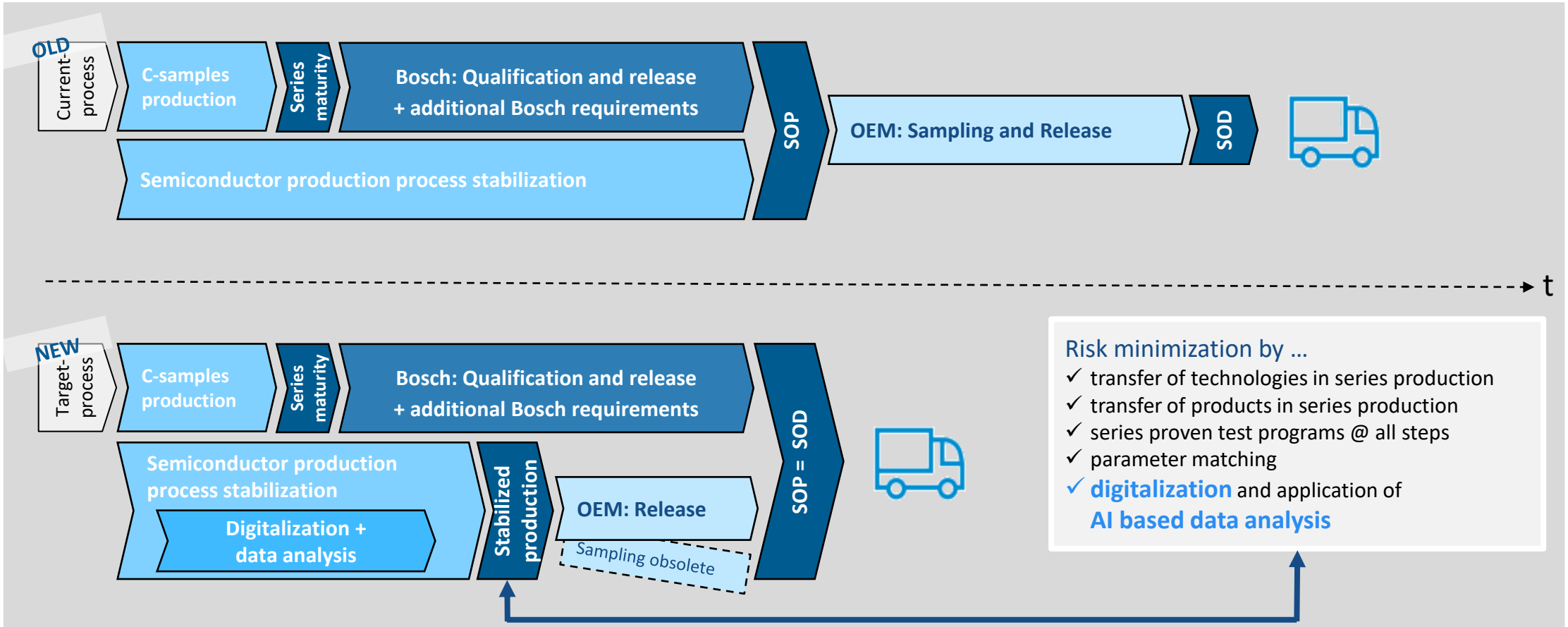
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Approach for data driven release



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Simplification and impact on release timeline





AIoT SC Manufacturing

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We make the world safe, smart and accessible.

**Thank you for your
attention**



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Invented for life