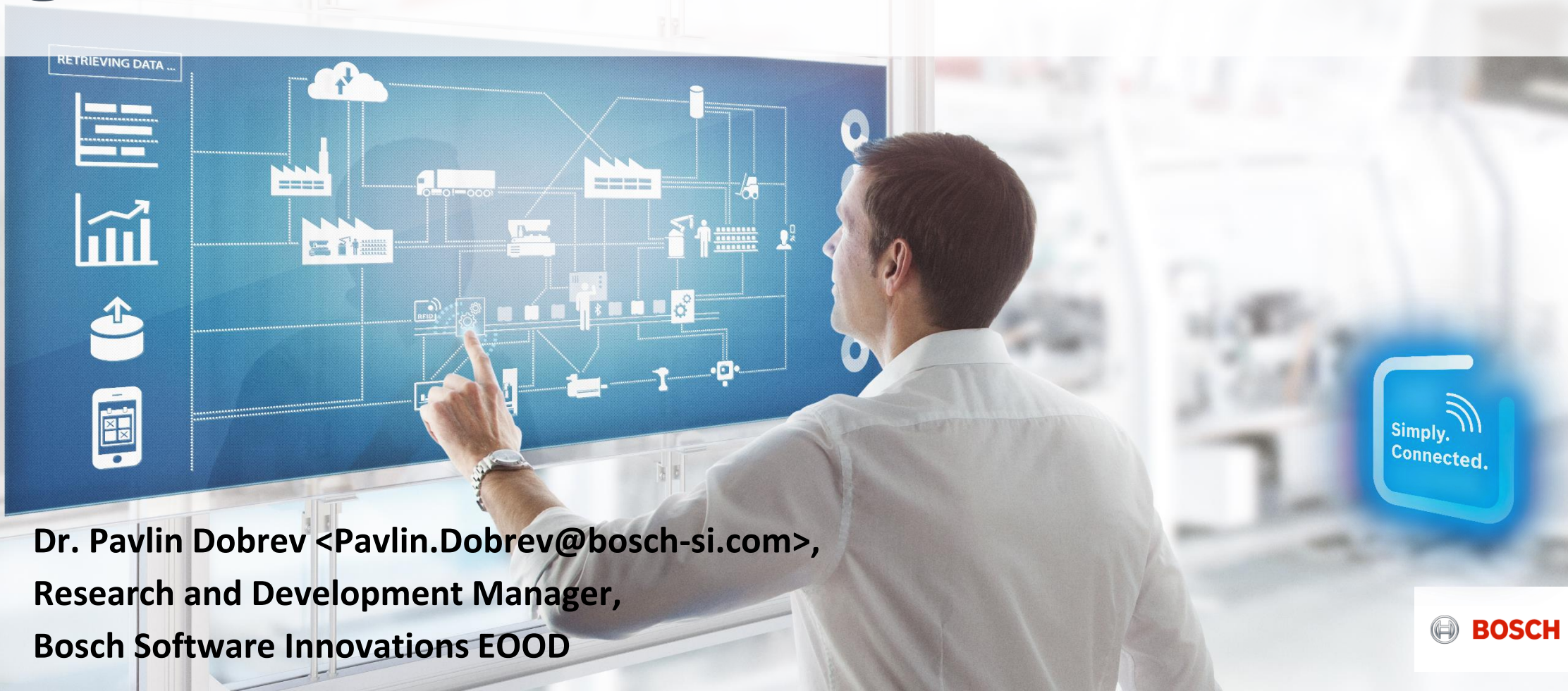


FUTURE PRODUCTION WITH INDUSTRY 4.0 @BOSCH



**Dr. Pavlin Dobrev <Pavlin.Dobrev@bosch-si.com>,
Research and Development Manager,
Bosch Software Innovations EOOD**



Rapid development of the connection of people and things



**2020
7 billion
connected
people**

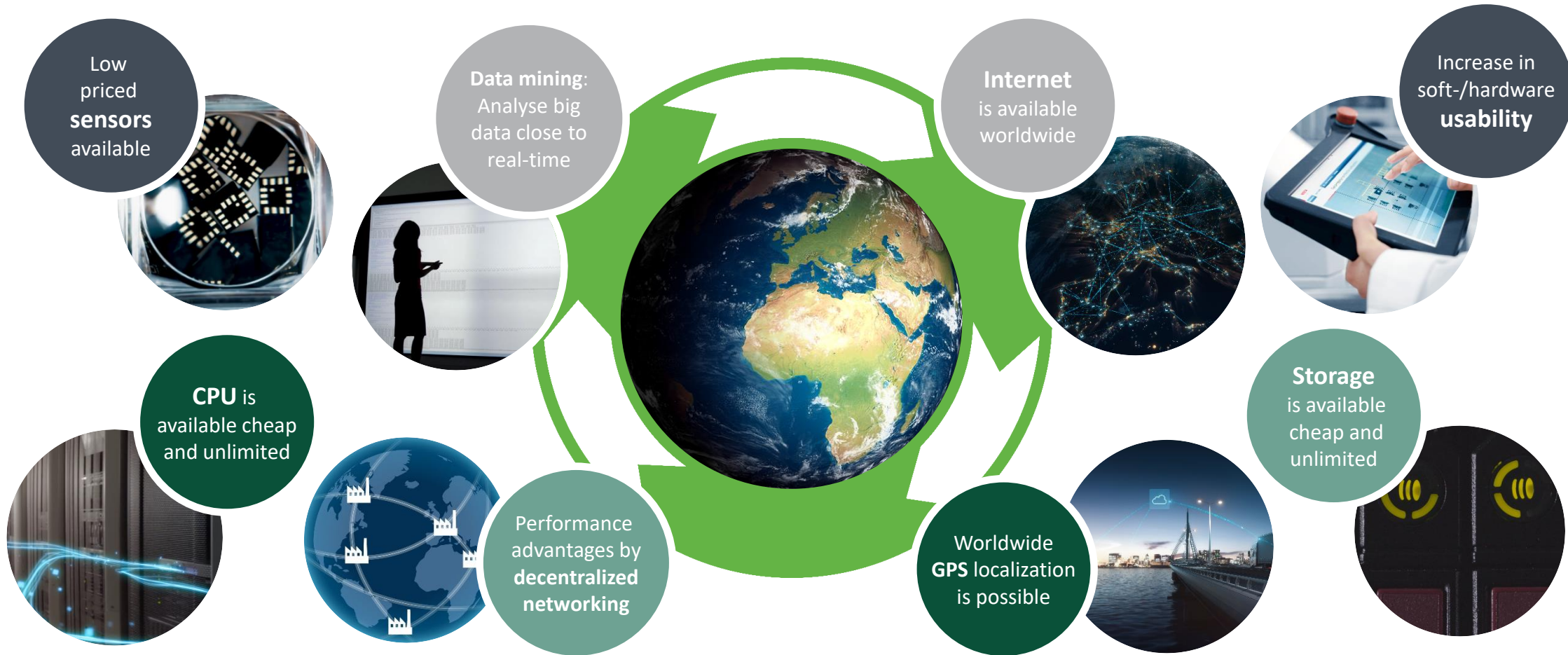
1995
15 million
people have
access to the
internet

**2020
50 billion
connected
devices**

1997
6 million
computers
with internet
access

Industry 4.0 at Bosch

Important changes in recent years

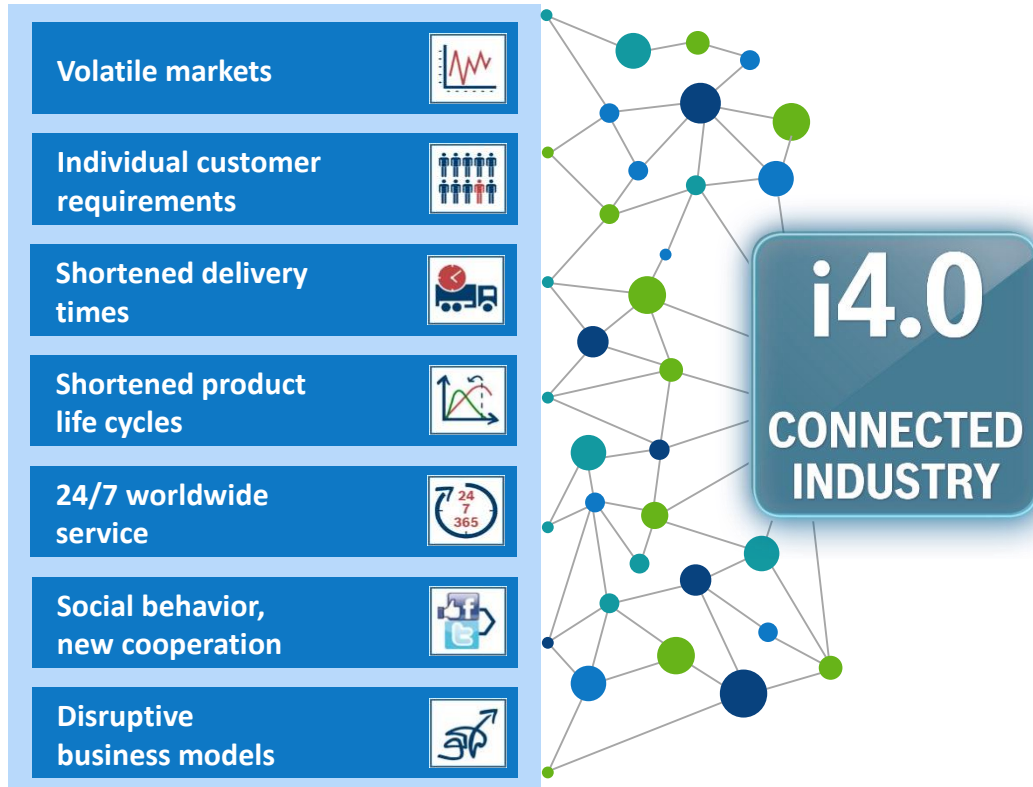


Internet of things



Industry 4.0 at Bosch

Industry 4.0: challenges & chances



**Added value potential
for Germany ≈ 80 bn €¹**

there of:

15 bn €



23 bn €



12 bn €



**390.000 additional
workplaces²**

there of:

50.000



95.000



- 1) Added value potential of selected industries until 2025 by I4.0 in Germany; Source: Industrie 4.0 – Volkswirtschaftliches Potenzial für Deutschland; Studie BITKOM 2014
- 2) Added new workplaces until 2025 by I 4.0 in Germany; Source: BCG Study for Wirtschaftswoche



automobile &
-parts



machine
building



electrical
equipment

Industry 4.0 at Bosch

Industry 4.0: definition



Fusion of the **physical world** of production with the **virtual world** of information technology and the internet.

Humans, machines, objects and systems are **connected** via ICT and the internet and communicate in a dynamic, real time optimised and self-organised way.

In these **intelligent production systems**, **all instances** of the added value chain from the supplier over logistics to the customer are connected **across the company**.

The industrial production can implement **individualized customer requests** on the well-known high-quality level, while reaching higher **flexibility** and **robustness** as well as **optimal resource allocation**.

ICT = Information and communication technology

Industry 4.0: the next industrial revolution



Mechanization

Industry 1.0



Electrification

Industry 2.0



Digitalization

Industry 3.0



Connected Industry

Industry 4.0

1750

1800

1850

1900

1950

2000

2050



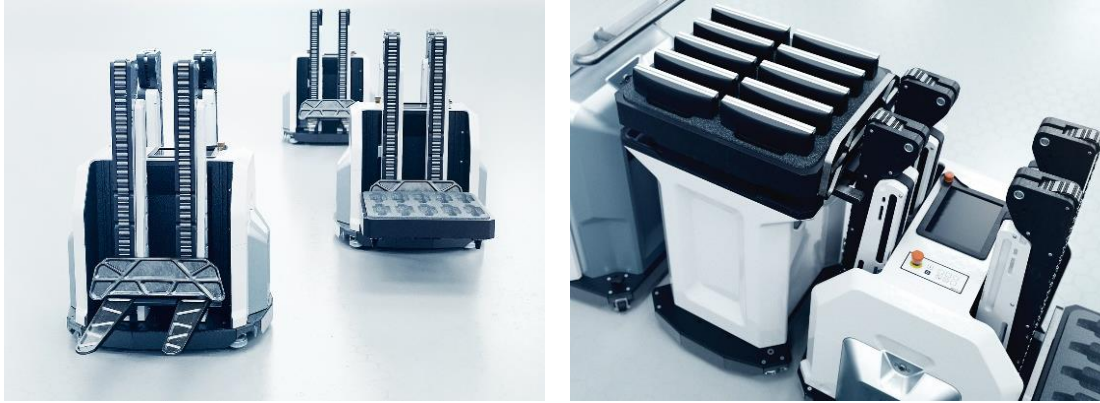
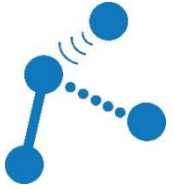
BOSCH

Features of Industry 4.0



Industry 4.0 at Bosch

i4.0 feature: distributed intelligence



Example: autonomous rollers

- Parts transport from the supermarket to the production line
- Autonomous navigation of the rollers on the shop floor
- Collecting, processing and communicating data
- Independent work of logistics tasks through swarm

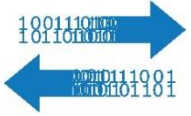


Example: flexible manufacturing modules with own controls

- Module knows its technical skills and autonomously organizes its work steps in the process
- Module detects different parts and processes them

Industry 4.0 at Bosch

i4.0 feature: fast integration and flexible configuration



Value-added network based on comprehensive broadband infrastructure

- Guaranteed latency, reliability and quality
- Ad hoc connection of people, processes and machines

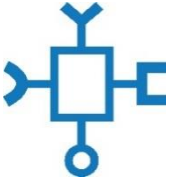


Flexible integration and (re) configuration of machines

- Quick setup of process modules for new tasks
- Modules are strung together ad hoc to form a large-scale production line
- "Plug and Produce" - modules can be interchanged quickly

Industry 4.0 at Bosch

i4.0 feature: open standards



Compatible equipment, machinery, components and services

- Easy integration of machines and components from different manufacturers
- Harmonized interfaces: e.g. of semantics, protocols, connectors
- Platform-independent and universal interfaces

Industry 4.0 at Bosch

i4.0 feature: people as key players



People play the decisive role in the connected plant

- Decisions based on contextual digital information
- Mastering complexity through new ways of visualization and operation

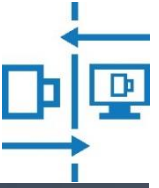


New ways of learning

- Individual integration of the employee in the work process
- Assistance functions and ability amplifier for people
- Health and well-being through adaptive workplace ergonomics

Industry 4.0 at Bosch

i4.0 feature: virtual real-time representation



Virtual real-time representation of objects and their states

- Assignment of real objects to their virtual image through unique identification
- Virtual description of manufacturing and assembly processes
- Acquisition of real object properties and real-time updating of the virtual image
- Simulation of processes based on the real-time virtual representation
- Objects with digital memory

Industry 4.0 at Bosch

i4.0 feature: digital life-cycle management



Engineering on the basis of all relevant information relating to the life cycles of products, machinery, and plant

- Seamless integration and processing of all data along the value stream
- Automation, acceleration and protection of engineering and business processes
- Evaluation and optimization of simulated scenarios (workpiece-quantity, machinery, value-stream scenarios ...)

Industry 4.0 at Bosch

i4.0 feature: secure value-creation network

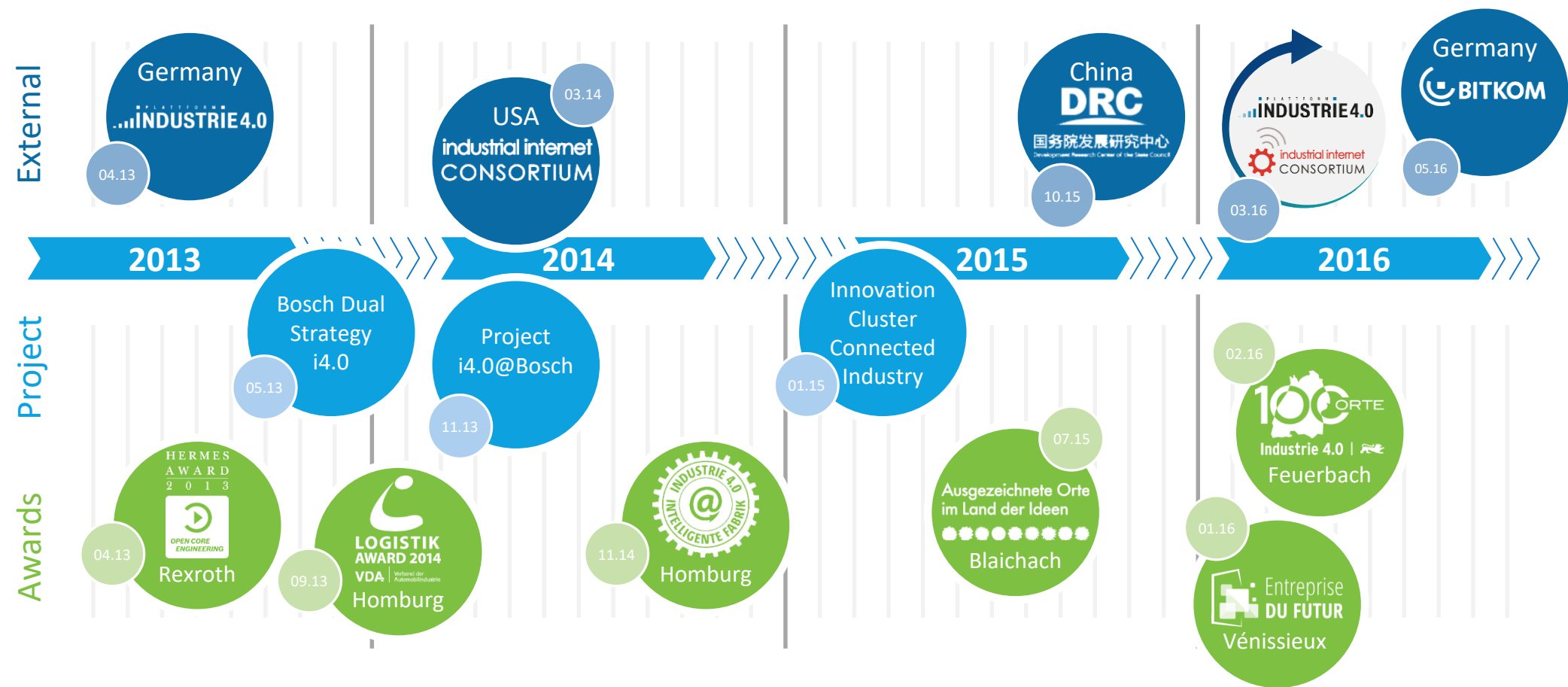


Secure cross-company value-creation networks

- Secure infrastructure for people, processes, and data
- Protection of the means of production and the company's IT systems from attacks and disturbances (data security)
- Unique tamper-proof digital identity for each intelligent component, machine, and product
- Tight and secure collaboration between people and machines (safety)

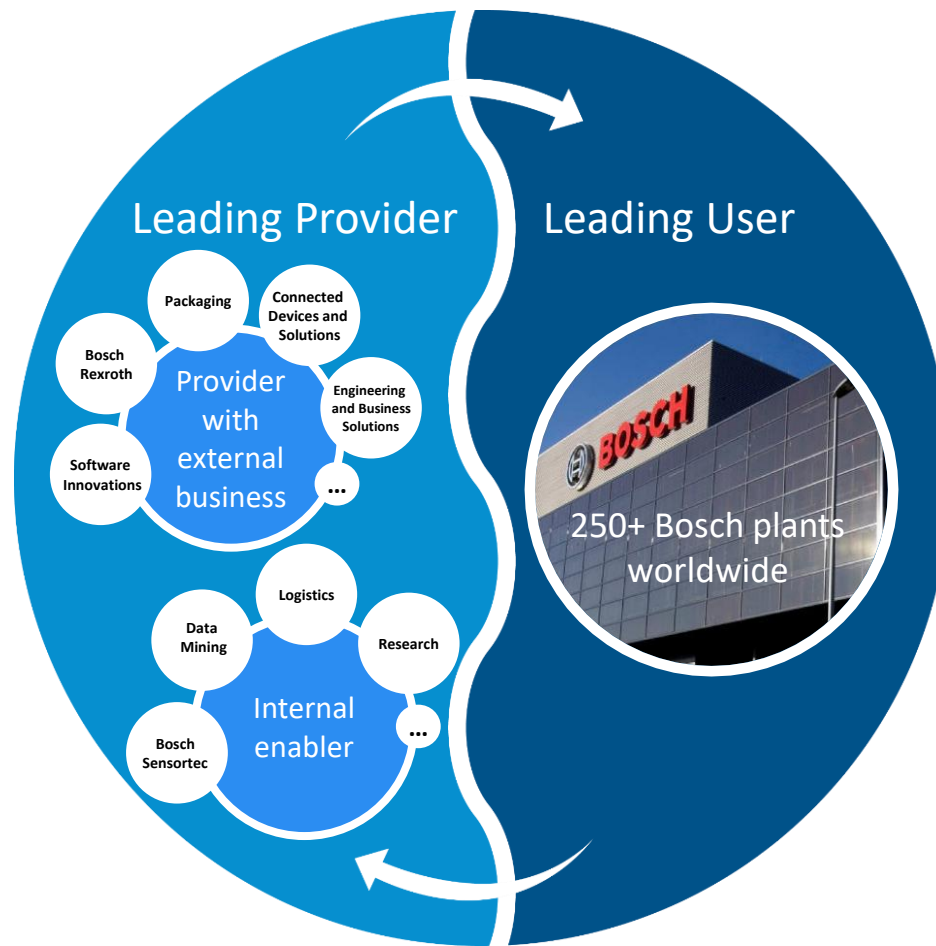
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i4.0 our journey and achievements



Industry 4.0 at Bosch

Dual strategy for Connected Industry



International Production Network



Industry 4.0 at Bosch

Logistics with RFID



30%
reduction of stock
in processes

10%
efficiency increase
in processes



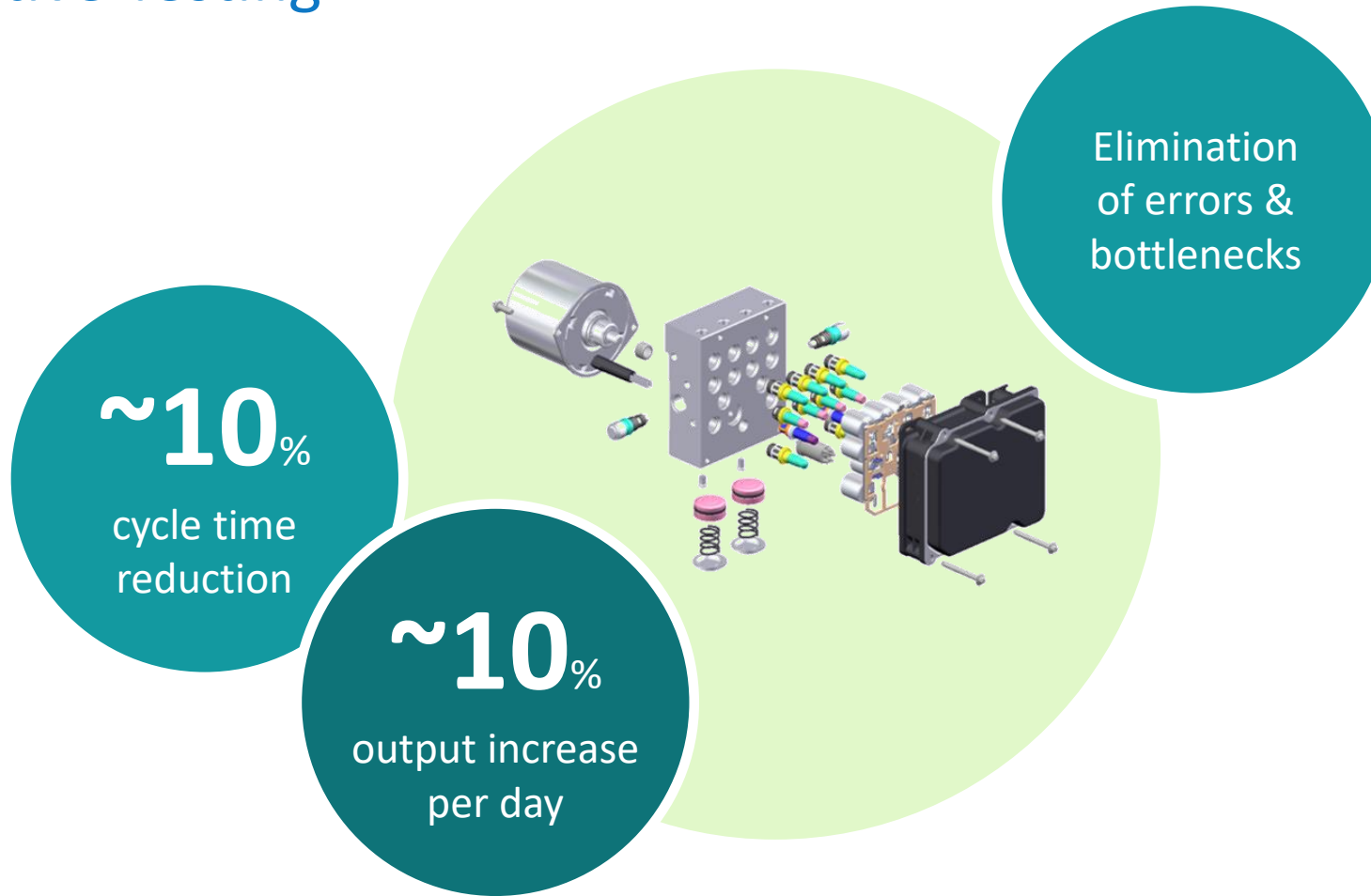
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Production quality: Smart tightening



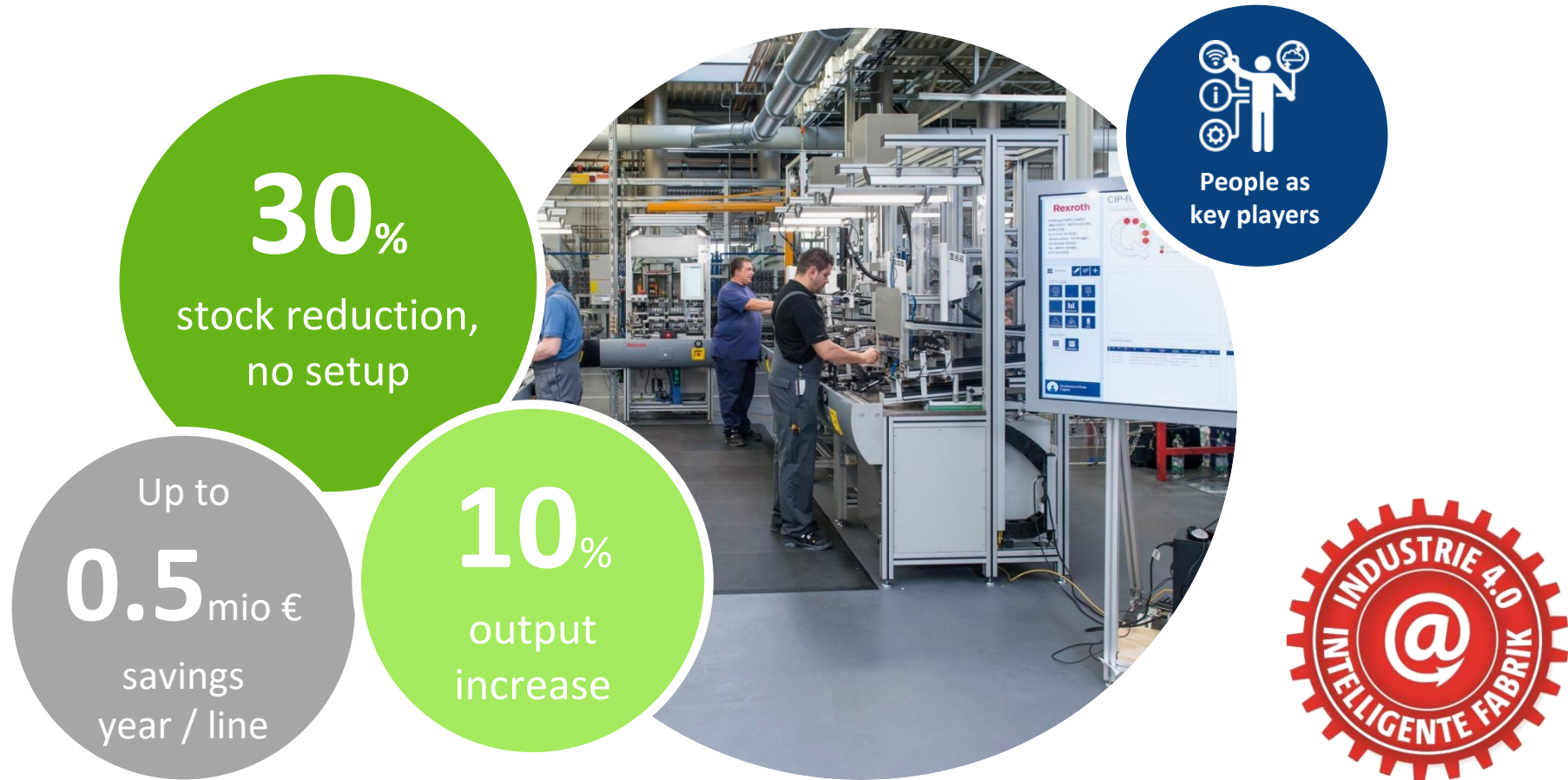
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Smart Adaptive Testing



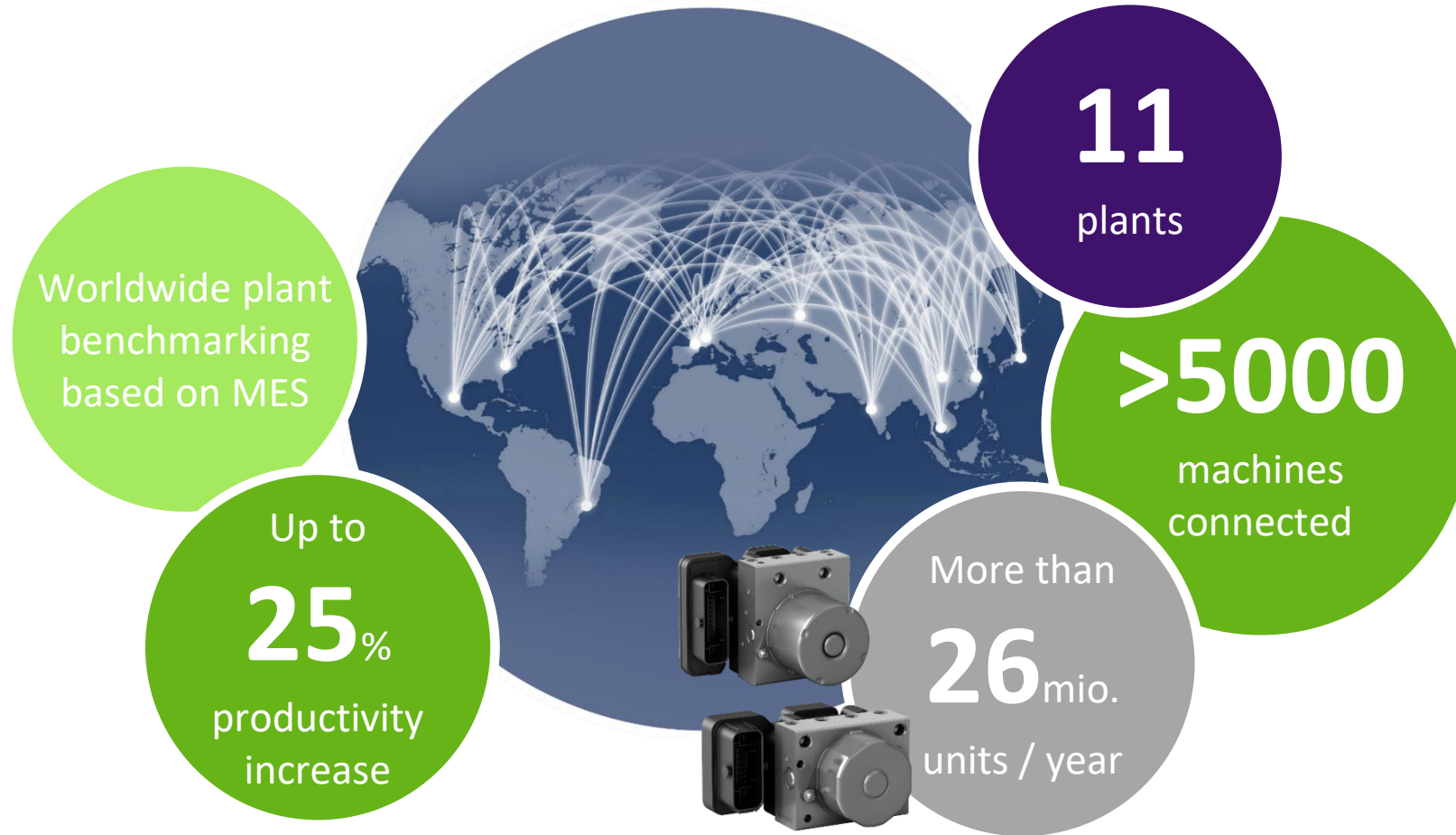
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i4.0 in an entire line – example Homburg



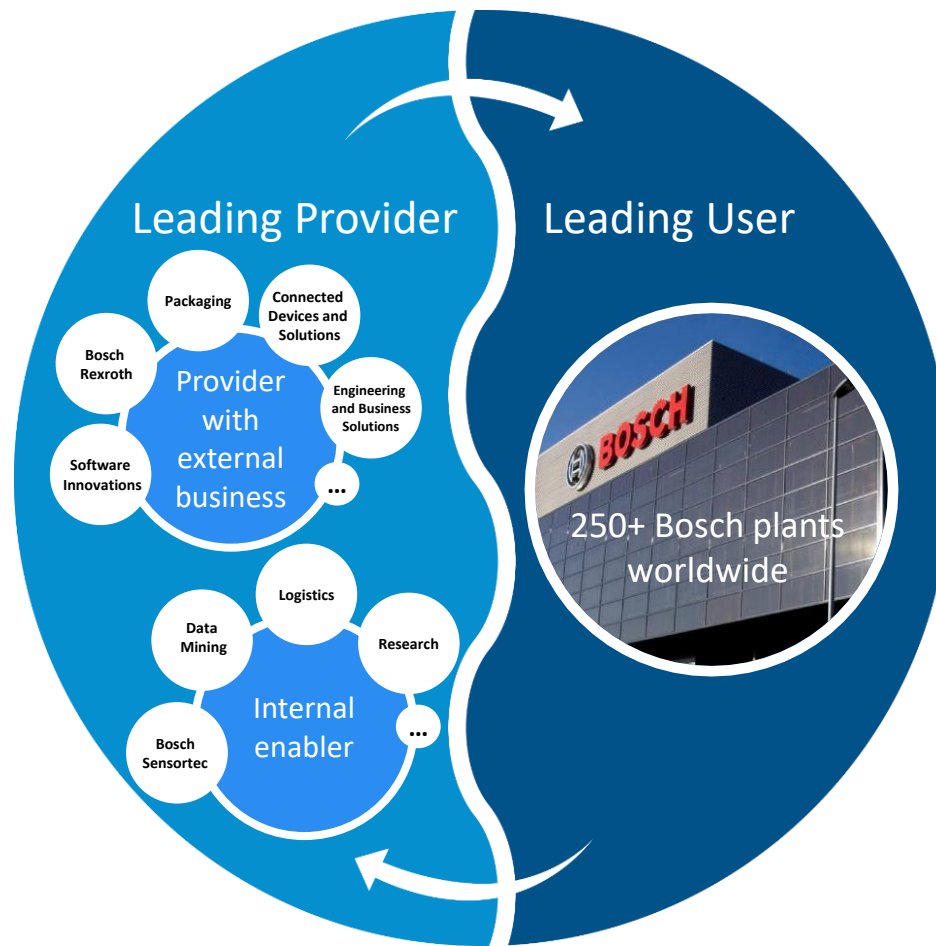
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i4.0 in an IPN – example ABS / ESP



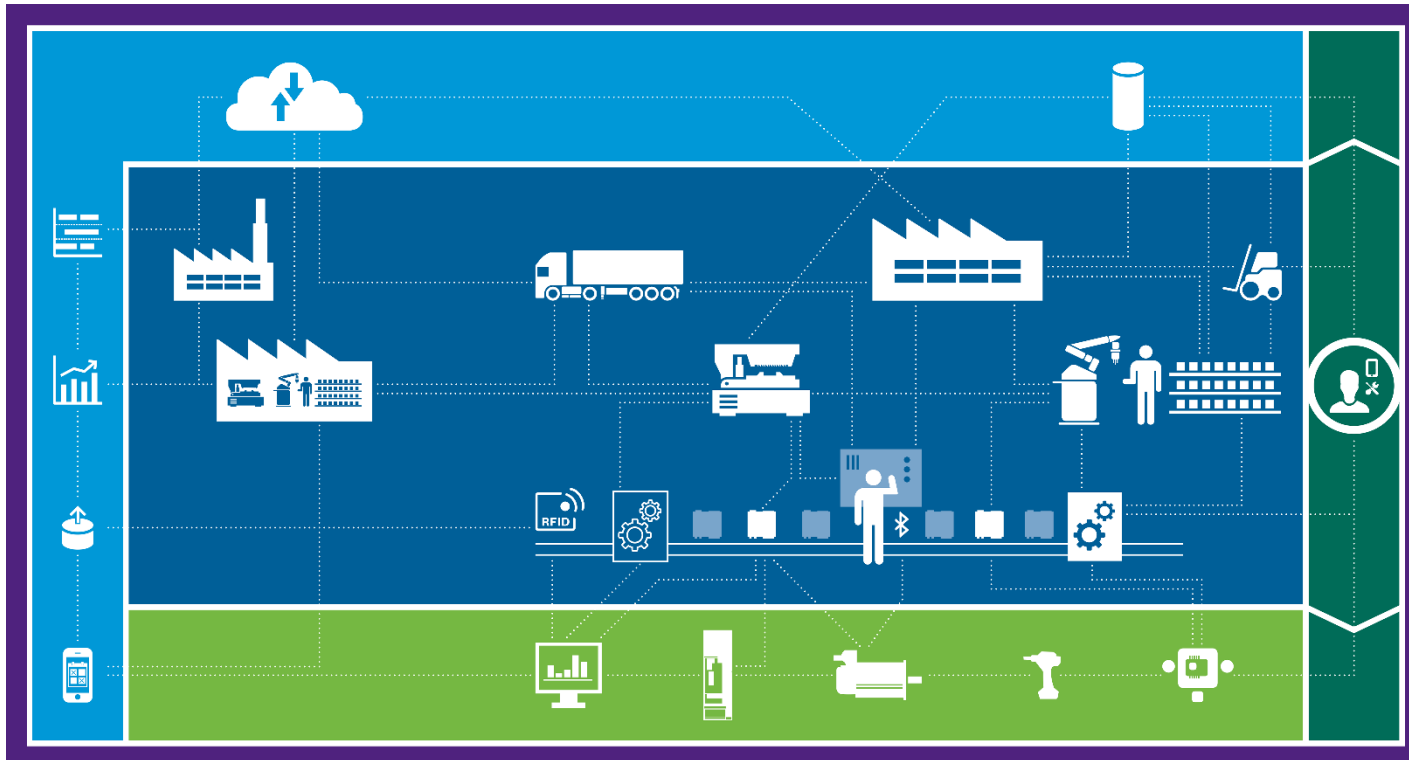
Industry 4.0 at Bosch

Dual strategy for Connected Industry



Industry 4.0 at Bosch

Our portfolio for your future



- Software Solutions**
The element that links all modules and subsystems along the value stream with people and third-party systems.
- Logistics and Manufacturing**
Solutions that connect machines and whole manufacturing lines to value-creation networks.
- Field Level Equipment**
Components, modules and systems that enable the integration of equipment into networked i4.0 environments.
- Services and Consulting**
A broad range of services and consulting including collaborative projects to test new business models.
- Solution Sets**
Customer-specific combination of Bosch i4.0 components and systems resulting in an integrated solution.

Industry 4.0 at Bosch

Flexible Automation - APAS assistant

- Flexible
- Mobile
- Collaborative
- Connected

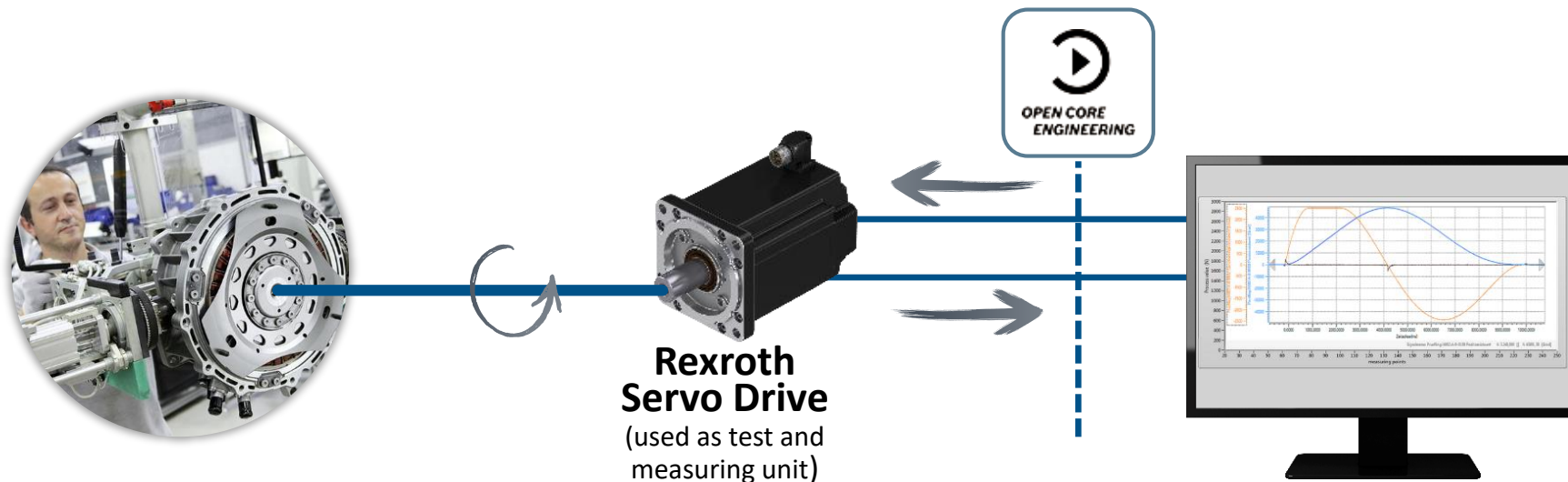


Industry 4.0 at Bosch

Open Core Engineering

New freedom in engineering

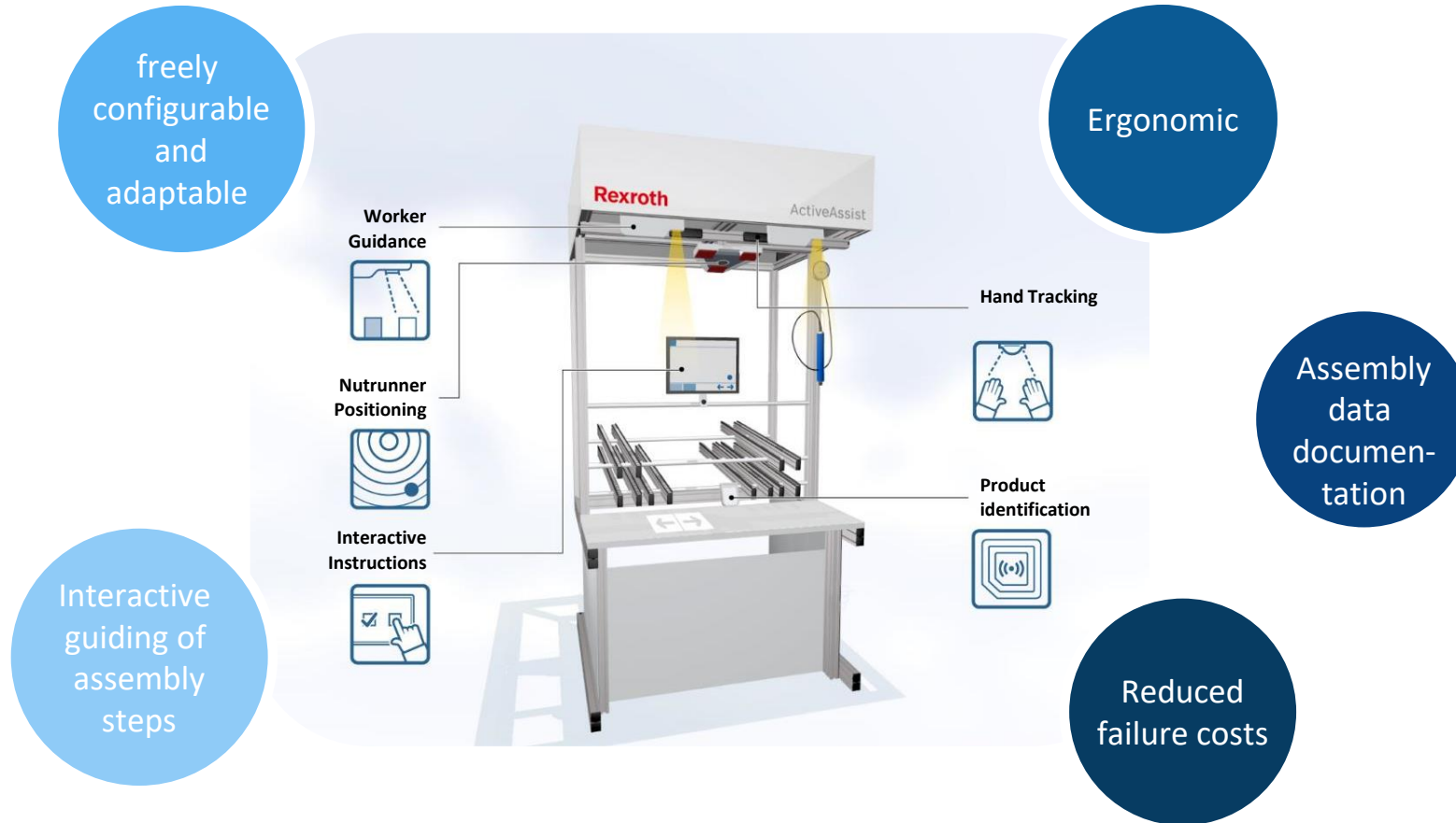
The revolutionary new approach to software engineering that enables unprecedented customization, speed, efficiency and automation intelligence. Open software interface for direct function access to control core.



Open Core Engineering facilitates the networking in Connected Industry production

Industry 4.0 at Bosch

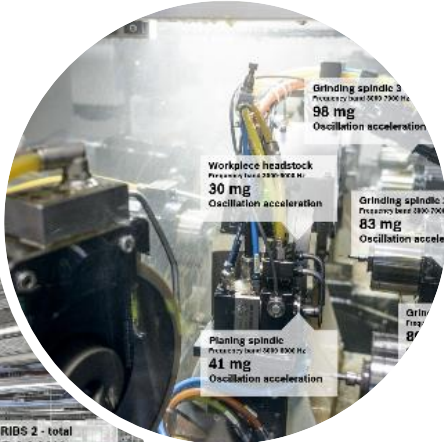
ActiveAssist Industry 4.0 Workplace



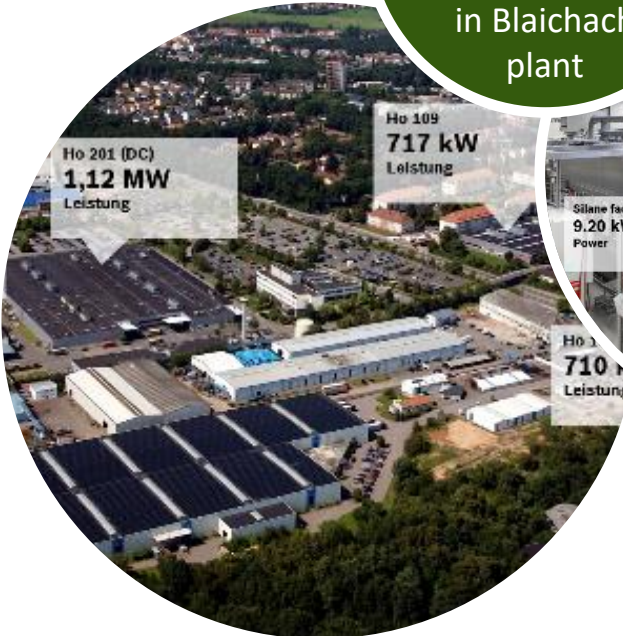
Industry 4.0 at Bosch

Bosch Energy Platform

40%
cost reduction for
compressed air
in Blaichach
plant



Reduction of
energy consumption
1.65 Mio. EUR
p.a. in Homburg
plant



Improved
resource
efficiency with
condition-based
maintenance



Industry 4.0 at Bosch

Digitalization in manufacturing - OSRAM

Bosch and OSRAM have connected over 80 different kind of machines, some older than others, at OSRAM's Berlin location

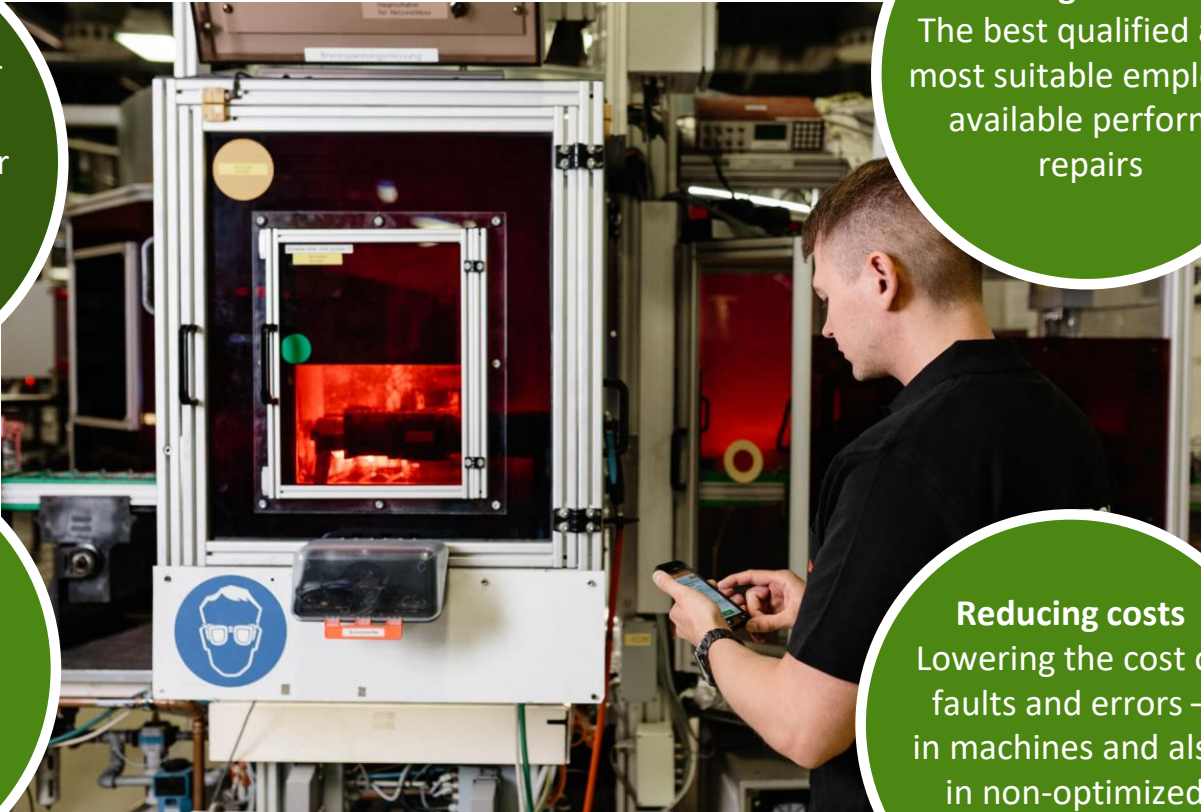
Boosting efficiency
The best qualified and most suitable employee available performs repairs

Ensuring that production runs on schedule
Transparency and consistently fast troubleshooting

Reducing costs
Lowering the cost of faults and errors – in machines and also in non-optimized planning

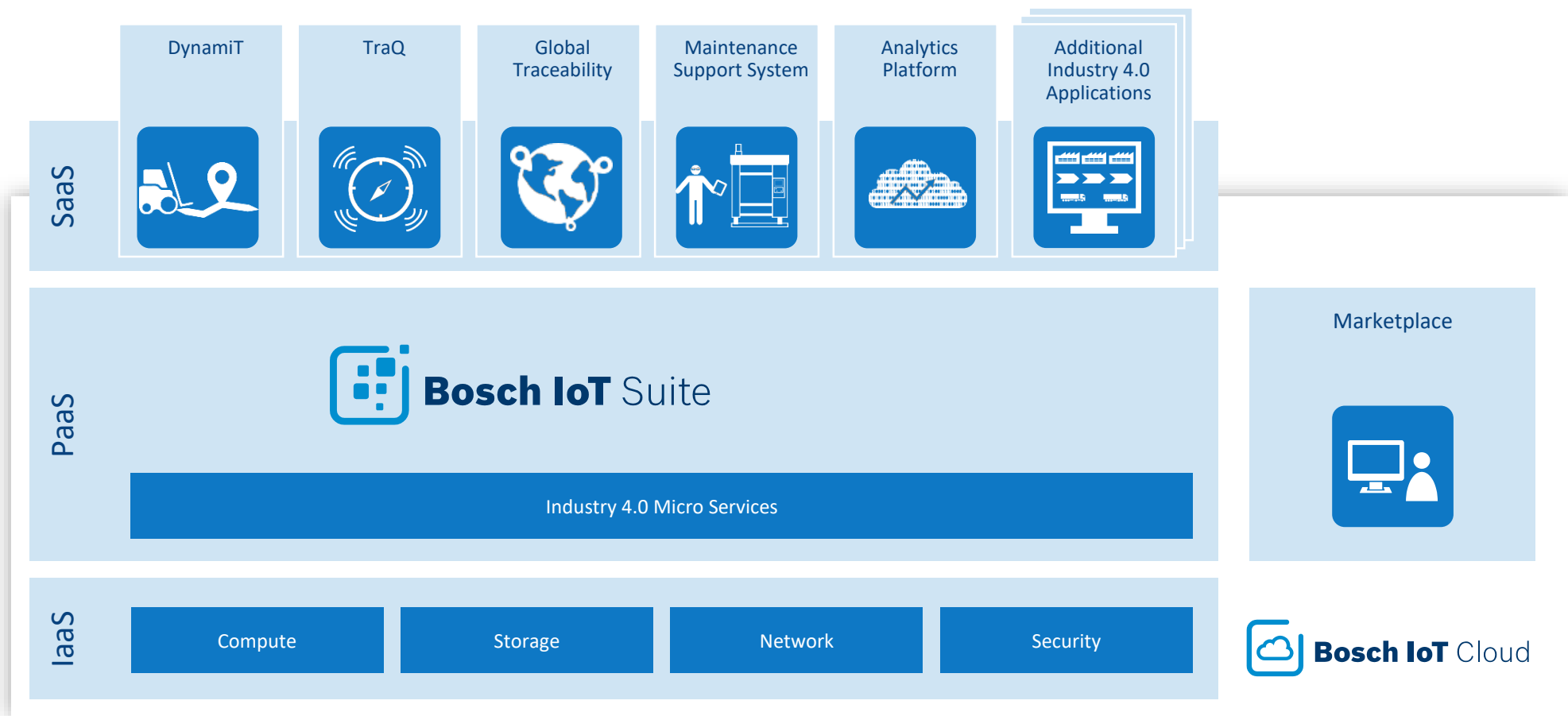
“Connectivity and digitalization give us a chance to do things differently – and better.”

Dr. Frank Sroka,
Industry 4.0
Project Manager, OSRAM



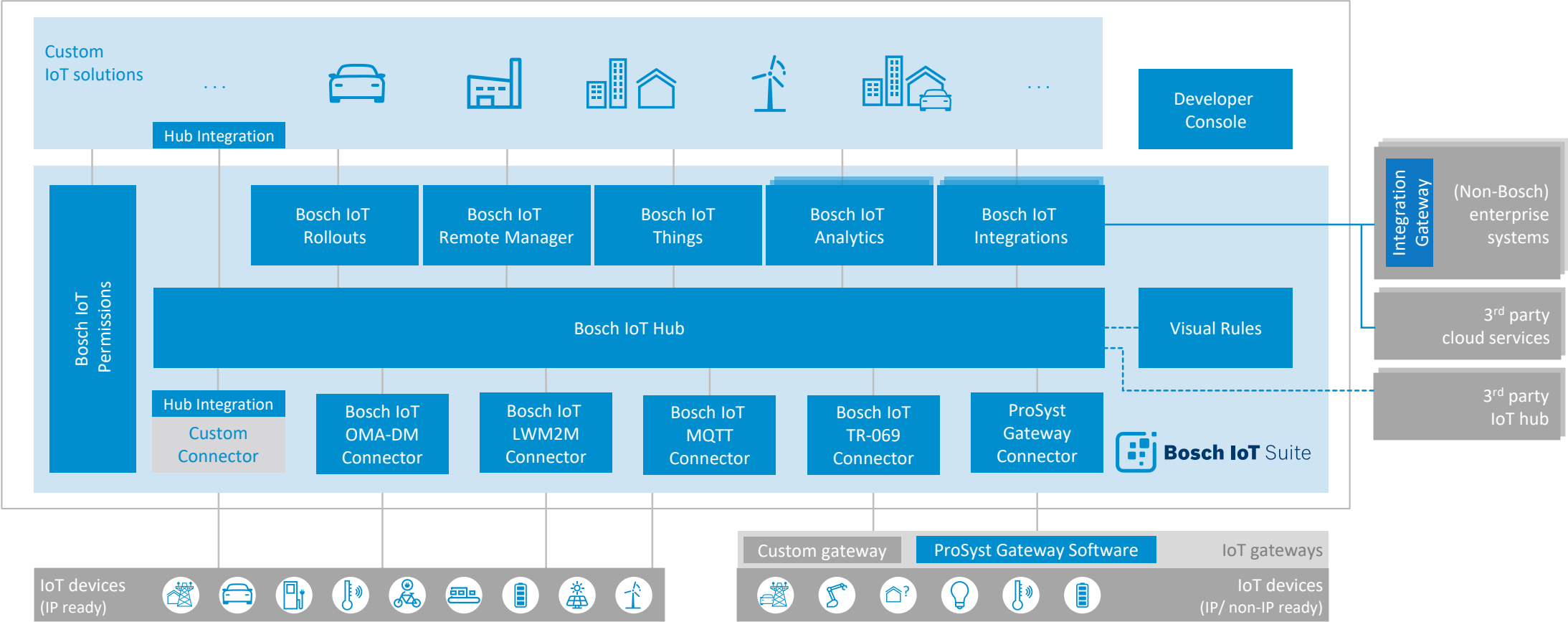
Industry 4.0 at Bosch

Bosch IoT Cloud & IoT Suite as Foundation for Industry 4.0



Industry 4.0 at Bosch

The Bosch IoT Suite – Technical View



Industry 4.0 at Bosch

Bosch IoT Gateway



Sensors and software take Robert Bosch's from 1887 into the age of Industry 4.0

Apps for data collection, data processing and data publishing.

The IoT Gateway provides

- ▶ **Dashboard App** for system administration, configuration and parameterization
- ▶ **Devices App** for integration of I/O-modules and sensors
- ▶ **Processing App** for processing of signal values and forwarding of information to MES systems, database and cloud application

Industry 4.0 at Bosch

Bosch IoT Gateway



Existing machines

10101010101010101010
1010101010101010

Hydraulic test bench



10101
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Rexroth
Bosch Group

IoT Gateway



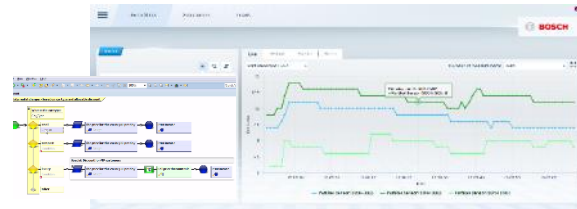
ProSyst
Gateway Software



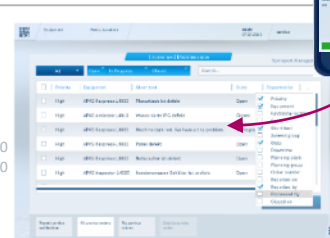
Bosch IoT
Remote Manager



Connecte



Production Performance Manager and Production Rules Configurator



Maintenance Support System

ROI < 1,5 years

Reduction
Maintenance
costs about
25%

OEE
Increased
by up to
5%

The Outlay of manual testing reduced by **20%**



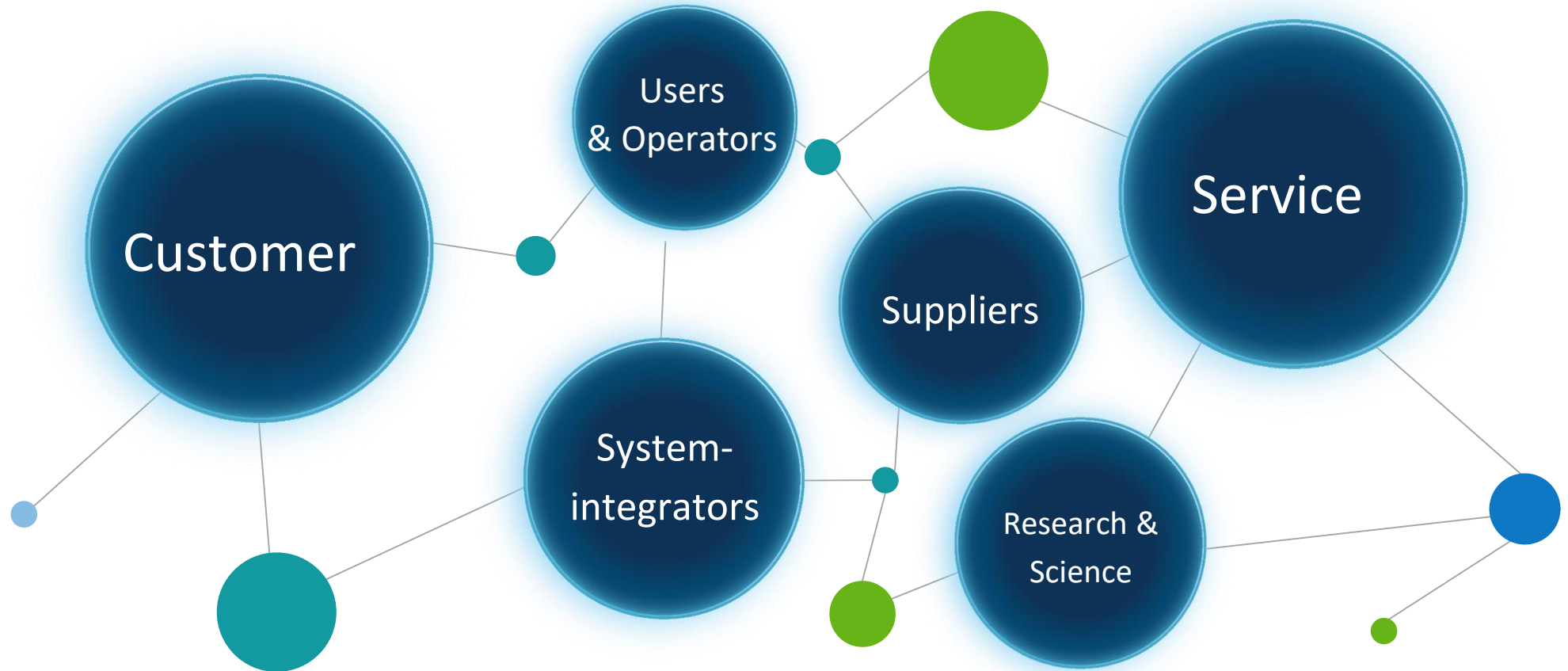
Blue standards



- ▶ Maintenance notification/tickets
- ▶ Maintenance completion

Industry 4.0 at Bosch

Connected Industry: orchestrated involvement of all actors



Let's connect and cooperate for new exciting business models!

How can machine manufacturers benefit from the IoT?

Predictive maintenance

Prevention of production downtimes

thanks to continuous remote monitoring of machine data

Improved SLA management

Improved KPI monitoring, enables new service-based business models instead of traditional product sales



New Aftersales offerings

new services can be offered based on data analytics



Future-proof investment

Sustainable technology for future applications and economical invest both for low- and high-wage countries



Machines at customer's premises are distributed globally

Vendor benchmark: Industry 4.0 Platforms

Leader position: Bosch Software Innovations

Internet of Things (I4.0)
Platforms, Services & Solutions
Leader Germany

2018

ISG Provider Lens™

ISG Provider Lens™

Internet of Things (I4.0) Platforms, Services & Solutions

Industrie 4.0 Platforms
Germany 2018



ISG Provider Lens™

Internet of Things (I4.0) Platforms, Services & Solutions

Industrial Analytics & Visualization
Germany 2018



Importance of business models for the IoT

Solid foundation for highly complex projects

The Business Strategy and Innovation Framework is the most in-depth Industrial IoT-focused business strategy framework comprising expert vision, experience and business strategy best practices from IIC members, including Bosch Software Innovations, InterDigital, Hewlett Packard Enterprise, and Machina Research.



IoT and partner ecosystem

Working together for innovative applications



Eclipse Foundation: strategic membership

Actively engaged within the Eclipse IoT Working Group



Eclipse Ditto

... where IoT devices and the state of their digital twins get together



Eclipse Leshan

A Java library for implementing Lightweight M2M servers and clients



Eclipse hawkBit

A domain-independent, back-end solution for managing software rollouts in IoT



Eclipse Vorto

A smart, open approach to the interoperability of IoT products

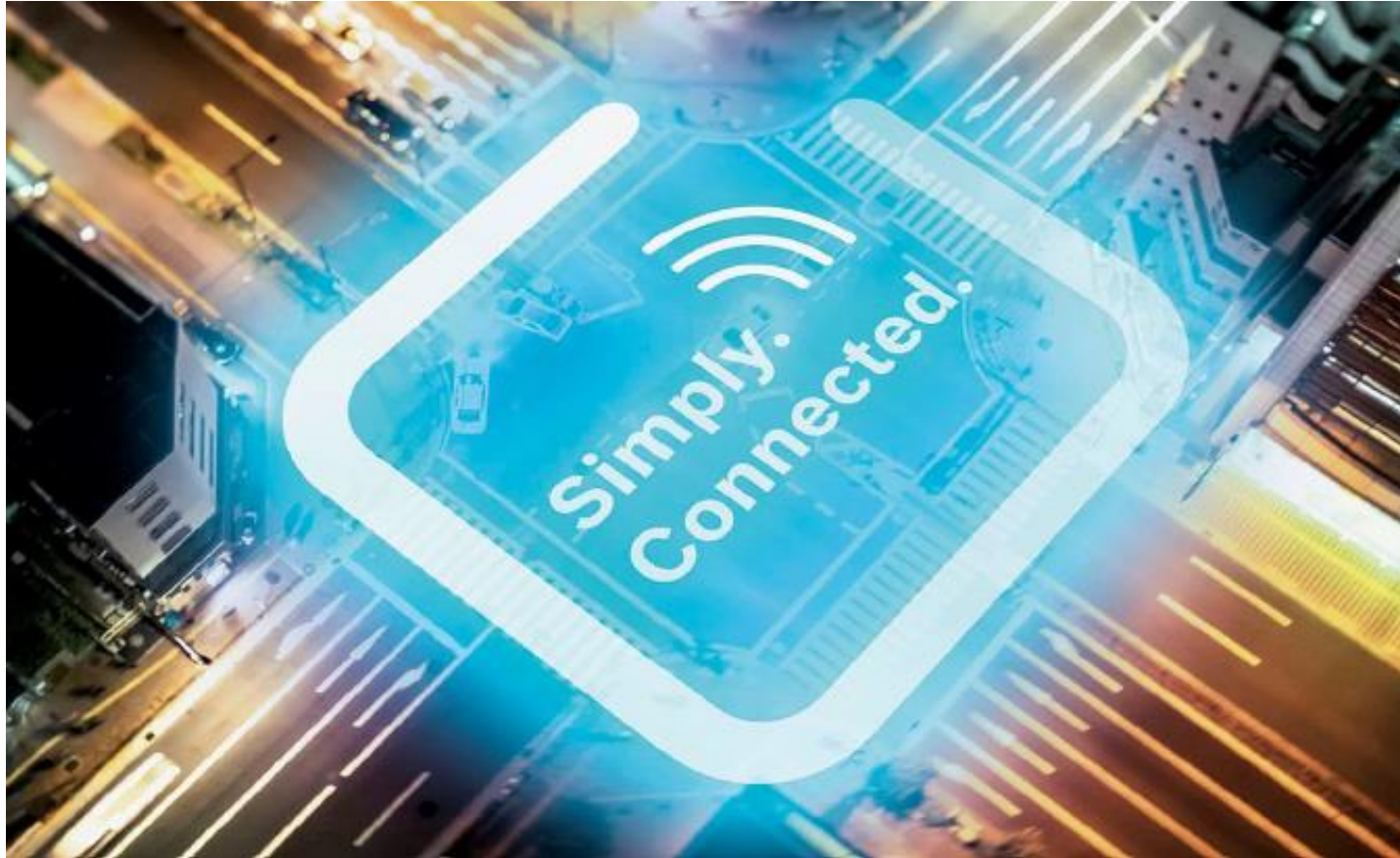


Eclipse Hono

Enabling device-related communication between connected devices and IoT applications in the cloud



Thank You!



Bosch IoT Cloud will play a key role in industry

- Sensors, software, services and now Cloud enable new business models in industry

Industry 4.0 is a people`s business

- People and partnerships play the decisive role in the connected plant

Invented for Life

- The Bosch IoT Cloud together with Industry 4.0 will make life easier

Industry 4.0 at Bosch

I4.0 movies



Future Production with Industry 4.0

<https://www.youtube.com/watch?v=ISk64bJ35yM&feature=youtu.be>

Industry 4.0 – Solutions at Bosch

<https://www.youtube.com/watch?v=RN3Ud2O5xxA&feature=youtu.be>

THANK
YOU