The Internet of Things: Connected Products – Connected Manufacturing

Dr. Rainer Kallenbach, CEO, Bosch Software Innovations GmbH

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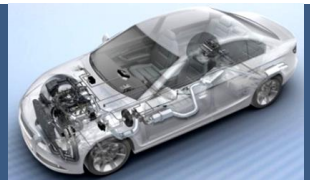
Bosch Key Figures 2014

Bosch Group

- 48,9 billion EUR in sales
- 290 000 associates
- 225 manufacturing sites

Automotive Technology

68 % share of sales



Industrial Technology

Energy and Building Technology

32% share of sales

Consumer Goods

Europe

- 53 % share of sales
- 174 400 associates
- 140 manufacturing sites

Americas

- 21 % share of sales
- 33 500 associates
- 33 manufacturing sites

Asia Pacific [2]

- 26 % share of sales
- 73 500 associates
- 52 manufacturing sites

[2] Including other regions

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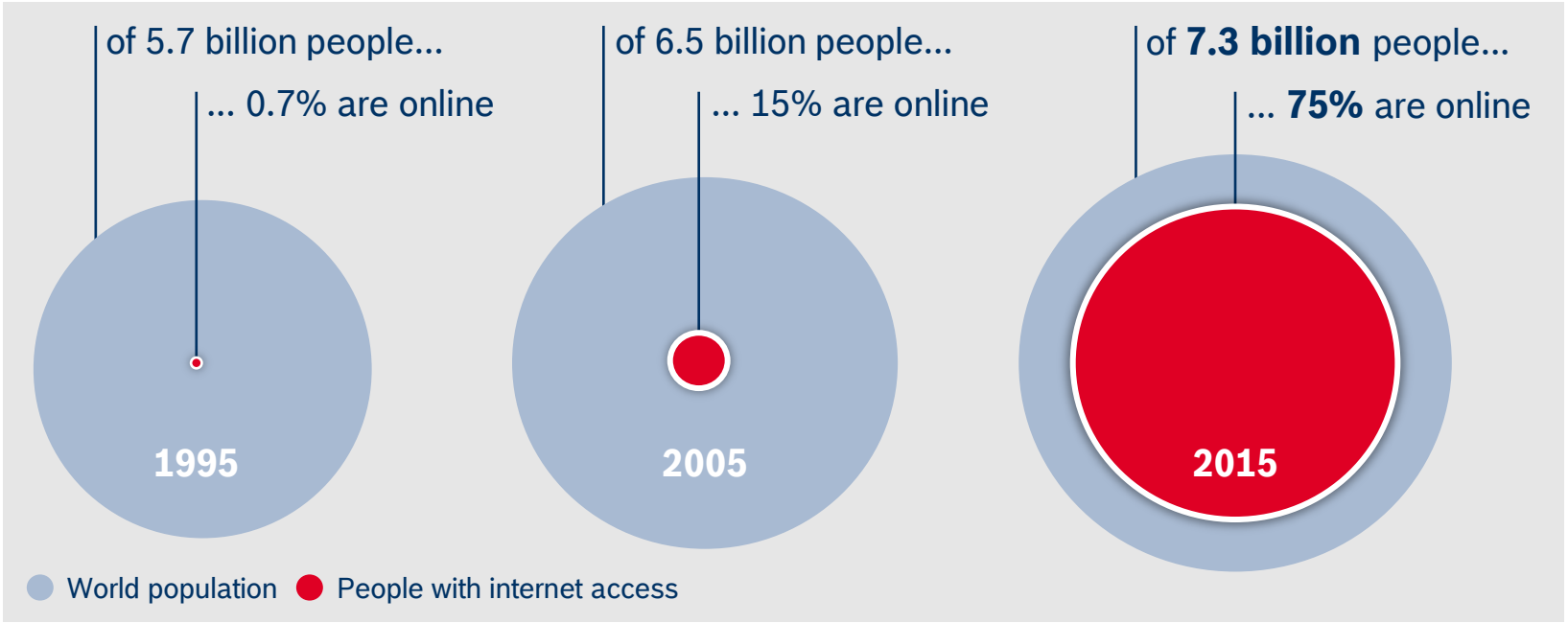
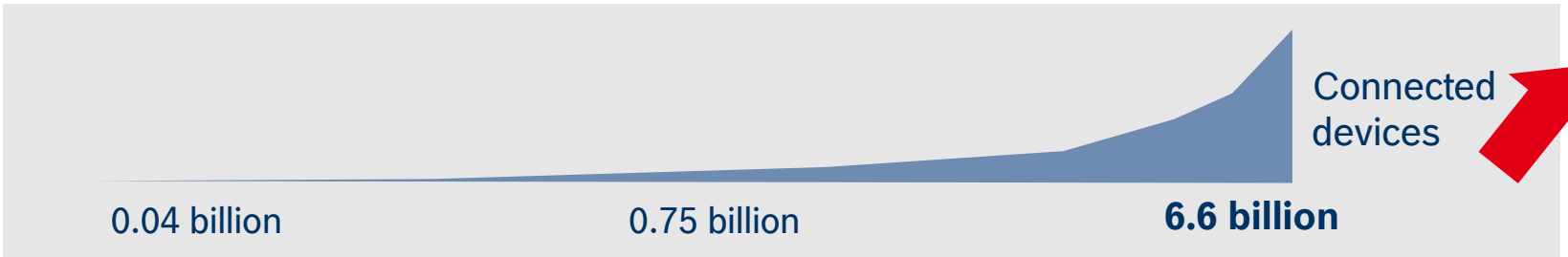
On the way towards a connected world ...





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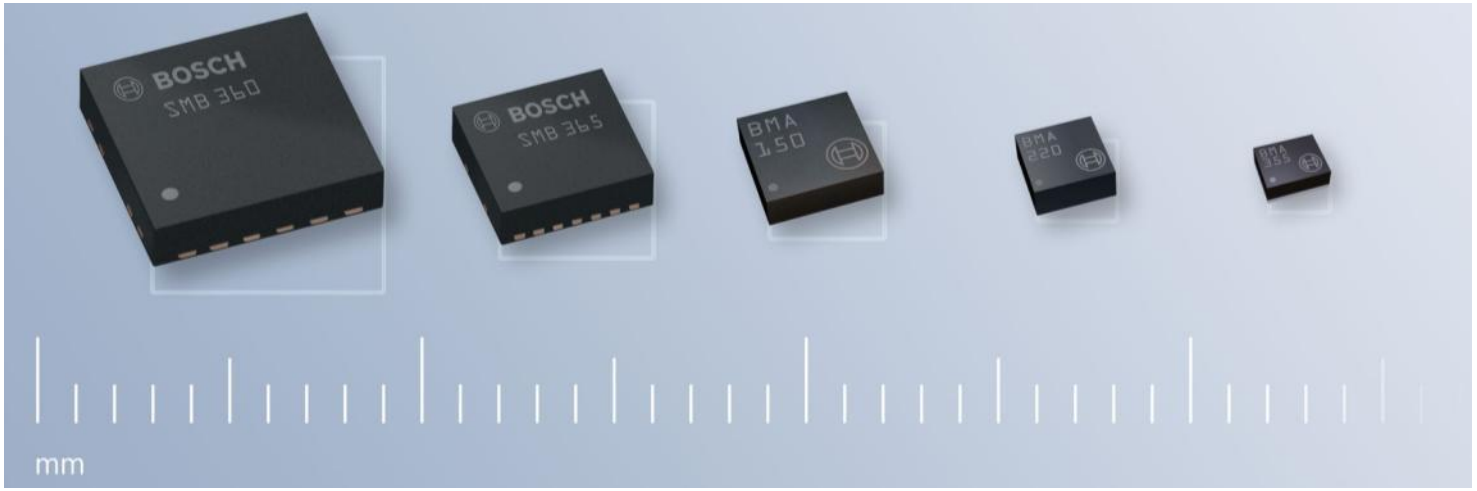
Enabling Technology: MEMS Sensors

“Moore´s law” in MEMS

➔Continuously shrinking size/footprint and reducing power consumption



2005 | 2006 | 2007 | 2010 | 2013

Bosch Sensortec 1st with 3x3 mm²

Bosch Sensortec 1st with 1.2 x 1.5 mm²

Bosch Sensortec 1st with 2x2 mm²

Source: Bosch Sensortec

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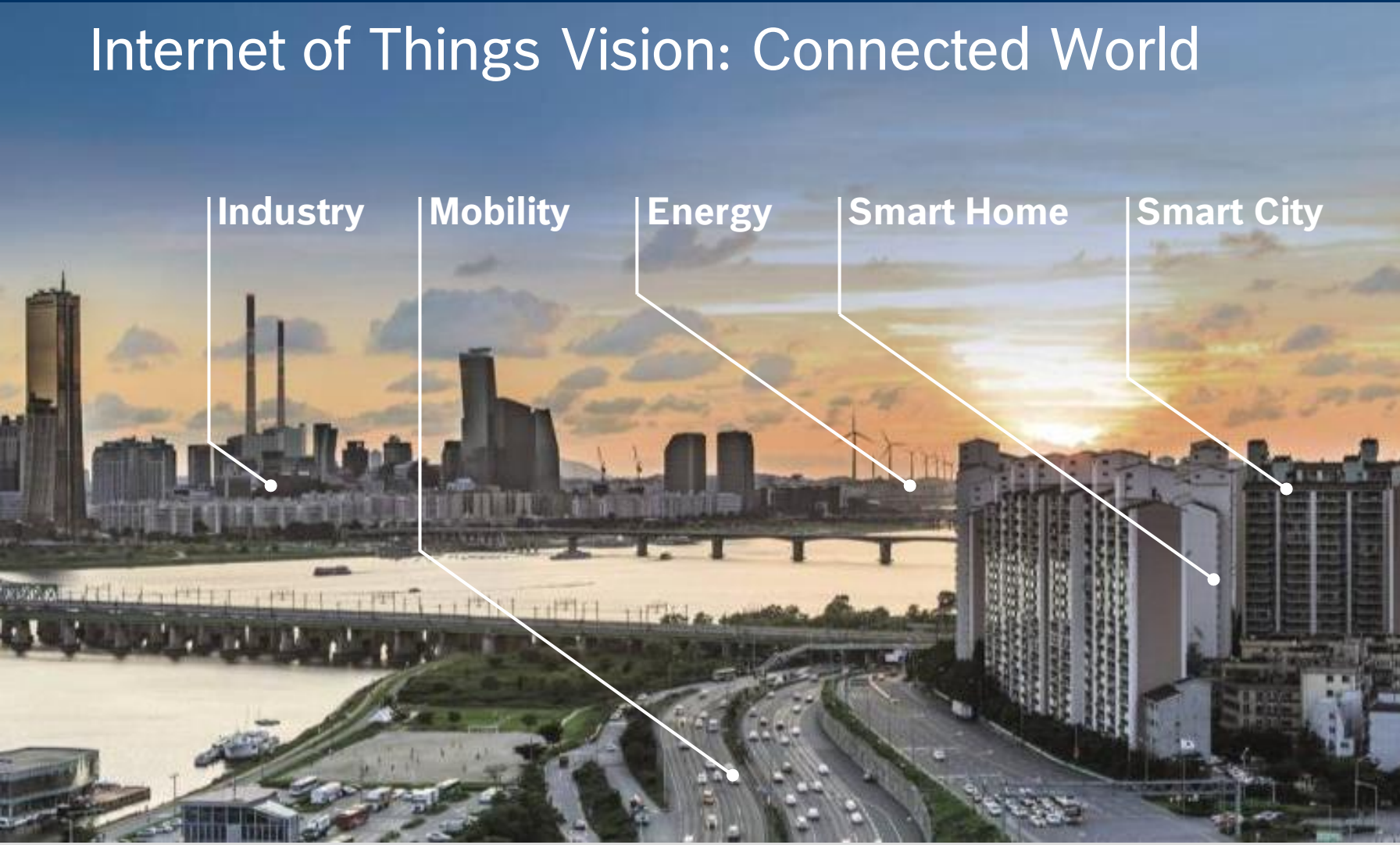
Internet of Things Vision: Connected World



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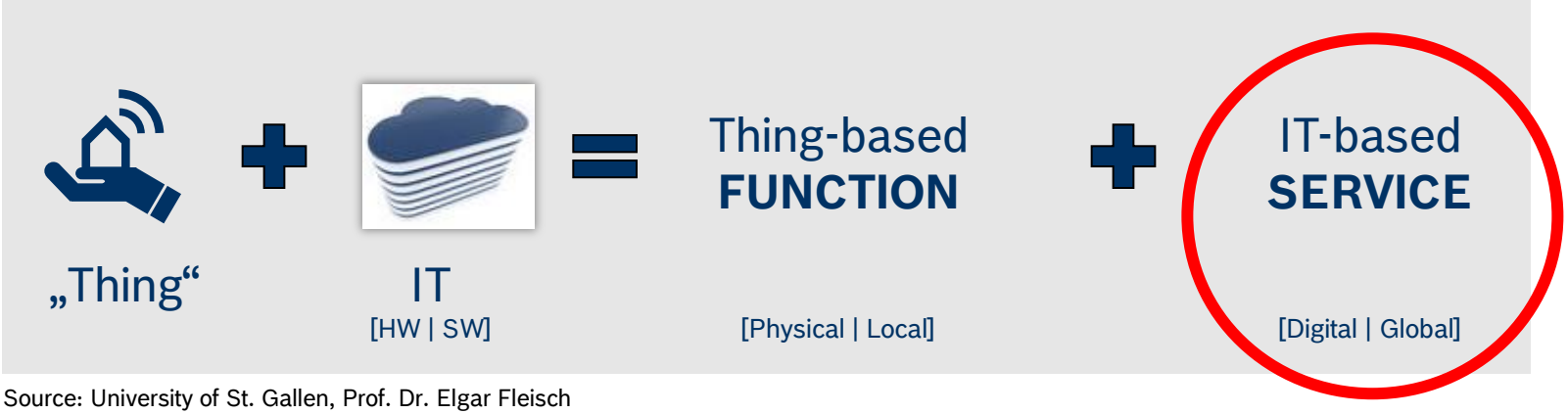
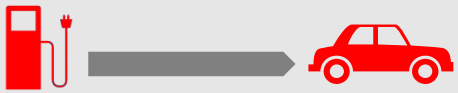
Connected “smart” things allow new services



Source: University of St. Gallen, Prof. Dr. Elgar Fleisch



Example FUNCTION:
Charging EV with electricity.

Example SERVICE: Find charging station, reserve and pay as you go.

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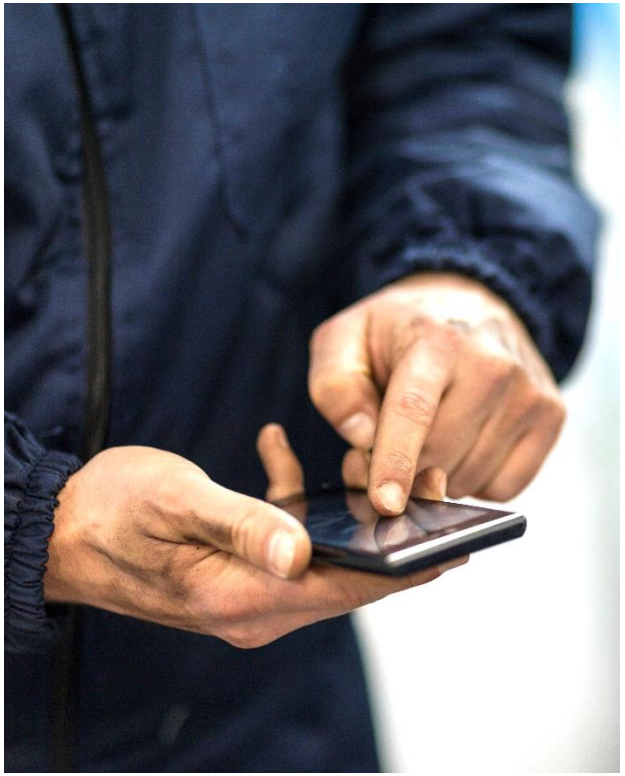
First Step Toward an IoT Solution

Add connectivity to the basic functionality.



adding connectivity

smartphone app

connected

remote control

managing all devices

connected home

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The Way Towards an Intelligent Solution

Add smart sensors to increase functionality.

motion detector

increased comfort

smart sensing

internet based

remote management

lighting pattern

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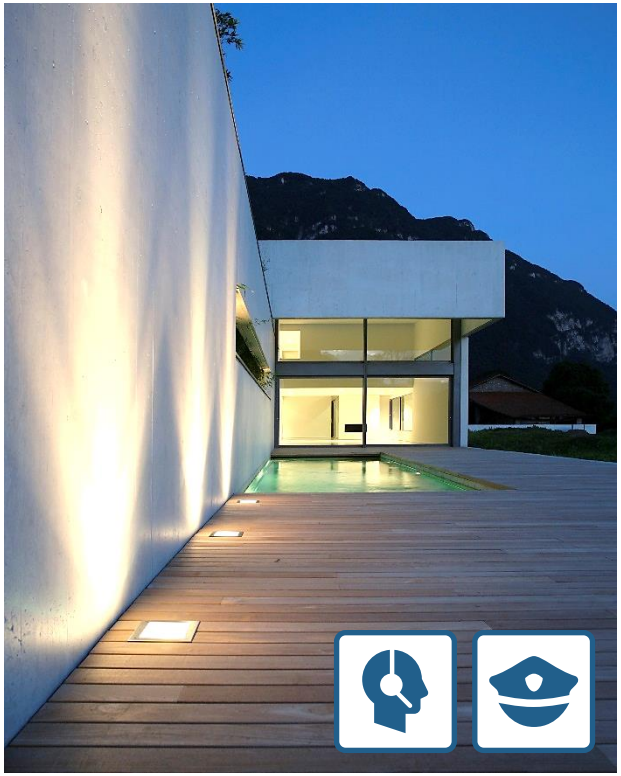
Finally: Added Value for the Customer

Find convenient new services based on the technological possibilities.



local intelligence

minimal additional costs

internet service

added value

security service

new business models

more: www.comfylight.com

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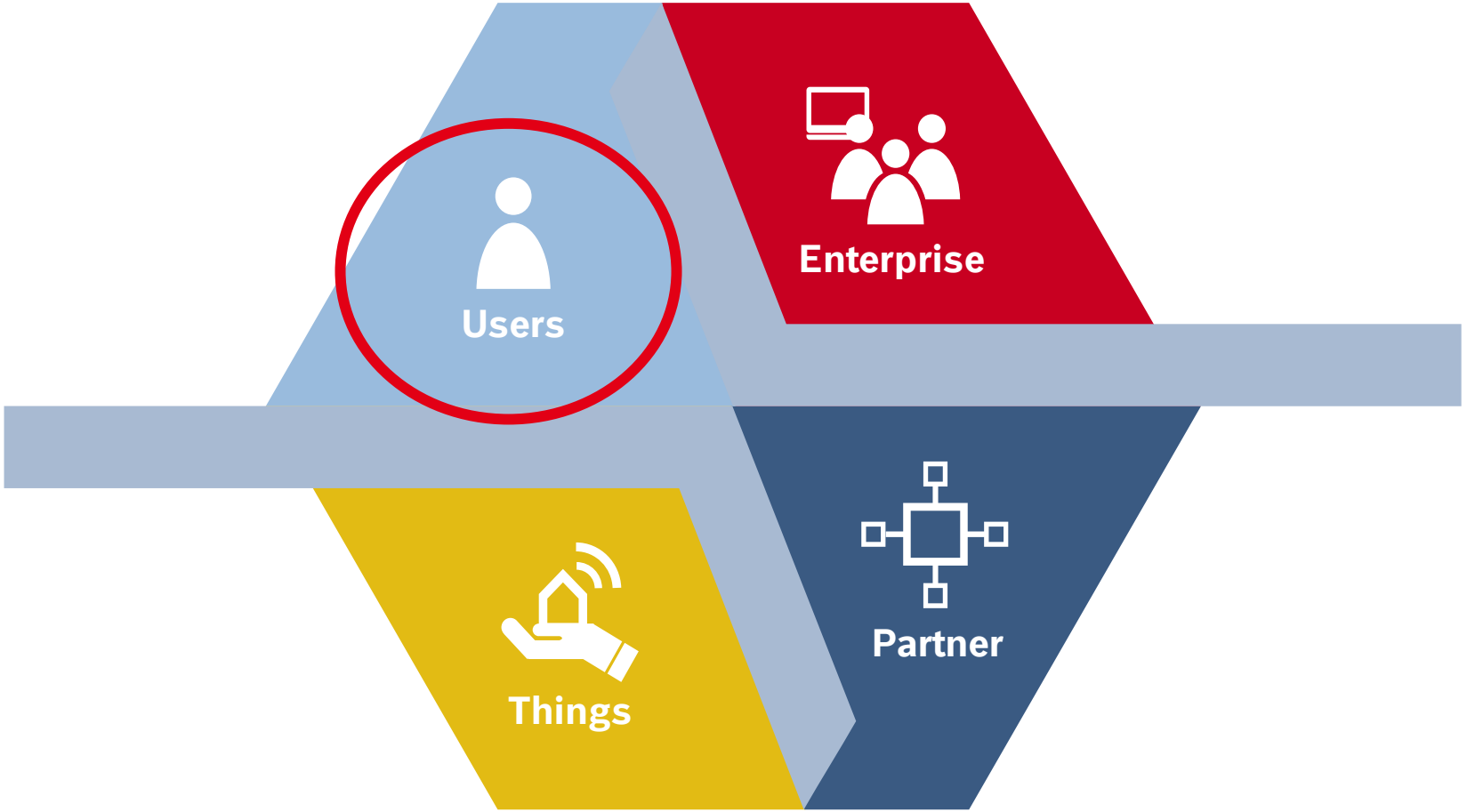
Connected World Solutions cover 4 Areas



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Connected Manufacturing Example: Service Portal

Machine Operator

- One portal for all maintenance applications
- Integration of existing processes and systems
- Comprehensible and accurate accounting of warranty services

Enterprise

- Maximize uptime
- Better planning of maintenance activities
- Use maximum lifetime of spare parts and products
- Increased productivity

Machines & Components

- Real-time compilation of machine and sensor data
- Rule-based analysis of machine data to create mal-function prognosis
- Mapping of maintenance processes

Service Partner

- Optimize services offered for customers
- Revenue through new services
- Increase margins by offering services remotely

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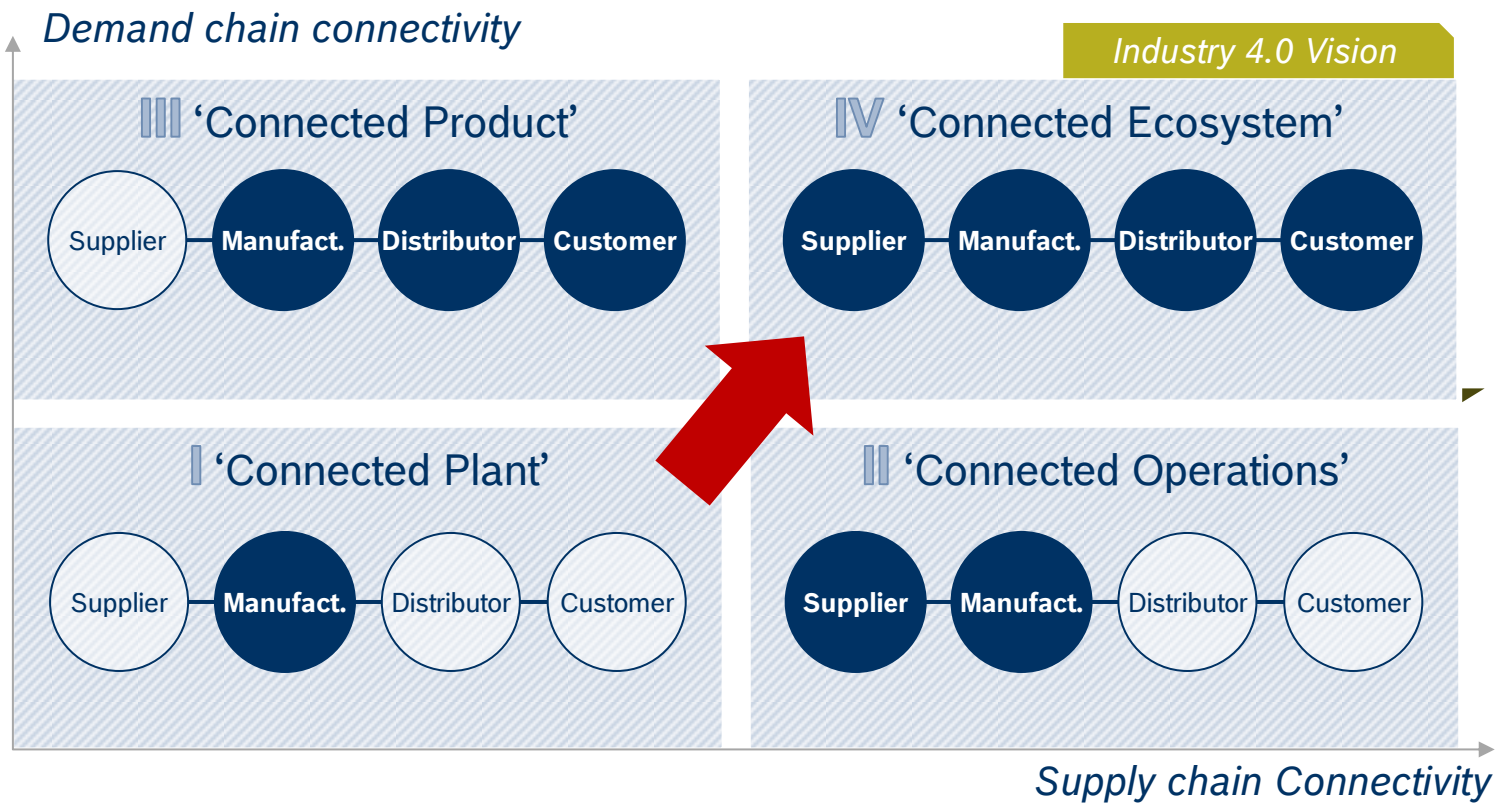
Industry 4.0: Solution Quadrants



Source: Demand chain management in manufacturing and services: Web-based integration, drivers and performance, Markham T. Frohlich , Roy Westbrook

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The IoT in Manufacturing: Industry 4.0

Increasing competitiveness by combining IT expertise and domain competency in new solutions

Shortening reaction times

Converting fixed costs into variable costs

Optimizing the work environment

Developing new business models

Expanding market share

Increasing output

Reducing total costs

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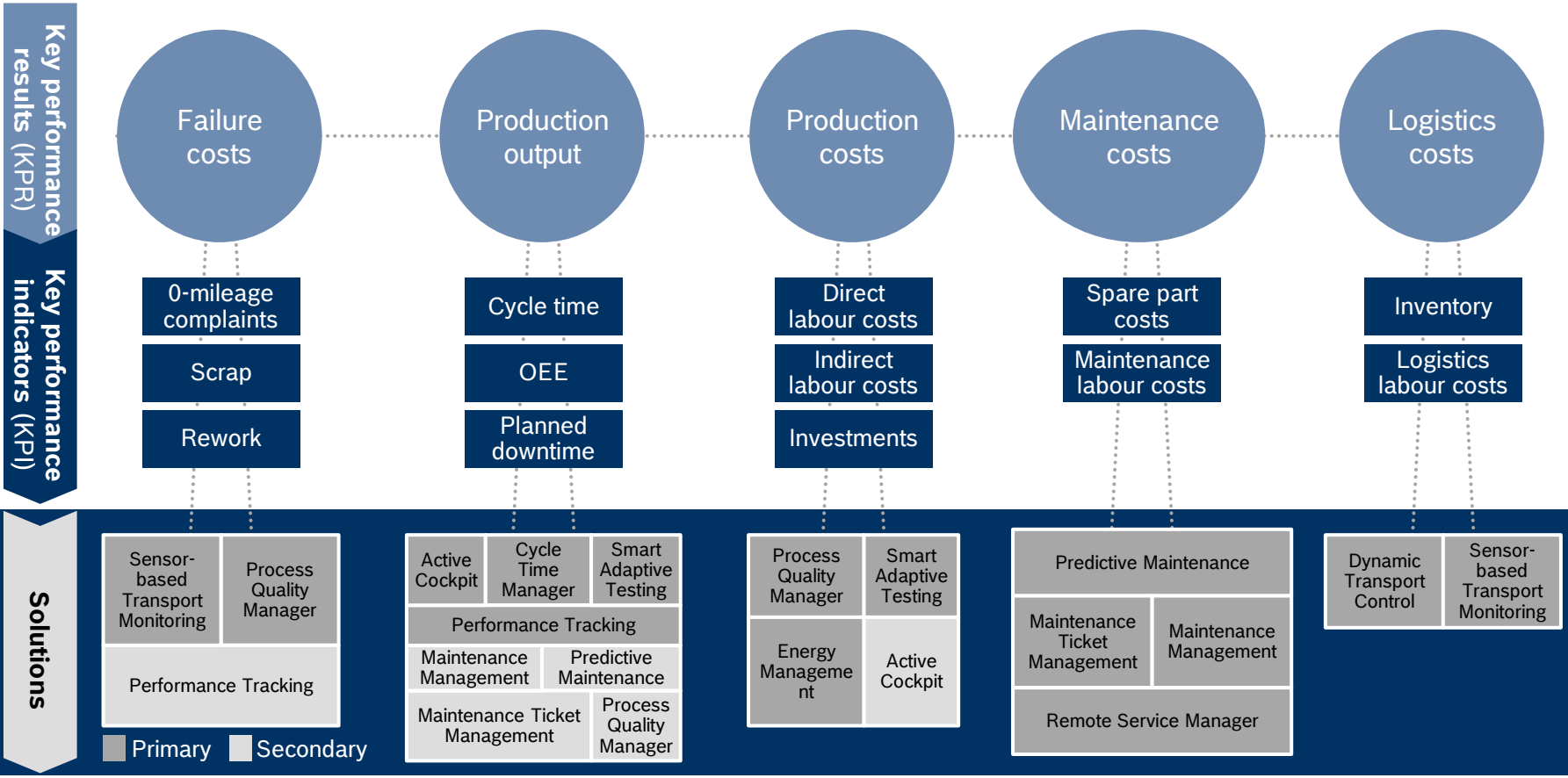
Our solutions for higher competitiveness



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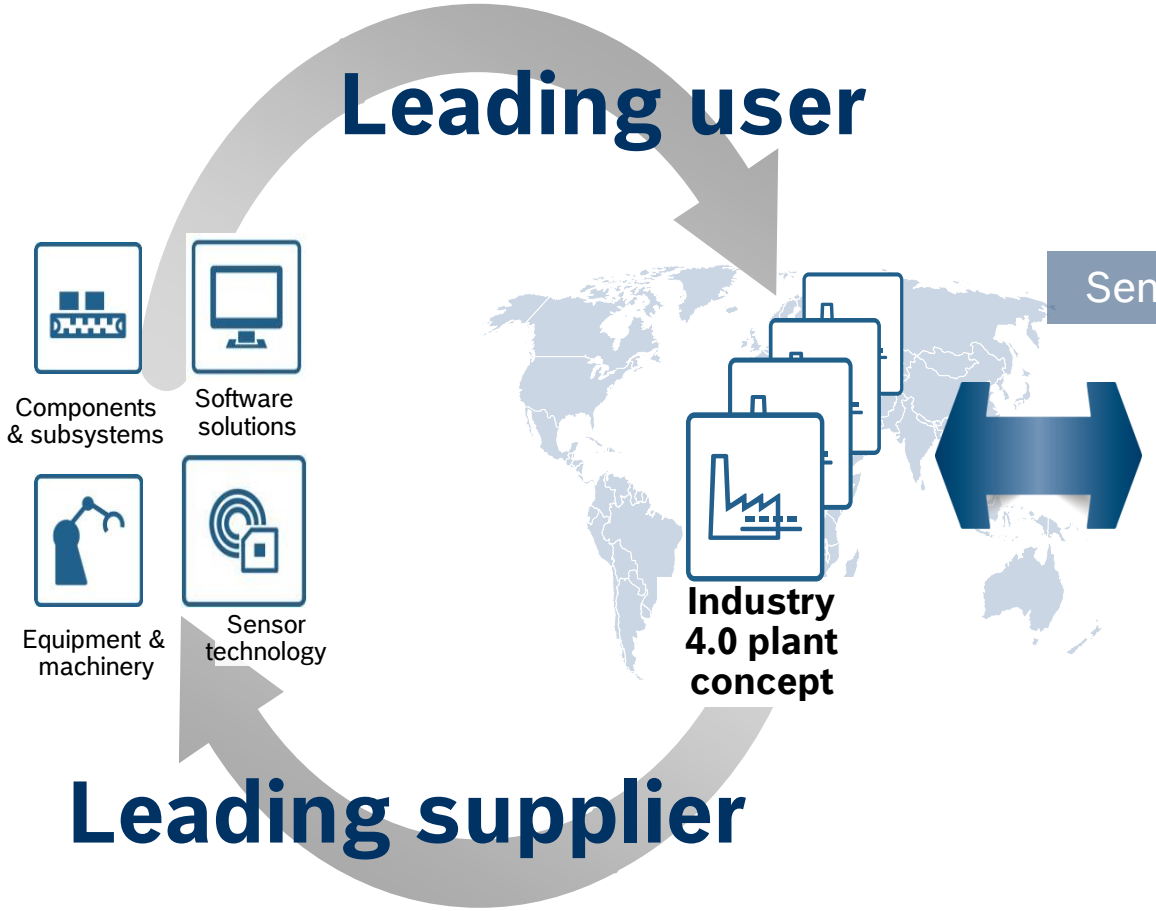
Bosch's dual strategy towards Industry 4.0



More than 50 pilot projects in Industry 4.0

- Cycle time monitoring
- Sensor-based Transport Monitoring
- Connected production
- Machine health monitoring
- Service management
- Predictive Maintenance
- Adaptive logistics
- Adaptive production
- Smart Adaptive Testing

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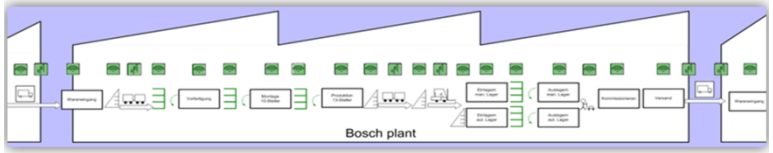
Industry 4.0 example: RFID creates transparency

RFID within Bosch Production System



Process orientation	Physical = virtual process
Pull system	Strict kanban process by RFID
Waste elimination	Lean processes for operator
Associate involvement	Real time feedback with history
Continuous improvement	Supported by continuous monitoring

Use case

- Logistic based on a consequent application of RFID throughout the entire value stream

I 4.0 aspects

- Distinct identification of products including their “Internet of things” participation
- Create product memory for e.g. quality data
- Decentralized self control (e.g. automatic Kanban-Principles; Link to MES)
- Automatic order processing throughout the entire value stream (closed loop from supplier up to customer)

Exemplary results

- Simplified management of variants (Poka-Yoke „inherent to the system“)
- Improvement in process efficiency **+10%**
- Transparency in Real time; thereby reduction of stocks **-30%**

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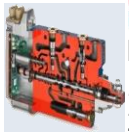
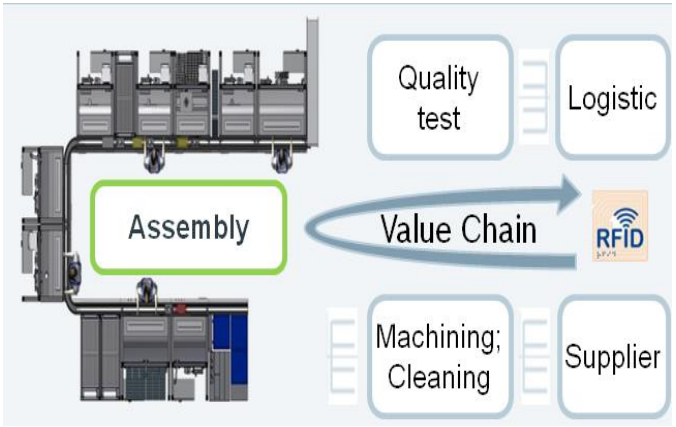
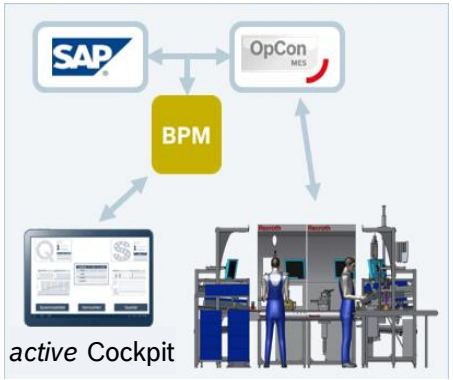
Homburg Plant 2: I4.0 assembly line for hydraulic valves



Rexroth
Bosch Group
Hydraulic valves
100.000 p/a
2.200 parts





Key data	Actual	Pilot Line
Product variants	3-10 per line	~ 25 + new types
Assembly lines	6	1
Set-up [min]	5-30	~ 0
Stock [days]	2	< 1

- Unique product identification by RFID, coupling with work plan, product informs flexible line about process steps
- Replaceable autonomous stations, update of virtual image by work plan configuration
- Automatic ergonomic adjustment of stations/ machines to operator
- Line and product status, stock data in MES/ERP; real-time reporting and actions by *active* Cockpit

Adaptive assembly line to manage high product variance

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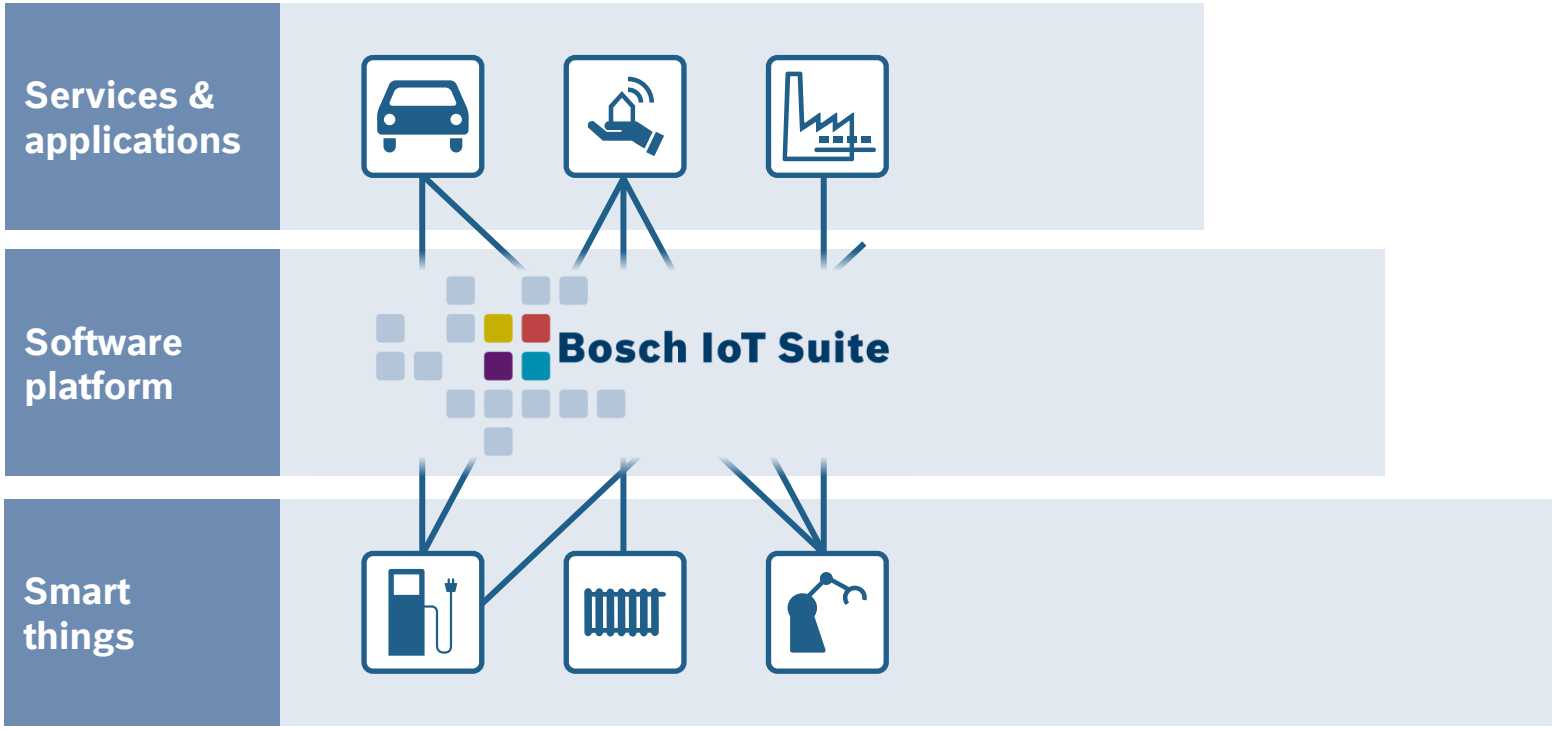
The Three Layers of the IoT

- A software platform converts information provided by smart things into services.



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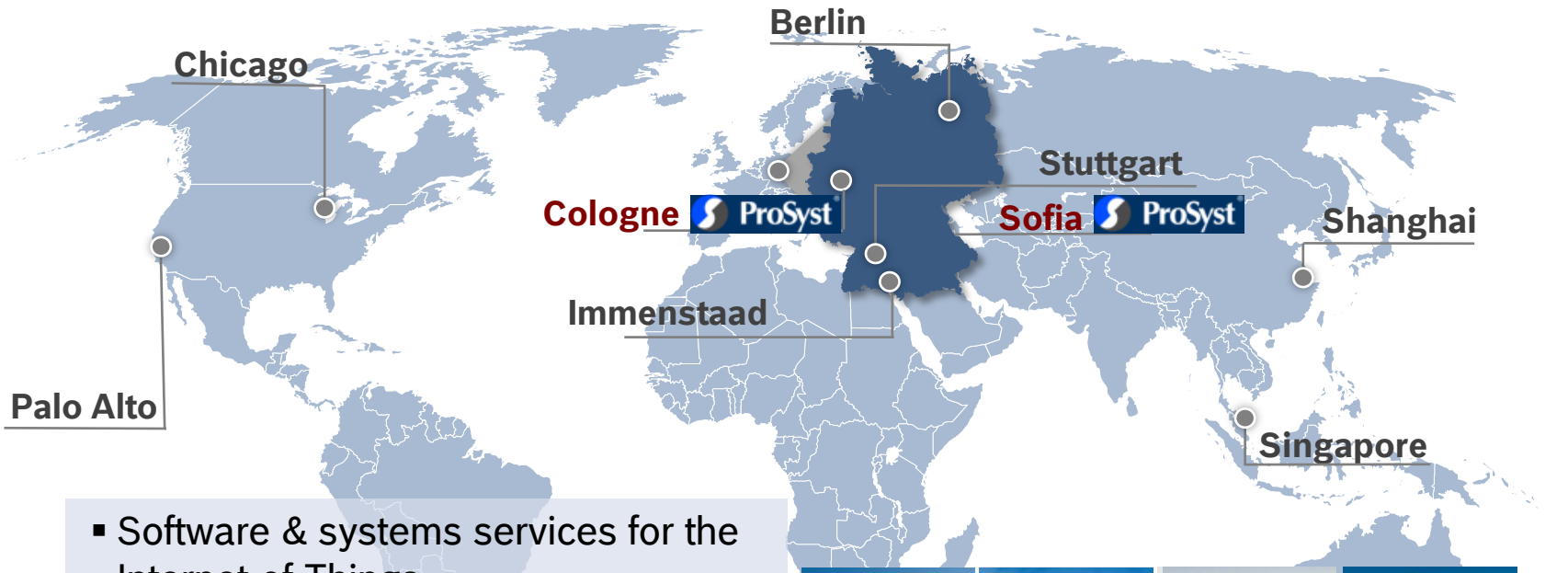
Bosch Software Innovations and ProSyst



- Software & systems services for the Internet of Things
- Broad experience from embedded electronics to complex IT systems
- 730 associates worldwide, strongly growing

Connected Industry

Connected Mobility

Connected Energy

Connected Home & Building

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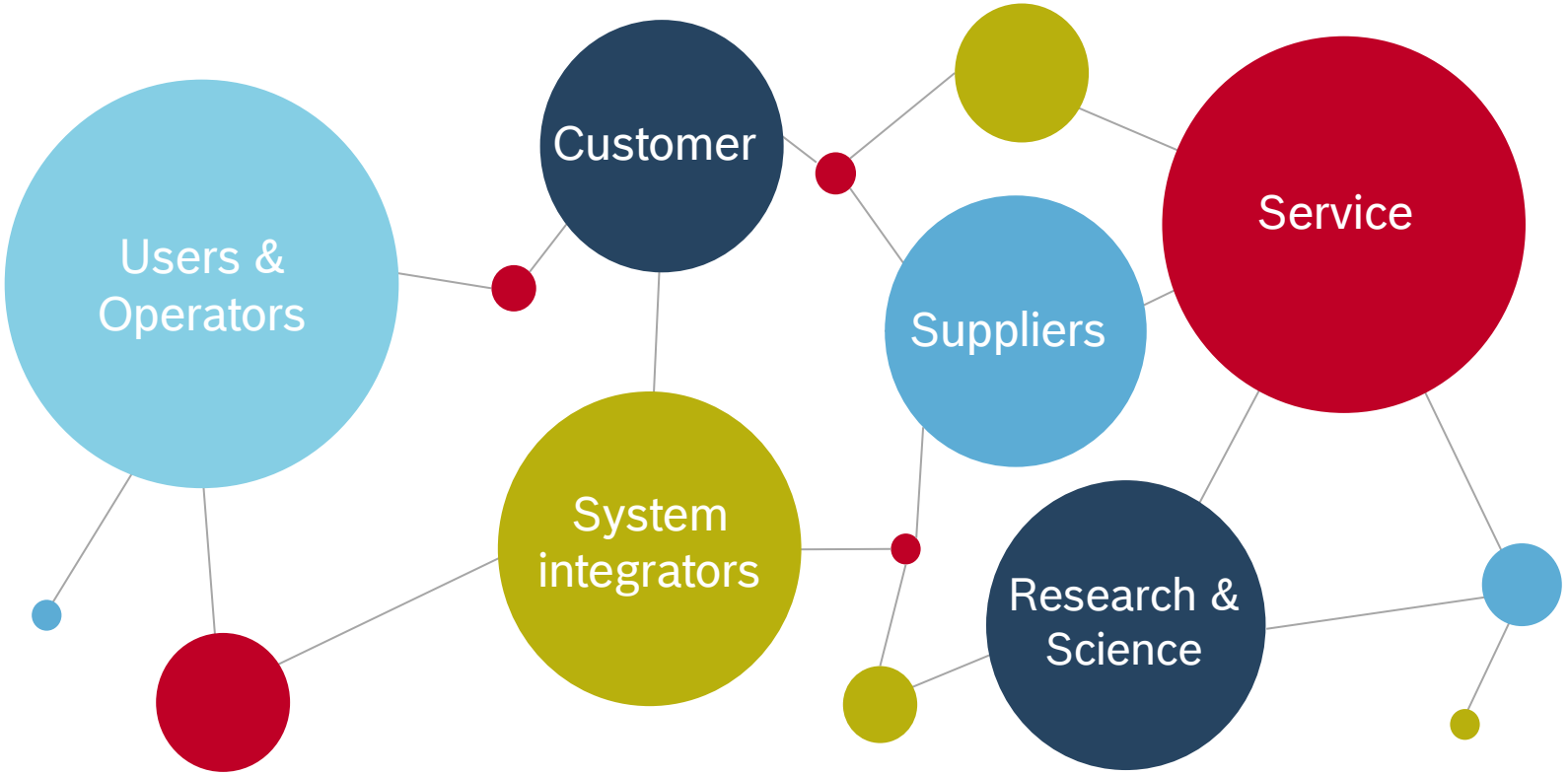
Connected world: nobody can do it alone



- “Eco-Systems” of business partners
- Strong involvement of users

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Our Partners (examples)

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The Internet of Things: Connected products – connected manufacturing

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