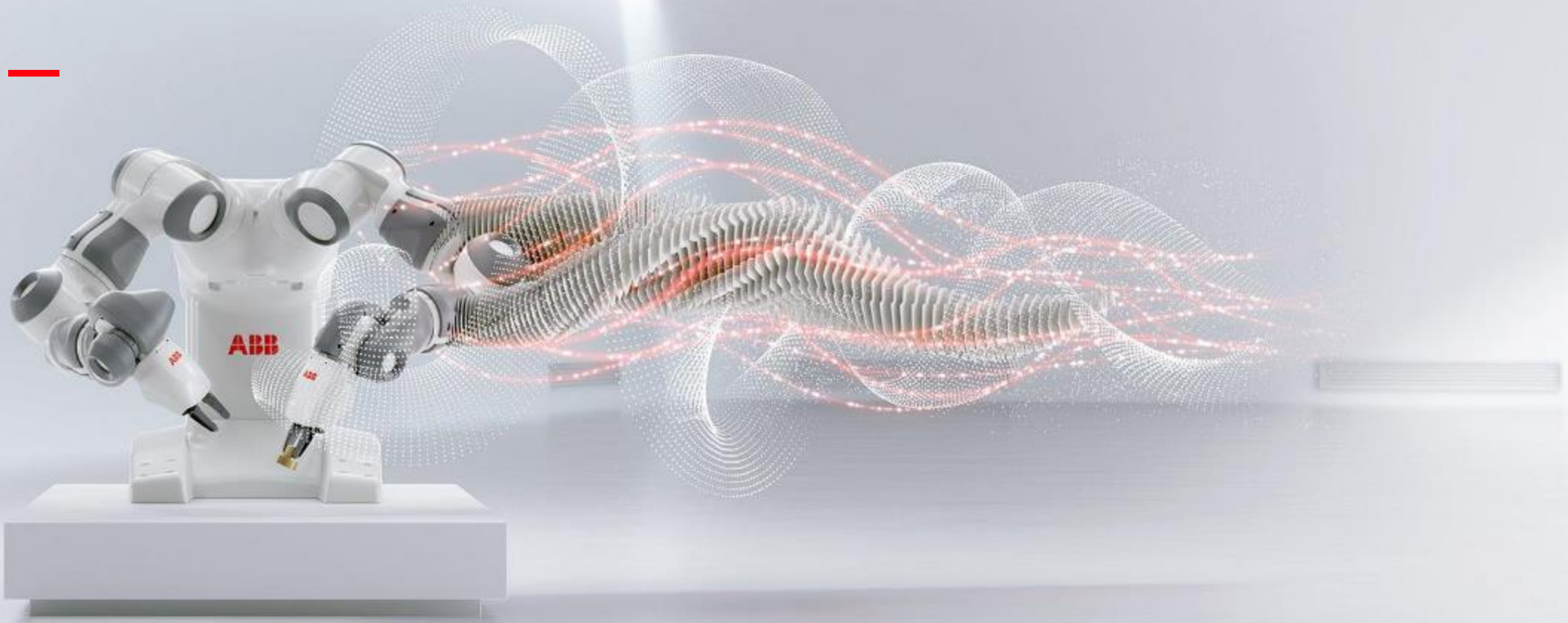


MAY 18THTH 2017

La robótica del futuro

Digital y colaborativa

Marc Segura, Local Division Manager Robotics & Motion

La robótica del futuro: digital y colaborativa

La industria de la robótica nació en los años 70 en el sector del automóvil. Durante tres décadas los grandes avances se centraron en dotar de más fiabilidad, velocidad y precisión al tiempo que se reducían los costes. Pero hoy la situación ha cambiado: aprovechando desarrollos exponenciales de otras industrias (sensores, cloud, data analytics, baterías eléctricas, IA etc.) la robótica se encuentra en un momento de explosión tecnológica en cuanto a nuevas prestaciones que permiten aplicarse a los robots de forma masiva y en cualquier industria.

- La robótica industrial hoy
- La fábrica del futuro
  - Digitalización
  - Robótica colaborativa

ABB: the pioneering technology leader

What (Offering)	**Pioneering technology**		
	Products 58%	Systems 24%	Services & software 18%
For whom (Customers)	**Utilities**	**Industry**	**Transport & Infrastructure**
	~35% of revenue	~40% of revenue	~25% of revenue
Where (Geographies)	**Globally**		
	Asia, Middle East, Africa 38%	Americas 29%	Europe 33%

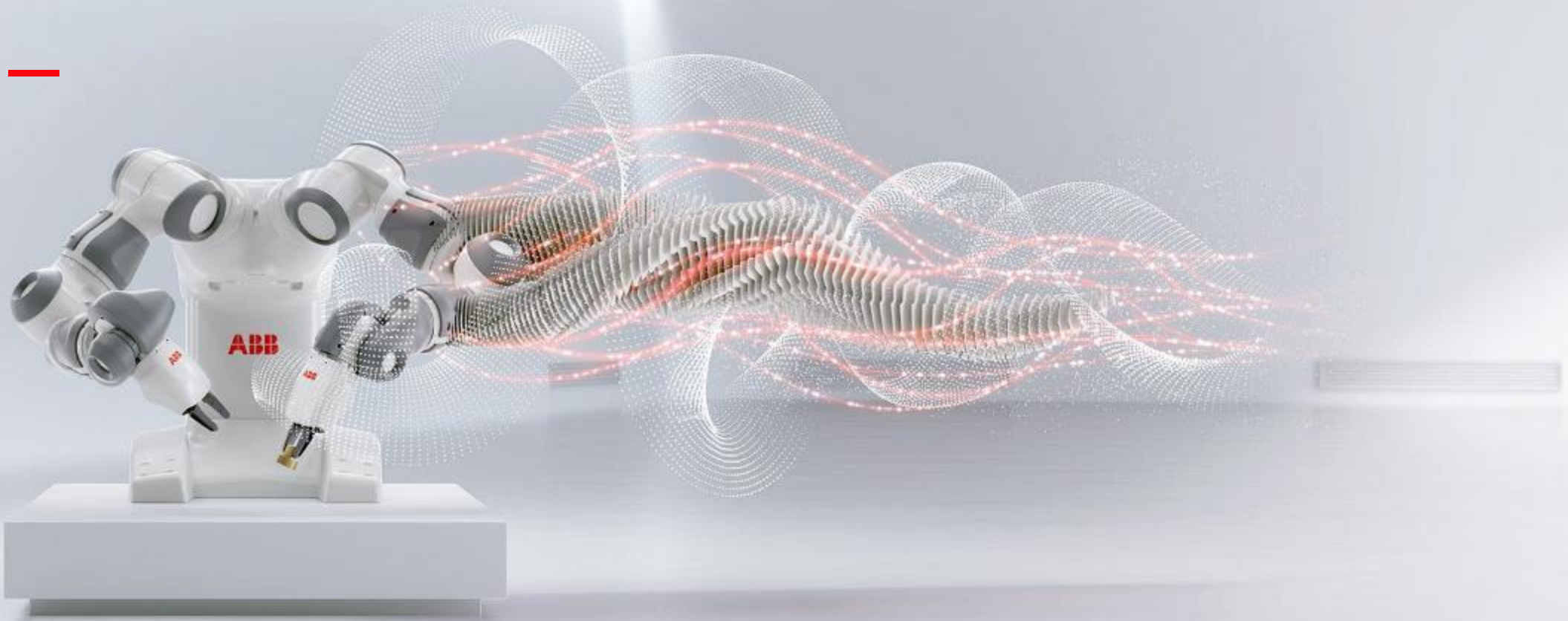
~$34 bn revenue	~100 countries	~132,000 employees

Attractive markets: Energy and Fourth Industrial Revolutions

The Energy Revolution

The Fourth Industrial Revolution

Utilities	Industry	Transport & Infrastructure



Robotics today

Overview

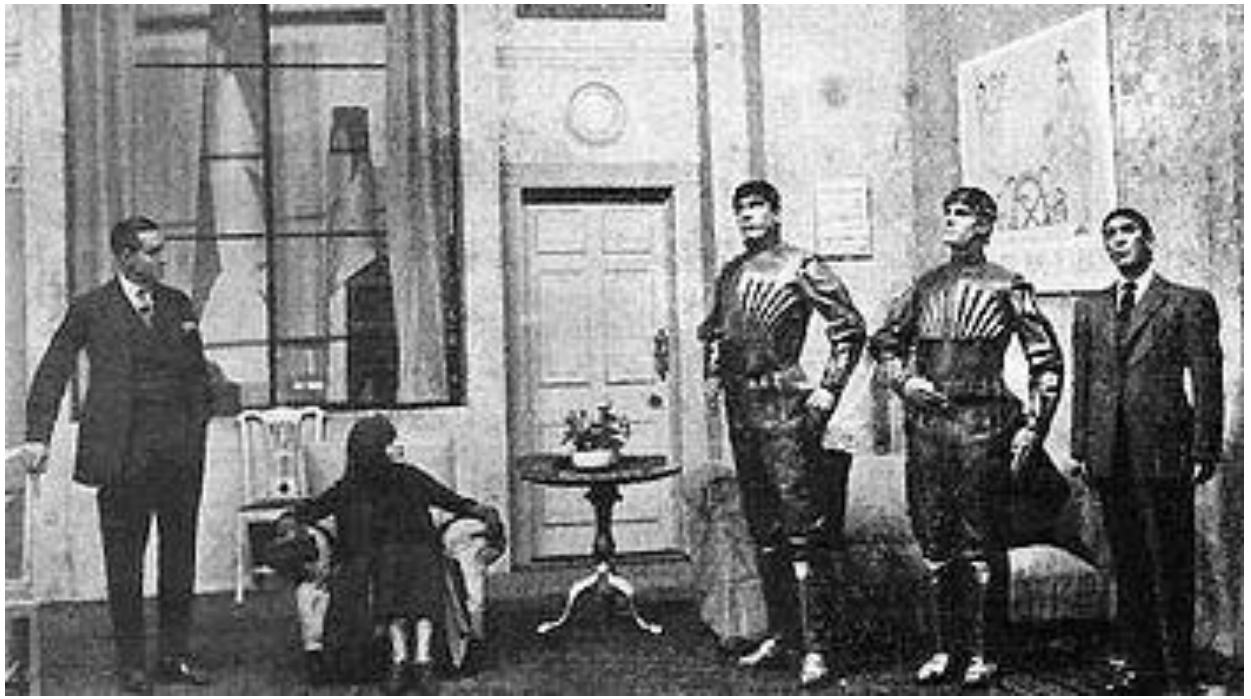
Robotics today
What is a robot?

DEFINITION OF A ROBOT

Manipulating industrial robot as defined in ISO 8373

An automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.

Robotics today
What is a robot?

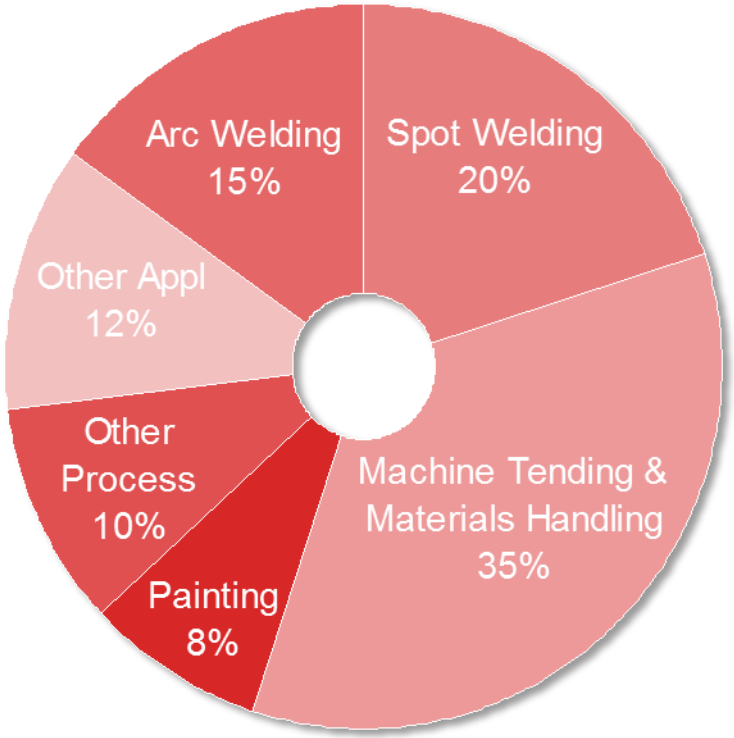


R. U. R. (Robots Universales Rossum) – en checo *R.U.R. (Rossumovi univerzální roboti)* - es una obra teatral de ciencia ficción escrita por el checo Karel Capek en 1902.

Es conocida por contener la primera aparición del término "*Robot*". Dicha palabra había sido ideada por el hermano del autor, Josef Čapek (1887 - 1945) a partir de la palabra checa «*robota*», que significa «trabajo» (sobre todo el de los siervos de la gleba).

Robotics today

Main applications



Robotics

The ABB Robot Family

Robotics

Software: RobotWare

RobotWare for Ease-of-Use

- Spot Welding
- Arc Welding
- Laser Cutting
- Plastics (Injection Molding)
- Diecasting
- Machining Force Control
- Machine Tending
- Assembly
- Packing
- High Speed Picking
- Press Tending

Robotics

Software: RobotStudio®

RobotStudio for Simulation and Offline Programming

RobotStudio is the easy-to-use, low cost software for visualization and offline programming of ABB robots. It is the tool you need to maximize your productivity.

- Create a common view in the planning stage
- Verify tooling and fixtures in the design stage
- Program robots faster in the start-up stage
- Modify programs without downtime in the production stage

Robotics

Modular Manufacturing Cells and Function Packages Global Standardized Robot-based Solutions

Arc Welding

FlexArc

Machining

Machining FunPack

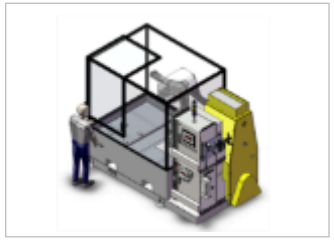
Finishing

FlexFinishing

Machine Tending

FlexMT®

Washing



FlexWasher

Palletizing

PalletPack

Painting

Paint Application Pack

Picking & Packing

RacerPack

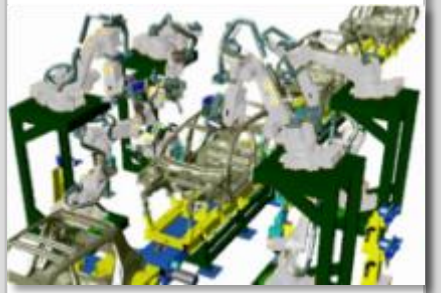
Robotics

Automotive Systems: Overview

Press Automation

Complete press-line solutions using standard, pre-tested modular products to reduce project risk, time and costs

Body-in-White



Standard modules deliver high uptime, lower life-cycle costs, shorter lead times and high flexibility for your body shop

Paint Automation

A complete range of solutions to help you improve the productivity and quality of your paint shop operations

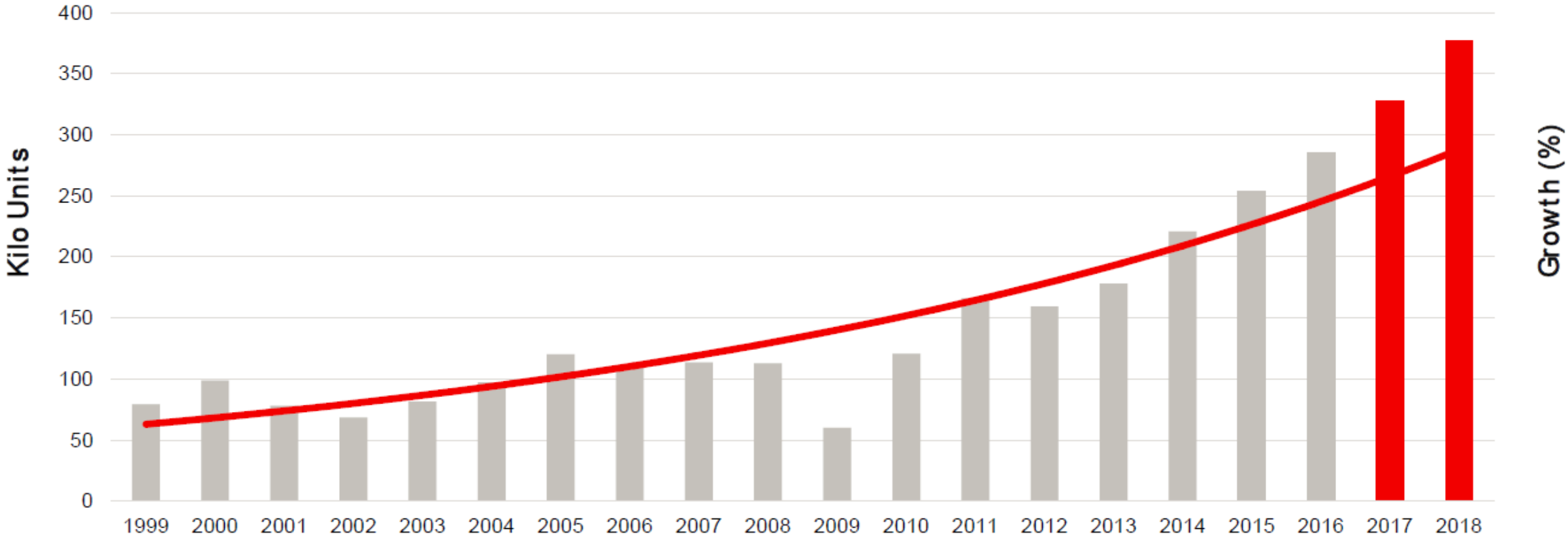
Powertrain Assembly

Standard configurable modules for assembly and test systems for engine, transmission and axle lines

BUT…….THINGS ARE CHANGING

The future looks bright

Shipments projected to increase by 15% till 2018 (IFR)



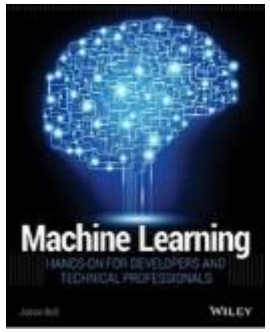
Digital technologies are driving new innovation in industrial markets

Media is focused on B2C but the “killer app” is in B2B

Virtual/augmented reality

Software-defined machines

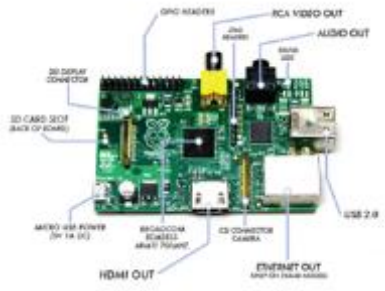
Machine learning



Time-sensitive networking

Big data

Inexpensive computing

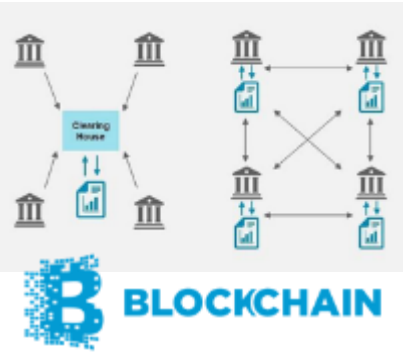


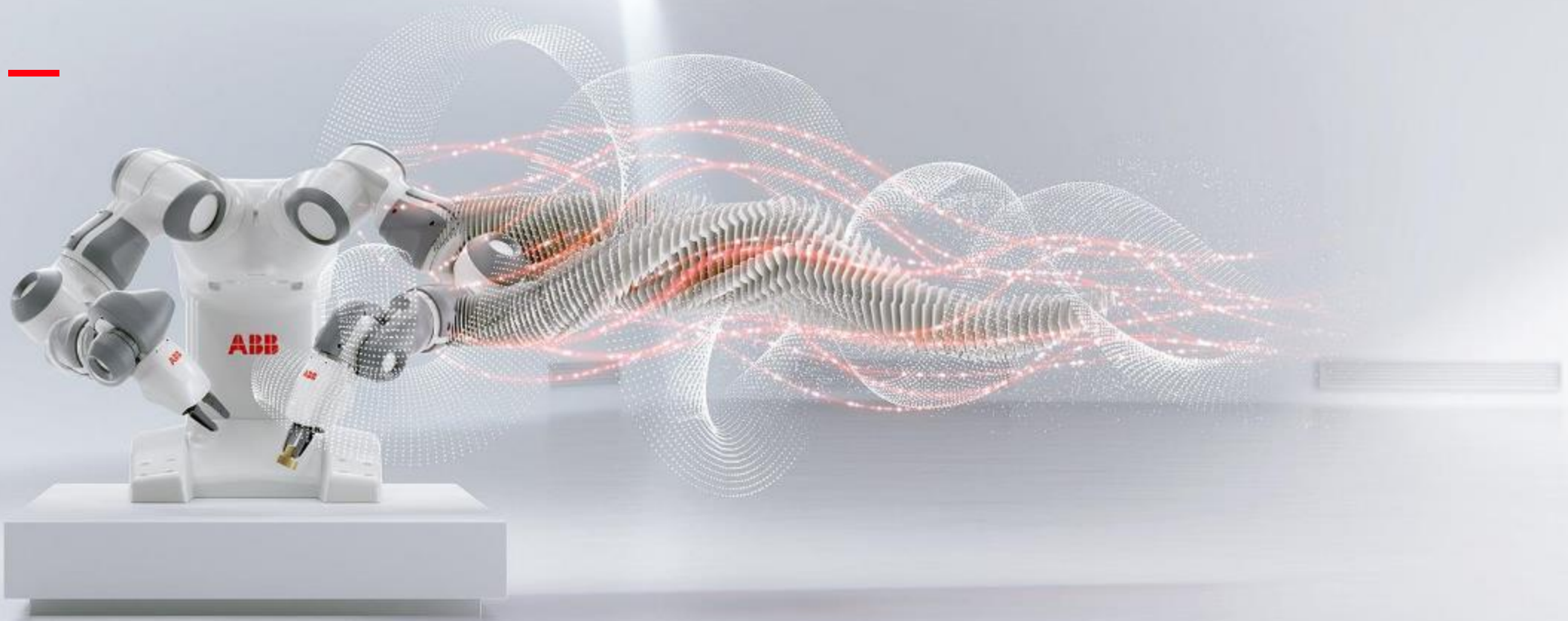
Cloud computing

Cybersecurity

Connectivity

Blockchain





Robotics – Factory of the future

Overview

Industry trends and focus

Digitalization at scale is the driver 100% flexible and integrated manufacturing systems

		Flexible Automation	Collaborative Automation	Adaptive & Configurable	Near 100% automation
Digital space	Control	Fully pre-determined programming	Based on production / process	Based on product / part	Autonomous / Self-learning
	Intelligence & optimization	In machine	At the machine & in cloud	Connected edge-to-cloud	Mobile Robotics
Physical space	Hardware	Robotic & hard automation mixed with manual	Machines, Co-bots and Sensors	Machines and adaptive robotics	No humans doing dangerous or heavy manual jobs
	Material flow	Mainly conveyor based; no integration outside plant	Use of AGVs in mixed areas; no integration outside plant	Mobile, self-optimizing logistics	Full integration across Supply chain

Digitalization in ABB Robotics today

Opportunity: driving customer value through the entire automation lifecycle

Engineering efficiency

Critical to the flexible factory of the future

Faster product launches and changeovers

Increase integration and collaboration

Reducing downtime

Critical in capital intensive industries such as automotive

Reliability important to emerging growth sectors like food and beverage

Reduce maintenance burden on total cost of ownership

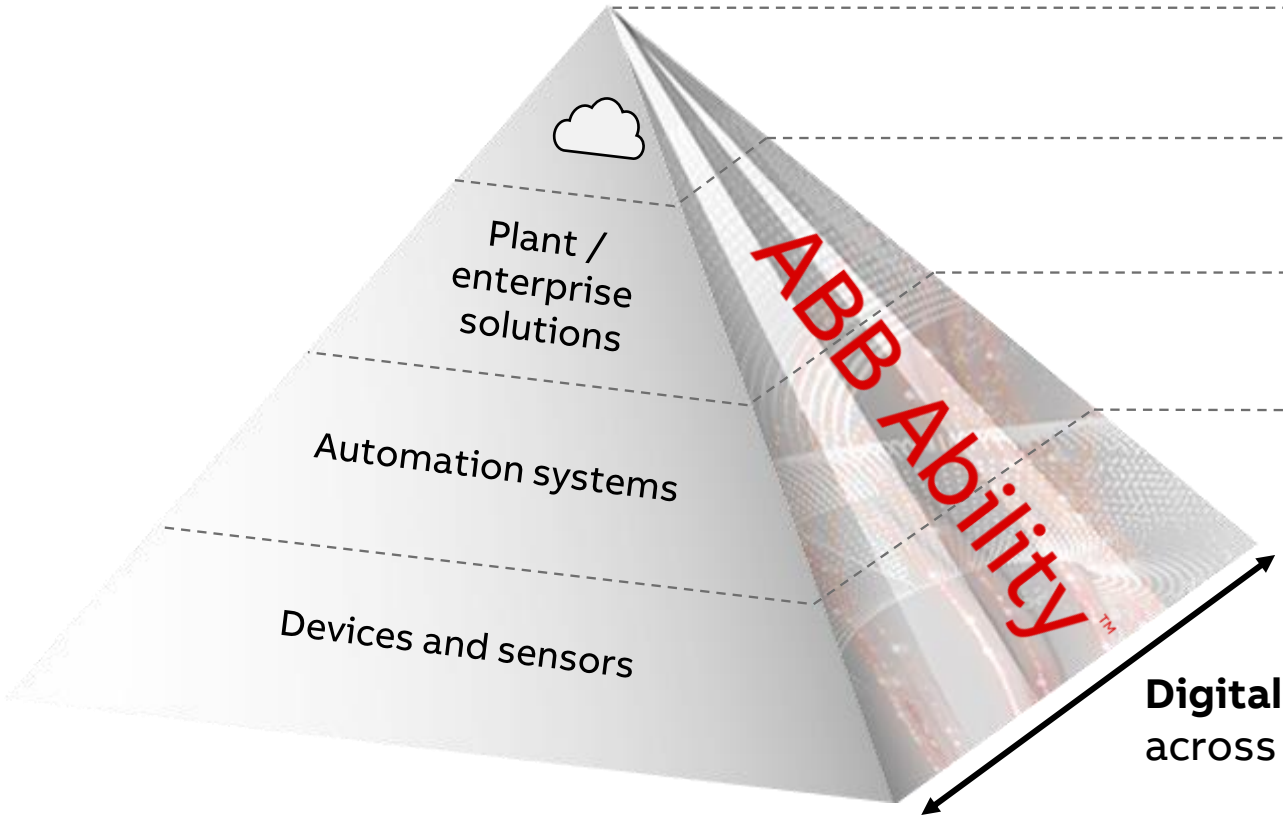
Driving down cost

Traditional drivers such as quality and productivity remain very valid

Automation to offset rising wages and talent shortages

Quantum leap in digital: ABB AbilityTM

Creating one common offering for digital end-to-end solutions



Build on customer trust, domain expertise, deep process knowledge

Open access, intelligent cloud

New end-to-end digital solutions

Closing the loop with connected devices

Digital ABB offering
across businesses: integrate, penetrate, replicate

All of Robotics is Digital

We will expand in Solutions building on data and connectivity

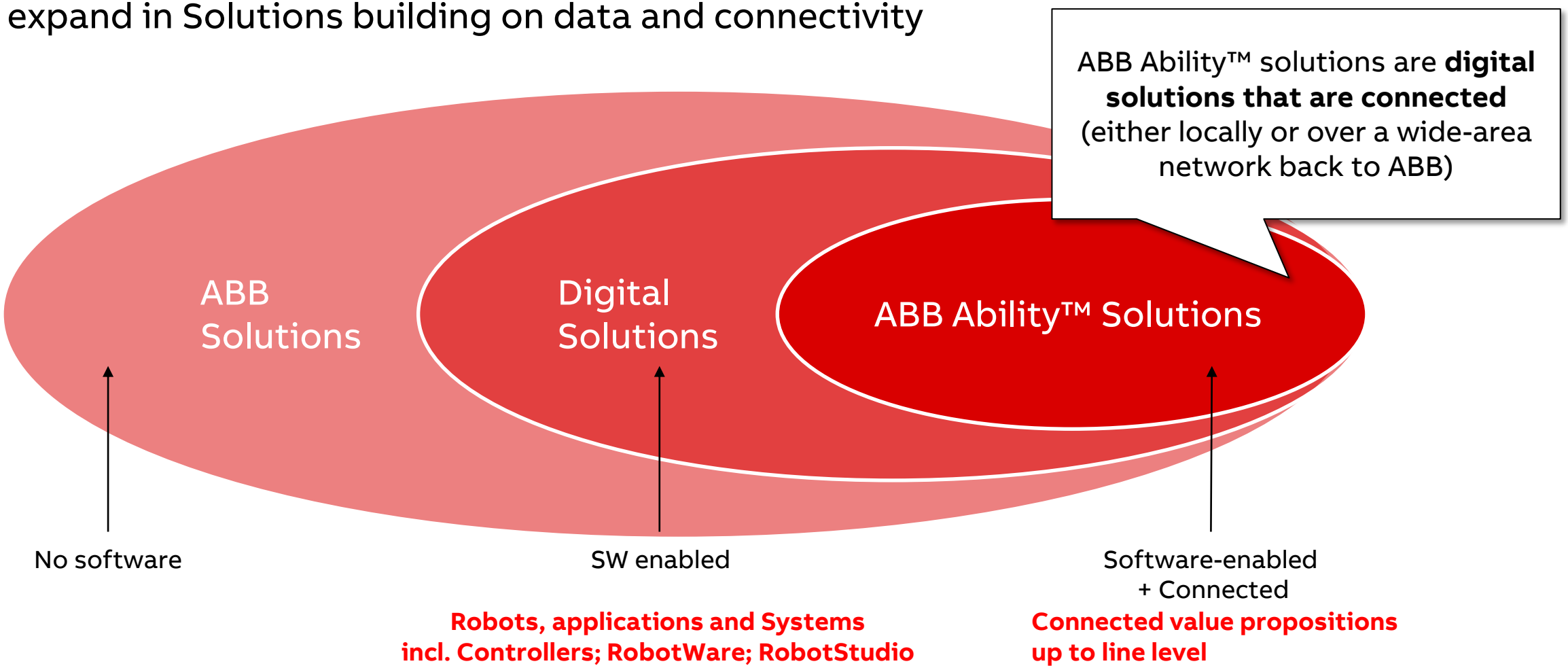
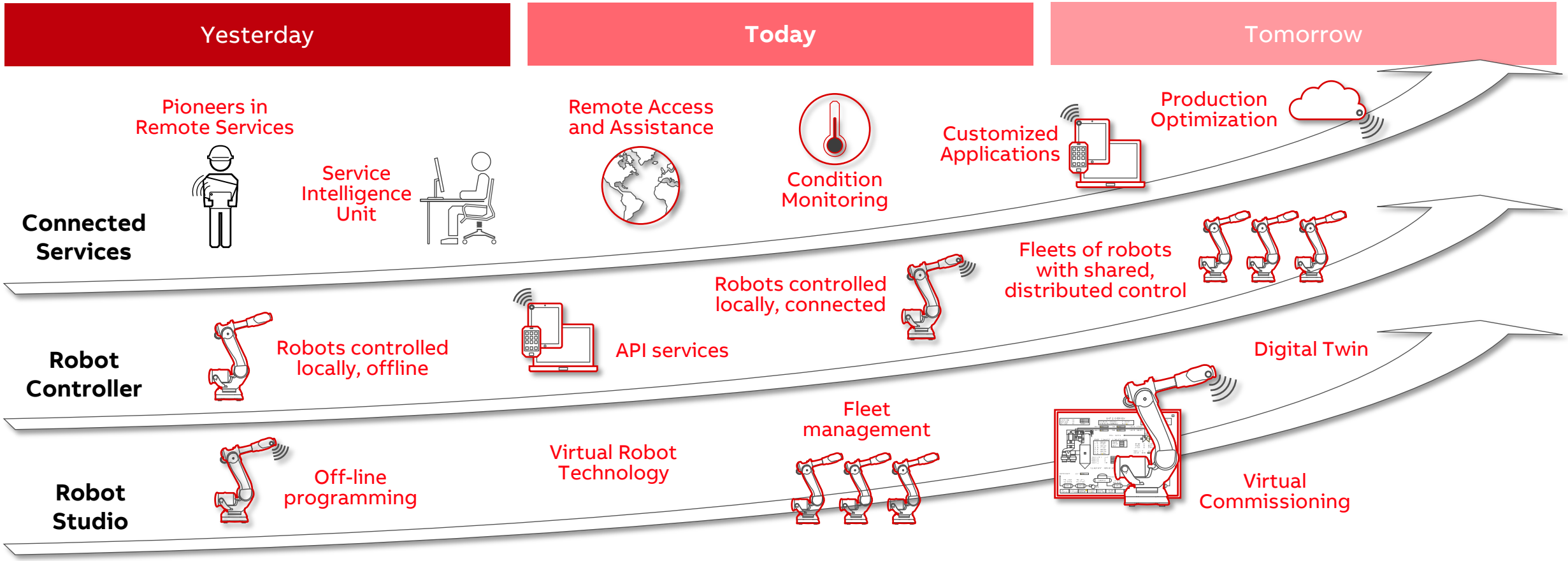


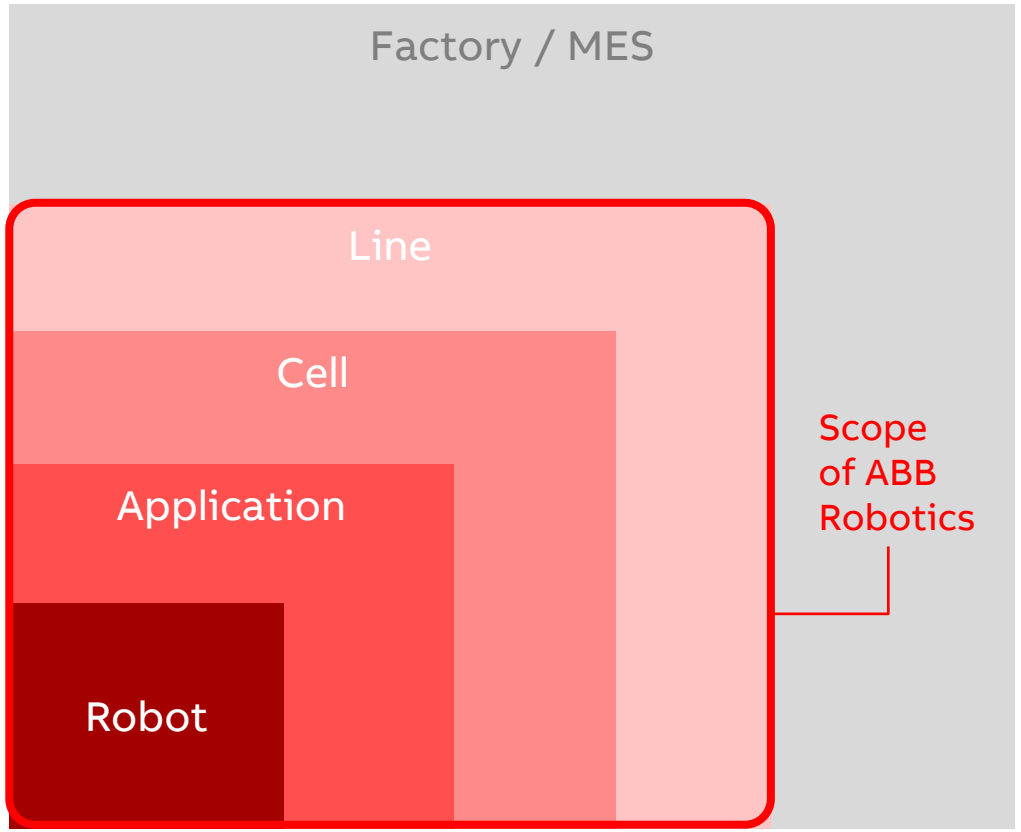
ABB Ability and digital development in our portfolio

Increasing Uptime, Reliability and Efficiency throughout the Life Cycle



We have a unique position in focus market segments

Domain expertise + our wide installed base are the core enablers to capture value

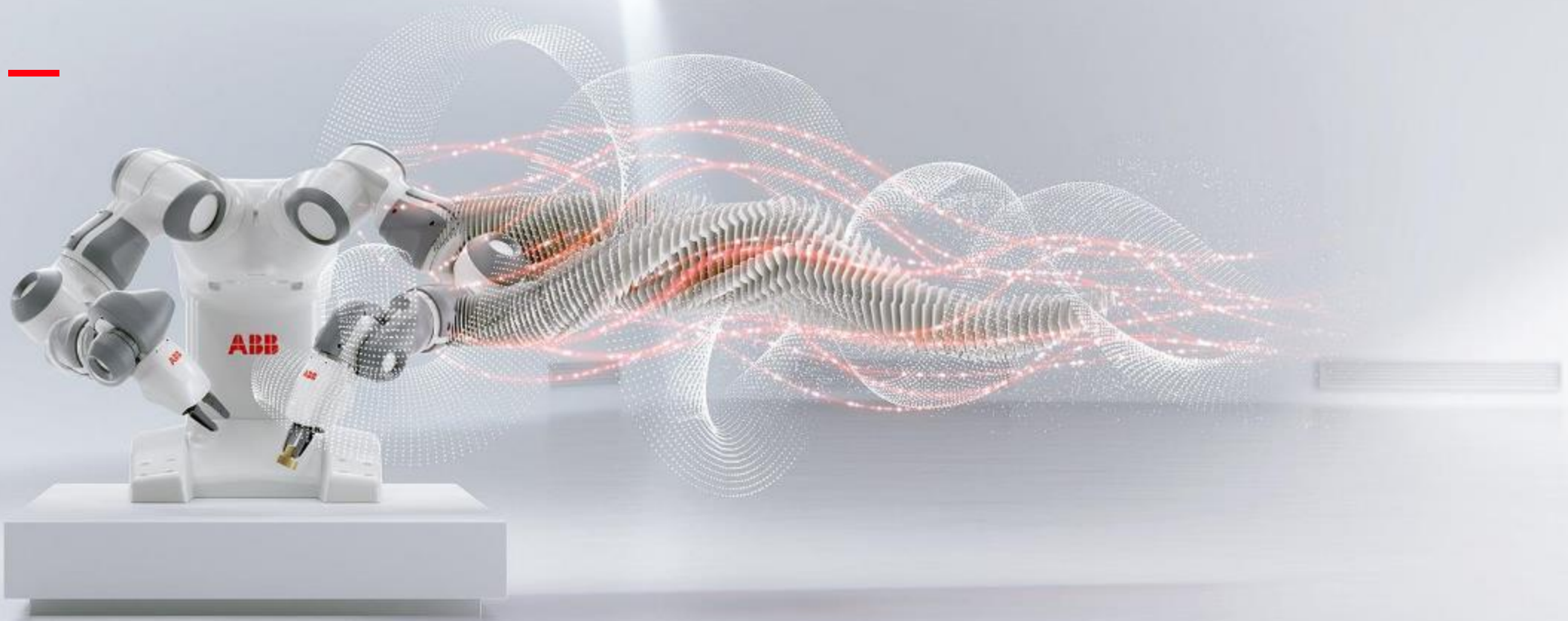


Line level optimization

Self-optimizing cells

Optimized function packages

Condition Monitoring and Predictive maintenance



Digital robotic cells

New game

Customer Story

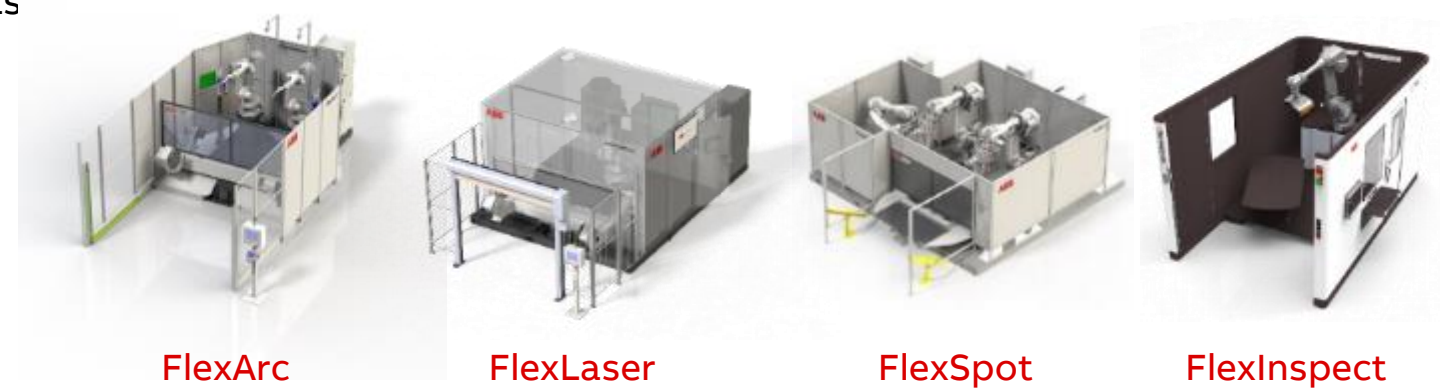
Robotic Manufacturing cells: UPQ a quantum leap before us

Story

Robotic manufacturing cells are the basic unit of most of advanced discrete manufacturing industries today.

While robots have improved its reliability and connectivity enabling new “connected services”, most of robotic cells were designed and built as ad-hoc projects, not connected to cloud. This avoided the possibility to remote diagnose/control them nor gather fleet data to be analyzed and used.

ABB Robotics pioneered the standardization and global roll-out of a series of robotic cells in several welding & cutting applications and quality inspection such as



FlexArc FlexLaser FlexSpot FlexInspect

This standard portfolio is the foundation for ABB to take, at ONCE, a quantum leap in manufacturing cells…..

Value Steps of UPQ Cells

A proposal for portfolio structure in “Digital Cells”. Example on a FlexSpot

Conditioning Monitoring & Diagnostics

Based on **connectivity**

- Cell view
  - Production status
  - Main cell KPIs
- Component view
  - Tree view of all relevant components (robots, weld gun, timer, tip dresser, fluids panel , turntable etc.)
- Dashboards and trend charts

Uptime & LCC management

Based on Cell/components physical + statistical (Big Data – Machine Learning) **models**

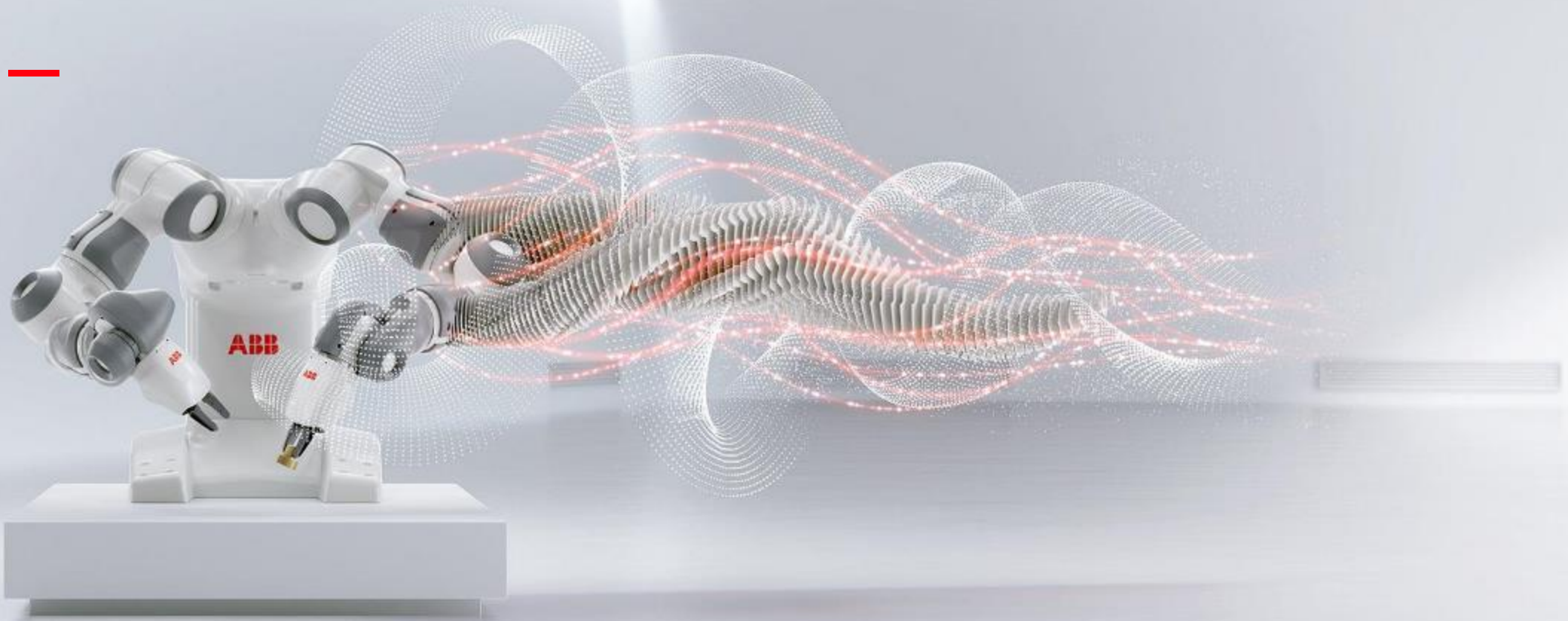
- Individual Component Predictive maintenance plan based on individual working conditions
- “Strength of models” to allow different business models from “pay per savings” to “bulletproof uptime insurance”

Performance & Quality optimization

Based on our unique **Application/process know-how**

- Cell cycle time optimization through robot path assessments vs fleet (incl. AI –deep learning)
- Cell energy efficiency optimization
- Quality improvement through process parameter setting and 3D vision analysis

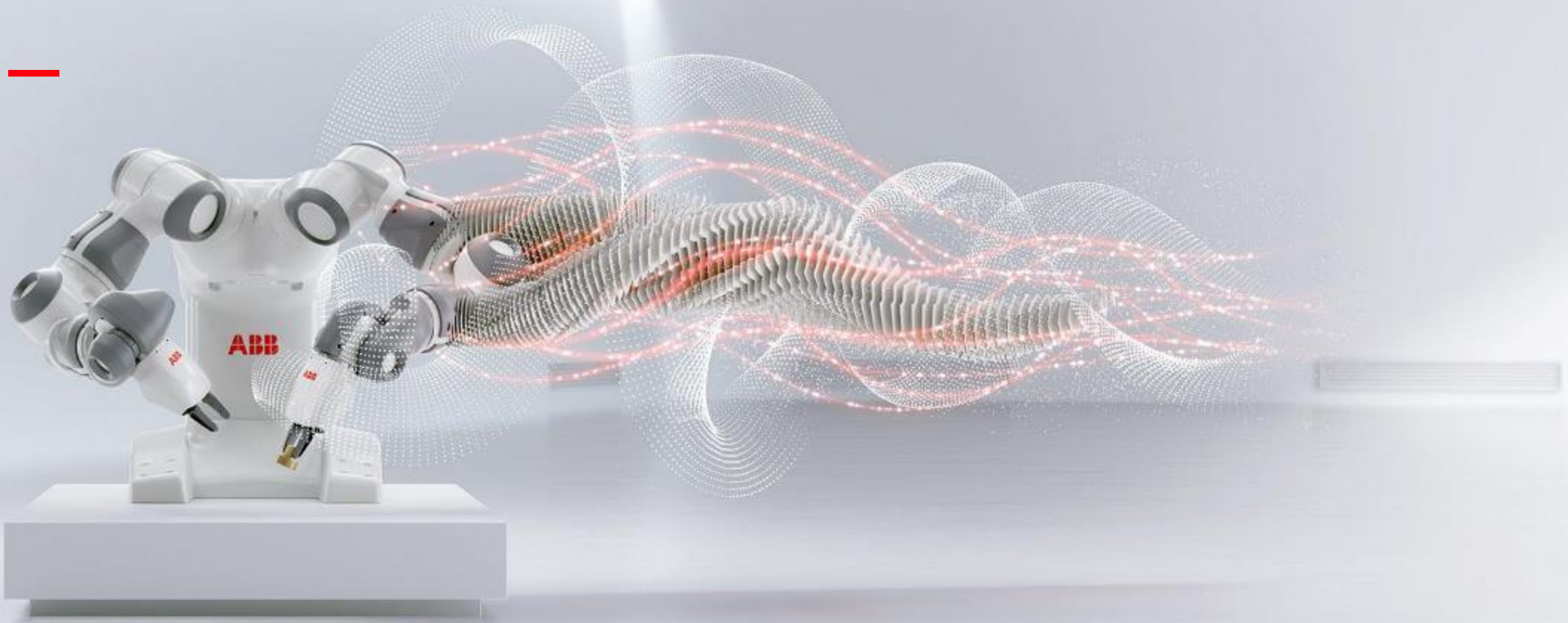
All steps designed “from customer point of view” through comprehensive surveys to capture value creation enabling right business model choice



Collaborative robots

New game

YUMI



ROBOTICS FEB 2017

ABB total quality inspection

Executive summary

How does a structured white-light sensor work?

Automatic sensor-based quality inspection improves productivity with higher speed and reliability and digitalizing the information

Image of the object is taken

- A structured white-light image is projected onto the object
- A picture is taken and digitalized into a cloud of 3D points

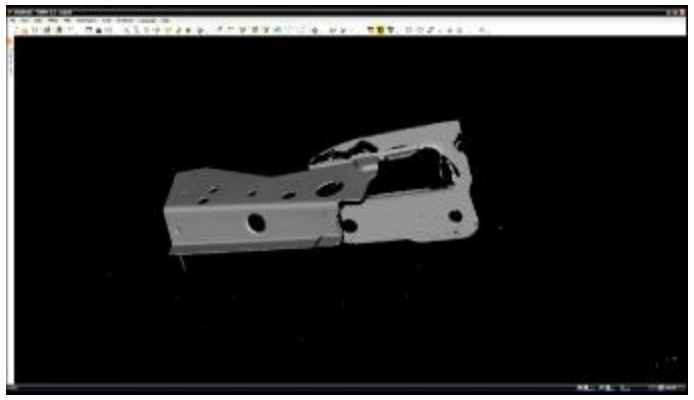
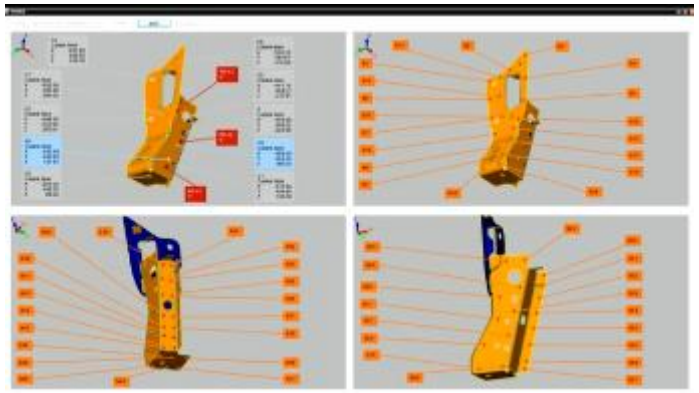


Image comparison

- Image compared with electronic version of object
- Typically the CAD version of the object is used as the reference



Analysis is visualized and stored

- Results can be used to improve the R&D and manufacturing processes

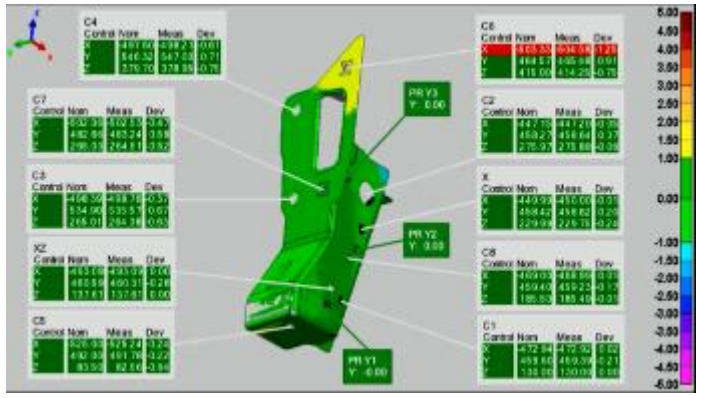


ABB and NUB3D is a component of the IoTSP strategy for digital factories

Product Portfolio

InspectPack, a new generation of In-LINE quality control solution powered by ABB

InspectPack

- Automatic calibration Unit
  - VDI 2634/II artifact integrated
- All the electronic integrated
  - Robot Electronic
  - Optical Sensor electronic
  - CAD Comparison computer
- Automatic Report Generation
- RobotStudio Measurement Simulator PowerPack
- Optical measurement system
- Graphical & touch interface

InspectPack, a new generation of In-LINE quality control solution powered by ABB (Video)

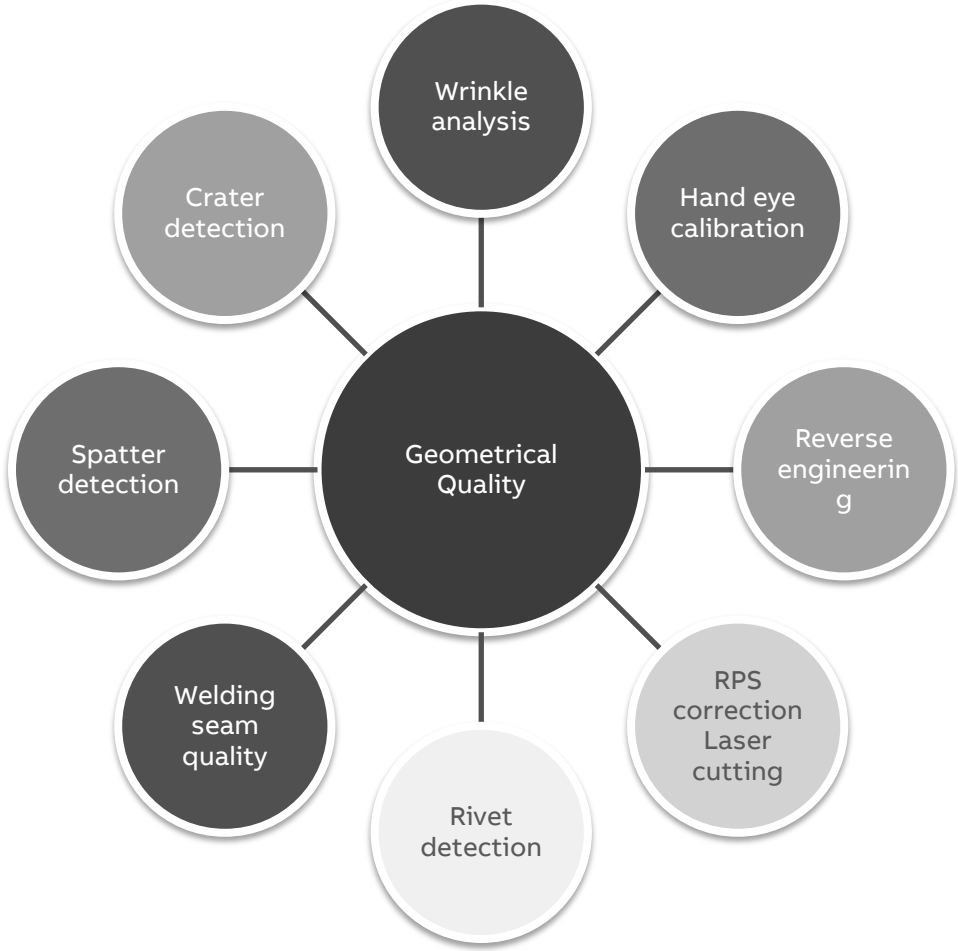
3DVision & Metrology

Robotic Quality Inspection – APP´s

Geometrical Quality

- Reverse engineering
- RPS correction Laser Cutting
- Rivet detection
- Welding seam quality
- Spatter detection
- Crater detection
- Wrinkle analysis
- Hand eye calibration

Plug-ins to increase functionality



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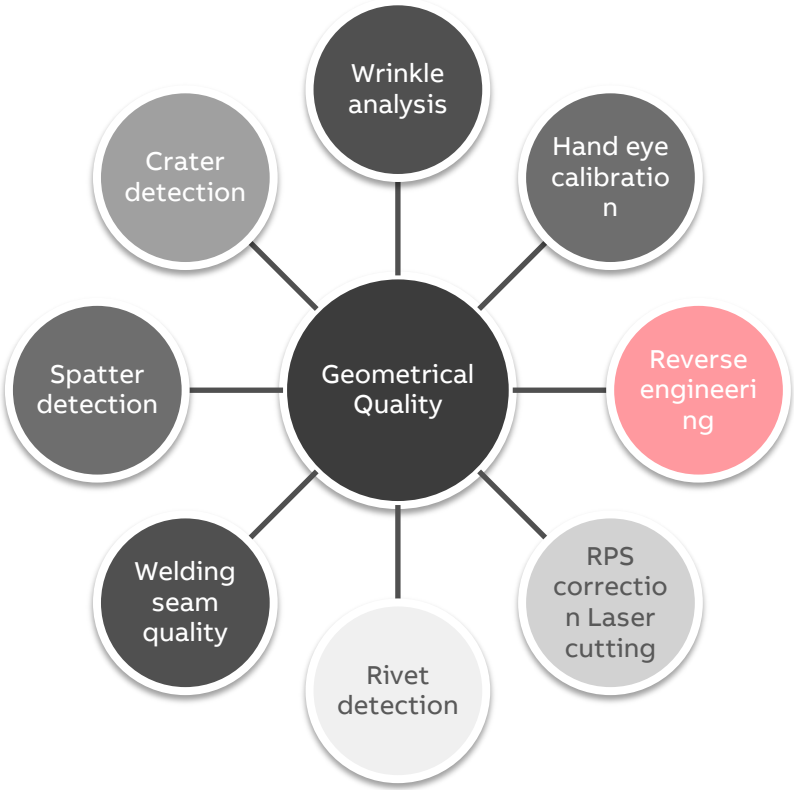
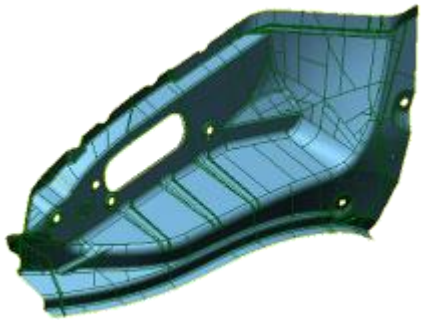
Robotic Quality Inspection – APP´s

REVERSE ENGINEERING

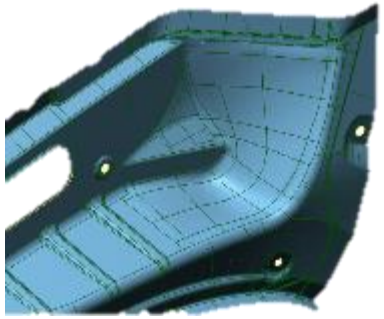


1- Original CAD

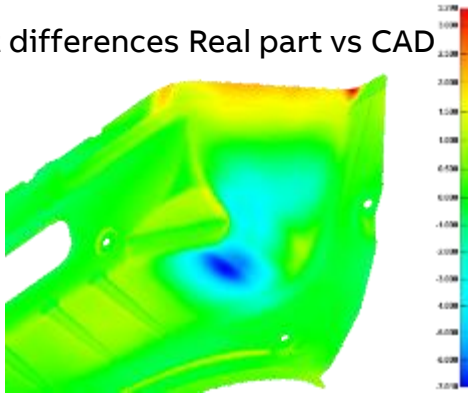


2- scanning real parts

4- Reverse Eng. Create new CAD Surfaces



3- Get differences Real part vs CAD



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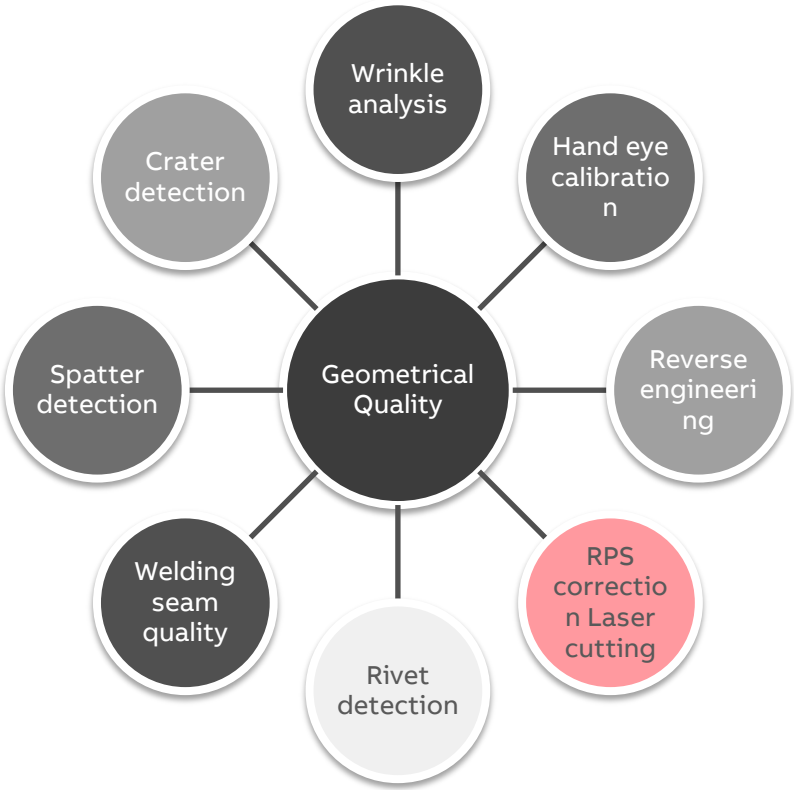
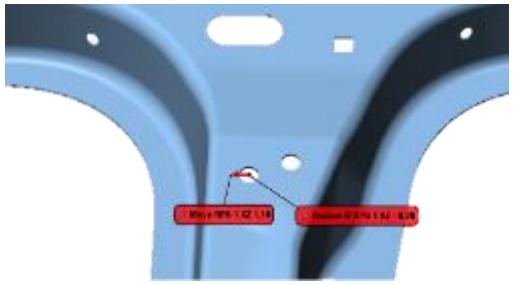
Robotic Quality Inspection – APP´s

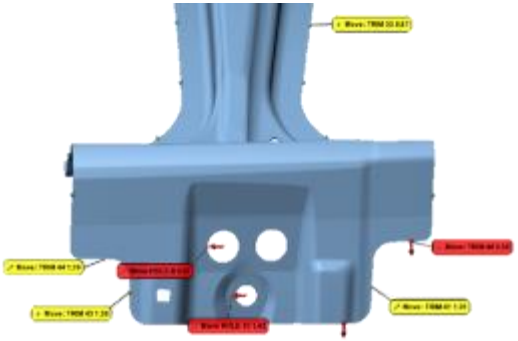
RPS CORRECTION FOR LASER CUTTING



1- Part to be placed onto FlexInspect for automatic inspection



2- The system analyzes RPS by volume fitting. Recommended correction is done if the RPS is not OK

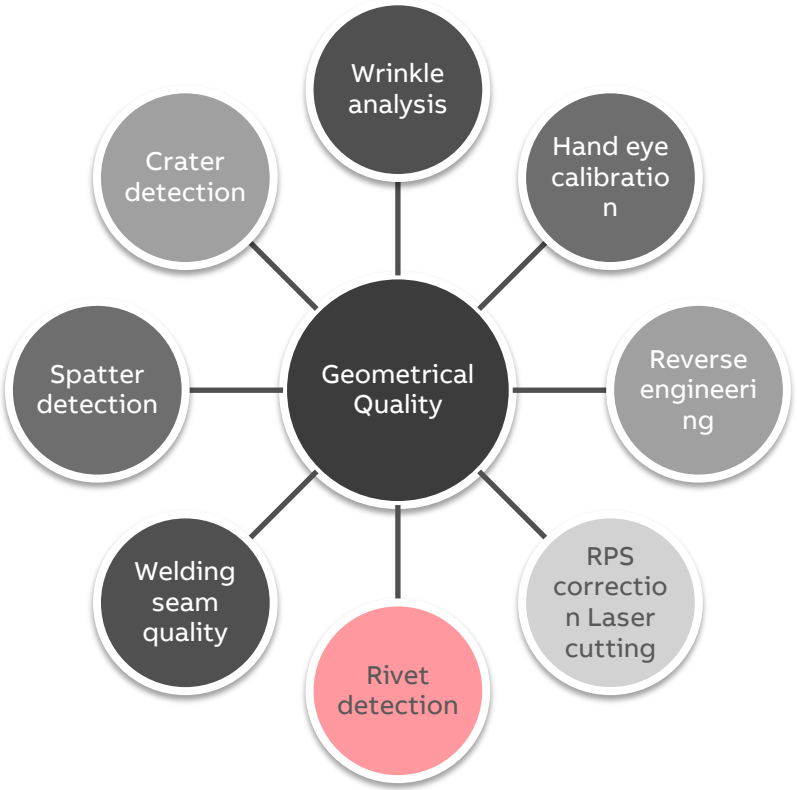


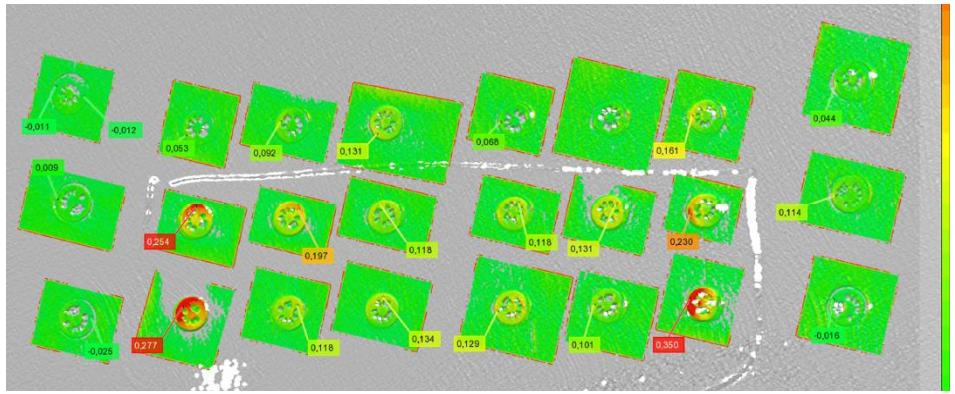
3- If RPS are OK recommend corrections for trim edges, holes and slots

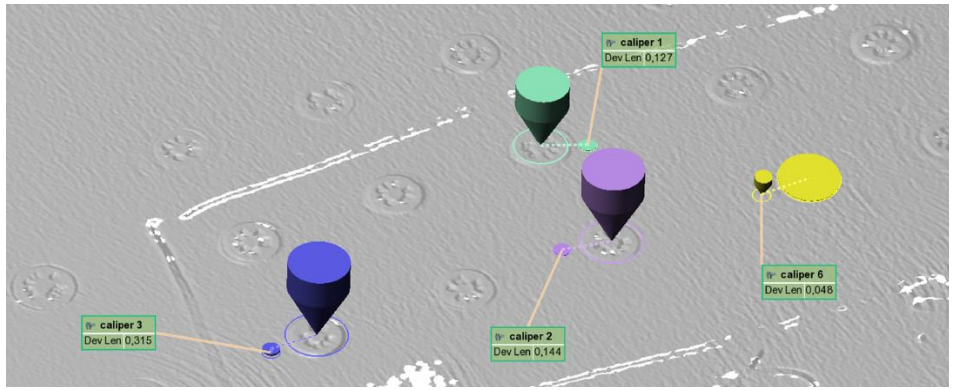
3DVision & Metrology

Robotic Quality Inspection – APP´s

RIVET DETTECTION



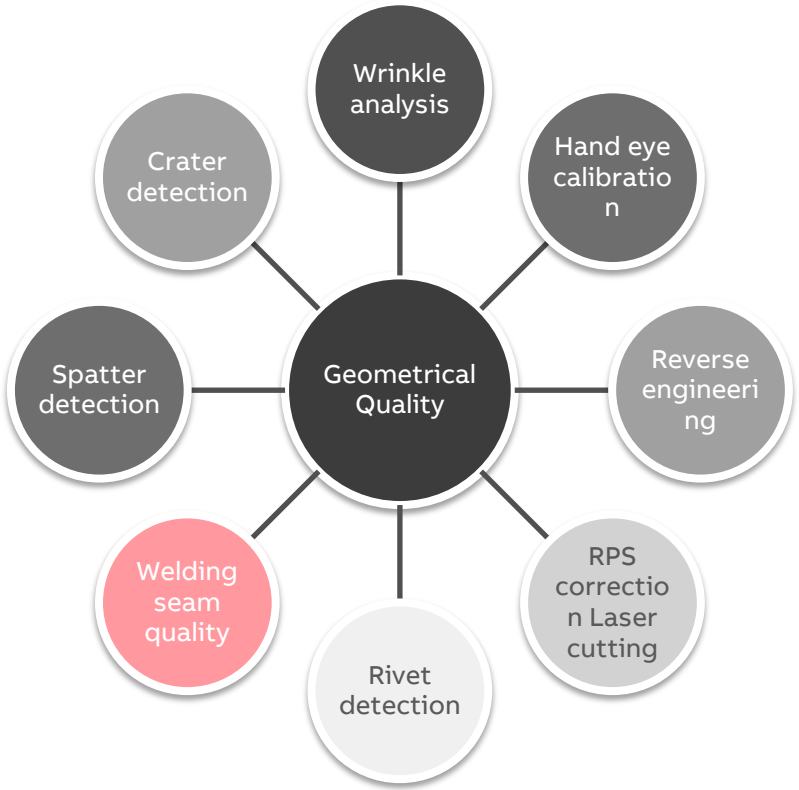


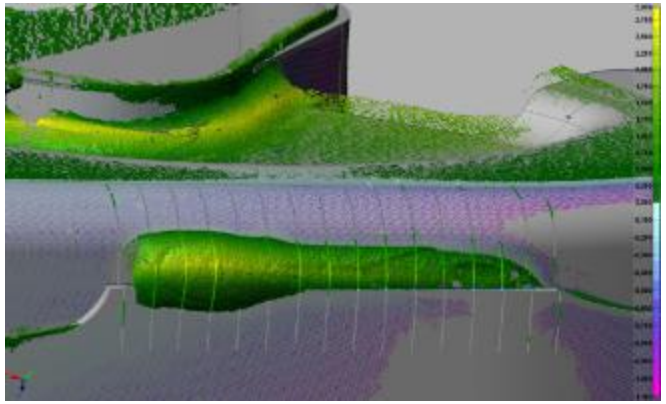


3DVision & Metrology

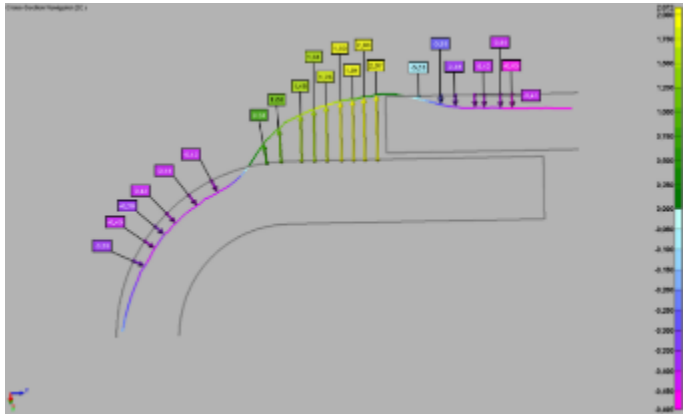
Robotic Quality Inspection – APP´s

WELDING SEAM QUALITY





At the same scan, welding seams with high resolution can be detected

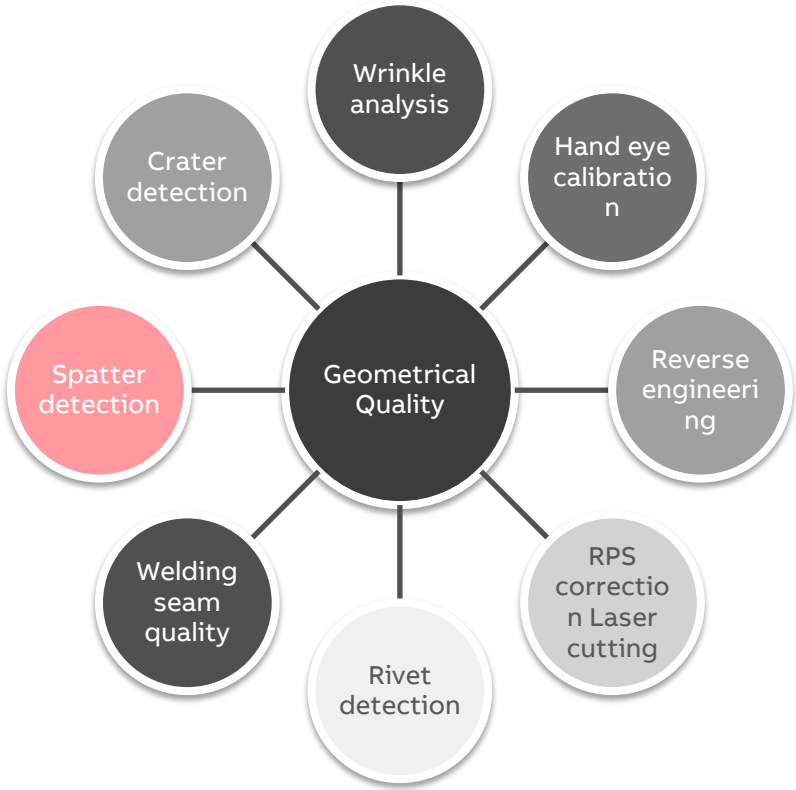


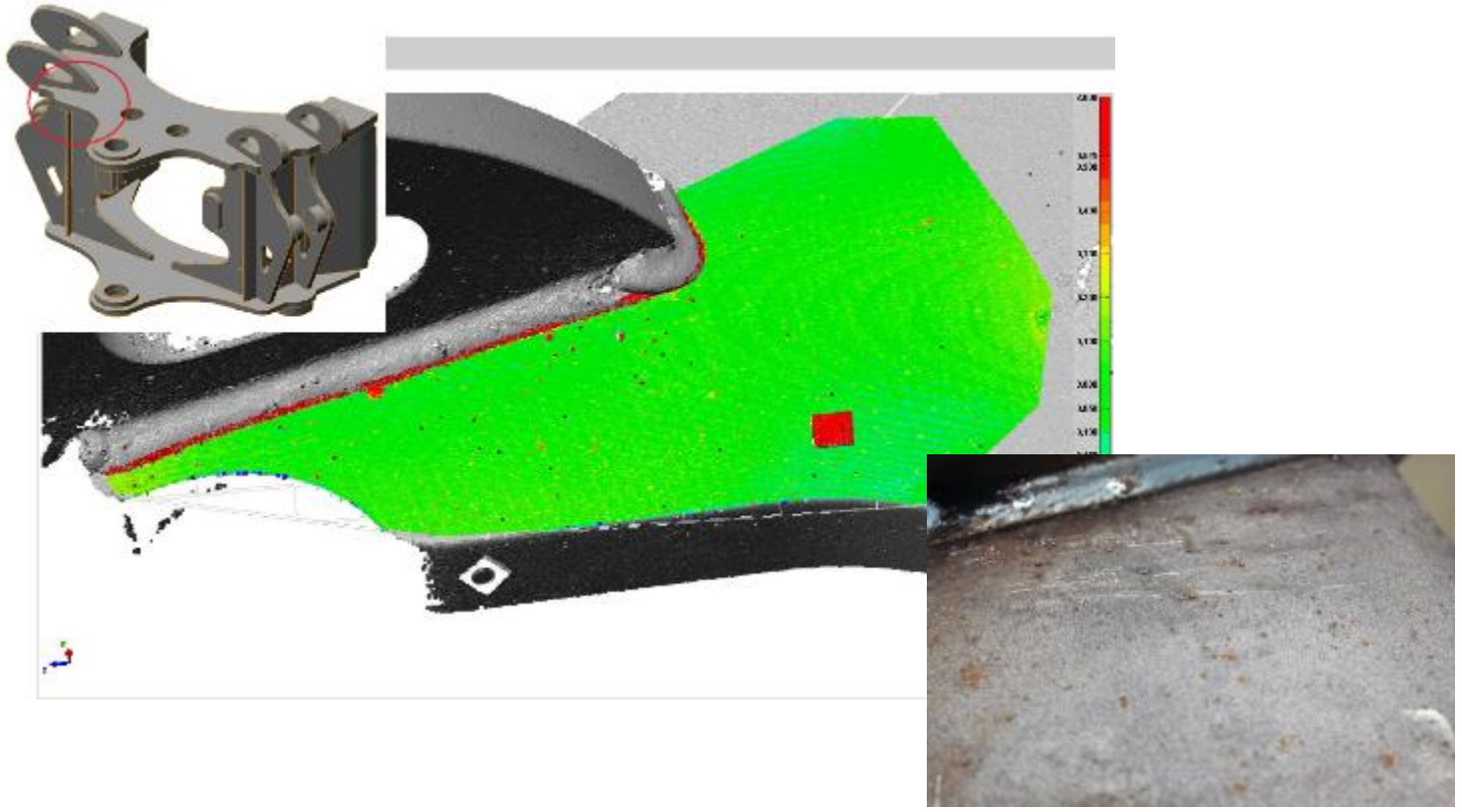
The software is able to analyze:
- size
- Position
- cross sections
- presence
- absence
- position of the metal parts

3DVision & Metrology

Robotic Quality Inspection – APP´s

SPATTER DETECTION

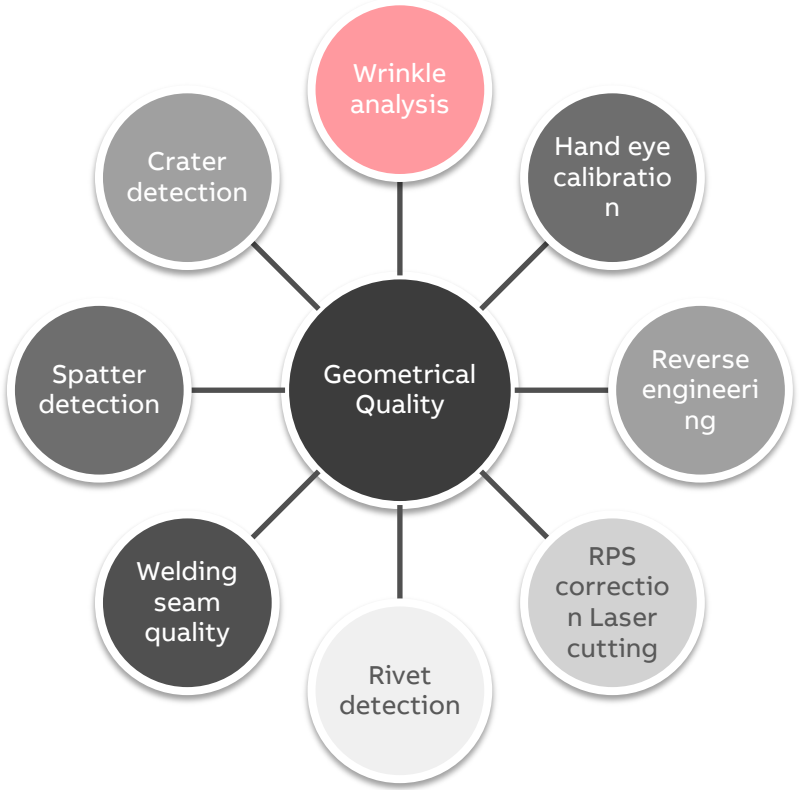


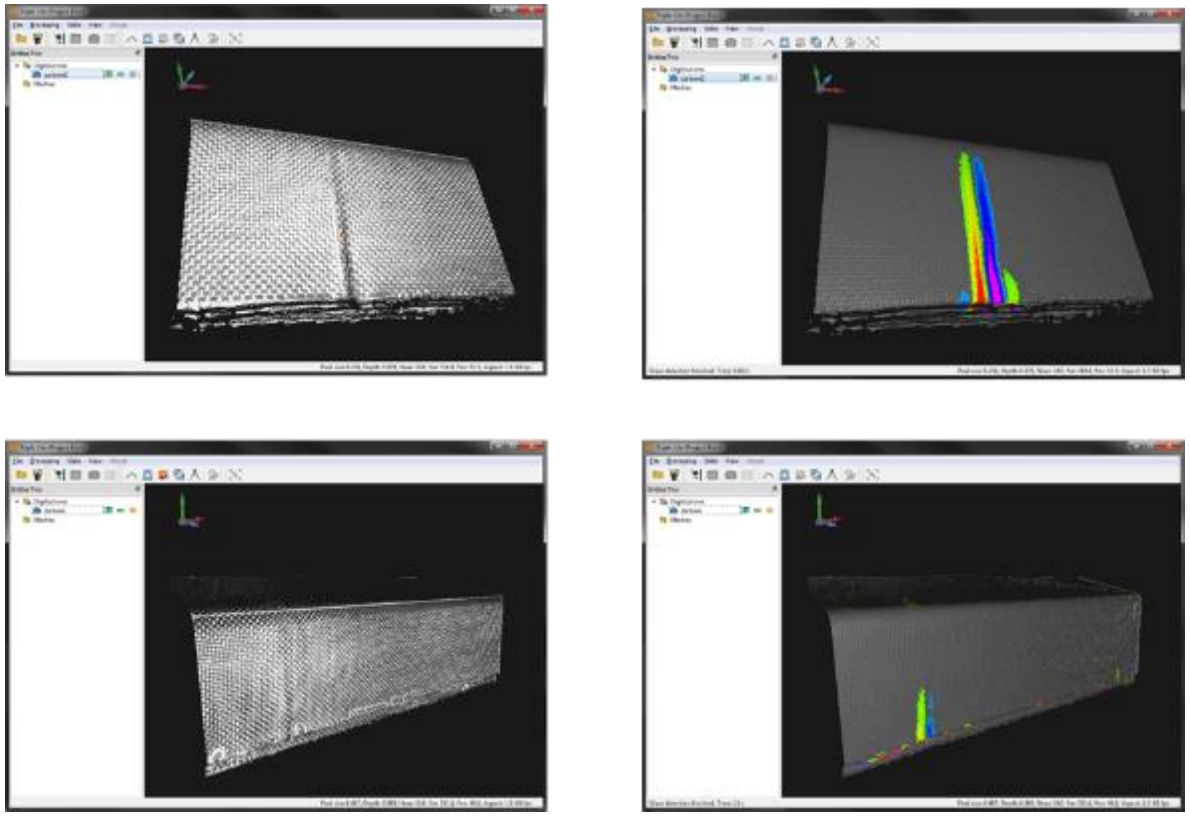


3DVision & Metrology

Robotic Quality Inspection – APP´s

WRINKLE ANALYSIS





Industry trends and focus

Digitalization at scale is the driver 100% flexible and integrated manufacturing systems

		Flexible Automation	Collaborative Automation	Adaptive & Configurable	Near 100% automation
Digital space	Control	Fully pre-determined programming	Based on production / process	Based on product / part	Autonomous / Self-learning
	Intelligence & optimization	In machine	At the machine & in cloud	Connected edge-to-cloud	Mobile Robotics
Physical space	Hardware	Robotic & hard automation mixed with manual	Machines, Co-bots and Sensors	Machines and adaptive robotics	No humans doing dangerous or heavy manual jobs
	Material flow	Mainly conveyor based; no integration outside plant	Use of AGVs in mixed areas; no integration outside plant	Mobile, self-optimizing logistics	Full integration across Supply chain

Hallmarks of ABB

Boilerplate

ABB (ABBN: SIX Swiss Ex) is a pioneering technology leader in electrification products, robotics and motion, industrial automation and power grids, serving customers in utilities, industry and transport & infrastructure globally. Continuing more than a 125-year history of innovation, ABB today is writing the future of industrial digitalization and driving the Energy and Fourth Industrial Revolutions. ABB operates in more than 100 countries with about 132,000 employees.