



IoT in Production

CECIMO Webinar



cecimo

European Association of the Machine Tool Industries
and related Manufacturing Technologies

We are looking forward to discuss with you our latest insights on IoT in production – please do not hesitate to contact us



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We are a European born, global top-5 strategy consulting firm with extensive experience across all industries and functional areas

Our profile

Founded in **1967** in Germany by Roland Berger

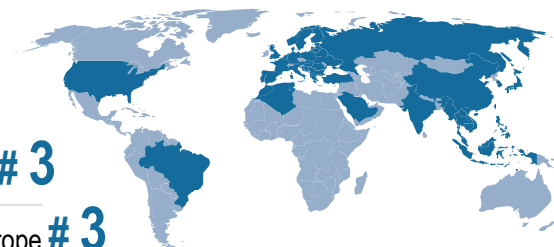
51 offices in **36** countries, with around **2,400** employees

Nearly **270** RB Partners currently serving **~1,000** international clients

International position

2019

Market position in the strategy segment



Germany **# 3**

Core markets in Western Europe **# 3**

Growth regions China and Russia/CEE **# 2**

World **# 5**

Roland Berger



We serve ...

- ... **The largest** international companies:
30% of the Global 1000
40% of Europe's leading companies
- ... **The most dynamic** and innovative mid-size companies
- ... **Governments** about to deregulate and privatize



Entrepreneurship

We follow an entrepreneurial approach and provide creative and pragmatic solutions

Excellence

We achieve excellent results and develop global Best-practices to ensure measurable and sustainable success

Empathy

We are insightful and responsible advisors who contribute to the greater good

Our values

Extensive experience

In today's webinar we will discuss latest technological and application trends for IoT in production based on our recent publication

Whitepaper: IoT in Production

IoT in Production

The latest on IoT adoption & technologies in manufacturing industries



[Free download](#)

Selected highlights from the whitepaper



Within the next decade, the **"smart" and "autonomous" factories** will become reality: Most **OEMs** already **manufacture products** with **embedded smart chips** that facilitate AI capabilities and IoT connectivity.

New technologies like 5G, LPWA and Edge devices will even enable those products to send data to a cloud **without** necessarily having to **use conventional industrial communication networks**.

OEMs will be able to **analyze their products while in operation**, which, in turn, will **lead to better evolutions in production**, higher customer satisfaction, and more reliable products.

OEMs are facing several challenges: business model, go-to-market processes, delivery processed and right skill set of people

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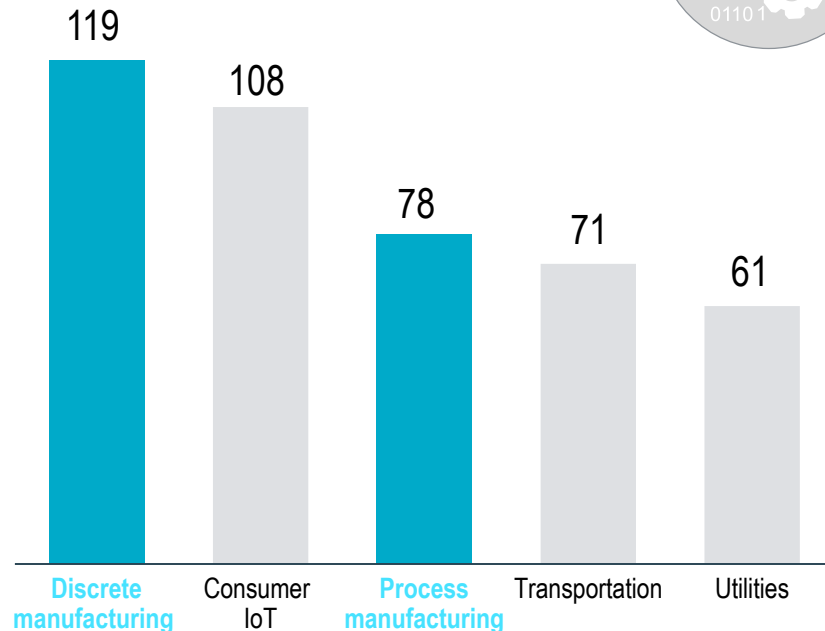
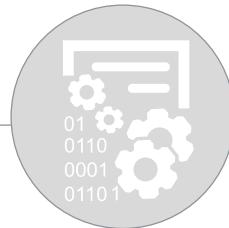
A. Industrie 4.0 and IoT use cases framework for production



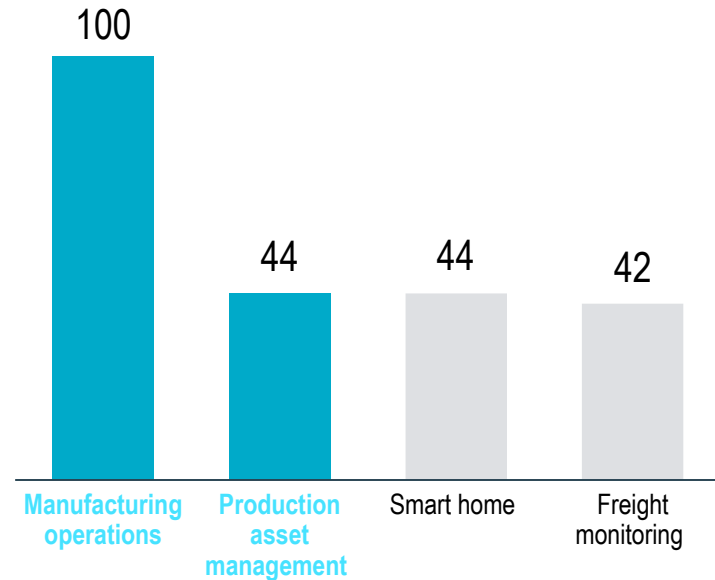
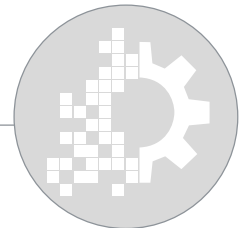
Most spending and highest level of investment in IoT in 2019 was done in the discrete and manufacturing environment

IoT spending and use case in 2019 [USD bn]

Worldwide spending on the Internet of Things

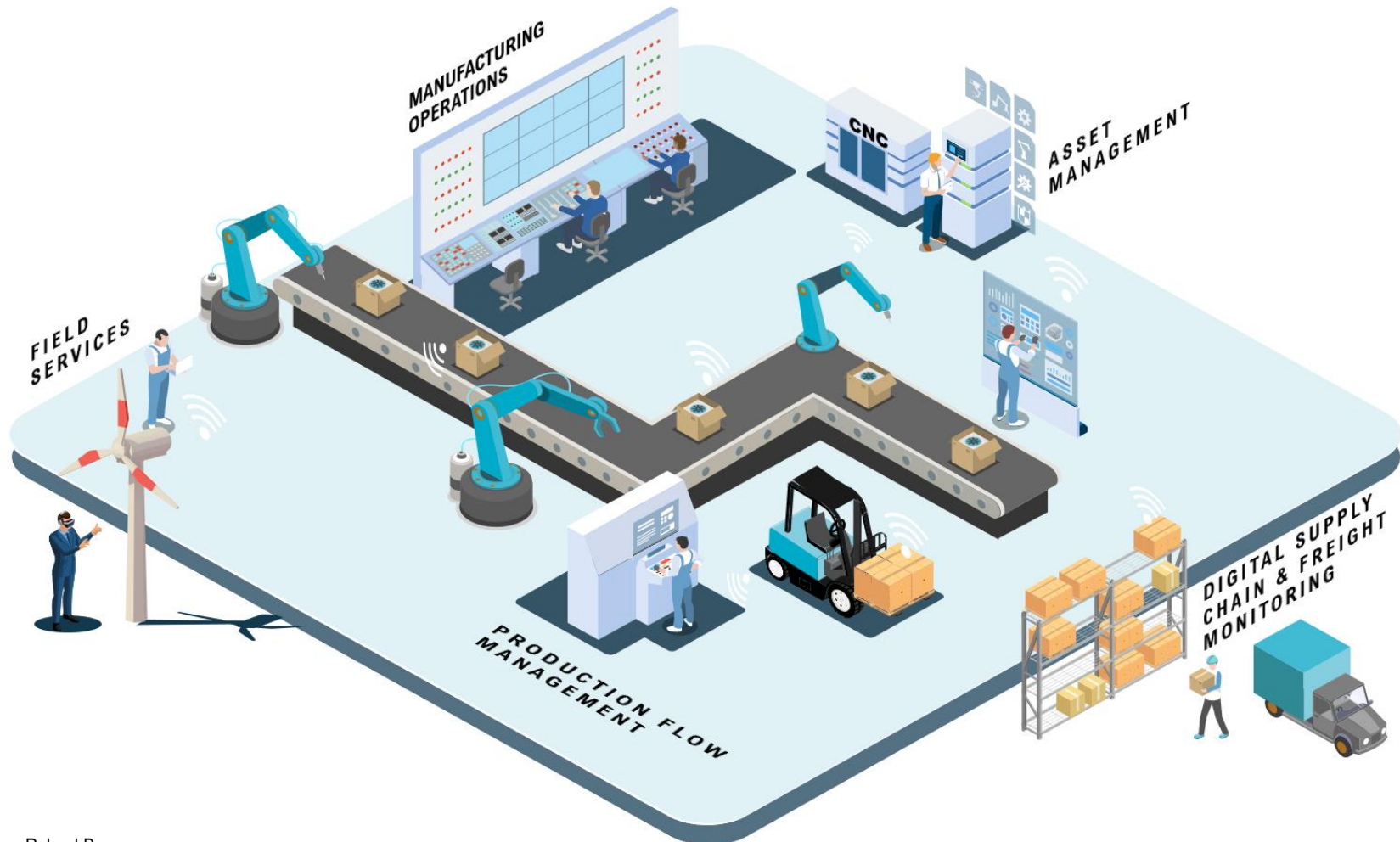


IoT use cases with greatest levels of investment in 2019



Industrie 4.0 and IoT use cases in production reach from manufacturing operations to digital supply chain and field services...

Illustration of Industrie 4.0 and IoT use cases in manufacturing



Industrie 4.0 and IoT use cases are closely linked – Industrie 4.0 uses local networks, while IoT solutions use internet networks

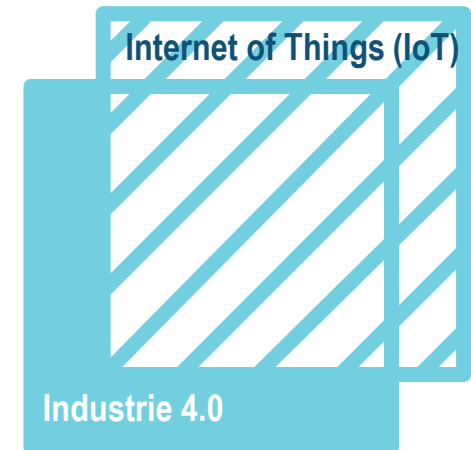
Definition of Industrie 4.0 and IoT

Industrie 4.0

The **digital networking of people, machines and products** - In essence, it is about both **efficient production** down to **batch size 1** and entire value-added processes in the **intelligent factory** (Smart Factory). Based on highly networked and automated machines that use **local network** resources and interfaces to monitor themselves and their environment, the so called **machine-to-machine (M2M) communication**.

Internet of Things (IoT)

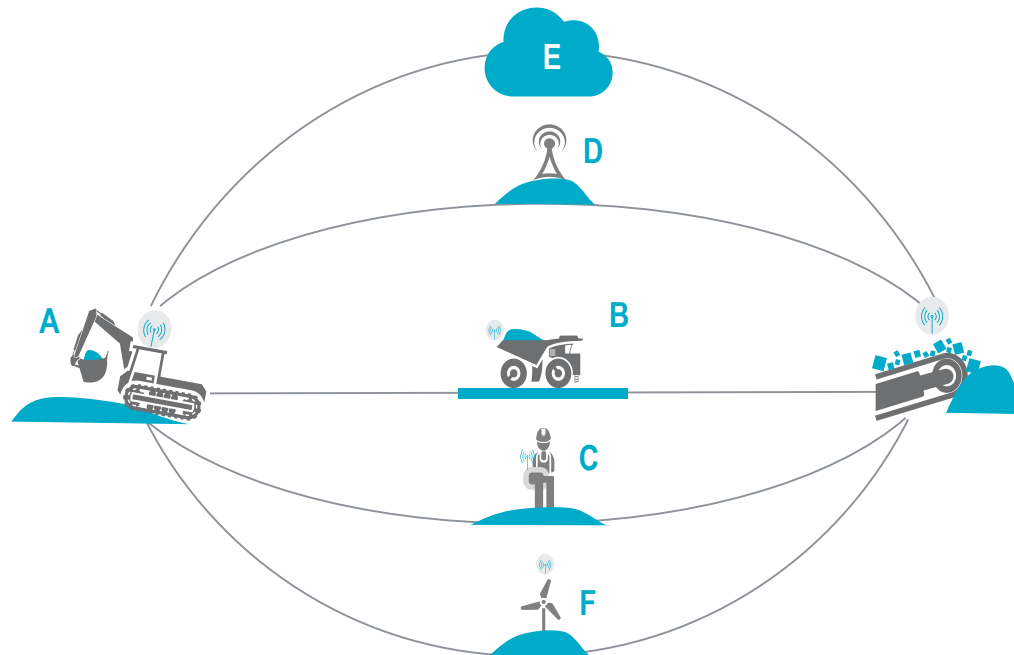
A **system of interrelated computing devices, mechanical and digital machines** provided with unique identifiers (UIDs) and the ability to transfer data **over the internet** without requiring human-to-human or human-to-computer interaction. **IoT refers to interconnected sensors, instruments, and other devices networked together with computers' industrial applications**, including manufacturing and energy management. The **Industrial IoT** is an **evolution of a distributed control system (DCS)** that allows for a higher degree of automation by using **cloud computing** to refine and optimize the process controls.



Industrie 4.0 and IoT use cases are closely linked and can follow same purposes. However, Industrie 4.0 solutions use mostly the local enterprise network, while IoT solutions use the internet or cloud networks.

Roland Berger structures Industrie 4.0 and IoT solutions in 6 categories and provides detailed use cases

Solution categories



A Advanced automation & robotics



B Logistics and material handling



C Augmented operator



D Connectivity and communication



E Big Data and AI analytics

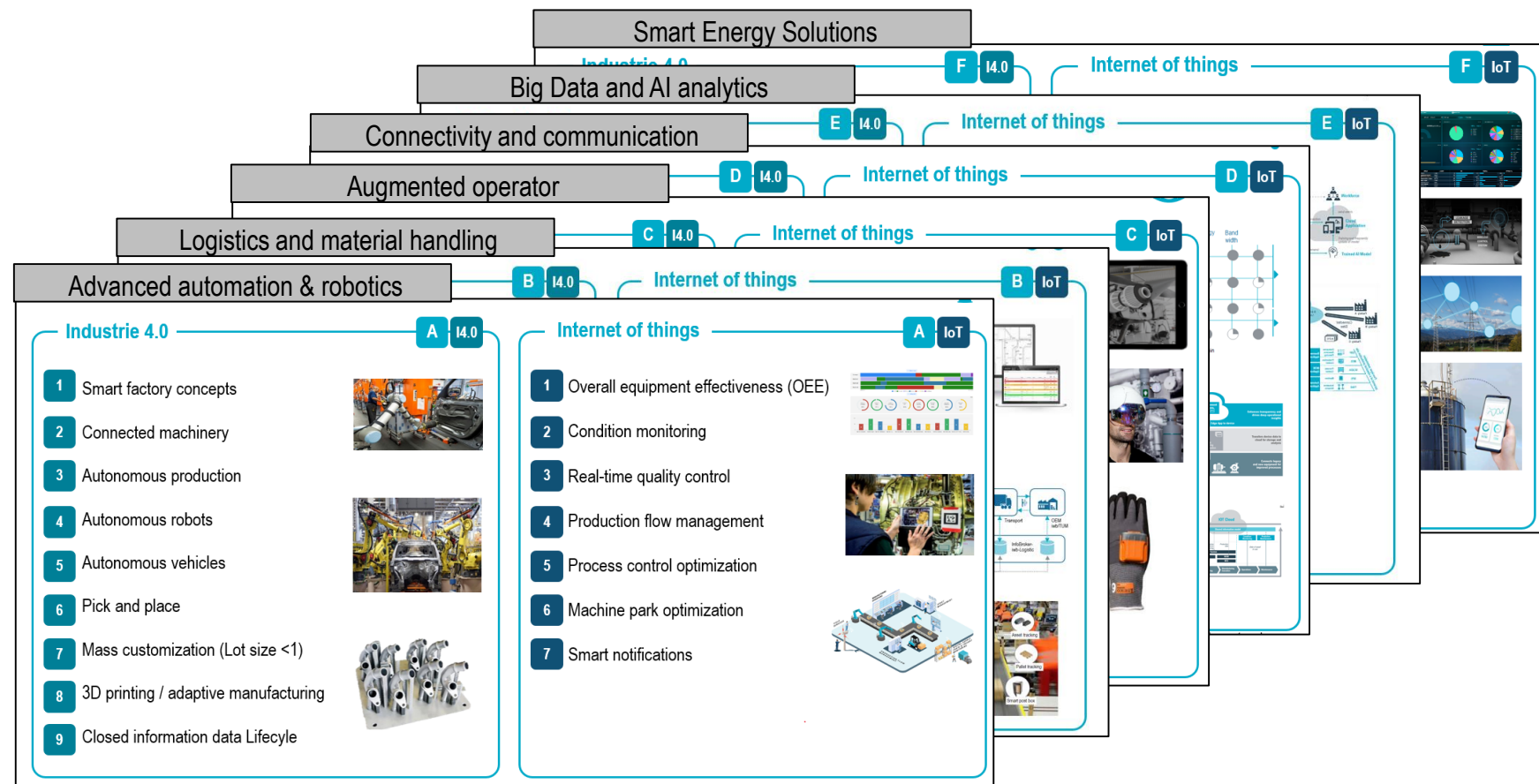


F Smart Energy Solutions



Based on our project experience across industries we have developed a framework with more than 100 production use cases

Roland Berger IoT and Industrie 4.0 use case collection



Advanced automation and robotics use cases focus on increasing automation and efficiency of manufacturing processes

A - Advanced automation & robotics



Industrie 4.0

A I4.0

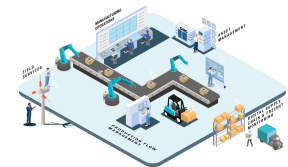
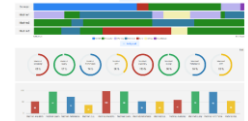
- 1 Smart factory concepts
- 2 Connected machinery
- 3 Autonomous production
- 4 Autonomous robots
- 5 Autonomous vehicles
- 6 Pick and place
- 7 Mass customization (Lot size <1)
- 8 3D printing / adaptive manufacturing
- 9 Closed information data Lifecycle



Internet of things

A IoT

- 1 Overall equipment effectiveness (OEE)
- 2 Condition monitoring
- 3 Real-time quality control
- 4 Production flow management
- 5 Process control optimization
- 6 Machine park optimization
- 7 Smart notifications



Implementation of an autonomous aluminium skimming and sampling robot to increase consistency and cycle time

Use case: Skimming and sampling in aluminium crucibles



Industrie 4.0

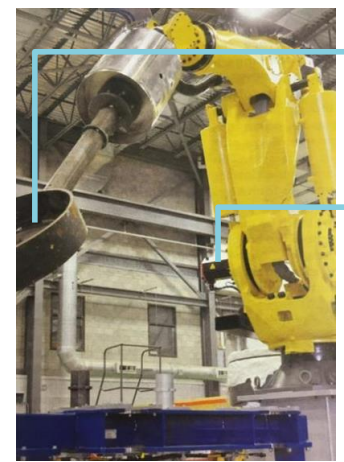
A I4.0

Internet of things

A IoT

- 1 Smart factory concepts
- 2 Connected machinery
- 3 Autonomous production
- 4 Autonomous robots**
- 5 Autonomous vehicles
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Use case: Skimming and sampling in aluminium crucibles



- Skimming & sampling switch**
 - > Equipped with skimming and sampling tools switching autonomously
- Optical analysis**
 - > Camera to conduct a first analysis and collect optical records of hot metal surface
- Connectivity**
 - > Results of sampling are shared with control center in real time

Impact

- > Increased **health and safety standards** by reducing operator exposure to hazardous environments
- > **Improved and consistent product quality** of the metal
- > **Optimized cycle times** by combining skimming and sampling
- > **Energy savings** due to faster handling of hot metal and thus reduced loss of temperature

Success factors

- > **Optimized equipment utilization** to leverage the benefits of autonomous manufacturing equipment
- > Usage of collected data to continuously **improve product and process quality**

Advanced sensor technology combined with artificial intelligence enables offering OEE optimization-as-a-Service

Use case: OEE as a Service



Industrie 4.0



Internet of things



- 1 Smart factory concepts
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- 6 Pick and place
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1 Overall equipment effectiveness (OEE)

Use case: OEE as a Service

Data collection

Data analysis

ifp Software: oee.cloud

- > Sensors collect data about performance, availability and quality
- > Data is analyzed automatically in real time and made accessible for operators on mobile devices
- > Machine learning is applied to identify patterns within the data

Sensor technology
Ready-to-plug-in sensors can be installed within minutes

Precise root causes
Simple collection of root causes with mobile devices

Detailed reporting
Detailed analysis of equipment availability, performance, etc.

Quick success
Levers can be defined, prioritized and monitored

Impact

- > **Easy and quick installation** of the system **without the requirement for up-front investment** – service fee is charged on a monthly basis
- > Data is collected and analyzed automatically providing a **holistic view on performance, quality and availability** in real time
- > Measures can be derived, prioritized and monitored by means of a **data-driven approach**

Success factors

- > **Integrated consideration** of collected data to achieve the overall optimum
- > **Collection of detailed root causes** through operators for best possible data output
- > **Acceptance** among operators and **mindset towards continuous improvement**
- > Leverage **existing knowledge** of process engineers

Mixed-reality applications for the HoloLens are applied to train and support technicians more efficiently and enable hands-free working

Use case – Augmented reality for maintenance operations



Industrie 4.0

C I4.0

Internet of things

C IoT

1 Supportive robotics



1 Mixed & Augmented Reality



Use case: Augmented reality for maintenance operations



Microsoft HoloLens

- > Untethered mixed reality device with apps and solutions for enhanced collaboration
- > Developed for industrial/commercial applications



Impact



- > **Improved process quality and consistency** through standardized repair procedures
- > **Improved ergonomics** through hands-free working
- > **New way of training operators** more interactively and efficiently with the option to scale up trainings
- > **Remote-support** for operators by experts from around the globe
- > Increased **process efficiency** and **lower error rates**

Success factors



- > Sufficient **wearing comfort** for the operator
- > **Roll-out of technology** for a high number of applications to leverage full potential
- > Balance of **inhouse knowledge and capabilities** and **capabilities of external service provider**

actions



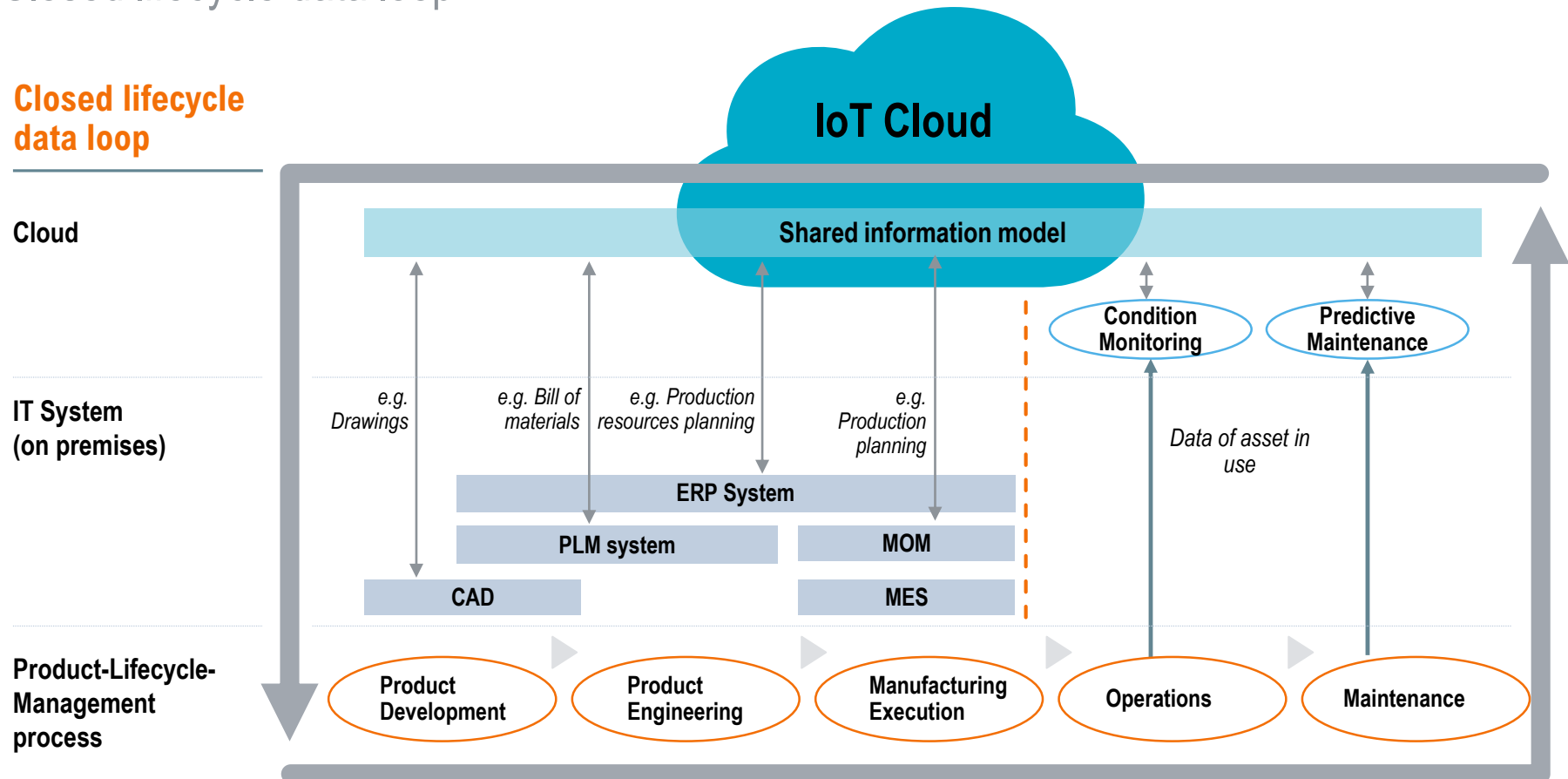
B. High level architecture for IoT in production



IoT use cases in manufacturing should be combined with a closed lifecycle data loop as a foundation for additional value creation

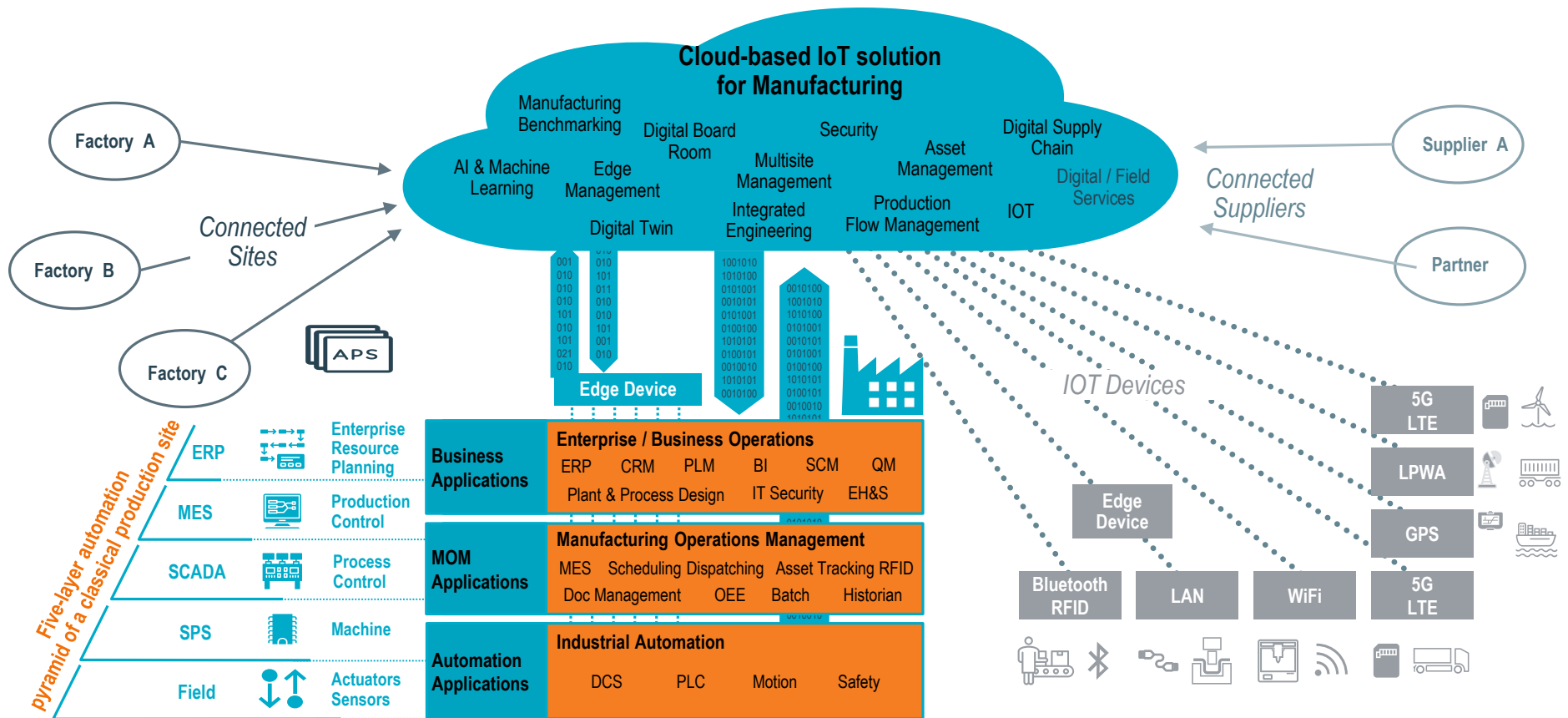
Closed lifecycle data loop

Closed lifecycle data loop



A cloud-based IoT solution for Manufacturing is the core element, connecting different parts of the industrial ecosystem

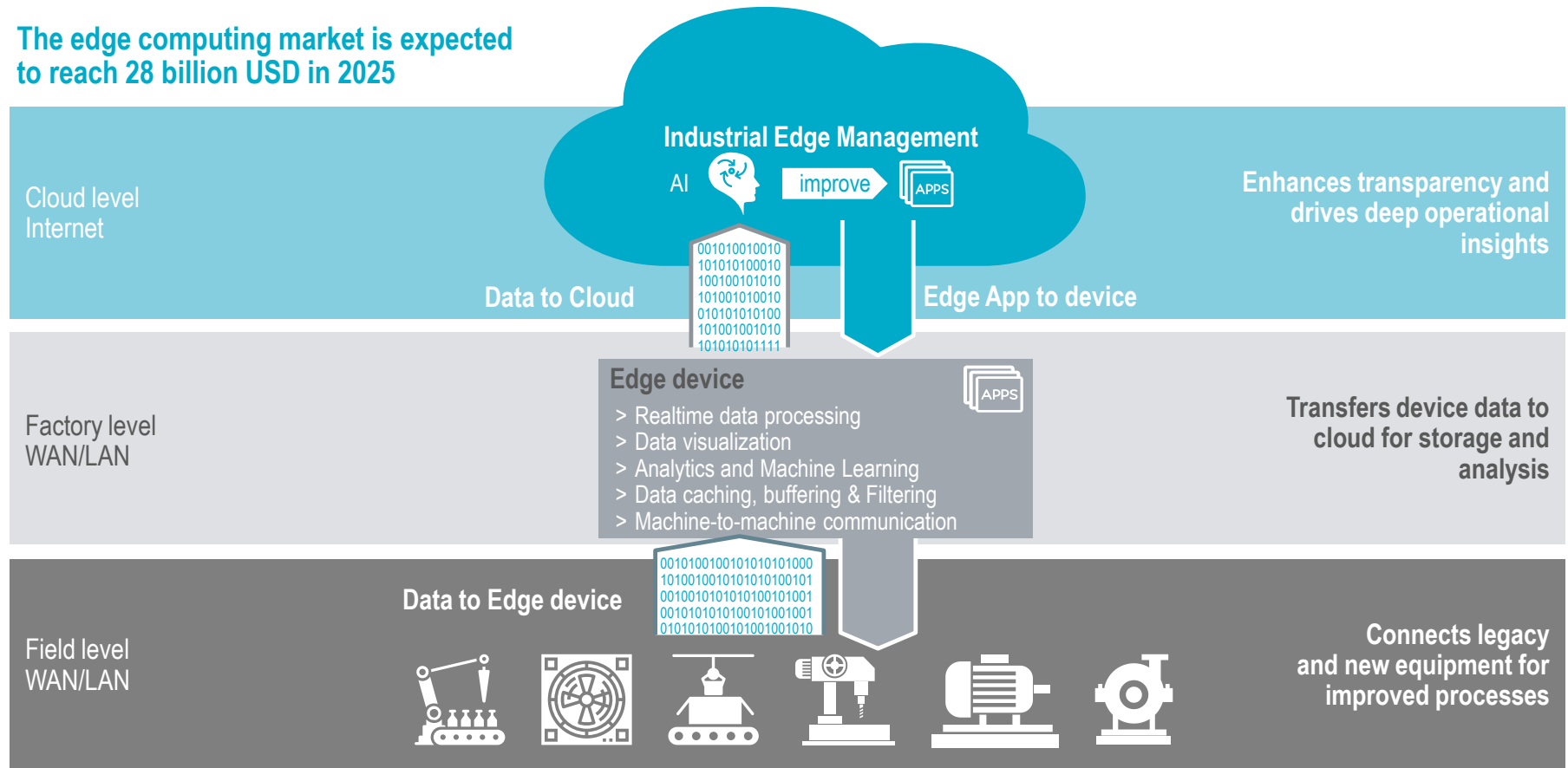
Cloud-based IoT solutions for manufacturing



Edge devices bring the advantages of cloud computing to the factory network and enable real-time data processing

Edge devices

The edge computing market is expected to reach 28 billion USD in 2025



Organizational and technological challenges that hinder a fast commercialization of Industrie 4.0 and IoT

Challenges of Industrie 4.0 and IoT

Organizational



- > Lack of IT specialists
- > Missing knowledge of software business
- > Business processes must be adapted e.g. ERP system
- > Lack of skills of own employees e.g. sales
- > Employee concerns
- > Development of market attractive business models
- > Identification of customer pain points
- > Added value of the applications is often difficult to quantify
- > Partner landscape of solution provider, suppliers, and system integrators is still immature

Technological



- > High complexity of topic
- > Data security and data integrity
- > Enablement of brownfield installations
- > Integration of devices, things, sensors
- > High volume of data ingest
- > Missing industry standards and data models
- > IT systems with outdated operating systems
- > Relevant infrastructure for 5G, LPWA is missing

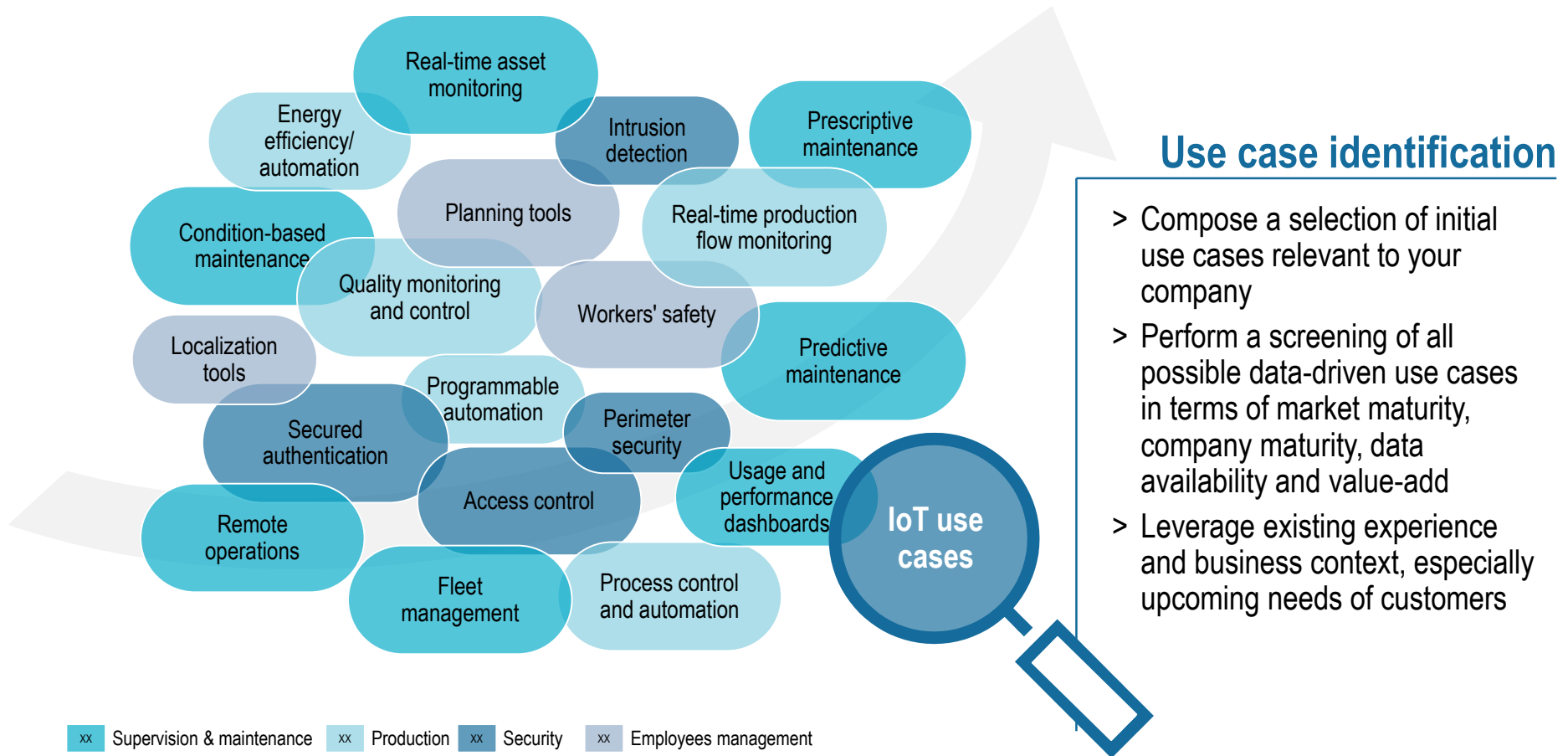
C. IoT use case operationalization and commercialization



Identifying the right use cases is key to develop successful products and business models

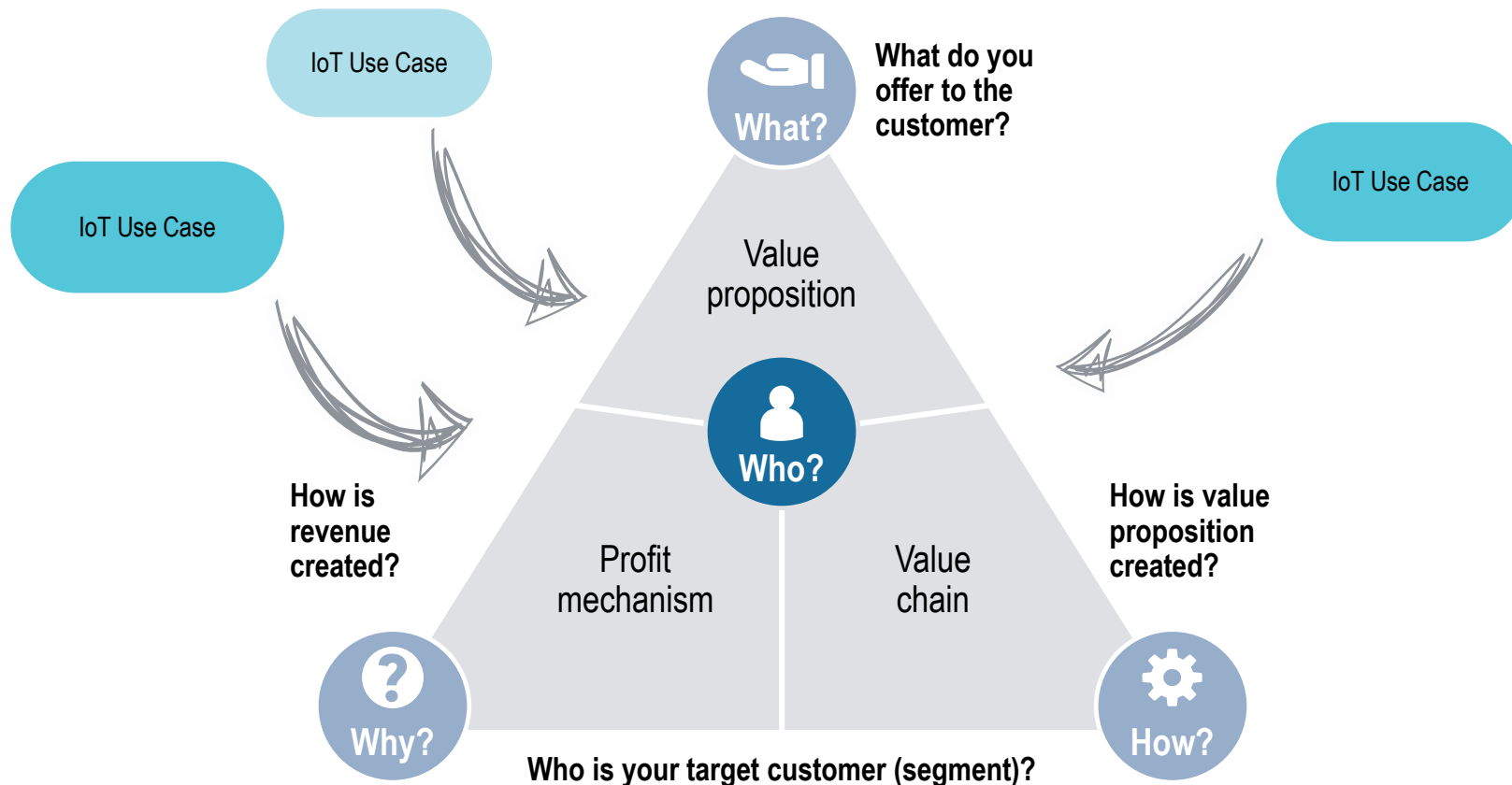
Use cases and data value proposition

Examples



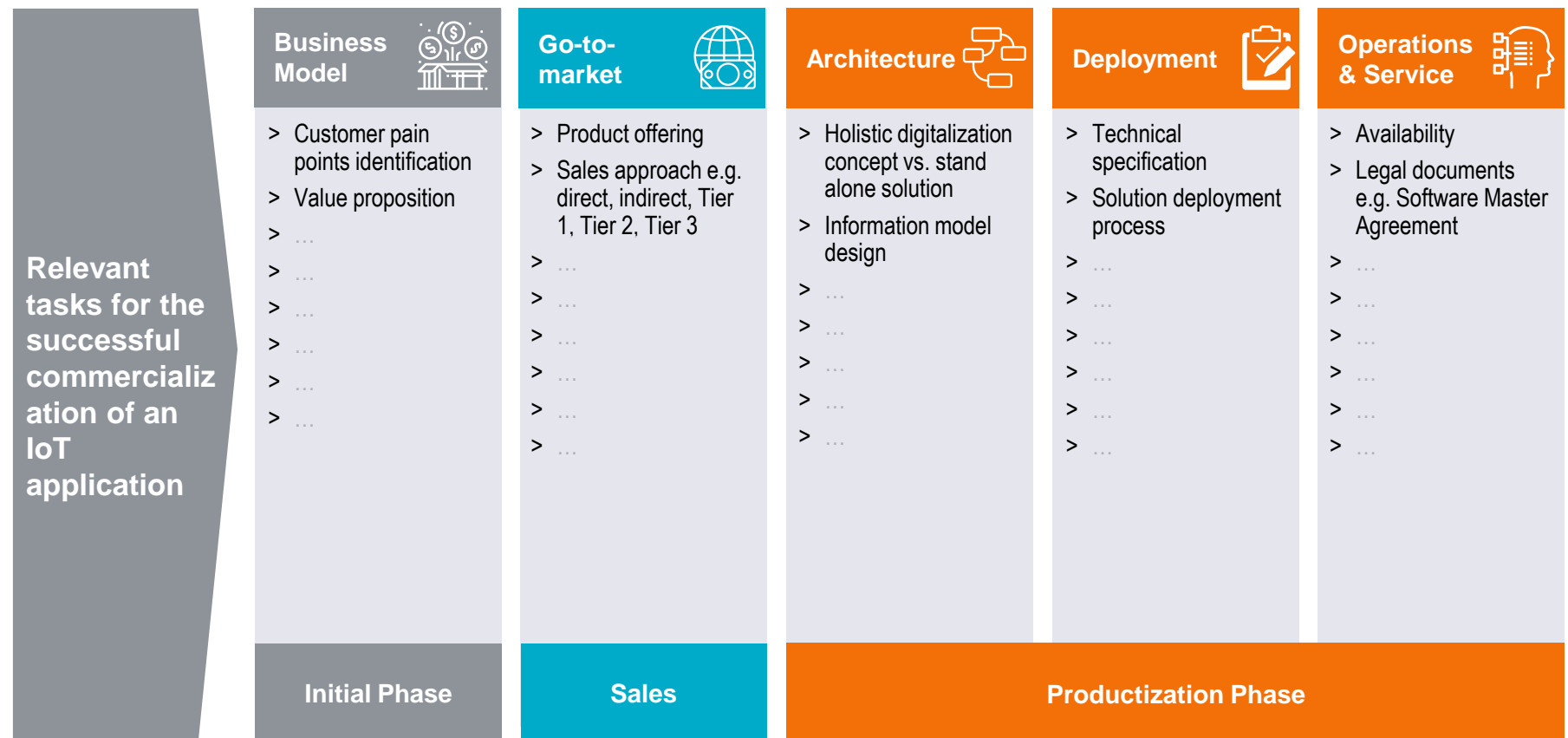
Selected IoT use cases must be combined with a business model detailing value proposition, value chain and profit mechanism

General business model structure



The RB Business Model Assessment covers all relevant steps for the successful commercialization of an IoT product

Roland Berger IoT Business Model Assessment



We have proven our technology knowledge and industry expertise in several publications and vertical specific case studies

Selected Roland Berger publications and case studies

IoT in Production



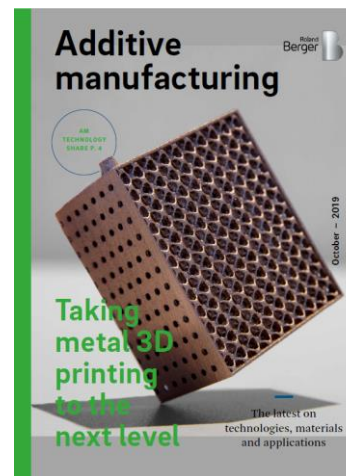
The latest on IoT adoption & technologies in manufacturing industries

Rise of the machines



How robots and artificial intelligence are shaping the future of autonomous production

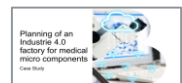
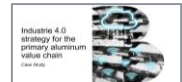
Additive manufacturing



Taking metal 3D printing to the next level

Selected industry-specific case studies

- > Railway industry
- > Electromechanical industry
- > Primary aluminum industry
- > Automotive industry
- > Metal 3D-printing of turbines
- > Medical micro components
- > Metal and Mining industry
- > (Semi-finished) Metal industry



Roland Berger has a senior expert team with in-depth knowledge and insights in Industrie 4.0 and IoT

Selected Internal Experts

Expert



**Dr. Bernhard
Langefeld**

Partner
German

Experiences

- > In-depth knowledge in Industrie 4.0, global footprint design, and operations management
- > Kaizen and Industrie 4.0 at an Asian automotive OEM
- > Conducted an I4.0 BootCamp tour to discover state of the art industrial digitization strategies and pioneer I4.0 solutions
- > Development of an investment teaser for the sale of 6 entities of client during a 3 week project
- > Using the Extended Plant Assessment Roland Berger assessed 3 W./F. plants (CZ, US and IN), focusing on Lean Management and I4.0



**Alexander von
Paumgarten**

Senior Consultant
German

- > In-depth knowledge in Digitalization, Industrie 4.0, Cloud, IoT, AI and Data Science
- > Successful conception and implementation of more than 20 IoT-, applications within the process industry
- > Business model design for more than 10 industrial applications
- > Design of a high level cloud architecture for an EPC company in the Oil & Gas industry
- > Development of pricing models and go-to-market strategies for several software products
- > Certified Data Scientist

Roland
Berger

THINK:ACT

