



Realizing Industry 4.0 through Connected Manufacturing Solutions

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Bosch Software Innovations

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BOSCH

Key Figures*

Bosch Group → 48,9 billion euros in sales → 290,000 associates		
Mobility Solutions → One of the world's largest suppliers of automotive technology		
Industrial Technology → Leading in drive and control technology, packaging, and process technology	Bosch Software Innovations	
Energy and Building Technology → Leading manufacturer of security technology → Global market leader for energy-efficient heating products and hot-water solutions		
Consumer Goods → Leading supplier of power tools and accessories → Leading supplier of household appliances		

* Preliminary figures as of 01.15

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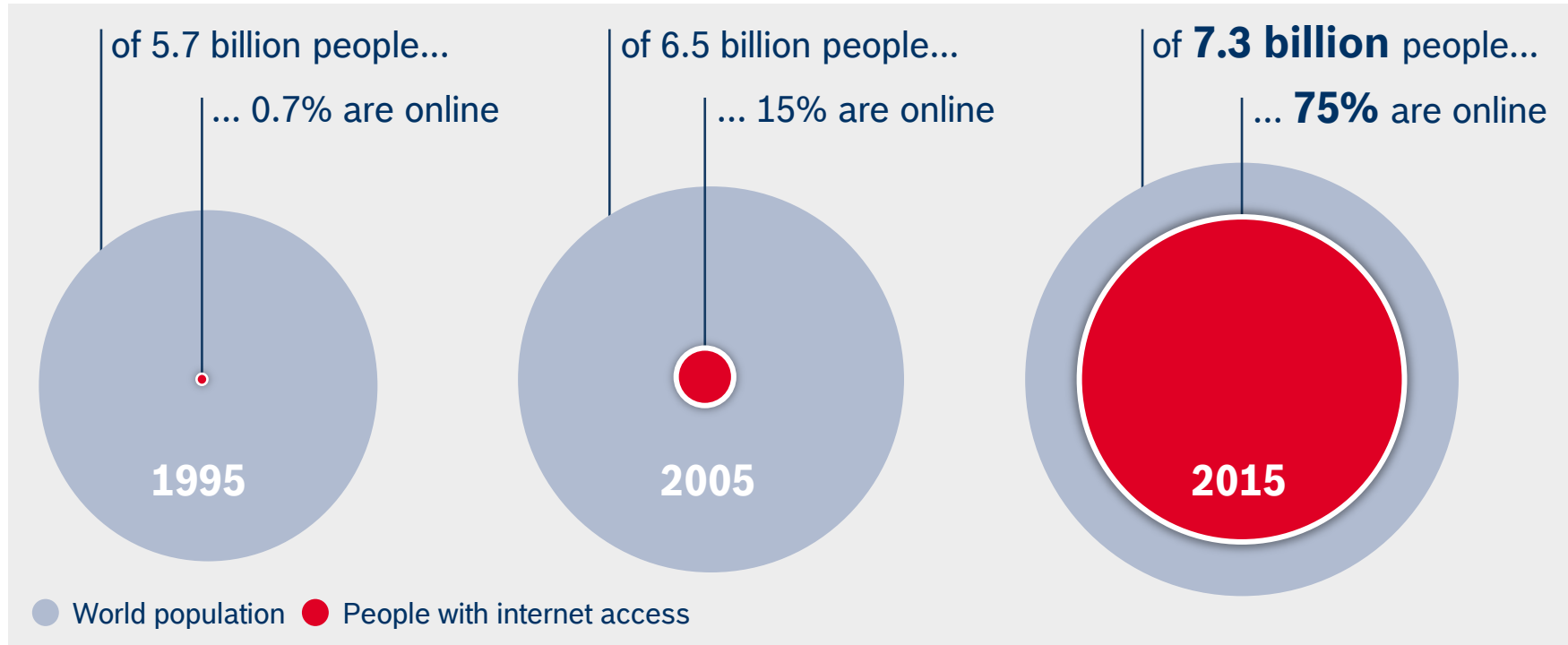


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Megatrends in a Fast Changing World...



...A Highly Connected World



2022

14 billion
connected devices*



2022



596 billion
IoT-based revenue*

* Source: Machina Research

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IoT Formula



Thing



Connectivity



Service



Solution



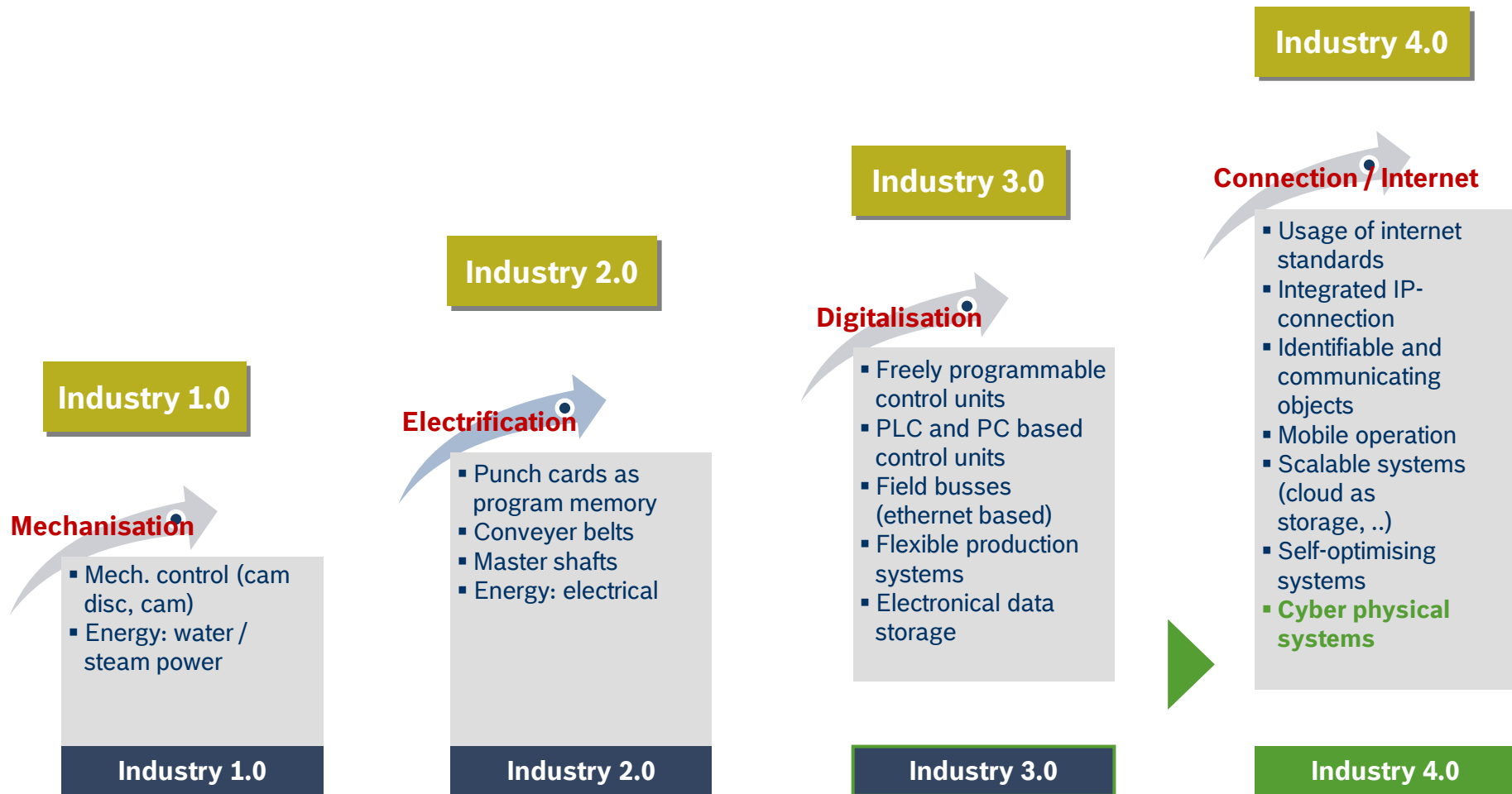
Key success factor within the connected world is the integration of services.

Connectivity provides the necessary information flow from the thing...

...but does not provide the adequate response:
Who repairs the car?
How will the driver get to his destination?

Only interaction between the thing, connectivity and services creates customer value!

Connected Manufacturing: the next industrial revolution



The transformation of industry 3.0 to industry 4.0 (connected industry) occurs gradually

Industry 4.0 – Connected Manufacturing

Goal

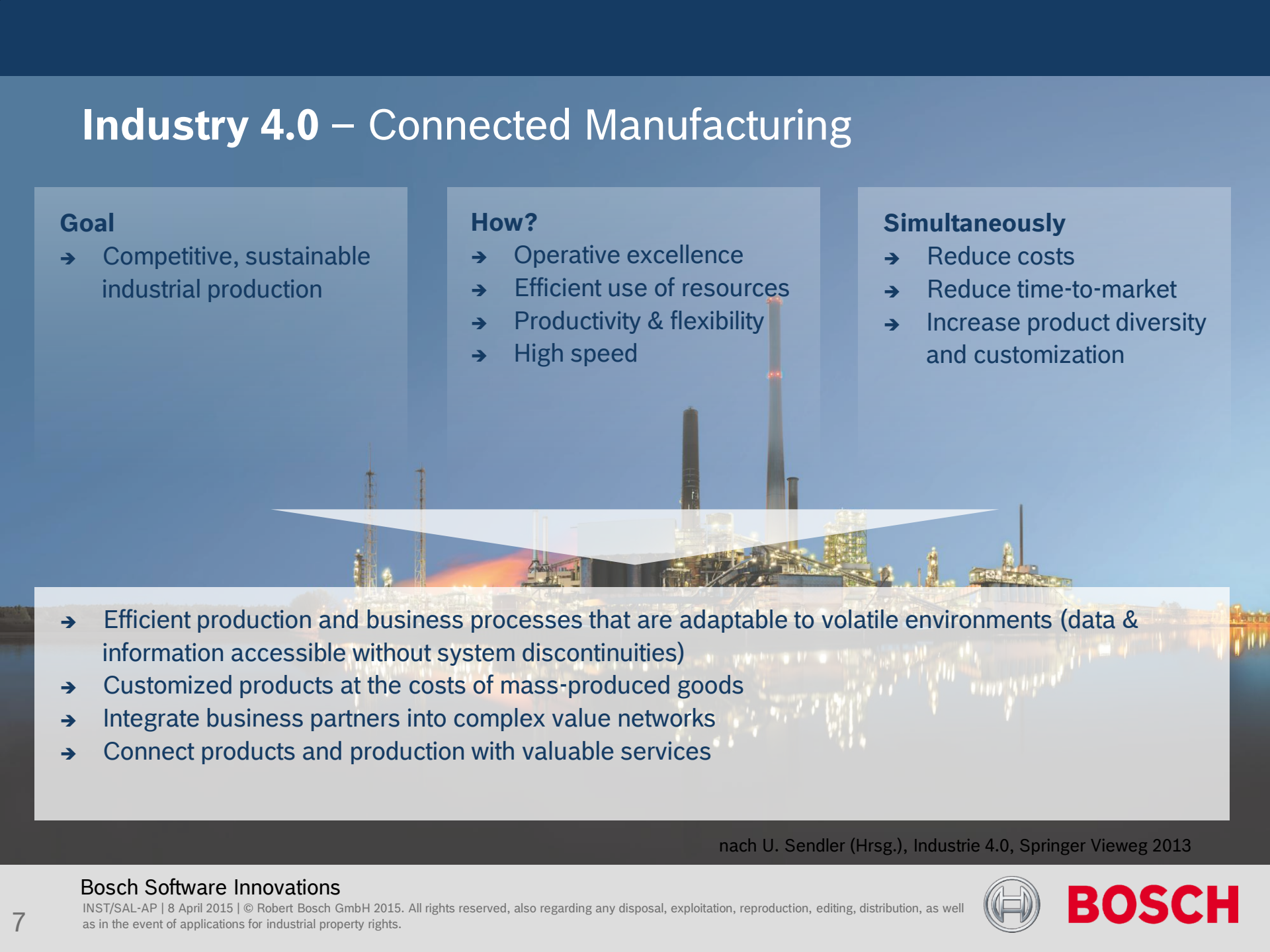
- Competitive, sustainable industrial production

How?

- Operative excellence
- Efficient use of resources
- Productivity & flexibility
- High speed

Simultaneously

- Reduce costs
- Reduce time-to-market
- Increase product diversity and customization

- 
- Efficient production and business processes that are adaptable to volatile environments (data & information accessible without system discontinuities)
 - Customized products at the costs of mass-produced goods
 - Integrate business partners into complex value networks
 - Connect products and production with valuable services

nach U. Sendler (Hrsg.), Industrie 4.0, Springer Vieweg 2013

Connected Industry: 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 optimized and self-organized way.

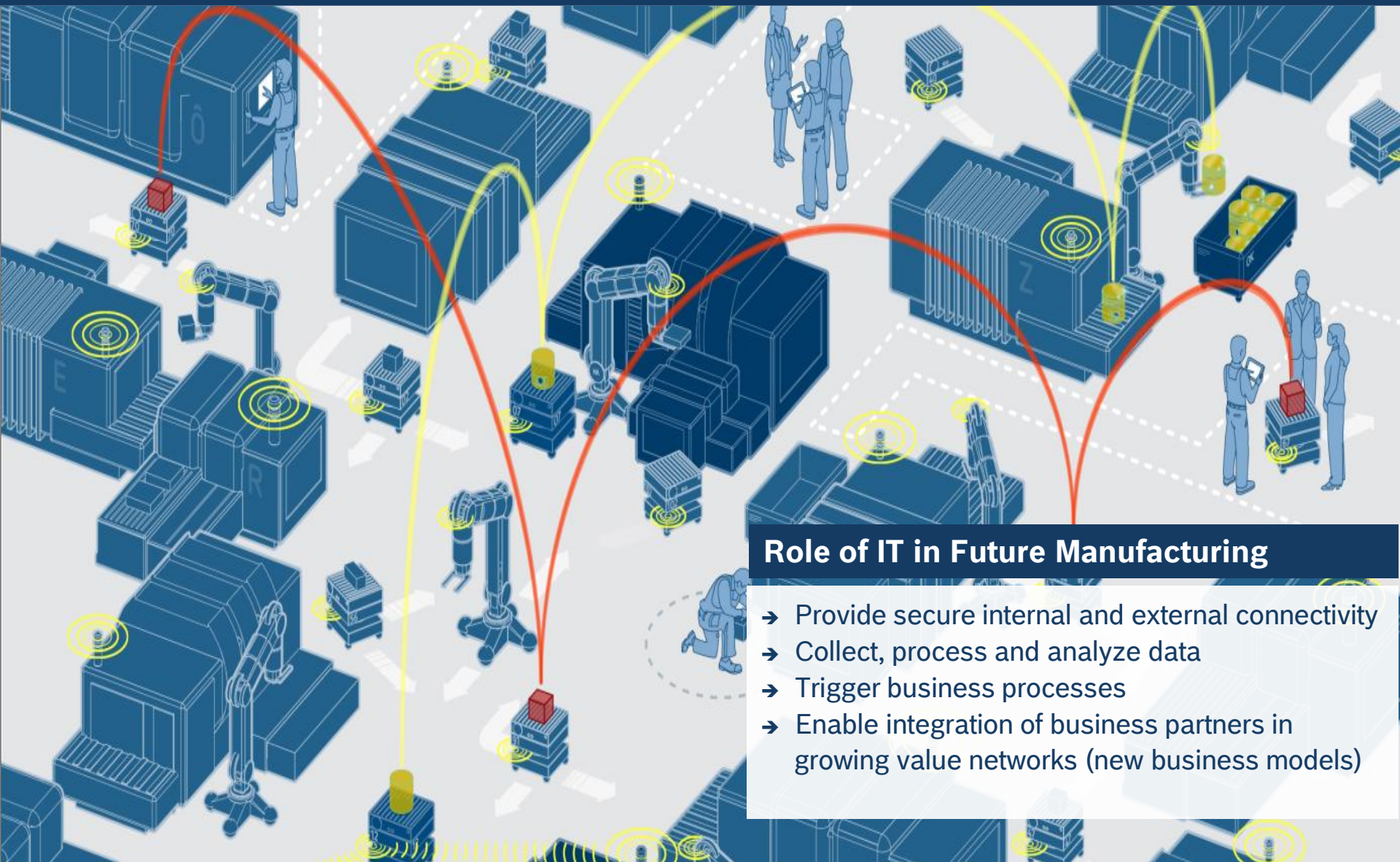
In these **intelligent production systems**, **all instances** of the added value chain from the supplier over logistics to the customer are connected **across the company**.

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**.



What Industry 4.0 means to us





Role of IT in Future Manufacturing

- ➔ Provide secure internal and external connectivity
- ➔ Collect, process and analyze data
- ➔ Trigger business processes
- ➔ Enable integration of business partners in growing value networks (new business models)

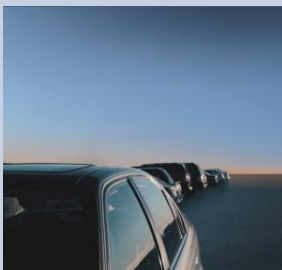
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Energy



Smart Metering
Virtual Power
Plant

Mobility



Fleet Mngmt.
eMobility
Intermodal
Transportation

Industry



Service Portal
Predictive
Maintenance

Building



Smart Home
Smart Heating

Connected Devices



Smart Devices
Cameras
Sensors
Actuators

City



City Platform
City Navigator
Security
Dashboard

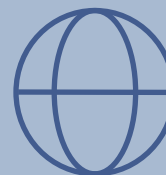
Bosch IoT Suite

M2M

BPM

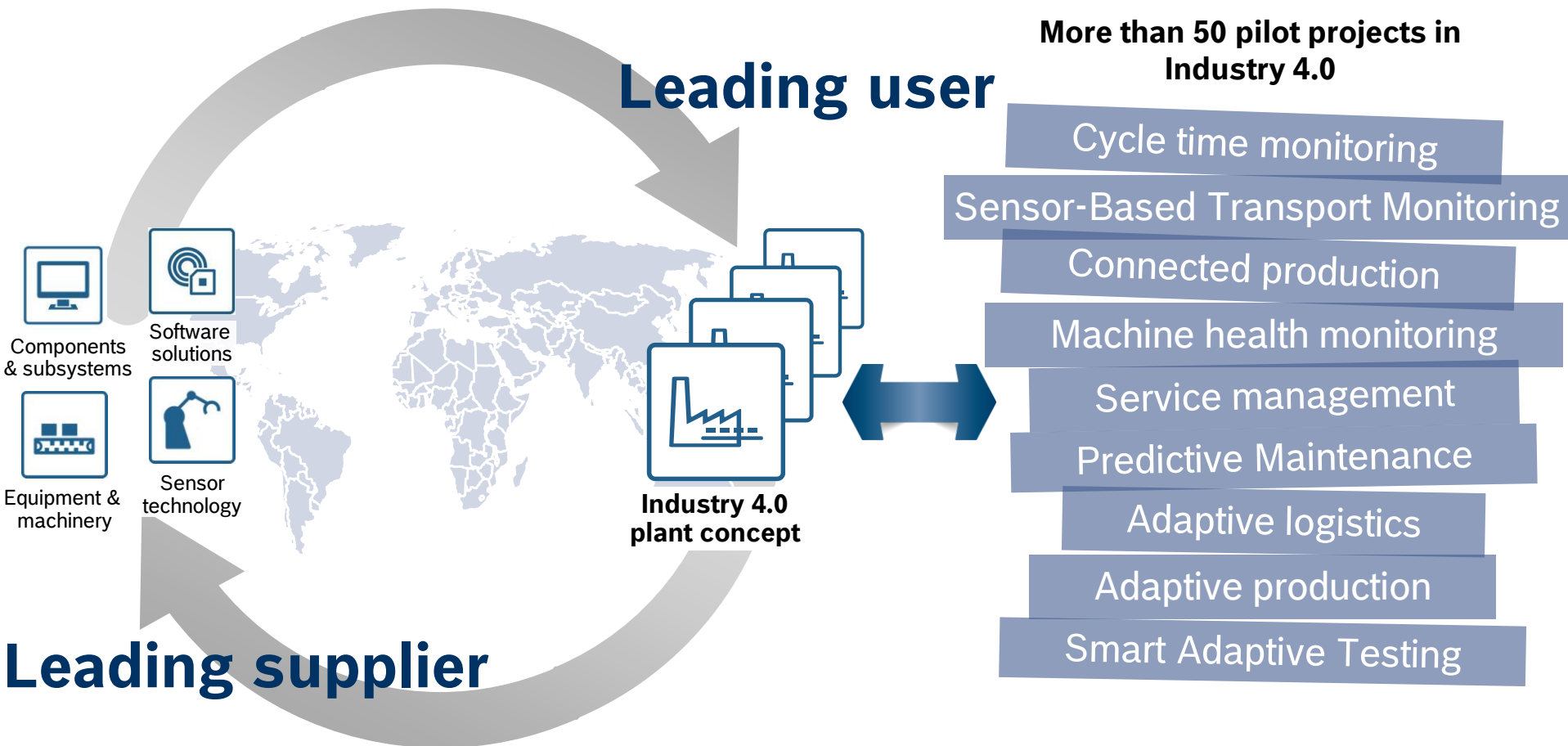
BRM

BDP



Providing Solutions for the Internet of Things

On the way to Industry 4.0: Bosch's dual strategy



Objectives



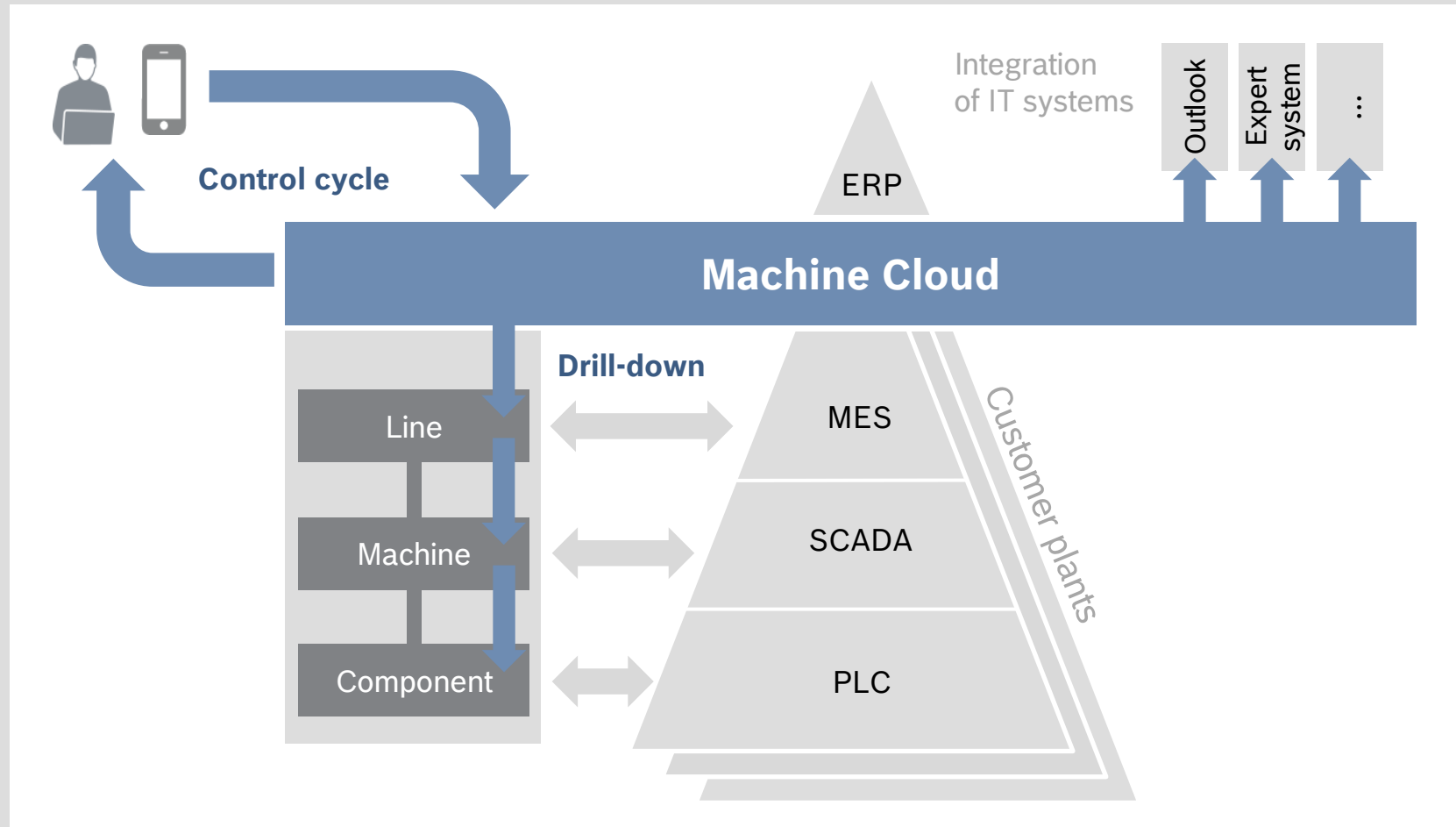
Integration of existing IT-Systems

A central tool to process and visualize existing manufacturing data for **continuous improvement**

Immediate, targeted notification of experts

Automated analysis of deviations and trends

System overview



Process Quality Manager

1. Initial situation

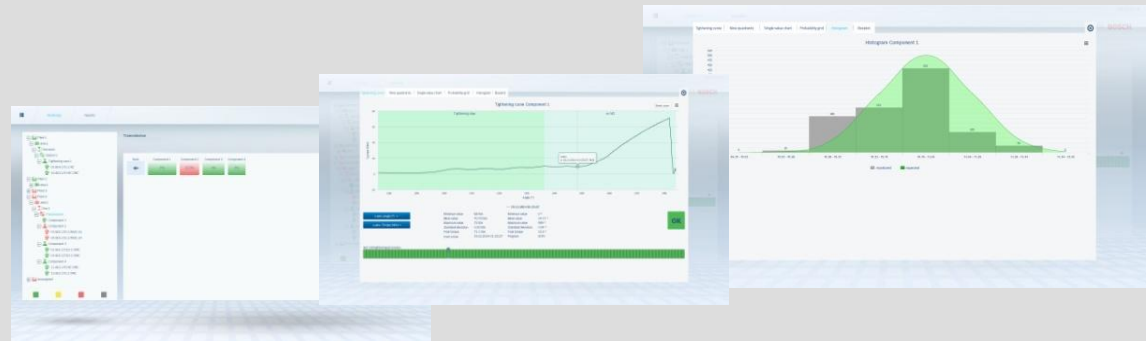


Safety-critical tightening processes require **close monitoring and analysis**:

- **Automatic anomaly detection** and user-friendly **deep drills** in real time are not possible

2. Our approach

- **Central processing and visualization** of production process data (curves, quality information, limits, etc.)
- **Automatic data analysis** in real time by user-defined **rule models**
- Role-specific **alerts and triggering of organizational processes**
- User-specific **dashboard status reports**



3. Customer benefits

- **Faster line ramp-ups** thanks to close process monitoring, both manual and automatic
- **Reduction of failure costs and technical downtime** due to quick reaction on process issues
- **Higher utilization of expert knowledge** thanks to central access to worldwide process data

Process Quality Manager: Minimized failure costs and downtime, plus faster ramp-ups

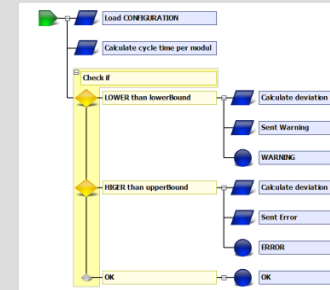
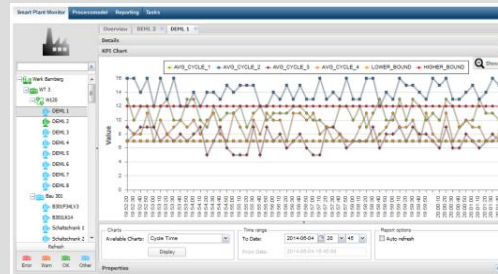
Cycle Time Monitoring

1. Initial situation

- **Impossible to monitor cycle times** of numerous different machining centers
- **Significant production output loss** due to deviations from target cycle times

2. Our approach

- **Central processing and visualization** of cycle times
- **Role-specific alerts** based on automatic cycle time analysis vs. lower and upper limits
- **Triggering of standardized machine check routines** for defective components
- **Remote modification of process parameters** to achieve target cycle times



3. Customer benefits

- **Increased production output** due to automatic identification of deviations
- Role-specific alerts enable better **utilization of expert knowledge**
- **Continuous improvement** based on plant-wide cycle time statistics

Integrated Cycle Time Monitoring of stand-alone machines: Increased production output

Machine Cloud – Practical examples “Cycle Time Manager”

Monitor machine measurements

Achievements

- **Increase of technical capacity** (output)
 - Fewer shifts
 - Reduction of PPC (planned production costs)
- **Real-time overview of machines**
- **Monitor effectiveness of improvements**

Nov 14

70 % reduction of slow stations

Dec 14

Without Machine Cloud

With Machine Cloud

Production increase:

6 € à 250 parts = 1,500 €/day (Dec 2014)
or
375,000 €/year/per Line (250 working days)



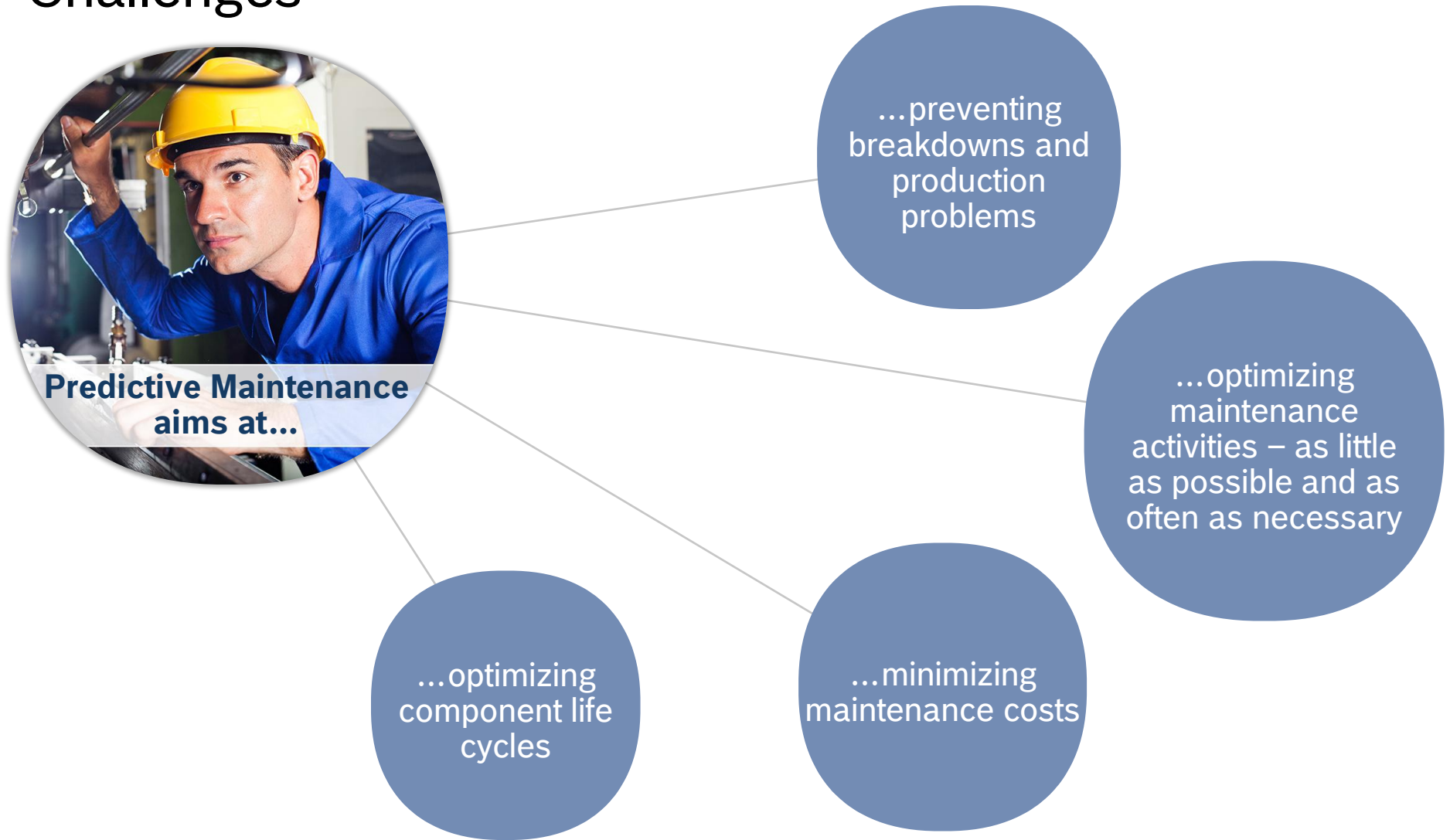
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Compare cycle-times

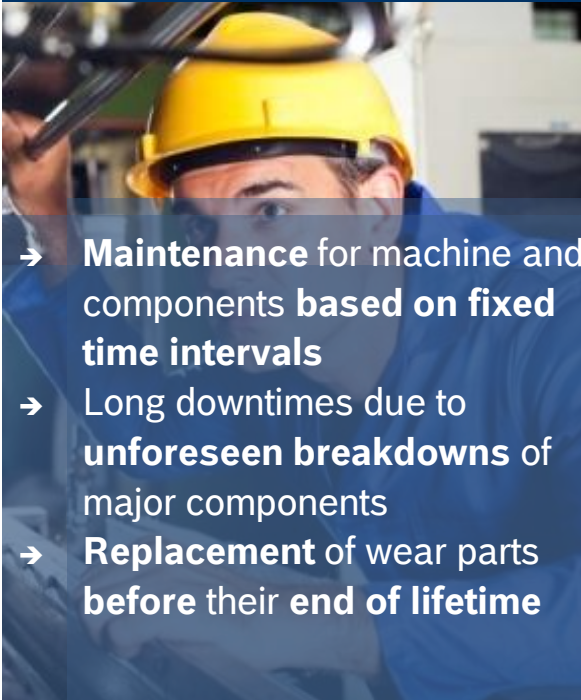
Create a list of machines running too slowly

Trigger standardized machine check

Challenges



1. Initial situation



- **Maintenance** for machine and components **based on fixed time intervals**
- Long downtimes due to **unforeseen breakdowns** of major components
- **Replacement** of wear parts **before their end of lifetime**

2. Our approach

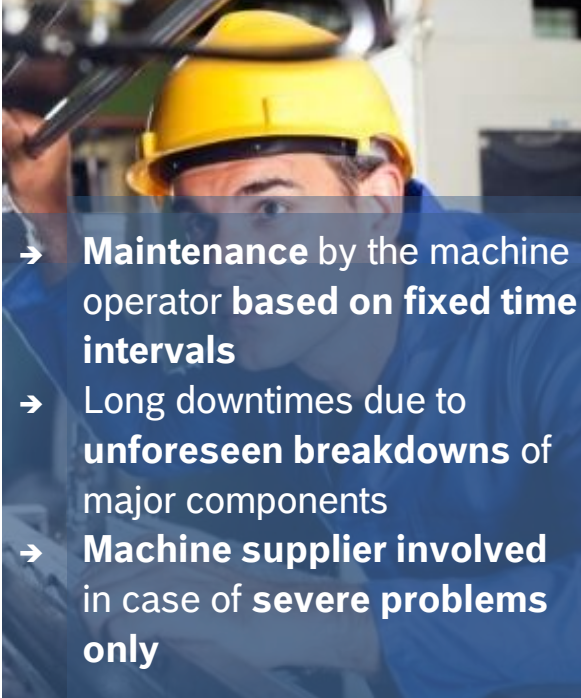
- **Central processing & visualization** of machine, process, and sensor data
- **Data analysis and derivation of causal dependencies** to predict malfunctions in cooperation with experts from the customer side
- Transformation of causal dependencies into **rule-based evaluation models**
- **Automatic application of rule models** on production data in near real time
- **Automatic triggering of maintenance processes**

3. Customer benefits

- **Higher production output** due to less planned downtime for maintenance/fewer unforeseen breakdowns
- **Reduced maintenance costs** thanks to maximum usage of components and wear parts until their end of lifetime

Predictive Maintenance: Increased production output, reduced maintenance costs

1. Initial situation



- **Maintenance** by the machine operator **based on fixed time intervals**
- Long downtimes due to **unforeseen breakdowns** of major components
- **Machine supplier involved** in case of **severe problems only**

2. Our approach

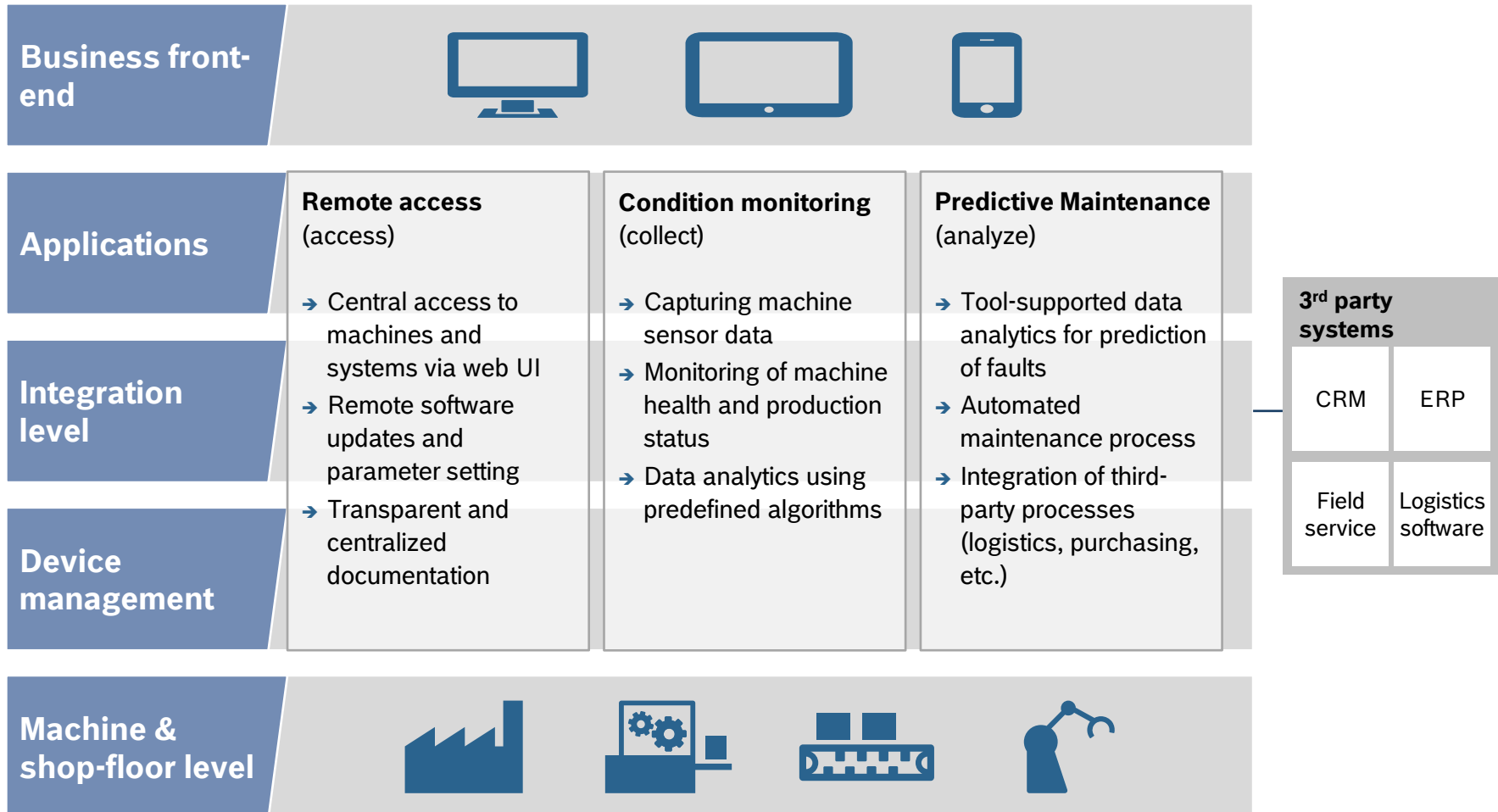
- **Secure remote access** (using our Multi-stage Security Platform) to machines operating in various customer locations
- **Data analysis and derivation of causal dependencies** to predict malfunctions in cooperation with experts from the machine supplier
- Transformation of causal dependencies into **rule-based evaluation models**
- **Automatic application of rule models** to neutralized production data
- **Triggering of maintenance service processes** to be offered to the machine operator

3. Customer benefits

- **New pay-per-use business models** based on predictive maintenance
- **Improved competitiveness** and **sales growth** thanks to additional service offering

Predictive Maintenance service offerings: Improved competitiveness and sales growth

Solution architecture

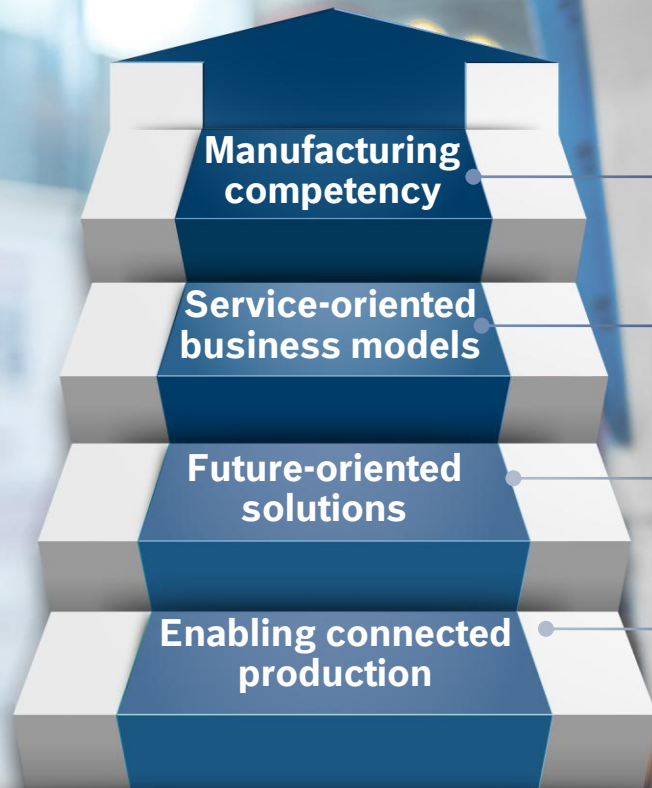


CRM = customer relationship management, ERP = enterprise resource planning, M2M = machine-to-machine



Our vision:

Become the leading supplier of beneficial & user-oriented Industry 4.0 solutions

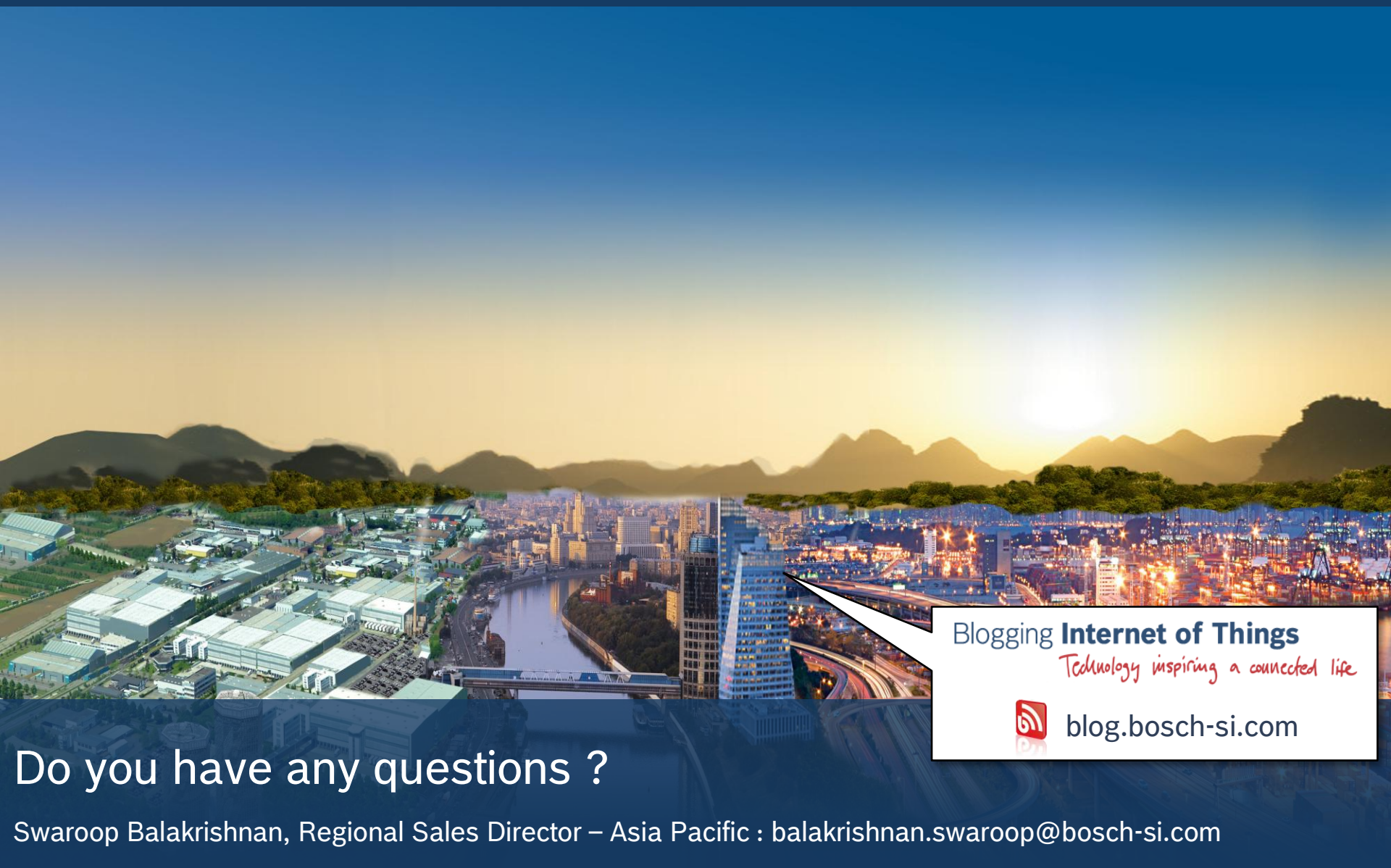


We use Bosch's manufacturing competency to support our internal and external customers by intelligently connecting machines, data, and processes along the entire value chain

We develop service-oriented business models that allow our customers to surpass the competition and enter new markets

We create future-oriented solutions for the manufacturing industry that efficiently support employees in their daily work

We enable the sustainable connected production of the future: productive, flexible, responsible, customized, and cost-effective



Do you have any questions ?

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