



BOSCH

Invented for life






Product Catalog

Industry 4.0 at Bosch



TABLE OF CONTENTS

04		Increasing connectivity: The ever-growing numbers of connected people and objects are beginning to transform many aspects of our private and professional lives. This is also having a fundamental impact on value creation in manufacturing. The concept of Industry 4.0 is opening up new potential for productivity and efficiency.
06		Based on experience: Bosch is in a unique position to apply a dual strategy in regard to Industry 4.0. As a leading user, we are compiling real-life experience in outfitting our own plants with Industry 4.0 technology. At the same time, we are using our experience in the development and application of new Industry 4.0 products, systems, software, and solutions to become a leading provider as well.
10		Ready for Industry 4.0: Based on our extensive field experience, Bosch has identified seven features that determine the Industry 4.0-readiness of every solution. These features are valid for all technologies, suppliers, and applications.

SOFTWARE SOLUTIONS

IT Shopfloor Solutions	31
Process Quality Manager	48
Production Rules Configurator	49
Remote Service Manager	50
Production Performance Manager	51
Manufacturing Analytics tools & services	52
Energy Platform	53
Rexroth Open Core Engineering	55
Rexroth WebConnector Universal translator for the IoT	56
Rexroth ActiveCockpit	57
iNVH Smart Phone App	58

LOGISTICS AND MANUFACTURING

Cross Domain Development Kit XDK110	62
Transport Data Logger	63
Rexroth ActiveAssist	64
APAS family	65
CPI – Track & Trace software solution	71

FIELD LEVEL EQUIPMENT

Rexroth Connected Automation	75
Rexroth IndraMotion MLC motion logic system	77
Rexroth IndraMotion MTX CNC system solution	78
Rexroth LMS Linear Motion System	79
Rexroth IndraControl XM embedded control hardware	80
Rexroth IndraControl L embedded control hardware	81
Rexroth IndraControl FM control hardware	82
Rexroth IndraDrive servo drives	83
Rexroth IndraDrive Mi cabinet-free drive technology	85
Rexroth IndraDyn S synchronous servo motors MS2N	87
Rexroth CytroPac Hydraulic Small Power Unit with up to 4 KW	88
Rexroth ABPAC Hydraulic Power Unit	89
Rexroth Absolut IMS-A Integrated Measuring System	90
Rexroth Nexo WIFI enabled cordless nutrunner	91
Rexroth PRC7300 Mid-frequency welding control	92

SERVICES AND CONSULTING

Remote Service	96
Bosch Smart Monitoring	97
Rexroth ODiN Predictive Maintenance	98
Smart Technical Service Solutions – PI-Kit	99
Smart Technical Service Solutions – Video Analysis System (VAS)	100
Smart Technical Service Solutions – Shopfloor Connectivity Services	101
Rexroth mMS4.0 Modular mechatronic training system	103

SOLUTION SETS

Process Quality Manager with Tightening Systems	107
---	-----

THE PACE OF CONNECTIVITY IS ACCELERATING



Each year, more and more people and things are becoming connected via the internet. By 2020, we expect about 7 billion people and 50 billion things to be online. A large variety of devices are connected over the internet of things: computers and smartphones, vehicles and household appliances, as well as industrial machinery and fork lifts, workpieces, and transport boxes. Web-enabling technologies allow them to exchange information and give them unique identifiers in the form of their own IP addresses. This trend will have a tremendous impact on our daily lives, on the way we interact with each other, and on the way we manufacture and distribute goods.

The framework is changing – new challenges cannot be met with old answers. Today, our business environment is characterized by volatile markets, individual customer requirements, shortened delivery times and product life cycles, the need to provide 24/7 global service, new forms of social interaction, and new cross-domain alliances. We are already seeing disruptive business models driven by the internet. They are challenging our current value creation but also opening up previously unimagined potential for more productivity, flexibility, and quality.

THE INTERNET OF THINGS



The internet of things is already a reality. It is both the driver behind and the target of our business activities. The Bosch Group has extensive expertise in both the “world of things” and the “world of IT.” Bosch is not only a leading user of Industry 4.0 but also a leading provider. We are currently focusing our activities in our Innovation Cluster Connected Industry. Having both a view of the bigger picture as well as the expertise that comes from our own manufacturing activities in more than 250 plants, our experts are in a position to support you in implementing connectivity solutions in your own production. Offering advice and assistance at every step of the way, they can help you get your own operations up and running quickly.

Dual Strategy for unique experience: At Bosch, we combine expertise gained from our own manufacturing activities with our competence as a leading provider of industrial solutions along the value stream. Bosch Rexroth delivers controls that are internet- and IT-enabled, as well as network-ready automation components. Our Bosch Packaging Technology division builds entire packaging machines for the food and pharmaceuticals industries. The portfolio of our Assembly Systems and Special Machinery business unit features intelligent IT shopfloor solutions for greater transparency and efficiency in production, as well as changeable automation in the form of collaborative, agile, flexible, and networked manufacturing islands featuring the APAS family of mobile production assistants. In addition, our Bosch Software Innovations subsidiary offers proven software used in daily manufacturing environments across the Bosch world.

Bosch Connected Devices and Solutions offers intelligent and connected sensor devices as well as complete and integrated solutions for condition monitoring and predictive maintenance. Bosch Energy and Building Solutions helps commercial customers to significantly increase their energy efficiency with an integrated approach, reducing their energy consumption and carbon footprint.

As a leading user, we are not only optimizing our own worldwide manufacturing base in numerous plants. We also are actively seeking to work with our partners to build a value creation network beyond company boundaries and turn Industry 4.0 into reality.

THE FOURTH INDUSTRIAL REVOLUTION



Over the history of industrial manufacturing, we can identify four fundamental technological innovations that have led – or in the case of the fourth, are in the process of leading – to tremendous gains in productivity.

Industry 1.0 – Mechanization: The invention of the steam engine at the end of the 18th century ushered in the era of industrialization. For the first time, machines took over physically demanding work from humans on a large scale. These early machines were powered by mechanical gears, pulleys, and belts.

Industry 2.0 – Electrification: Electricity replaced steam power at the end of the 19th century. It also led to new ways of working: with assembly-line production, goods could be produced in large volumes for the first time and thus be offered at a lower cost, leading to increased personal wealth. The introduction of punch cards led to the machine processing of information to control manufacturing.

Industry 3.0 – Digitalization: The development of the first programmable logic controllers (PLCs) at the end of the 1960s and of increasingly powerful microchips paved the way to digitalization and the first use of software in manufacturing. This made

machines more productive, precise, and flexible, and led to an increasing degree of automation. Machines took over ever more dangerous and straining tasks from humans. The first networks were set up, in which several machines were pooled together as one production cell with a shared master controller.

Industry 4.0 – Connected Industry: Industry 4.0, otherwise known as the fourth industrial revolution, integrates people and digitally-controlled machines with the internet and information technology. People are key players in this concept, and their work is facilitated to a greater degree than ever by software-based systems. This involves the entire value stream: objects being pro-

duced or used in manufacturing are always uniquely identifiable and communicate independently with one another. Information flows vertically from the individual components all the way up to the company's IT platform and the other way around. Information also flows horizontally between machines involved in production and the company's manufacturing system.

Bosch has identified seven features that are essential for connected value-creation networks. This classification also reflects the systematic approach Bosch uses to create Industry 4.0-ready products and solutions. You can learn more about this in the following pages.

SEVEN FEATURES OF INDUSTRY 4.0



Based on the experience we have gained in numerous pilot projects and the changes we have implemented in our more than 250 plants worldwide, Bosch has identified the seven key features of Industry 4.0-ready equipment, software, and solutions. They form a solid framework for future-proof architectures and are our guiding principles for the development of Industry 4.0 solutions on all levels. At Bosch, these seven features are part of the

R&D specifications for every new product, service, and piece of software, as well as for continuous product improvement. In this product catalog, the seven features provide orientation as to how every solution contributes to the realization of Industry 4.0. To ensure a successful synergy between the real and digital world, all components and systems must meet at least some of these requirements.



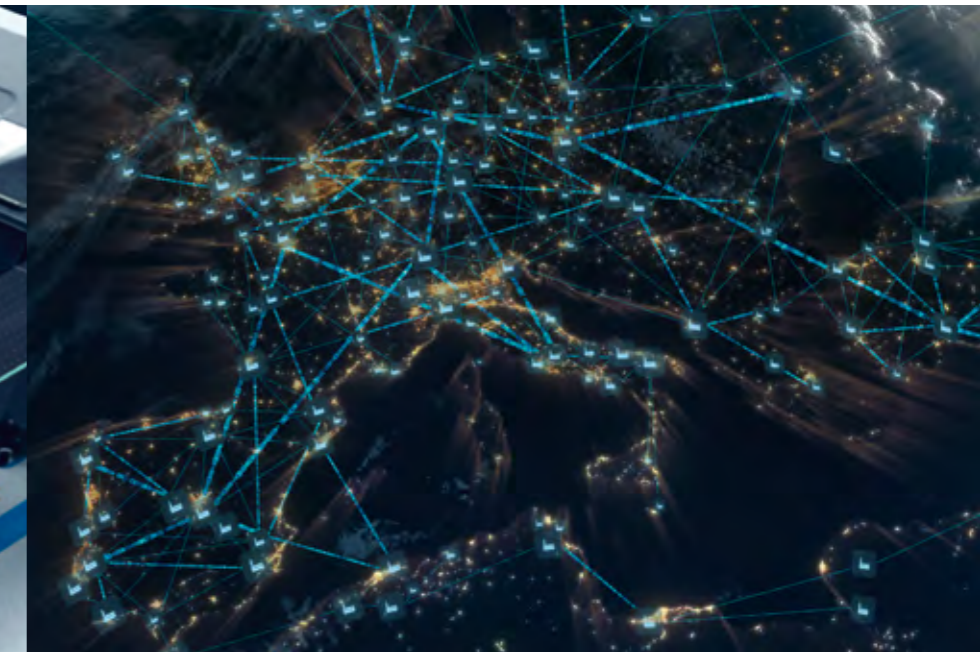
From autonomous rollers to flexible manufacturing modules: with distributed intelligence, modules know their technical skills and organize themselves decentrally.



DISTRIBUTED INTELLIGENCE

Field level components and systems with distributed intelligence and integrated software perform their tasks independently according to the specifications of higher-level systems. They make autonomous decisions, relieving higher systems. Distributed intelligence is a basic requirement for modular machines and facilities that adjust themselves flexibly to changing conditions.

They are equipped with preprogrammed technological functions and increasingly run diagnostics on themselves. Distributed intelligence enables the self-organization of production systems, increasing their flexibility and facilitating automated production changes. At the same time it reduces complexity, making it easier for people to operate and adapt the systems to new requirements.



Intuitive adaption: operators use smart devices to control the status of production lines and to change modules to new tasks without programming in machine languages.

FAST INTEGRATION AND FLEXIBLE CONFIGURATION

Fast integration and flexible configuration facilitate the adaptability of Industry 4.0. People, machines, processes, and flows of goods are connected. Ad hoc changes to configurations can be made easily by way of software commands. Software tools simplify the commissioning, integration, and (re)configuration, as well as the diagnosis and maintenance

of all components, modules, and machines. The manufacturing equipment can be quickly adapted to ever-changing requirements and extended with additional modules. Operators do not need to have extensive knowledge in PLC programming. Using a smart device, they simply select a new action on their control panel and the manufacturing

line adapts the workflow to the new product automatically. Specially-developed apps enable changeovers to be made with just a few finger taps.

Bosch software solutions manage the information exchange between enterprise resource planning systems (ERP) and real machinery. Bosch supports existing information models, thus even enabling the flexible integration of existing equipment.



Open standards are essential to integrating equipment and software of various suppliers into connected concepts.

OPEN STANDARDS

Industry 4.0 marks the end of proprietary systems. Open standards that extend across manufacturers and are platform-independent form the basis for horizontal and vertical integration and thus for the seamless exchange of information in value-creation networks. Bosch has always supported open

standards on the shopfloor level as well as on the software level. This allows the easy integration of systems, machines, and components into heterogeneous system environments and the development of value-creation networks across company boundaries.



Virtual real-time representations of objects interact with each other and with software systems.



VIRTUAL REAL-TIME REPRESENTATION

All products and components are represented as virtual real-time representations in various software environments. These virtual real-time representations are closely linked to their physical counterparts. Sensors monitor their location, environmental conditions, and operating parameters. The systematic analysis of this data in real time opens up new

possibilities in manufacturing and logistics. For the first time, it is possible to monitor goods after they leave their production site and secure their quality. The real-time analysis of all relevant manufacturing and logistics data with the appropriate software prevents resources from being wasted, increases process stability, and reduces unit cost.



Aggregating and analyzing all the available data during the complete lifespan of a product helps to continuously improve the design and manufacturing processes.



DIGITAL LIFE-CYCLE MANAGEMENT

All of a product's relevant data are collected over the course of its lifespan – from development, manufacture, and operation, all the way to servicing and repair – and stored in its virtual representation. The evaluation of this field data makes it possible to continuously optimize the design and manufacturing process throughout the complete product life-cycle. In addition, the information enables condition monitoring

and predictive maintenance, identifying wear and tear before it leads to damage. Digital life-cycle management also accelerates and troubleshoots the planning and engineering processes in the virtual world before implementing them in the physical world. The result is a higher level of quality and a longer lifespan for products.



SECURE VALUE-CREATION NETWORK

Safety and security for Industry 4.0 includes, firstly, the protection of people from machinery-related hazards (safety) and secondly, the protection of production facilities and corporate IT from attacks and faults from the surrounding environment (security). The latter involves the securing of sensitive data as well as the prevention of intentional and unintentional malfunctions. Safety and security are not static properties but processes that have to adapt to fast-changing challenges and threats. The evolution from value-adding

chains to inter-company and inter-regional value-creation networks with data flowing across their boundaries have made these issues more important than ever. All partners of value creation networks have to apply the same standards and processes to make the common network safe and secure. Bosch is a working member of all major initiatives dealing with these issues and is participating in defining necessary standards. These results are continuously implemented into all components, systems, and solutions Bosch provides.



1 Wearing smart glasses, service technicians can use augmented reality to analyze complex problems and find solutions quickly.

2 All relevant information to hand: production data is aggregated in real time for continuous improvement of processes.

3 Mobile production assistants of the APAS family work hand in hand with people.



PEOPLE AS KEY PLAYERS

In Industry 4.0, people are the key players. Real-time big data will not take away people's power to make decisions or their responsibility, but it will support people by providing relevant information in real time, thus enabling continuous improvement of processes. Increasing people's freedom to decide and participate leads to better, more informed decisions. Digital and analog assistant systems will support people

better than ever, taking over dangerous or difficult work. Human-machine collaboration will increase in a safe and intuitive way – but machines will continue to play a subordinate role. People's health and well-being will be safeguarded and enhanced through adaptive workplace ergonomics, digital assistance functions, and ability amplifiers.

OUR PORTFOLIO FOR YOUR FUTURE

Bosch already has all the relevant enabler for Industry 4.0 in its portfolio in the form of ready-to-use products, systems, software, and solution sets, from single sensors and automation components on the field level to solution sets combining hardware and software for manufacturing and logistics. Based on our first-hand experience from our own plants, we offer advisory

services for machine manufacturers, system integrators, and machine users. We empower companies to turn their ideas and concepts into connected reality in an economical way. By providing new service business models, we are helping to significantly improve the availability of machinery.

On the factory level, Bosch solutions for complete machines as well as for interior and exterior logistics are connected horizontally and vertically. Software solutions based on our daily manufacturing experience enable users to monitor relevant KPIs in real time in order to improve productivity and quality.

Together with ready-to-install solutions, Bosch offers services and consulting, thus helping manufacturing companies turn Industry 4.0 into reality. Featuring distributed intelligence and open standards, our components and solutions fit seamlessly into Industry 4.0 ecosystems.

SOFTWARE SOLUTIONS

Bosch software solutions are forged in the daily routines of more than 250 Bosch plants. We design our software to serve people with intuitive human-machine interfaces, incorporating user experience from the very beginning. The result: full-grade connectivity, complete transparency, and reduced complexity. Our Industry 4.0 software is the element that links all modules and subsystems along the value stream with people and third-party systems, and helps you continuously improve defined key performance indicators. ▶ Page 28

LOGISTICS AND MANUFACTURING

At this level, solutions connect machines and whole manufacturing lines to value-creation networks. This also encompasses the end-to-end monitoring and coordination of inter- and intra-logistics, from the raw materials, to their various stages of manufacturing, all the way to their integration into the machine user's product. Solutions for logistics and manufacturing are the link between the automation level, the ERP system, and cloud-based applications. ▶ Page 60

FIELD LEVEL EQUIPMENT

Components, modules and systems which machine manufacturers use to enable their equipment to be integrated into vertically and horizontally networked Industry 4.0 environments. ▶ Page 72

SERVICES AND CONSULTING

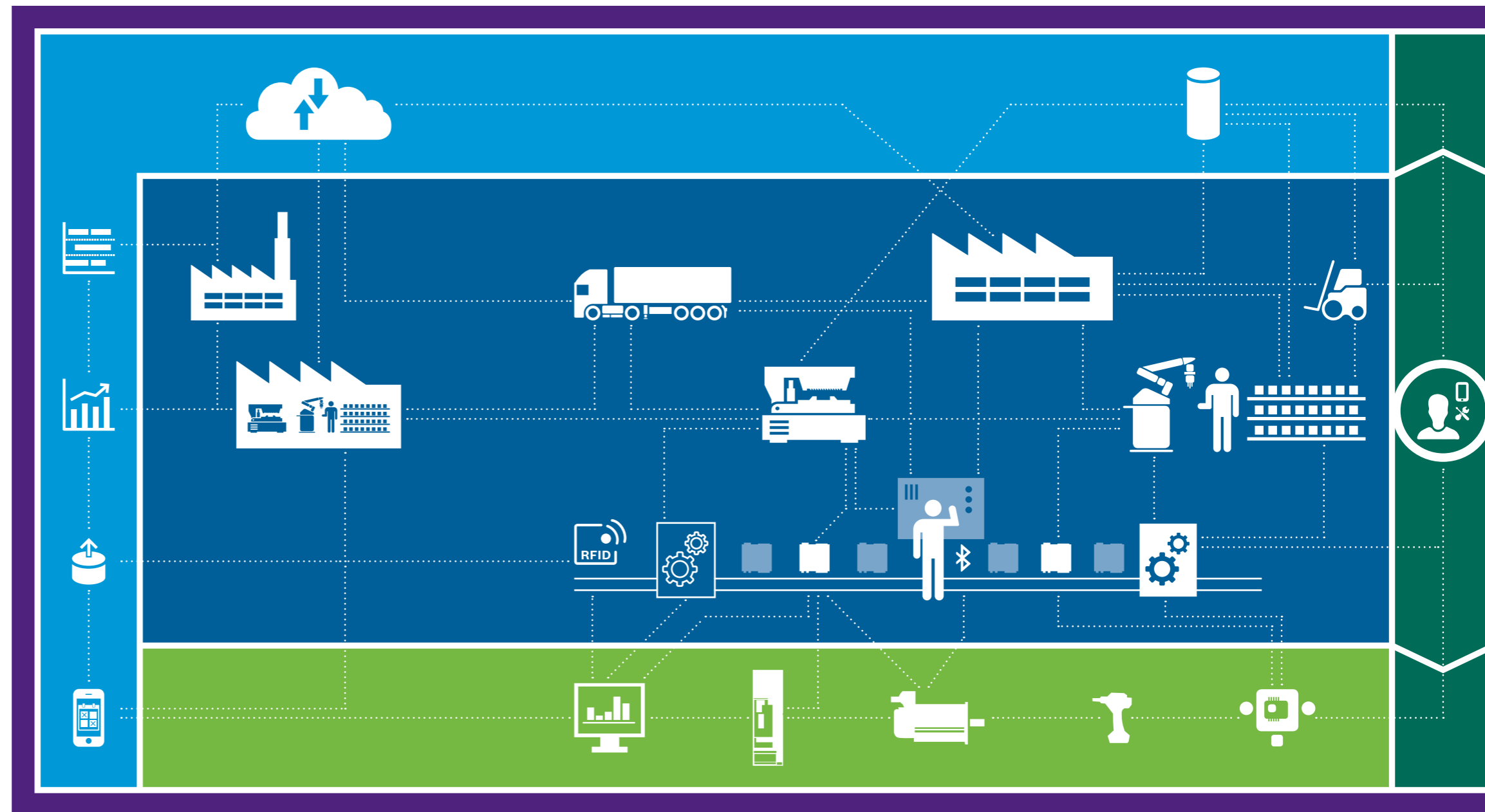
Bosch offers a broad range of services and consulting including collaborative projects to test new business models. The systematic analysis of huge data sets leads to new, predictive service strategies that increase the availability of manufacturing equipment. In our

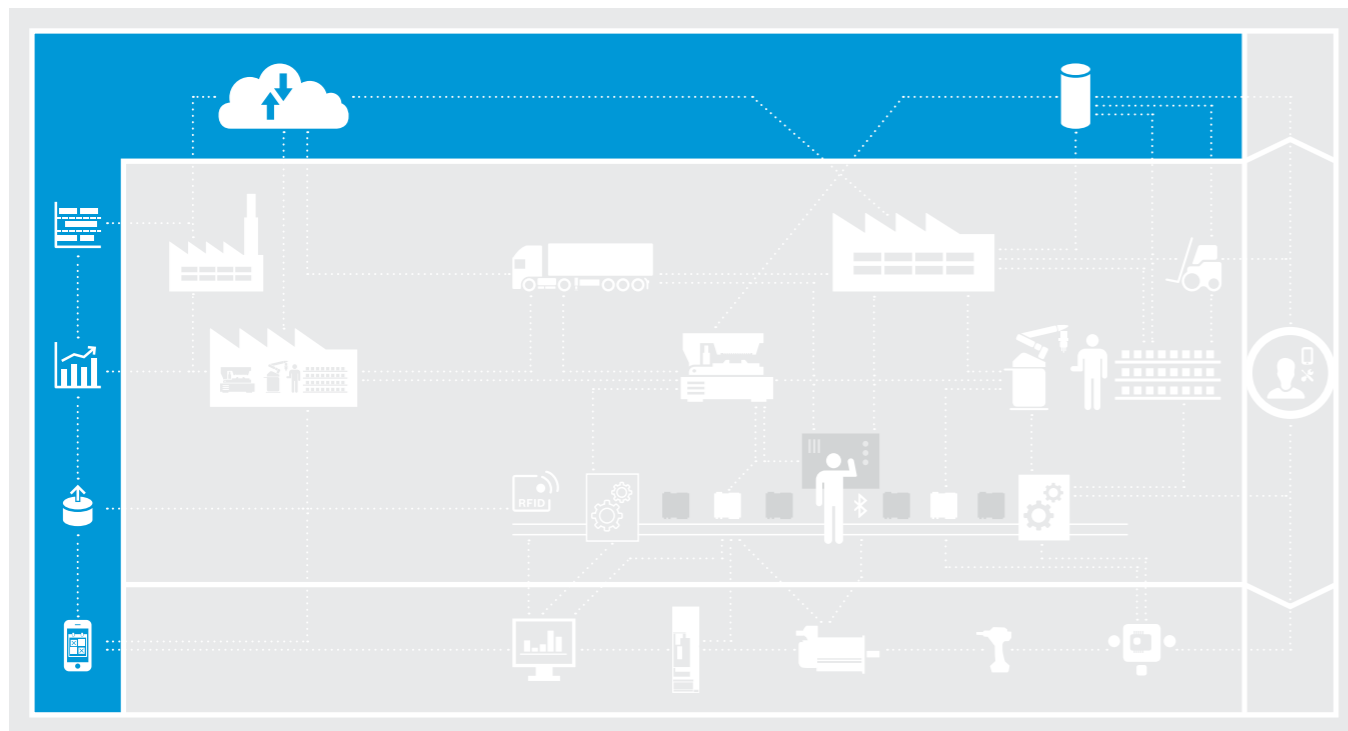
consulting, we draw on our own experience in automation solutions, logistics, and manufacturing, as well as in software and services. We also use the experience we have gathered in retrofitting our own plants with Industry 4.0 concepts. ▶ Page 94

SOLUTION SETS

Solution sets combine Bosch Industry 4.0 components and systems from different domains into an integrated solution. The value of our solution sets is more than the sum of their components.

Every solution set is adapted to customer-specific requirements and interacts seamlessly with your logistics and manufacturing network. ▶ Page 102





SOFTWARE SOLUTIONS AT BOSCH

All Bosch software solutions for Industry 4.0 prove their value every day in Bosch's international manufacturing network. Our modular software portfolio is perfectly suited for bringing entire plants online and making them Industry 4.0-ready. Our software solutions connect all relevant people, products, machinery, and systems – horizontally and vertically. They are designed to be easy to use and to help improve processes, cut costs, increase both productivity and product quality, and create complete transparency.

We deliver a modular and scalable automation system that coordinates the machinery and equipment of different suppliers, thus enabling efficient plant engineering. In addition, our software enables users to efficiently plan and control processes related to manufacturing, quality, and logistics, including order allocation, backtracing, quality management, and many other functions in conjunction with established ERP systems.

Our software solutions for connected manufacturing and logistics gather, visualize, analyze, and monitor machine, process, and sensor data. They translate this data into final information that serves as a source for their rule and process-based actions, creating complete transparency. The software solutions are going to operate optionally on the Bosch IoT Cloud which encompasses infrastructure, platform and software offerings as frame for new business models. This empowers people to determine precisely where to optimize production and logistics processes along the entire value chain.

Bosch software solutions support established standards. This makes it easy to integrate both existing and new machinery as well as software systems into consistent networked concepts with a minimum of interface definitions.

IT Shopfloor Solutions – MES Engineering & Application Services

One of our IT Shopfloor Solutions is a product-independent MES solution (Manufacturing Execution System). The system covers a variety of requirements from the different production areas of the entire value stream (part manufacturing, SMT, assembly and testing lines, packaging and delivery). The system is independent from the machine suppliers/products and scalable to the respective needs – e.g. from a single machine up to a fully automated production line with many sublines. For this system we offer worldwide engineering support and application service (installation and configuration) with high customer orientation as well as a competent and fast after-sales service.

i4.0 Approach

- ▶ Flexibly applicable in any discrete production
- ▶ Applicable in all production areas (part manufacturing, SMT, assembly and testing lines, packaging and delivery)
- ▶ Independent from product type and used identification (barcode, DMC, RFID, plain writing, ...)
- ▶ Scalable to the respective requirements (application for one station as well as for the plant wide full expansion)
- ▶ Modular and configurable – only the needed modules are used in the project, e.g. equipment management, quality management, traceability, process control, planning & deviation management and information management & HMI
- ▶ Support from the engineering, worldwide application and 24/7 service and support as well as trainings
- ▶ Already in operation since many years in most of the Robert Bosch business units and plants as well as at Robert Bosch suppliers and joint ventures

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Available in many different languages (de, en, fr, es, it, zh, ...)
– project specific translations possible at any time
- ▶ In worldwide use since many years and under continuous development
- ▶ Standardized system and still open for local extensions
- ▶ Worldwide service with access to the systems, if necessary
- ▶ Technology with uniform machine interface
- ▶ High data security since this system can be installed on premise



People
as key players



Distributed
intelligence



Fast integration and
flexible configuration



Open
standards



Virtual real-time
representation



Digital life-cycle
management



Secure value-creation
network

IT Shopfloor Solutions – Equipment Management

The module Equipment Management consists of a bundle of products for the optimization of manufacturing equipment. The collection of machine data and disruption reasons, an efficient material and tool management, fast reaction systems and proactive maintenance and service concepts ensure a smooth use in production. Solutions: Andon, Asset Management, Maintenance Support System (MSS), Process Data Acquisition (PDA), Electronic Shiftbook, Shopfloor Dashboard, Tool Control.

i4.0 Approach

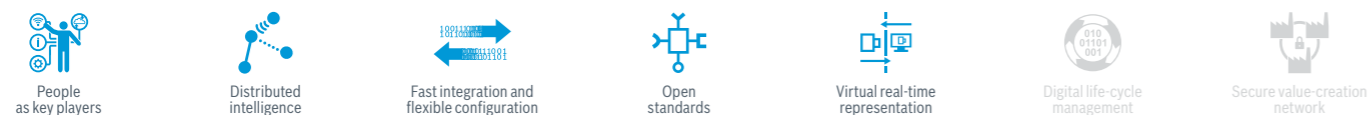
- ▶ Production planning and analysis from one tool, detailed reports from web portal
- ▶ Andon enables performance transparency and works as a fast response system
- ▶ Real-time information about machine condition on mobile devices enable fast response time in case of failure
- ▶ Machine information and shared knowledge about maintenance directly available on line.
- ▶ Higher transparency through real-time production KPIs shown on shopfloor dashboard
- ▶ Open machine interface and flexible configuration of services
- ▶ Virtual real-time representation with visualization solutions
- ▶ Real-time control of tool usage and asset condition to schedule repair and maintenance activities

Benefits

- ▶ Detect disruptions and downtimes at an early stage
- ▶ High transparency due to detailed PDA
- ▶ Pareto analysis to control effectiveness of measures
- ▶ Increased awareness by live displaying KPIs on shopfloor
- ▶ Short reaction time due to automated escalation mechanisms via email or SMS
- ▶ Tool management system to reduce failure related downtimes
- ▶ Optimized maintenance process

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services



IT Shopfloor Solutions – Quality Management

The module Quality Management includes all aspects of quality assurance and optimization of process data in the production. The value chain is covered completely and gets analyzed and controlled at defined quality gates. Solutions: characteristic traceability (storage of quality data, e.g. press-in force etc.), management of defaults, set-up specifications/prescription data, support of quality gates, SPC (Statistic Process Control).

i4.0 Approach

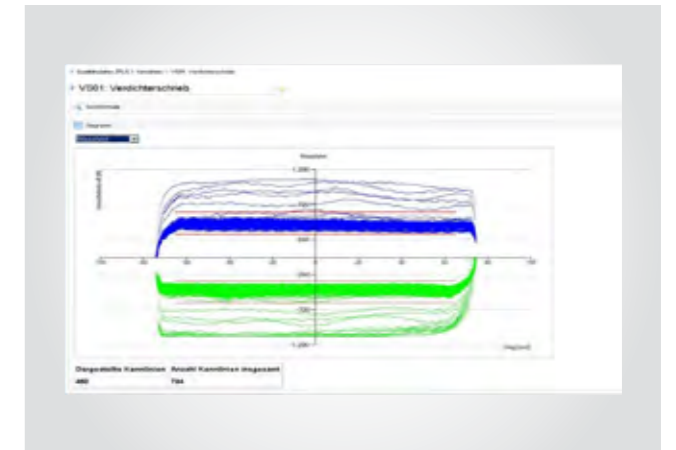
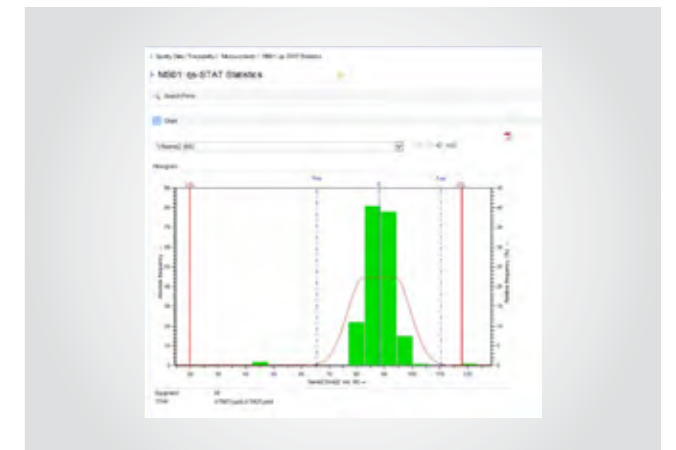
- ▶ Digital life-cycle management: process and product data are stored for reporting as well as for long term archiving
- ▶ Visualization and mathematical analysis of process parameters to detect anomalies and prevent hidden defects at an early stage
- ▶ Process control including multiple machines within a connected shopfloor
- ▶ Open standards: universal interface to manufacturing equipment, including integration of 3rd party tools (e.g. Q-DAS qs-STAT)
- ▶ Virtual real-time representation: data is processed in real time, system gives immediate response to machine

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Increase of process reliability through quality gates
- ▶ Intelligent process control supported by algorithms
- ▶ Reduction of rework costs due to early detection of defaults
- ▶ Improved analyzing possibilities by quality database
- ▶ Long term archiving of production data to prevent product liability
- ▶ Improved delivery quality



IT Shopfloor Solutions – Traceability

The traceability functionality covers two aspects:

Component Traceability: Capturing of materials from the incoming to the use/built-in in the production process.

Materials with unique part ID (serial numbers) or charge oriented capturing of process steps is enabled.

Packaging Traceability: Components/products are assigned specified pallets or boxes. These again can be assigned a specific delivery note or general accompanying documents. In addition, a digital capturing or processing of delivery documents is possible.

Base for the consistent traceability is a reliable, centrally managed allocation of numbers/IDs.

- ▶ Generating codes for any kind of identification (e.g. serial number)
- ▶ Managing unique number across several areas (also across line borders)
- ▶ Configurable codes (hex-, decimal-, characters, counters, shiftnumbers, constants, etc.)
- ▶ Configurable counter steps/value resets (shift, day, year, etc.)

i4.0 Approach

- ▶ Fast integration and flexible configuration: centralized tracking of all components for the final product over the complete value stream, batch- or part oriented traceability of components with or without added value until packaged in boxes and ranges
- ▶ Various logistic stations with graphical user interface support the packaging and re-packaging process complying with central guidelines
- ▶ People as key players:
 - Central reporting system for quality and production worker
 - Multiple functionalities: quality assurance, quality control and traceability (top down or bottom up)
- ▶ Open standards: independent from identification type (barcode, DMC, text, ...), support of direct and indirect identification

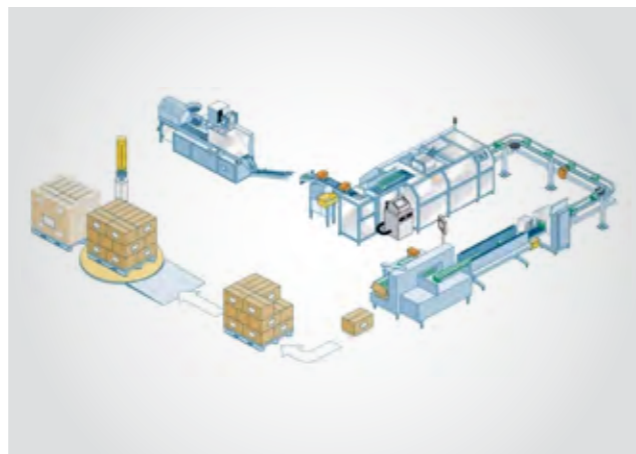
i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Visualization of measured values in production
- ▶ Component traceability of parts at line level (single parts and also charge oriented)
- ▶ Packaging traceability at the end of the line (part in box; box on pallet)

- ▶ User friendly – graphical user interface for packaging station and logistic batch processes
- ▶ Interface for PLC (e.g. automatic palletizer)
- ▶ Additional security – optional Quality Gates before packaging process available
- ▶ Connectivity to further 3rd party systems for packaging processes and OEM systems
- ▶ Tool for unique ID generation (allocation of numbers)
- ▶ Worldwide data exchange with other plants possible



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

IT Shopfloor Solutions – Process Control

With the module Process Control we offer a real-time interface for the machines in a production line to secure the process sequences for serial parts. Software-based support of production processes e.g. rework and analyzing process with predefined parameters. Furthermore Distribution Control enables efficient routing of products through the production, considering the cycle times of single machines as well as any necessary changeover or transport time.

i4.0 Approach

- ▶ Fast integration and flexible configuration: real-time communication 'PLC – Server – PLC' with less than 50 ms
- ▶ Virtual real-time representation – information on production status, position and additional information for each part is always available
- ▶ Self-organizing/adaptive logistic: load balancing even at machines with unequal balanced capabilities
- ▶ Open standard – applicable for all PLCs due to universal machine interface

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Broad coverage – allows handling for single parts, batches or multi-carrier (multiple ID handling)
- ▶ High process reliability – control of the process sequence against a predefined route list
- ▶ Higher security – observation of blocked parts, processes and stations

- ▶ Optimized rework process
- ▶ High connectivity – data exchange between processes/stations
- ▶ Increased efficiency and throughput by distribution control
- ▶ Lower overall costs
- ▶ High flexibility – individual adaptations possible



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

IT Shopfloor Solutions – Planning & Deviation Management

Software tools for planning of production and documentation of deviations. Among others, the comprehensive shift planning and order management is part of it. The current production status is displayed on large screens in the shopfloor with dashboards. Solutions: Order Management, SMC, Shiftbook, Andon.

i4.0 Approach

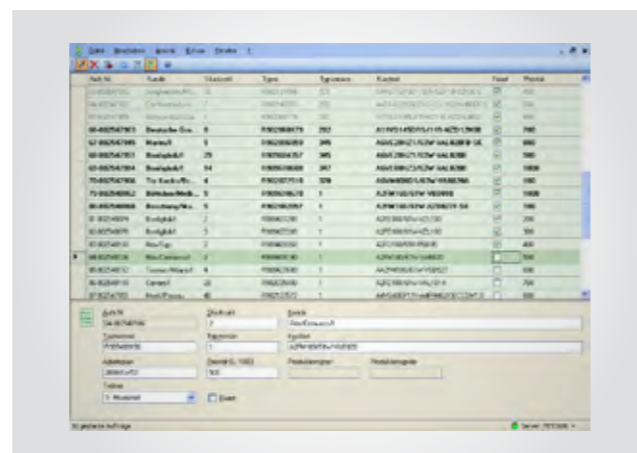
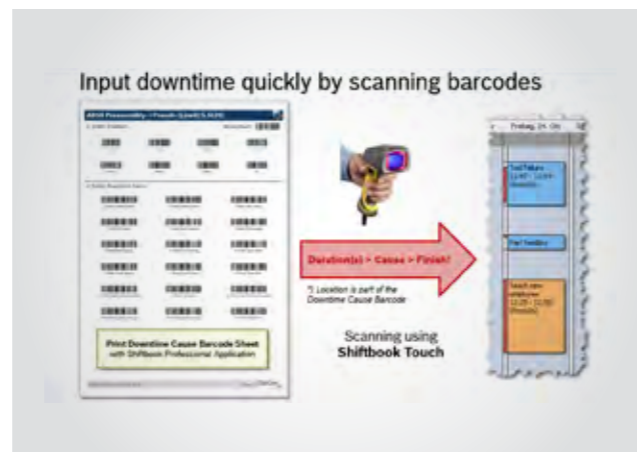
- ▶ Intuitive user interface
- ▶ Increased employee awareness due to displaying production KPIs in the shopfloor
- ▶ Universal machine interface
- ▶ Deviation analysis with automated messaging

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Fast reaction system in production with acoustic and optical signals for the team leader by activating 'trigger line'
- ▶ Visualization of deviations from the standard process
- ▶ Visualization of delivery status (lot sizes)
- ▶ Shiftbook as underlying planning tool
- ▶ Independent of the control system of devices



IT Shopfloor Solutions – Information Management & HMI

Visualization of manufacturing data and entering of information on different devices. The portfolio includes many adjusted solutions – from modern surfaces for logistic terminals to displaying for more transparency in the production to visualization for the management. In addition, there is a comprehensive, web based module to analyze manufacturing data and create reports. The reports can also be created automatically and sent to predefined persons by email.

i4.0 Approach

- ▶ Personalized panel for the visualization of predefined KPIs
- ▶ Use of Mobile Solutions – fast and compact information everywhere
- ▶ Quick overview on Management View or detailed and interactive reports in web portal
- ▶ Automatical 'escalation features' via SMS, email etc. – quick reaction process
- ▶ Individual interfaces for different user groups – user orientation

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

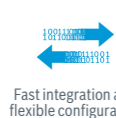
- ▶ Production status at one glance – from single line to entire production
- ▶ Quick access to real-time information
- ▶ High comparability due to predefined KPIs
- ▶ Higher awareness of production data
- ▶ Easy identification of improvement potentials



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



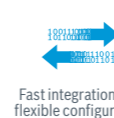
Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

IT Shopfloor Solutions – Automation Platform

The Automation Platform is a modern, modular and open platform for an efficient machine-building and plant engineering. It includes scalable automation systems consisting of controllable functions and modern visualizations in combination with modular i4.0 added value functions, e.g. the Cycle Time Diagnosis, the Energy and Condition Monitoring, the Event and Data Recording and the Production Data Acquisition.

i4.0 Approach

- ▶ High flexibility and a variety of open interfaces by a modern, service-oriented architecture (SOA)
- ▶ Project realization out of the construction kit – standardized interfaces enable seamless integration of the machines and systems into the IT infrastructure of the production
- ▶ Provision of process and machine data such as consumption values, defects, warning notices and trace data, which can be visualized and analyzed by app in the HMI, on tablets, on panels and other external software systems
- ▶ Autonomous monitoring of cycle times as well as recognition of fluctuating cycle times and messages of changes and maturity dates of components
- ▶ Easy interaction with the machine for the machine operator as well as for the service employee thanks to consistent HMI and engineering concept

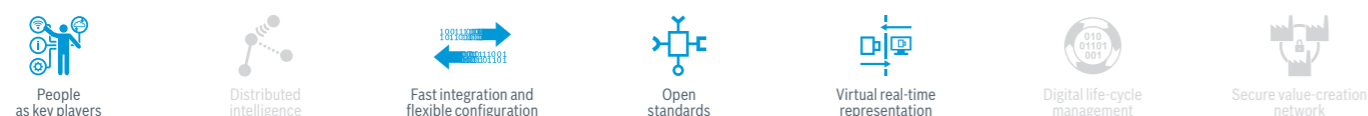
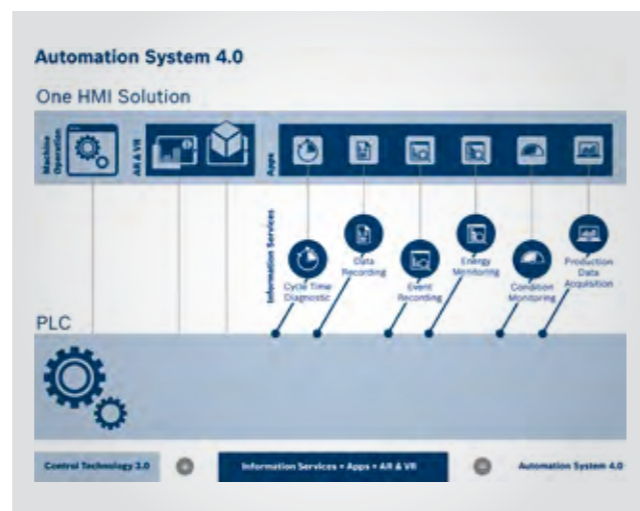
i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Easy software development with new engineering tools
- ▶ Continuous modular and reusable software and software objects
- ▶ Clearly defined interfaces and overall system
- ▶ Reduced development and total costs of the machine and the complete value chain
- ▶ Flexible and appropriate configuration of the software modules

- ▶ No cross query within the project structure
- ▶ Recording of changes within the object without testing the overall system again
- ▶ Automatic creation of partially aspects by the new software structure
- ▶ Logical combining of codes and data into a unit due to object oriented programming (OOP)
- ▶ Due to OOP, the system is operable without programming knowledge



IT Shopfloor Solutions – Automation Systems

The scalable automating and operating system (from the cloud to the hardware) based on newest computer architecture with the integrated functions control technology, visualization, motion, data technique, measurement technique and image processing enables highest flexibility in realizing different automation tasks. Typical application areas are assembly and the process and testing technologies.

i4.0 Approach

- ▶ Modern automation system with integrated solutions
- ▶ Slipping of sub systems and necessary special knowledge or the so-called hero systems
- ▶ Standardized and open interfaces for the integration in the production
- ▶ Mobile machine operator concept

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Based on the hardware concept, the automating system provides the right software for each variant
- ▶ Software library for software scaling
- ▶ Engineering scaling offers appropriate solutions for any concept in mechanical engineering, from in-cabinet terminal control and embedded control panels to PCs
- ▶ Since the system is harmonized, the same software components can be implemented into different systems, which guarantees maximum quality of the components
- ▶ Optimizes cost solutions due to consistency in the operation on the basis of scaling in coordination



IT Shopfloor Solutions – Energy and Condition Monitoring

Energy Monitoring – fully automated recording and storing of energy consumption data. Therefore, access to data is possible at any time to create evaluations and detect energy fluctuations.

Condition Monitoring – intelligent real-time monitoring of machine and process characteristics. With the help of warning and alarming limits, deviations can be recognized at an early stage. Therefore, by detecting wear and monitoring of product life time predictive maintenance is possible.

i4.0 Approach

- ▶ Provision of process and machine data by standardized and open interfaces
- ▶ An overlaid data analysis enables the identification of weaknesses and the monitoring of a constant quality and output
- ▶ Service-oriented software architecture with modular software solutions
- ▶ Transparent involvement of humans into the machine data flow due to direct data evaluation and analysis via apps on the machine
- ▶ Fast reaction and guarantee of the machine output due to the connection of the continuous target-actual comparison to the alarming system
- ▶ Value-added functions and services are directly and fully integrated into the machine
- ▶ Real-time collection and visualization of machine data such as quantities
- ▶ Transmission of these data via open interfaces into overall systems like MES
- ▶ Quantities can be analyzed and visualized in the context of disruption times, cycle times and process courses
- ▶ Integration into the HMI via app for transparent data visualization on the machine, tablet or other mobile devices

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Continuous monitoring and direct visualization of consumptions and process values at the machine
- ▶ Fast and easy access allows the operator to initiate process measures directly on the machine
- ▶ Standard interfaces send the data to overall software systems such as MES
- ▶ Energy and process data can either be observed and monitored directly at the machine or centralized at the overall system



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

IT Shopfloor Solutions – Cycle Time Diagnosis

The integrated Cycle Time Diagnosis on the machine enables a real-time ad hoc recording of production processes and their cycle time. The intuitive HMI app supports the simple teach-in of reference cycles. The software service allows the comparison of cycle times by using fingerprints and the reference cycle. Furthermore, a fast recognition of and reaction to cycle time deviations is possible. The transparent provision of the cycle times up to a single device enables a detailed and fast cause study.

i4.0 Approach

- ▶ Provision of process and machine data by standardized and open interfaces
- ▶ An overlaid data analysis enables the identification of weaknesses and the monitoring of a constant quality and output
- ▶ Service-oriented software architecture with modular software solutions
- ▶ Transparent involvement of humans into the machine data flow due to direct data evaluation and analysis via apps on the machine
- ▶ Fast reaction and guarantee of the machine output due to the connection of the continuous target-actual comparison to the alarming system
- ▶ Value-added functions and services are directly and fully integrated into the machine
- ▶ Real-time collection and visualization of machine data such as quantities
- ▶ Transmission of these data via open interfaces into overall systems such as MES
- ▶ Quantities can be analyzed and visualized in the context of disruption times, cycle times and process courses
- ▶ Integration into the HMI via app for transparent data visualization on the machine, tablet or other mobile devices

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Continuous monitoring and direct visualization of the machine performance at the machine that ensures the machine output and the productivity
- ▶ Cycle time deviations caused by aging, wear or defects can be recognized and monitored directly at the machine as well as at the central overall system
- ▶ Fast and easy access allow the operator to initiate necessary measures directly on the machine
- ▶ Standard interfaces send the data to the overall systems such as MES
- ▶ Easy operation and use at the machine due to the high degree of integration without additional infrastructure



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

IT Shopfloor Solutions – Event & Data Recording

Event Recording – defects, warnings and information of the machine are collected and stored fully automatically. Thus it is possible to access the history of the machine data and create evaluations such as the top-10-fault-analysis, faults over a certain period or frequencies in a certain time distance.

Data Recording – generic service for the recording of different parameters of processes and machines. Consistent provision of the data for analyses. Source for the Internet of Things.

i4.0 Approach

- ▶ Provision of process and machine data by standardized and open interfaces
- ▶ An overlaid data analysis allows for the identification of weaknesses and the monitoring of a constant quality and output
- ▶ Service-oriented software architecture with modular software solutions
- ▶ Transparent involvement of humans into the machine data flow due to direct data evaluation and analysis via apps on the machine
- ▶ Fast reaction and guarantee of the machine output due to the connection of the continuous target-actual comparison to the alarming system
- ▶ Value-added functions and services are directly and fully integrated into the machine
- ▶ Real-time collection and visualization of machine data such as quantities
- ▶ Transmission of these data via open interfaces into overall systems such as MES
- ▶ Quantities can be analyzed and visualized in the context of downtimes, cycle times and process courses
- ▶ Integration into the HMI via app for transparent data visualization on the machine, tablets or other mobile devices

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Continuous monitoring and direct visualization of all machine events directly at the machine, which guarantees a maximum of transparency and maintainability
- ▶ Fault rate and fault design can be recognized and monitored directly at the machine as well as centralized at the overall system to react when required
- ▶ Fast and easy access allows the operator to initiate necessary measures directly at the machine
- ▶ Standardized interfaces send the data to overall software systems such as MES



IT Shopfloor Solutions – Smart Production Data Acquisition

With the help of the Smart Production Data Acquisition parts quantities as well as OK/NOK reviews are collected and stored fully automatical. Thus, complete access to all historical production results is possible and analyses such as the pareto or top-10-NOK-analysis can be done. The data can be visualized in the context of shift and process considerations.

i4.0 Approach

- ▶ Provision of process and machine data by standardized and open interfaces
- ▶ An overlaid data analysis enables the identification of weaknesses and the monitoring of a constant quality and output
- ▶ Service-oriented software architecture with modular software solutions
- ▶ Transparent involvement of humans into the machine data flow due to direct data evaluation and analysis via apps on the machine
- ▶ Fast reaction and guarantee of the machine output due to the connection of the continuous target-actual comparison to the alarming system
- ▶ Value-added functions and services are directly and fully integrated into the machine
- ▶ Real-time collection and visualization of machine data such as quantities
- ▶ Transmission of these data via open interfaces into overall systems such as MES
- ▶ Quantities can be analyzed and visualized in the context of downtimes, cycle times and process courses
- ▶ Integration into the HIM via app for transparent data visualization on the machine, tablet or other mobile devices

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Continuous monitoring and direct visualization of production results at the machine guarantees a maximum of transparency and maintainability
- ▶ Production capacity and results can be either considered and monitored directly at the machine, or at the centralized overall system to react if required
- ▶ Fast and easy access allows the operator to initiate necessary measures
- ▶ Standard interfaces send the data to overall software systems such as MES



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

IT Shopfloor Solutions – Mechatronic Engineering Toolbox

The Mechatronic Engineering Toolbox supports the development of machine applications. Once defined, mechatronic models can be stored in a standard and defined way. This enables a high degree of reusability within the engineering process and therefore contributes to a quality improvement and cost reduction. The construction kit guarantees an efficient engineering based on the software model CONTROL plus and EPLAN P8.

i4.0 Approach

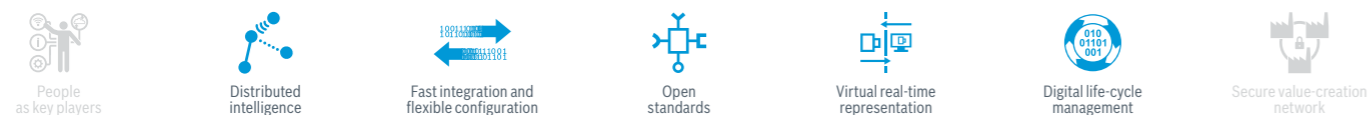
- ▶ The engineering tools enable a model-based, hardware-independent engineering under the use of comprehensive libraries for devices and functionalities
- ▶ Modern interfaces and the use of 3D models enable the simulation already in an early stage of the development of the machine
- ▶ The process guarantees a high extent of software quality and efficiency
- ▶ The system guarantees compatibility and enables the operator during the whole life-cycle of the machine to participate at innovations and developments

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Support at making workflows continuously more effective and efficient
- ▶ Reuse of tested software modules
- ▶ Standardized software templates for the development of applications
- ▶ Wizard-guided software development
- ▶ Encapsulated software in components and function-oriented modules
- ▶ Vertical integration by using efficient interfaces for continuity in the plant and development processes
- ▶ Functional engineering for cross-trade standardization and project planning
- ▶ Take over of existing data e.g. from ECAD



IT Shopfloor Solutions – i4.0 HMI Technologies

To fulfill the requirements of a user-centric architecture, i4.0 HMI Technologies offer several solutions to integrate humans into the data and communication stream of the intelligent machine. In this way, the topics Augmented Reality, more and more use of apps and the 3D HMI play an important role. Location and context sensitive data get overlaid with the field of view of the operator and can get used without additional expert knowledge. This makes new maintenance and inspection scenarios possible and guarantees a high machine availability.

i4.0 Approach

- ▶ With the help of Augmented Reality the classic control concept can get significantly expanded – the real world and computer generated elements are combined
- ▶ Thanks to 'appization' (use of apps), the different user tools can be added to the machine interface as required
- ▶ The 3D HMI supports the user at the fast localization of faults, at the parts search and each point of interest (POIs)

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ The real image seen from a person is completed by virtual, computer-generated elements, which embed themselves locally precise and context sensitive
- ▶ Thus, things and information become visible for the viewer, which are not visible for the naked eye
- ▶ Models of machine parts, which are hidden behind other things, can be inserted
- ▶ Tools can be inserted at the right place to support the employee at service and assembly operations and show the matching working steps and how to fulfill them
- ▶ Live data from the machine can be presented in real time and by coloring the corresponding machine part, limit exceedance can be shown



IT Shopfloor Solutions – i4.0 Image Processing

IT Shopfloor Solutions – Image Processing are robust, flexible and economic solutions within the optical measurement and testing technology in production. Our experience is the result of more than 10,000 successfully implemented image processing applications. Therefore, we provide the fully integrated range of services, from consulting, project planning, engineering, application up to training and service for industrial image processing.

i4.0 Approach

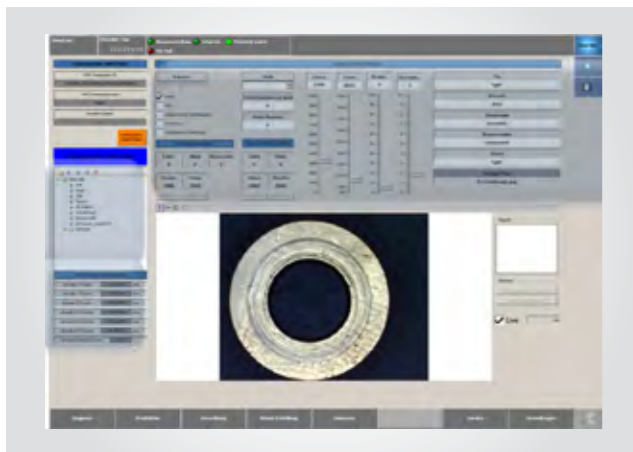
- ▶ Each system is optimally designed according to the specific task
- ▶ Competent, short-term and cost-saving customer support via the Bosch network
- ▶ User-friendly interface for easy and intuitive operation
- ▶ Standardized interfaces enable an application into different systems
- ▶ High quality technology which monitors itself

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Protection of reliable product quality
- ▶ Reduction of running costs for testing, almost to 100 %
- ▶ Detection of production faults right after their formation
- ▶ Documentation of production processes and the product quality
- ▶ Constant objective, comprehensible and reproducible testing results
- ▶ Touchless regulation and controlling of processes
- ▶ Fast, safe and precise guidance of robots and handling systems
- ▶ Cost reduction by avoiding product recalls, complaints and image losses



IT Shopfloor Solutions – Image Processing – Construction Kit 4.0

The Image Processing – Construction Kit 4.0 is a fully integrated construction kit consisting of compatible and experiences components and services for the realization of image processing applications. Different camera and lighting technologies, image processing algorithms and procedures for the robust use in an industrial environment. Resulting solutions are for example: Optical Process Control, Process Control and Assembly Guidance, Visual Setup State Monitoring, Image Processing 360 Degree, CAD based visual 3D Inspection, Identification Systems, Mobile Optical Inspection Solutions.

i4.0 Approach

- ▶ Optical real-time representation of processes within production lines
- ▶ Easy operation and controlling thanks to user-friendly interfaces
- ▶ Thanks to its open architecture, the components can be supplemented by local components or standards
- ▶ Flexible and fast adaptable monitoring of production processes guarantees a high automation and a flexible production of small batches
- ▶ Flexible configuration based on a fast and simple machine set-up and teach-in of different types thanks to special software concept
- ▶ Automated analysis and monitoring of quality parameters lead to an early detection of deviations in the processes before bugs occur
- ▶ Documentation of the production data in the MES (Manufacturing Execution System)
- ▶ Interaction with the machine operator and visualization of the current testing on the user-friendly HMI
- ▶ Monitoring of camera based systems by systematical and intelligent self tests

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Fast integration of applications of industrial image processes
- ▶ Access to tested, high quality components and procedures
- ▶ Availability of a fully integrated services package including consulting, implementation, commissioning, trainings and services
- ▶ Components are compatible with each other and can be used also in complete systems
- ▶ Objective and detailed documentation, also of fast processes
- ▶ Calibration of parameters can be done from outside the machine



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:
www.bosch-si.com/process-quality-manager

Process Quality Manager

The Process Quality Manager visualizes, monitors, and documents process data in real time, automatically detects process deviations and trends, and helps experts optimize production processes directly and on an ongoing basis. It is instrumental in achieving zero defects, transparency, and the best quality production output. In practice: using for safety-critical tightening processes.

i4.0 Approach

- ▶ Transparent factory: overview of all tightening processes
- ▶ Central collection of all relevant process and quality data
- ▶ Processing and visualization of real-time data
- ▶ Expert as the key player: being proactive instead of reactive in response to potential process deviations
- ▶ Web-based interface: access to data from wherever you are via PC or mobile device
- ▶ Open interface so that devices/controls can be connected regardless of the manufacturer
- ▶ Role-specific provisioning of information

i4.0 Solution Provider

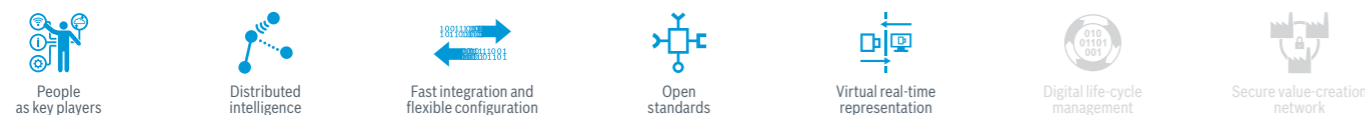
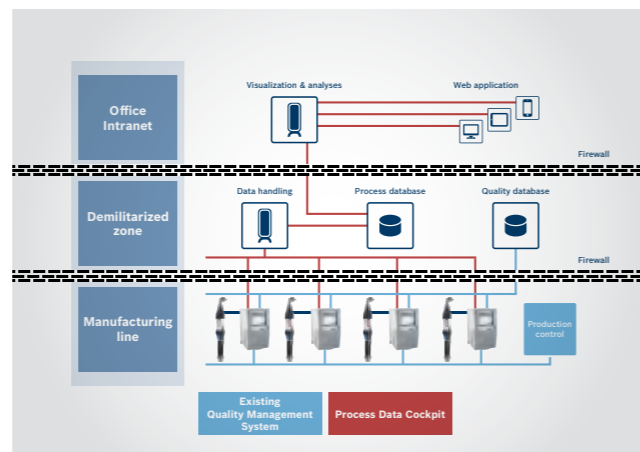
- ▶ Bosch Software Innovations GmbH
- ▶ Bosch Rexroth

Benefits

- ▶ **Early detection of process risks:** enables preventive measures and thus avoids failure costs
- ▶ **Faster reaction to process errors:** reduces failure and reworking costs, results in more output
- ▶ **Continuous process transparency:** supports continuous improvement and enhances utilization of specialist knowledge

KPI

- ▶ Failure costs: 0-mileage complaints, scrap, rework
- ▶ Production output: cycle time, OEE, planned downtime
- ▶ Production costs: direct and indirect labour costs, investments



Link to products:
www.bosch-si.com/production-rules-configurator

Production Rules Configurator

The Production Rules Configurator is a software tool which makes it easy to translate know-how into rules for evaluating production data (process and machine data) in order to trigger the required action in the event of deviations or trends. The tool can be tailored to the specific needs of each individual user in their production environment.

i4.0 Approach

- ▶ Rapid and smooth implementation for data acquisition
- ▶ Software for flexible rule-based analysis of production data
- ▶ Automated analysis of process and machine data (24/7)
- ▶ Simple graphical modeling of rules by manufacturing experts
- ▶ Central repository for capturing expert knowledge
- ▶ Customized configuration and scaling

i4.0 Solution Provider

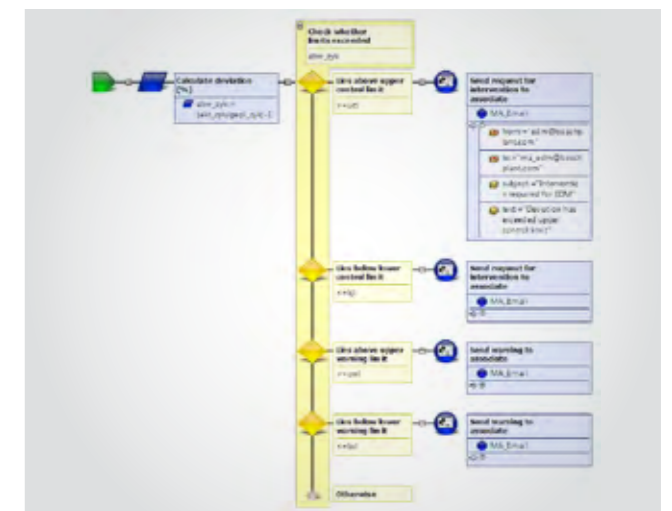
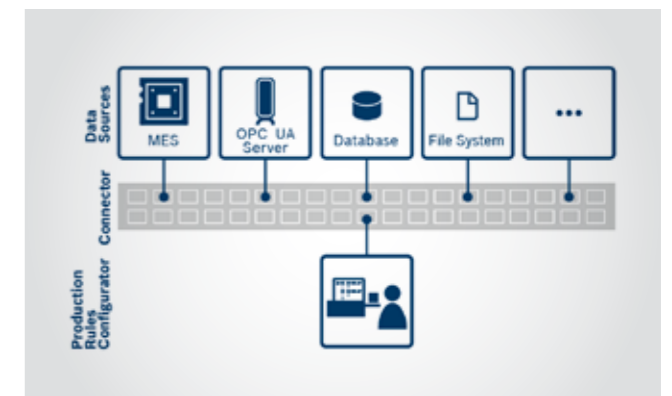
- ▶ Bosch Software Innovations GmbH

Benefits

- ▶ **Early detection of deviations:** gives you time to take measures to safeguard the production quality
- ▶ **Support dynamic maintenance intervals:** maintain machines, if production data so indicates
- ▶ **Simple, customized implementation:** the manufacturing expert creates and customizes the rule model

KPI

- ▶ Costs of maintenance and repair
- ▶ Failure costs
- ▶ Production output: emphasis on technical downtime and performance losses



Link to products:

www.bosch-si.com/remote-service-manager

Remote Service Manager

Disruptions have to be resolved rapidly, since unplanned equipment and plant downtime can quickly become costly. The Remote Service Manager is the perfect system platform for utilizing remote services securely and efficiently. A secure remote connection allows service technicians to complete launch, diagnostic, and maintenance work even faster and more efficiently than before.

i4.0 Approach

To guarantee the security of remote maintenance, there needs to be a secure communication channel between the machine and the user interface on the service technician's local computer. The Remote Service Manager features a sophisticated security concept that adheres to the most stringent security requirements.

- ▶ Authentication management: the connection can be established only by the customer system
- ▶ Security zones: remote access is established across multiple security zones, each of which requires individual authorization
- ▶ Virtual machine: remote access is made via an individual virtual machine, which is generated each time service is required
- ▶ Seamless integration: open interfaces mean the Remote Service Manager can be seamlessly integrated into the business IT and machine environment
- ▶ Manufacturer-independent: possible to integrate any IP-capable manufacturer's equipment and systems
- ▶ Easily scalable: extra systems or equipment can be added at any time

i4.0 Solution Provider

- ▶ Bosch Software Innovations GmbH

Benefits

Remote maintenance of machines, systems, and equipment situated at different physical locations offers numerous advantages:

- ▶ Boost to efficiency and quality of maintenance services without need for site visit
- ▶ Rapid error diagnosis and fault correction
- ▶ Real-time support for commissioning, functional testing, and system diagnostics
- ▶ Prompt installation of new machine and equipment software
- ▶ Safeguarding of current machine and equipment configurations in case of any disruptions or breakdowns

KPI

- ▶ Costs of maintenance and repair
- ▶ Performance increase: emphasis on technical downtime and performance losses



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

www.bosch-si.com/production-performance-manager

Production Performance Manager

The Production Performance Manager is a production information system which stabilizes and optimizes machine KPIs. This software solution visualizes production data in near real time, and communicates that data as notifications tailored to the associate's role in the production process and the nature of the deviation. It also initiates service processes on the basis of user-defined rules.

i4.0 Approach

- ▶ Central visualization and evaluation of machine data from a range of sources (existing production IT, additional sensors, etc.) in the software solution
- ▶ Access to machine data from any device (CIP board, smartphone, tablet, PC)
- ▶ Access to machine data for production associates wherever they are in the factory and in the production network in near real time
- ▶ Rules that allow production experts to flexibly visualize and evaluate machine data
- ▶ Optimization of service processes via IT-led ticket management
- ▶ Rapid machine integration thanks to the new 'generic interface' standard for connecting diverse data sources

i4.0 Solution Provider

- ▶ Bosch Software Innovations GmbH

Benefits

- ▶ **Less downtime** due to central LIVE data access and evaluation, quicker service processes
- ▶ **Improved application of expert knowledge** thanks to optimized data access and central data evaluation
- ▶ **Flexibility without IT knowledge** by giving the experts the tools to implement machine monitoring cases on their own
- ▶ **A software solution to stabilize and optimize your machine KPIs**

KPI

- ▶ Costs of maintenance and repair
- ▶ Failure costs
- ▶ Production output: emphasis on technical downtime and performance losses



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

www.bosch-si.com/manufacturing-analytics

Manufacturing Analytics tools & services

The Manufacturing Analytics portfolio comprises not just multi-stage services for individual analytics projects all the way up to automatic deployment of predictive models but also tools geared towards the typical problems encountered in production scenarios (e.g. tools for test time reduction). These help users and suppliers generate added value from the analysis of their production data.

i4.0 Approach

- ▶ We develop user-friendly, browser-based self-service tools for typical analytics tasks in a manufacturing context
- ▶ Tailored manufacturing analytics services offered as 3 stages: Initial Insights, Advanced Intelligence, Automated Analytics
- ▶ Service projects executed in accordance with the CRISP-DM standard
- ▶ Focus on an expert-level understanding of your problem in the manufacturing process as opposed to a purely data-oriented approach
- ▶ Innovative technology and algorithms specially for manufacturing
- ▶ Integration of data from a range of sources (machines, MES, ERP) for your manufacturing analytics project
- ▶ Iterative approach that quickly yields useful analytics results
- ▶ Automated analytics, e.g. for predictive maintenance in manufacturing
- ▶ Added value for machine and component suppliers thanks to integrated analytics functions
- ▶ Our service goes beyond the handover: benefit from lifecycle management with maintenance and support for your implemented analytics models

i4.0 Solution Provider

- ▶ Bosch Software Innovations GmbH

Benefits

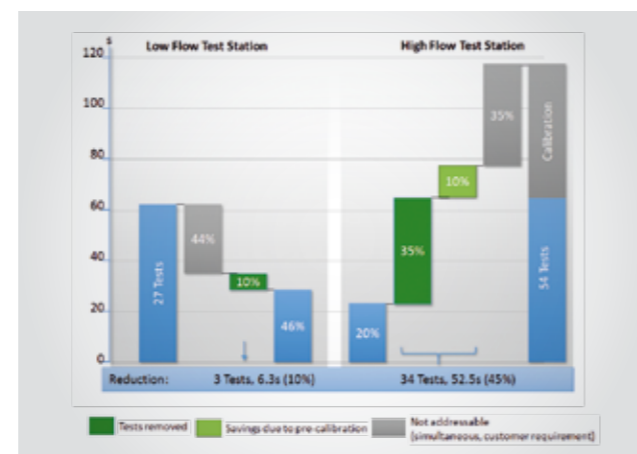
Use manufacturing analytics to:

- ▶ **Improve quality:** analysis of process quality, testing effort, root causes of scrap and rework and field data

- ▶ **Boost performance/increase output:** reducing calibration, test and cycle times helps manufacturing experts further increase output
- ▶ **Reduce maintenance costs:** when applied to real-time data, analytics functions unlock value such as predictive maintenance for machines and components, thereby reducing downtime

KPI

- ▶ Failure and warranty costs: 0-mileage complaints, scrap, rework
- ▶ Production output: cycle time, downtime, performance losses
- ▶ Costs of maintenance and repair
- ▶ Costs of logistics and inventory
- ▶ Product development costs



Accurate prediction of calibration and test results helps to reduce test and calibration time significantly (displayed example: by 10% respectively 45%).



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

www.bosch-energy.com

Energy Platform

Energy costs are a major factor in manufacturing enterprises. The Energy Platform provides a full breakdown of energy consumption and costs – for the whole facility or individual machines. The concept is as simple as it is effective: we first measure the precise consumption in all locations within production halls where energy is converted or required. These values are then transferred via a secure connection to the Energy Platform, where they are analyzed. They are then converted into useful data that can be viewed online. Thanks to our software solution the user is always able to look at his current energy data, which can be easily accessed via any Internet Browser.

i4.0 Approach

- ▶ Simple connectivity for meters, sensors and machines
- ▶ Web-based monitoring and analysis of energy flows
- ▶ Benchmarking of plants, production lines and machines
- ▶ Data transfer by using high secure encryption standards
- ▶ Easy and flexible configuration
- ▶ Condition-based maintenance of energy equipment and machines

i4.0 Solution Provider

- ▶ Bosch Energy and Building Solutions GmbH

Benefits

- ▶ Reduction of energy consumption and costs in production facilities
- ▶ Refund of energy taxes by assistance in ISO 50001 standard fulfillment
- ▶ Improved resource-efficiency by condition based maintenance
- ▶ Increase in employee productivity by automated energy reporting
- ▶ Reduction of CO₂-emissions
- ▶ Avoidance of blackouts by power quality transparency

KPI

- ▶ Energy consumption
- ▶ Energy costs per piece
- ▶ Costs for maintenance





Link to products:

www.boschrexroth.com/oce

Rexroth Open Core Engineering

Based on open standards, software tools, function toolkits, and Open Core Interface, Open Core Engineering combines high engineering efficiency in automation with the technologies, tools, and solutions of the IT world. Based on open standards, IT technologies and tools it enables the implementation of new services and business models for machine builders and end users.

i4.0 Approach

- ▶ Increased flexibility in customized product manufacturing using a software-based automation kit
- ▶ Increased modularization and decentralization with intelligent components/machine modules
- ▶ Improved data networking at the machine level via multi-protocol support of IndraDrive and IndraControl automation components
- ▶ Smart and simple machine operation to reduce complexity in the application through web-based technologies and HMI solutions
- ▶ Efficient engineering and simplified workflows via toolbox modules, automated software generation, model-based engineering and simulation
- ▶ Vertical networking of machines in production networks through the seamless connection of machine automation with IT automation solutions using open standards such as OPC UA and functional tool integration
- ▶ Using IT knowledge and software solutions as a basis for new mechanical engineering business models in production networks

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ High engineering efficiency in PLC automation with technology-oriented toolbox components for easy adaptation to machines and processes
- ▶ Scalable control solutions with decentralized intelligence for automation controls and drives from an extensive portfolio
- ▶ Combined PLC and IoT applications via Open Core Interface
- ▶ Multi-Ethernet-based communication and support of standardized web and IT technologies



Link to products:

www.boschrexroth.com/webconnector

Rexroth WebConnector

Universal translator for the IoT

WebConnector is the platform-independent, fast, easy-to-program communication interface for dialogue between control and web and IT applications. It combines the automation environment with the enterprise environment as easily as with stationary and mobile end devices. As a data processing gateway it also supports HTML5 and Java technologies.

i4.0 Approach

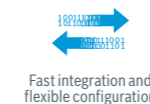
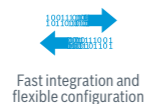
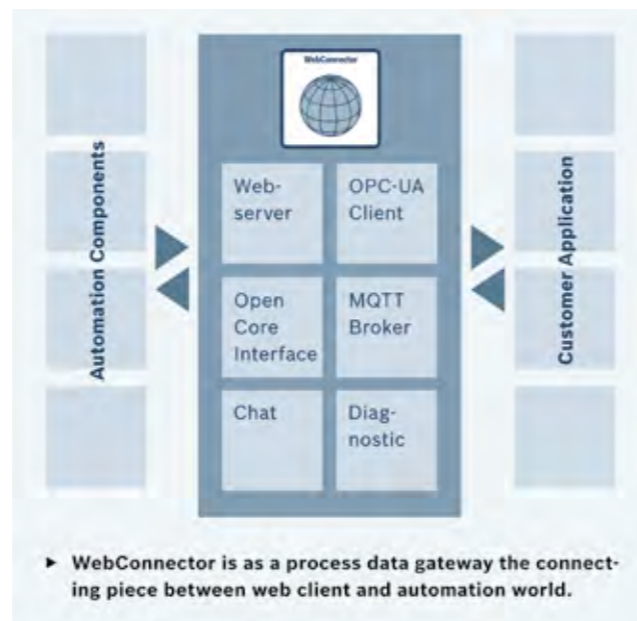
- ▶ Easily connect enterprise applications with automation applications
- ▶ Fast access to control and drive data via WebSockets – without knowledge of the underlying protocols
- ▶ Integrated web server allows integration of custom HTML websites via standard browser
- ▶ Platform-independent, through the use of Java technology – runs on any operating system that supports a Java Virtual Machine
- ▶ Direct data access to automation components via smart-phone or tablet

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Quick: access via WebSockets (JavaScript and .NET) to control units and drives, no detailed knowledge of the underlying communication required
- ▶ Flexible: connection of C#/.NET and web applications to Rexroth or 3rd-party components
- ▶ Support for Industry 4.0 protocols (e.g. MQTT)
- ▶ Integrated web server: for displaying HTML5 websites on a standard browser
- ▶ Independent: able to run on all operating systems accessible from Java Virtual Machine, for example Linux, Windows, Raspbian etc.

**Link to products:**

www.boschrexroth.com/activecockpit

Rexroth ActiveCockpit

As an interactive communication platform for the manufacturing industry ActiveCockpit processes and visualizes production data in real time. ActiveCockpit networks IT applications such as production planning, quality data management, e-mailing, with the software functions of machines and plants. The information serves as a basis for decision and process optimization.

i4.0 Approach

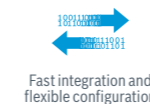
- ▶ Real-time collection, processing, and visualization of all relevant data of a manufacturing facility for the exchange of information between man, machine, and production processes on the shop floor
- ▶ Interactive software for the diagnosis and optimization of systems and processes as well as fault management
- ▶ Browser-based internet standards and accommodation of 3rd-party applications
- ▶ Easy connection to various back-end systems (MES/ERP)

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Higher productivity through continuous digital supported process improvement, integrated fault management and higher resource efficiency through improved planning
- ▶ Fast and efficient decisions through updated and consistent key figures. Increased transparency in production and real-time access to all relevant data for each person directly on the line
- ▶ Time savings by eliminating manual data collection and analysis
- ▶ Scalable end devices, from mobile devices up to large multi-touchdisplays



Link to products:

www.bosch-india-software.com/en/products_and_solutions/automotive/invh_app/invh_app_.html

iNVH Smart Phone App

iNVH is a smart and handy app that supports users in the assessment of Noise Vibration and Harshness (NVH) in the factory. By using the iNVH app on a smart phone, the user can record time data for noise and vibration, calibrate noise and export the data for further analysis.

i4.0 Approach

- ▶ The tool leverages the benefits of smart phones for performing NVH data acquisition.
- ▶ Connectivity through cloud to Bosch experts for support & feedback
- ▶ Latest calibration values for maximum mobile range
- ▶ Interactive and simple GUI
- ▶ Connectable with external class I sensors (both microphone and accelerometer)
- ▶ Multiple analysis modules: SLM, FFT, RPM measurement, multiple octave band analysis, FFT vs. time & compliance

i4.0 Solution Provider

- ▶ Robert Bosch Engineering and Business Solutions (RBEI)

Benefits

- ▶ Bridging the gap between an NVH lab and factory floor
- ▶ Highly customizable as per user requirements
- ▶ Increased mobility
- ▶ Enables real-time analysis and post-processing of data

KPI

- ▶ +/- 1 dB accuracy as compared to any other measurement equipment
- ▶ Reduced set-up time



People
as key players



Distributed
intelligence



Fast integration and
flexible configuration



Open
standards



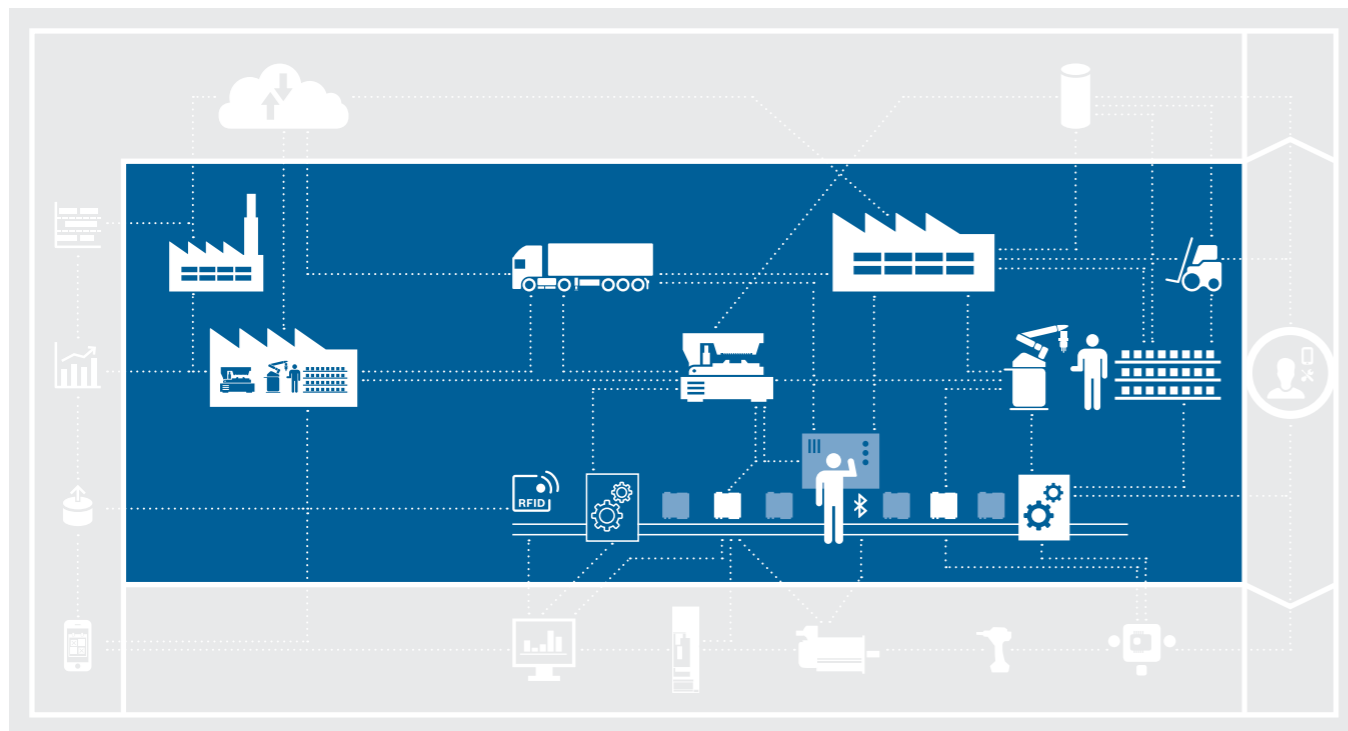
Virtual real-time
representation



Digital life-cycle
management



Secure value-creation
network



LOGISTICS AND MANUFACTURING AT BOSCH

On this level, Bosch offers machinery equipment and software for machine users to interconnect their factories along the complete value creation process and beyond. The machines and complete assembly stations open up new perspectives for the merging of hardware with the virtual world of information technology. New functions improve quality control and the flexibility of factory equipment to manufacture

small batch sizes economically. New approaches to logistics processes include a seamless tracking of components and monitoring of the conditions they are exposed to, including temperature, humidity, and vibrations. Deviations from the specified conditions are recognized in real time and countermeasures can be taken before faults lead to production stoppages.

Link to products:www.xdk.io

Cross Domain Development Kit XDK110

The Cross Domain Development Kit XDK110 is a wireless sensor device that enables rapid prototyping of sensor based products and applications for the Internet of Things (IoT). With state of the art sensor technology and ready-to-use software packages it enables you to immediately start an Internet of Things application.

i4.0 Approach

- ▶ The XDK enables professional users and software developers to immediately start an IoT demo or Proof of Concept project
- ▶ The software development environment (XDK Workbench) is easy to install and automatically updates itself
- ▶ An operating system based on the open source operating system FreeRTOS enables real-time IoT application
- ▶ Due to its small form factor, it can be retrofitted to objects of any size

i4.0 Solution Provider

- ▶ Bosch Connected Devices and Solutions GmbH

Benefits

- ▶ All-in-one scalable hardware platform enables time and cost effective prototyping
- ▶ Ready-to-use software: there is no need for component selection, hardware assembly, or deployment of a real-time operating system
- ▶ Drivers for all system components included

- ▶ PC-based development tools make it an easy to work with tool for any developer
- ▶ Community for support and exchange
- ▶ Low power consumption for long-term use
- ▶ An algorithm library and sample applications convenient for first-time programming
- ▶ The software development environment offers high-level API for the standard user and low-level API for the poweruser which allows the user to program at their preferred depth

KPI

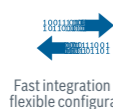
- ▶ The kit includes Bluetooth 4.0 LE and Wireless LAN connectivity, a 32-bit microcontroller, integrated antennas, a micro SD card slot and a Li-Ion rechargeable battery 560 mAh
- ▶ Pre-certified to CE, FCC and IC
- ▶ XDK includes a MEMS accelerometer, magnetometer and gyroscope, as well as humidity, pressure, temperature, acoustic and digital light sensors
- ▶ Small form factor
- ▶ Secure data protocol



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:www.bosch-connectivity.com/industry-logistics

Transport Data Logger

By being attached to the shipment and measuring and recording temperature, humidity, tilt, and shock, the Transport Data Logger (TDL) makes the delivery process of goods transparent. These measurements are visualized through a mobile application. Since the limits of each parameter can be individually configured, any transgression of these limits is traceable and clearly assignable throughout the entire supply chain.

i4.0 Approach

- ▶ The TDL is the cost-effective, simple, all-purpose and reliable way to bring transparency to the entire supply chain, with the usual Bosch quality
- ▶ The TDL is individually configurable, intuitive and easy to use, and can be integrated with little effort and without prior knowledge of the processes of a logistics chain
- ▶ The TDL gives the initiator of a delivery peace of mind and a good sense of control and transparency. In the event of a parameter limit transgression, the TDL provides a verifiable proof and a reliable indication for possible primary and secondary damage. If there is no transgression, the TDL is the evidence of a carefully conducted and failure-free transport chain.
- ▶ The TDL provides an added value for every logistical effort. It creates trust between the partners and provides important data for the optimization of logistics processes.

i4.0 Solution Provider

- ▶ Bosch Connected Devices and Solutions GmbH

Benefits

- ▶ Creation of transparency within the entire supply chain
- ▶ Simplified visualization via mobile application
- ▶ Easy installation with a well designed mounting concept
- ▶ Battery with an outstanding long lifetime resulting in less handling effort

KPI

- ▶ Reliable and precise MEMS technology by Bosch
- ▶ Simultaneous monitoring of multiple crucial parameter, such as temperature, humidity, tilt and shock
- ▶ Up to two years battery lifetime
- ▶ Industry proven design with IP54 enclosure protection class



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Rexroth ActiveAssist

ActiveAssist brings together people, equipment, and processing, through decentralized intelligence. The web-based software and standardized interfaces precisely identify work pieces and supports employees in a varied assembly. At the same time, it monitors the quality of the process and initiates corrective action. ActiveAssist is modular expandable.

i4.0 Approach

- ▶ ActiveAssist is a configurable platform for intuitive worker guidance and secure process control, and is especially suited to a widely variety of assemblies
- ▶ Web-based software with a standardized interface for networking with existing MES and ERP systems as well as current and future sensors (e.g. camera, ultrasound, and display devices)
- ▶ Precise identification of work pieces take place in real time. The worker receives the correspondent work instructions. A projection or pick-to-light system guides the worker through the steps of the assembly. The assembly steps are checked and approved by cameras, ultrasonic features, or torque of the nutrunner and 3D camera for handtracking.
- ▶ The instructions at the work station are individually tailored nutrunner and 3D camera for handtracking

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Shorter introduction period and reproducible quality in a varied assembly
- ▶ Standardized interfaces enable easy commissioning and integration with MES/ERP systems
- ▶ Intuitive user interface and optimized ergonomics for high worker acceptance
- ▶ Customized products can be manufactured faster and more productive



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

Homepage: www.bosch-apas.com

YouTube: APAS Channel

APAS family

Based on its mobile production assistants the APAS family offers changeable automation and brings flexibility into production. The agile, compact designed production modules can be freely combined and positioned. In this way, individual solutions for production islands are created. This enables quick and easy changes of location in production. With the help of the dialog-controlled user interface, the modules can be adjusted easily to new tasks. The family currently consists of the APAS assistant, the APAS inspector and the APAS flexpress. To close the gap between manual and automated production processes, we offer the APAS workstation, a manual workstation, completed by a collaborative robot and an extensive options package for quality and production improvement. Additionally, there is the APAS safekin, a collaborative robot arm for the integration in partially automated production environments.

i4.0 Approach

- ▶ Quick change of location is possible, because each of the automation devices is mobile, thus there is no need for an exact or permanent alignment
- ▶ Collaboration is guaranteed by a comprehensive safety technology for each module. APAS assistant, the collaborative robot, is even certified by the German employers liability insurance association, the APAS family allows the direct collaboration with people without additional shielding
- ▶ The network connectivity between the APAS family members empowers the exchange of necessary workflow information and ensures efficient remote maintenance

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ The APAS family assists humans in production by taking over monotonous, dangerous or dull tasks
- ▶ Ad-hoc automation: Plug & Produce
- ▶ Highly flexible for various applications
- ▶ High scalability and reusability
- ▶ Especially useful for small series production, quality claims, prototype manufacturing, process validation, etc.
- ▶ Agile engineering with early results
- ▶ Modular design



Link to products:Homepage: www.bosch-apas.comYouTube: [APAS Channel](#)

APAS family – APAS assistant

The APAS assistant is a versatilely deployable automatic production assistant. As an intelligent and intrinsically safe robot system, the APAS assistant allows direct collaboration with humans without additional shielding. The robot arm is covered by a highly sensitive sensor skin, which reacts immediately when somebody approaches. Before there is any contact between human and machine, the APAS assistant stops and only continues its work, when the person is out of the danger zone. The APAS assistant is the first certified collaborating robot system for industrial use. The safety concept of the APAS assistant is completed by the module APAS speedswitch, which allows maximum working speed of the robot in case nobody is in the close proximity of the system. Additionally, the robot is equipped with a 3D camera system, which allows him to recognize objects for pick and place and leads to an automated recalibration in case of repositioning. Work plans can easily be created with a graphical and dialog controlled user interface.

i4.0 Approach

- ▶ Certified comprehensive safety concept for close human-robot collaboration
- ▶ Intelligent interaction of the robot system with its production environment by means of its 3D camera system
- ▶ Graphical user interface for easy system integration
- ▶ Standardized connectivity for fast and easy integration into typical production environment
- ▶ Network connectivity for an easy remote access and an inter-communication between different devices
- ▶ Quick release castors for easy repositioning

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ The APAS assistant supports humans in production by taking over monotonous, dangerous or dull tasks
- ▶ No need for additional safety guards allows space saving automation
- ▶ Multilevel safety concept allows high productivity and close human-robot collaboration in the same system
- ▶ Certified safety based on patented sensor skin for close human-robot collaboration
- ▶ Easy and fast teach-in of work plans without programming expertise
- ▶ High accuracy of gripping and placing
- ▶ Easy and fast repositioning based on the 3D camera system for maximum flexibility



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:Homepage: www.bosch-apas.comYouTube: [APAS Channel](#)

APAS family – APAS inspector

The APAS inspector is a mobile vision inspection system for the shopfloor. There are several different, manually exchangeable optical inspection modules. These modules are characterized by their robust 3D imaging technology. Thus, not only highly sensitive surface inspections, but also many different other sophisticated inspections are possible.

i4.0 Approach

- ▶ The APAS inspector is operated via a mobile touchpad. The user interface shows test results as well as process images
- ▶ Thanks to the 3D imaging, the system gathers comprehensive optical characteristics of each inspected object for a robust and precise fault detection and reliable quality classification
- ▶ The planar stage makes the APAS inspector flexible and changeable. Following the concept of setting-up by software instead of laborious mechanical adaption, the planar stage can easily be parameterized in order to enable different object views.
- ▶ The quick release castors enable mobile deployment of the APAS inspector in production. There is no need for a permanent alignment at the work place.
- ▶ Standardized connectivity for fast and easy integration into typical production environment

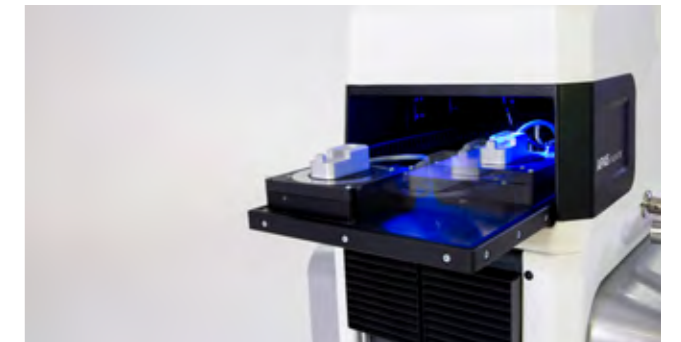
- ▶ Network connectivity for an easy remote access and an inter-communication between different devices

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ High reliability because of particularly robust 3D imaging technology
- ▶ Nearly unlimited possibilities due to different modes of the camera and illumination
- ▶ Fast and easy setup when requirements change due to the modular concept together with the flexible planar stage
- ▶ No permanent arrangement at the work place necessary



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:Homepage: www.bosch-apas.comYouTube: [APAS Channel](#)

APAS family – APAS flexpress

The APAS flexpress is a mobile production assistant for highly flexible and high-precision joining. Variable side plates make the system adaptable to work pieces in different sizes in a fast and easy way. The integrated safety technology allows the direct collaboration with humans.

i4.0 Approach

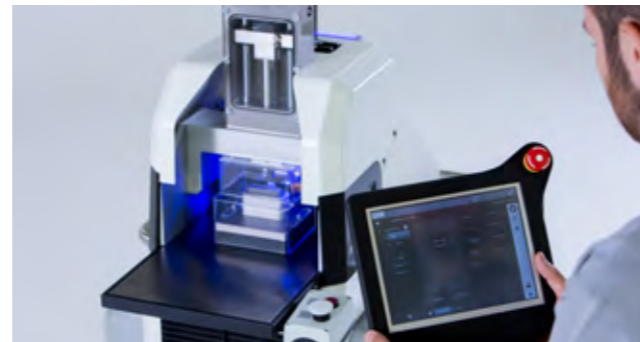
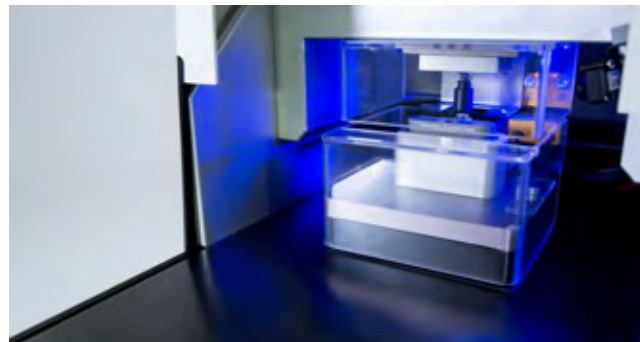
- ▶ The planar stage makes the APAS flexpress flexible and changeable. Following the concept of setting-up by software instead of laborious mechanical adaption, the planar stage can easily be parameterized in order to enable different joining scenarios.
- ▶ For each joining process, the APAS flexpress records a comprehensive force-distance-dataset for process validation, documentation and traceability
- ▶ The integrated safety concept allows close user-interaction.
- ▶ The APAS flexpress is operated via a mobile touchpad.
- ▶ With its quick-fixation casters the APAS flexpress is applicable in a mobile way in production. There is no need for a permanent alignment at the work place.
- ▶ Standardized connectivity for fast and easy integration into typical production environment
- ▶ Network connectivity for an easy remote access and an inter-communication between different devices

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Integrated safety technology for easy and direct cooperation with humans
- ▶ Connected with the APAS family
- ▶ Highly flexible and precise input of parts
- ▶ No permanent arrangement at the work place necessary
- ▶ High flexibility and mobile application
- ▶ Space saving automation



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:Homepage: www.bosch-apas.comYouTube: [APAS Channel](#)

APAS family – APAS safekin

The increasing trend towards collaborating robotic solutions has prompted Bosch to expand the APAS family with the safe robot arm APAS safekin. Just as in case of the APAS assistant, the sensor skin-protected automation component comes with a comprehensive and certified safety concept. Without needing a safety fence, it allows for the direct and safe collaboration with humans. Even before there is contact between man and machine, the APAS safekin stops and only restarts when the danger zone is empty.

i4.0 Approach

- ▶ Direct and close collaboration between human and robot thanks to a certified comprehensive safety concept
- ▶ Fast configuration of robotic jobs thanks to user-friendly interface
- ▶ Integrated teach-in and jogging of the robot via the user interface
- ▶ Semi automation of existing machine equipment and set-ups
- ▶ Intelligent interaction of the robot system with its production environment by its optional 3D camera system

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Fast and easy realization of projects which need direct and safe collaboration without safety fence
- ▶ Unique contact-free safety technology
- ▶ Easy integration of the robot controller into the standardized machine sequence IEC6-1131
- ▶ Certified comprehensive safety concept for close human-machine collaboration
- ▶ Low investment costs



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:Homepage: www.bosch-apas.comYouTube: [APAS Channel](#)

APAS family – APAS workstation

The APAS workstation is the first standardized workplace with an integrated collaborative robot kinematics (APAS safekin). Not separated by a safety fence, humans and machines can collaborate directly to form an effective team: while the robot greatly facilitates day-to-day work and delivers support with simple, monotonous or ergonomically challenging tasks, the human operator oversees and controls production, helping safeguard Germany's future as a production site. As such, the workplaces of tomorrow are and will remain oriented on the needs of the operator. Innovative features like automatic height adjustment, customizable lighting, and the adjustable see-through display offer excellent and attractive working conditions, inspiring employees today and into the future.

i4.0 Approach

- ▶ Intelligent, networked and ergonomic workplace, geared to the needs of its users (user-centered automation)
- ▶ Open interfaces
- ▶ Versatile and flexible use in terms of stand-alone, with an integrated APAS safekin or a provided APAS assistant
- ▶ Innovative features for excellent and attractive working conditions (Inspiring Working Conditions)

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Increase of productivity through efficient workplace design
- ▶ Robot supports by taking over simple, monotonous or ergonomically challenging tasks
- ▶ Unique contact-free safety technology
- ▶ Certified comprehensive safety concept for close man and machine collaboration



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:www.boschpackaging.com/en/pa/products/industries/pd/product-detail/cpi-software-28608.php?ind=1675&mt=16645

CPI – Track & Trace software solution

The CPI solution ensures a reliable connection of software and machine module within the customer's production process. The CPI, installed at the IT level manages serialization and can also connect single components and production lines at the packaging level and complete factories at the enterprise level.

i4.0 Approach

- ▶ Connection of single components, machines, packaging lines and complete factories
- ▶ Traceability over the whole serialization process and in sale
- ▶ Data transfer to central databases for product verification at the point-of-sale (legal driven requirement)
- ▶ Communication between machine and operators to optimize the production process e.g. consumables (ink refilling for data matrix printing)

i4.0 Solution Provider

- ▶ Bosch Packaging Technology, product division Pharma

Benefits

- ▶ Import of serial numbers and management of self-generated serial numbers incl. storage and display of status



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

- ▶ Export of serialization/aggregation data in different formats or customer-specific
- ▶ Real-time overview of activities and status of machines, packaging lines and facilities, as well as their status
- ▶ Summarized visualization of all packaging lines and their locations in a dashboard
- ▶ Batch Management (real-time status, batch-report, historical batch data, long term archiving)

KPI

- ▶ With our Track & Trace solution we step into the IT business in packaging and grow with future customer requirements
- ▶ Machine modules and MES software applications from a single source
- ▶ Experience from other Bosch divisions





FIELD LEVEL EQUIPMENT AT BOSCH

Field level equipment encompasses all the hardware and software products and modules that machine manufacturers need to make their machinery Industry 4.0-ready. Among the automation components Bosch offers are electrical drives and controls, hydraulics, and linear and assembly technologies, all based on our wide range of sensors. For decades now, Bosch has been a leading user of distributed intelligence and open standards, and at our own plants, an ever-greater number of functions which were formerly exe-

cuted mechanically or by humans are today being carried out by software. For example, a machine changeover can now be done with just a few clicks of a mouse.

Field level equipment includes a variety of software functions for process and quality control. In addition to Industry 4.0 readiness, field level components and modules comply with national and international safety regulations. They also contribute to the improved energy efficiency of factories.



Link to products:

www.boschrexroth.com/factory-automation

Rexroth Connected Automation

Bosch Rexroth as leading automation provider drives the next industrial revolution while using the production experience from its own plants. Connected Automation Solutions by Bosch Rexroth enable system manufacturers and operators to sustainably implement their Industry 4.0 concepts, with a complete portfolio of intelligent automation components and system solutions including full IT integration. With this, Rexroth offers leading solutions for the automation of various production scenarios – from mass customization up to high volume production. Connected Automation Solutions by Bosch Rexroth are a decisive contributor for a more efficient and flexible production process, higher material efficiency, while reducing complexity and downtimes.

i4.0 Approach

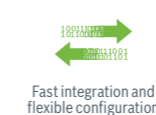
- ▶ Scalable control technology with decentralized device intelligence as a basis for Industry 4.0 conform automation architectures
- ▶ Broad range of proven application software for nearly all common production machines
- ▶ Comprehensive program of electrical drive technology components as well as electromechanical and electrohydraulic solutions
- ▶ Tools for simulation, development and configuration
- ▶ Middleware software, software development kits and APIs for the easy vertical and horizontal integration (M2M) of machine automation with the IT level
- ▶ Communication and data networking via open standards e.g. OPC UA and all common Ethernet communication protocols, as well as support from standardized web & IT technologies
- ▶ Consulting & Services

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ More efficient and flexible production process, higher material efficiency, and reduced complexity
- ▶ The open automation architecture allows for a fast and easy integration of various components as well as consistent integration from the actuator to the IT level
- ▶ Comprehensive access to process data and data from automation components, e.g. for data-based service models, data analysis for systematic quality improvement or energy management
- ▶ State of the art development tools and use of IT technologies create new application scenarios within production environments and increase the efficiency in the overall engineering workflow





Link to products:

www.boschrexroth.com/mlc

Rexroth IndraMotion MLC motion logic system

In the IndraMotion MLC control system, PLC-based machine automation and IT-based technologies come together to form a uniform complete system for all automation tasks. Innovative software and firmware functions, efficient engineering, and open system interfaces ensure maximum flexibility in all applications.

i4.0 Approach

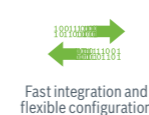
- ▶ PLC and IT Automation are combined into one automation system
- ▶ Scaled control hardware for flexible integration into Industry 4.0 compliant automation topologies
- ▶ Cross-manufacturer M2M communication using OPC UA architecture and WebConnector, and in real time via Sercos
- ▶ Development of automation functions in customary IT and Internet development environments without PLC knowledge
- ▶ Simple and quick PLC engineering using the integrated IndraWorks engineering framework

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Scaled and highly functional control solution with flexible expansion options in central and distributed automation topologies for all applications with PLC and motion control
- ▶ Homogenous integration in diverse topologies via Sercos, Multi-Ethernet and PROFIBUS
- ▶ Increased productivity and efficient engineering with IndraWorks and function toolkits
- ▶ Integration platform for SOA-based architectures of the Open Core Interface technology interface for integrating high-level language-based IoT applications in the total automation
- ▶ Integrated runtime system for motion, robot, and logic control, compliant with open PLC standard IEC 61131-3 on basis of CODESYS V3
- ▶ Regulation of up to 99 axes in one control unit with synchronized and coordinated movements
- ▶ Open Core Interface available as a software development kit with 600 library functions



Link to products:www.boschrexroth.com/mtx

Rexroth IndraMotion MTX CNC system solution

IndraMotion MTX is the unique, individually scalable CNC platform with integrated PLC. The outstanding performance and comprehensive technology functions open up new horizons, even in highly dynamic multi-technology machines. Now you can control up to 60 channels and 250 axes with one CNC. For maximum productivity and flexibility.

i4.0 Approach

- ▶ Cross-manufacturer machine-to-machine communication with open standards such as OPC UA, Sercos, and Open Core Interface
- ▶ Simple diagnostics, service and operation with smart devices
- ▶ Fast integration and flexible configuration with automation interface and IndraWorks Engineering
- ▶ Simulation of machines, machining processes and CNC control
- ▶ Digital life time management with GDS with services such as RCM, RPM, and RDL
- ▶ Consistent use of distributed intelligence with decentralized drives
- ▶ Security: User management, NC program encryption, mGuard support

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Shorter cycle times and greater processing precision for maximum productivity
- ▶ Simple engineering through predefined technology functions
- ▶ Easier modularization of machine concepts through decentralized intelligence and therefore rapid adaptation to customer-specific configurations
- ▶ Differentiation by means of consistently open automation architecture
- ▶ Controls up to 250 axes in 60 NC channels with one piece of hardware
- ▶ The only compact CNC solution for 5-axis machining

**Link to products:**www.boschrexroth.com/LMS

Rexroth LMS Linear Motion System

The Linear Motion System (LMS) is a unique platform which is easy to integrate in customer applications for transport and positioning of materials and products. It offers high accuracy, enables free programmable single and synchronized movements and is faster than traditional systems. The contactless magnetic driven concept features maintenance free and easy to use machine building.

i4.0 Approach

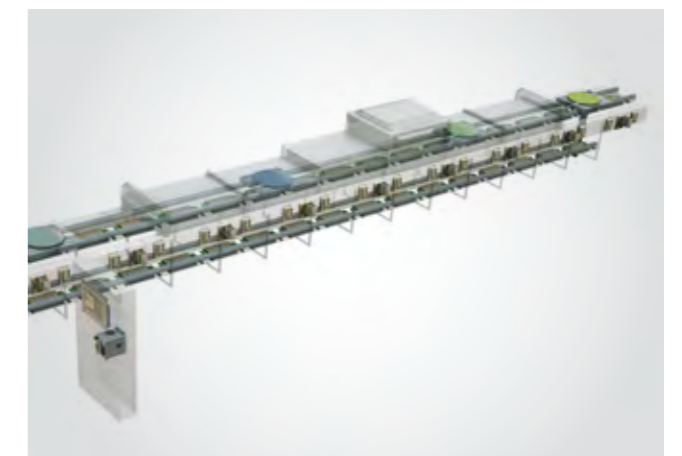
- ▶ A free scalable system
 - Carrier size & weight scalable (1 kg till 1.000 kg)
 - Configurable track layout
- ▶ Flexible and individual carrier control, all information available for use within Scada Systems
- ▶ Simplifies machine concepts
- ▶ Maintenance free
- ▶ Free programmable individual product positioning
- ▶ Data logging for visualization and diagnostics

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ High cycle times
- ▶ Flexible and individual carrier control
- ▶ High positioning repeatability
- ▶ Transport system can replace handling application axis
- ▶ High transport velocities and acceleration
- ▶ Simplifies machine concepts
- ▶ Cable free carriers
- ▶ Velocity up to 5m/s
- ▶ Carrier weight 1 till 1000 Kg
- ▶ Vacuum prove
- ▶ Positioning repeatability up to 10 µm



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

www.boschrexroth.com/indracontrol-xm

Rexroth IndraControl XM embedded control hardware

The IndraControl XM control platform offers the latest hardware technology in a robust housing design for different motion logic applications. It combines the high real-time capability of the Sercos automation bus and the flexibility and high performance of the I/O family IndraControl S20 with a modular and complete automation system for a variety of applications.

i4.0 Approach

- ▶ Simple and flexible system configuration with modular I/O expansion into decentralized architectures
- ▶ Scaled and modular device design with enhancements for I/O and communications and the latest processor technologies
- ▶ Multi-Ethernet-based multi-master/slave communication
- ▶ High real-time capability in interaction with control tasks and system peripherals
- ▶ Suitable for use in harsh environmental conditions

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Complete control system with high performance data processing
- ▶ Scalable in terms of performance and range of functions
- ▶ Robust design with extended temperature range and the lowest EMC emission
- ▶ Simple, flexible I/O integration through directly stackable or decentralized connected IndraControl S20 I/O modules through a variety of fieldbus couplers
- ▶ Sercos and Multi-Ethernet for the flexible integration in decentralized technologies
- ▶ Maintenance-free by eliminating parts that wear out, such as fans and batteries
- ▶ Protection category: IP20
- ▶ Onboard Sercos Master with minimal cycle time of 250 μs
- ▶ Extended temperature range from -25 °C to +60 °C



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

www.boschrexroth.com/indracontrol-l

Rexroth IndraControl L embedded control hardware

The IndraControl L control platform for motion logic systems fits flexibly, consistently, and transparently into a wide variety of automation structures. The modular, controller-based control hardware in DIN rail format supports the option of using high-level language programming for Industry 4.0 applications via the PLC-based automation CODESYS V3.

i4.0 Approach

- ▶ Modular and expandable with options for further expansion and communication and technology interfaces
- ▶ Complete control system with high performance data processing
- ▶ Scalable hardware platform
- ▶ High accessibility through compatible technology update

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Universal and efficient system-wide and solution-wide control concept
- ▶ Communicative and highly functional with configurable multi-protocol interfaces
- ▶ Scaled in terms of performance and range of functions
- ▶ Simple extension of function using functional modules (communication, technology)
- ▶ Simple I/O integration through directly stackable Inline I/O modules, or by integrating decentralized I/O stations via fieldbus
- ▶ Optimized to applications through stepped power output classes
- ▶ Code compatibility across all performance classes
- ▶ Up to 64 centrally controlled axes with the most powerful CPU



Rexroth IndraControl FM control hardware

The IndraControl FM control combines machine PLCs, I/O, and the Open Core Interface for Industry 4.0-enabled applications and is specifically designed for cabinet-free automation concepts. With protection category IP65, IndraControl FM unites a multitude of analog and digital I/O for direct connection of actuator and sensors in machines.

i4.0 Approach

- ▶ Cabinet-free connections for decentralized installation and commissioning of intelligent modules
- ▶ Standardized PLC functionality based on CODESYS V3
- ▶ Fast signal processing with minimal PLC cycle time of 250 µs
- ▶ Support for high-level language-based applications via Open Core Interface for Drives
- ▶ Integration of IoT-based applications via an optional embedded Linux expansion board

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Increased modularization in mechanical engineering through cabinet-free installation
- ▶ Flexible connectivity in heterogeneous automation topologies for a broad application spectrum through direct sensor/actuator connections and high communication capabilities
- ▶ Open integration of IT services in SOA-based Industry 4.0 architectures by using high-level languages parallel to the machine PLC
- ▶ Protection category: IP65
- ▶ 36 analog and digital I/O modules for sensors, actuators, and Modbus on Board
- ▶ Multiprotocol-capable ethernet interface (slave)



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

www.boschrexroth.com/indradrive

Rexroth IndraDrive servo drives

IndraDrive servo drives are intelligent automation components and cover the output ranges from 100 W to 4 MW with consistent functionality. Whether as a compact inverter IndraDrive C with direct network connection or as a modular system IndraDrive M with regenerative power supply units – up to 4 MW with the new IndraDrive ML – the universal inverter concept minimizes the variants, simplifies handling, reduces storage costs, and saves energy.

i4.0 Approach

- ▶ Open standards: Sercos and multi-ethernet interface allow the universal operation with diverse, ethernet-based communication protocols
- ▶ Web-based commissioning and diagnostics via drive-integrated web server
- ▶ Comprehensive access to drive data such as torque or power, for example, via WebConnector for preventive maintenance or database interfacing and data analysis
- ▶ Rapid Control Prototyping with programs like Lab-View or MATLAB/Simulink with direct access to the drive
- ▶ IndraDrives are intelligent automation components allowing modularization in mechanical engineering and flexible supplementation of production lines with additional stations through decentralized intelligent control functions
- ▶ Open Core Interfaces for Drives allows the development of automation functions with IndraDrive in customary IT and Internet development environments without SPS knowledge

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Consistent product kit from 100 W to 4 MW
- ▶ Innovative multi-encoder interface
- ▶ Feeding and energy recovery supplies
- ▶ Energy efficiency through common intermediate circuit, smart energy mode, electric or kinetic buffering
- ▶ Protection type consistent from IP20 to IP65, compact to modular
- ▶ Multi-protocol-capable, ethernet-based communication
- ▶ Integrated, certified safety technology for safe torque off and SafeMotion





Link to products:

www.boschrexroth.com/indradrive-mi

Rexroth IndraDrive Mi cabinet-free drive technology

The new generation of IndraDrive Mi cabinet-free drive systems can be adapted to individual conditions like no other decentralized drive system. The drive is 100% cabinet-free. This makes it ideal for use in all modular machines – for maximum flexibility in minimal space. With up to 90% less wiring and up to 100% less cooling load.

i4.0 Approach

- ▶ Open standards: multi-protocol communication interface allows universal operation with diverse, ethernet-based communication protocols
- ▶ Web-based commissioning and diagnostics via drive-integrate web server
- ▶ Comprehensive access to drive data such as torque or power via WebConnector for preventive maintenance or database interfacing and data analysis
- ▶ Rapid Control Prototyping with programs like Lab-View or MATLAB/Simulink with direct access to the drive

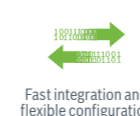
i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Up to 90% lower wiring costs
- ▶ The elimination of the control cabinet requires less space for machines
- ▶ Reduction of cooling loads in the control cabinet by up to 100%
- ▶ Machine manufacturers can assemble modules and operate them independently, thus realizing economical customized configurations
- ▶ Integrated safety technology on board for standard-compliant and transparent machine safety
- ▶ Flexible integration in heterogeneous automation structures through multi-ethernet interface

- ▶ All components at a high level of protection, IP65
- ▶ Up to 30 drives on one long hybrid cable of up to 200 meters
- ▶ Easy integration of additional machine modules, I/Os and fieldbus components
- ▶ Motor-integrated servo drives with standstill torques ranging from 2.2 Nm to 10.5 Nm and maximum torques of 9.4 Nm to 29 Nm
- ▶ Servo drive close to the motor drives with continuous currents from 6 A to 22 A and maximum current from 18 A to 36 A
- ▶ Supply module with 15 kW maximum power



Link to products:www.boschrexroth.com/ms2n

Rexroth IndraDyn S synchronous servo motors MS2N

*More torque, higher speeds, a practical single-cable connection and an extensive options program:
The new IndraDyn S MS2N motor generation by Rexroth combines high dynamics with compact dimensions and excellent energy efficiency. A selection of rotors with lower and medium inertia is available for optimal alignment of motor and load inertia.*

i4.0 Approach

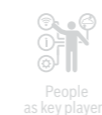
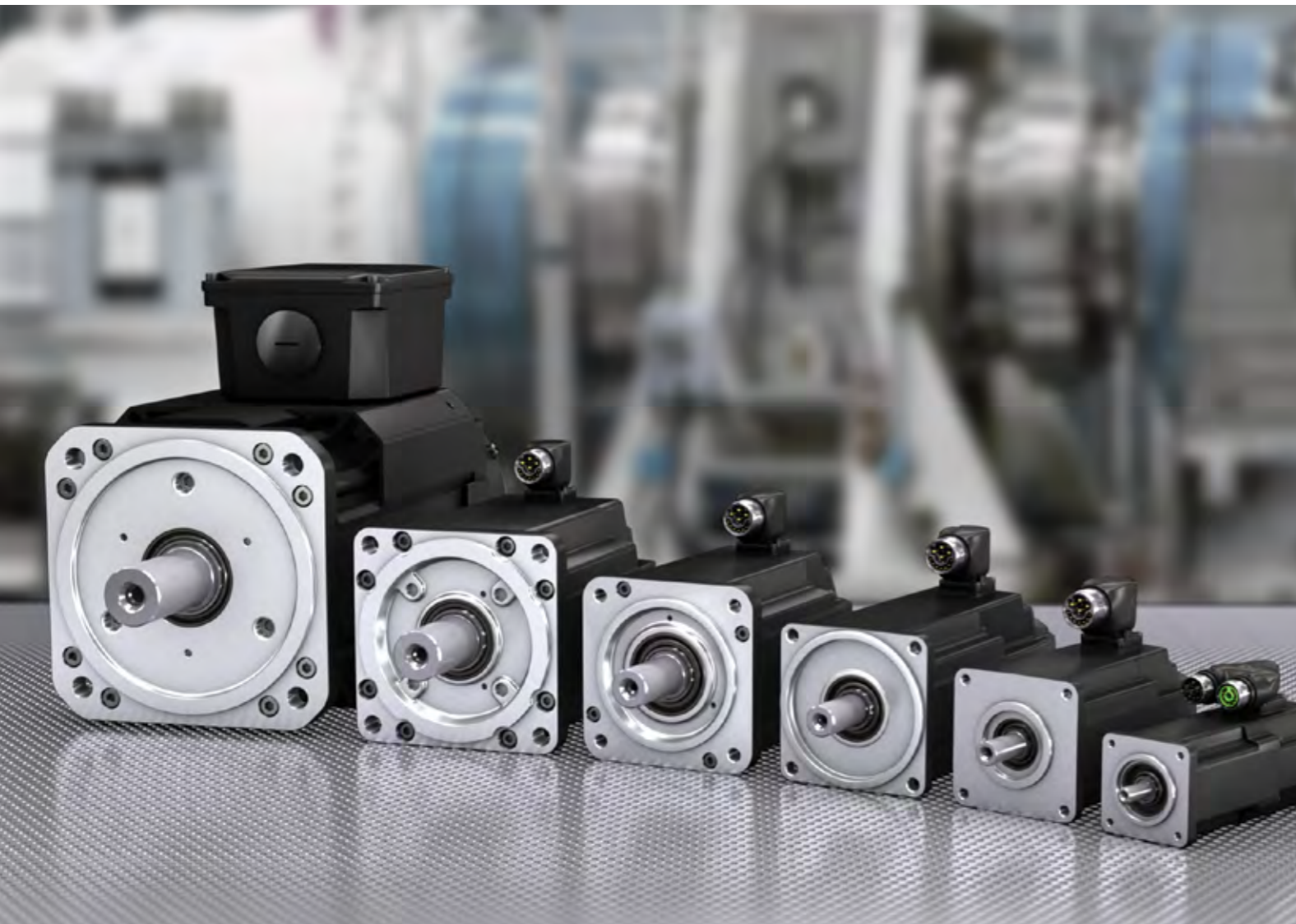
- ▶ **Distributed intelligence:**
In connection with the IndraDrive drive system, the MS2N servo motor is a reliable sensor and torque data source. Torque precision has been significantly increased by taking into account effects of saturation and temperature, and the manufacturing tolerances of each motor.
- ▶ **Virtual real-time representation:**
Identical dynamic temperature models of controller and motor in the IndraSize simulation tool and the IndraDrive drive controllers guarantee for identical behavior in simulation and actual operation, increasing the operational reliability of MS2N motors with simultaneously optimal utilization.
- ▶ **Fast networking and flexible configuration:**
An electronic nameplate in the motor allows plug and play with the IndraDrive drive system. The increased motor memory allows to record additional data of mounted components, such as gearboxes or pumps.

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Powerful – less space or more power, higher productivity, process quality and reduced operational costs
- ▶ Flexible configurations – cost-optimized – motor configuration tailored to requirements
- ▶ Single-cable connection – saves space, weight, costs, and time
- ▶ Intelligent system – MS2N as a data source for Industry 4.0, Safe utilization up to operational limits
- ▶ Continuous torque of 0.8...148 Nm
- ▶ Maximum torque of 3.8...360 Nm
- ▶ Winding variants for cost-optimized combinations of motor and drive controllers

People
as key playersDistributed
intelligenceFast integration and
flexible configurationOpen
standardsVirtual real-time
representationDigital life-cycle
managementSecure value-creation
network

Rexroth CytroPac Hydraulic Small Power Unit with up to 4 KW

CytroPac is a compact and energy-efficient standard power unit. Thanks to its innovative design, all key functions are integrated into the power unit. CytroPac is particularly silent because the noise sources are located inside the housing. The variable-speed pump drive ensures maximum dynamics and efficiency. The optimized tank reduces the oil volume and ensures proper degassing. The space-saving heat pipe system ensures optimal cooling. The integrated frequency converter serves as sensor node and sends the data directly to the machine control.

i4.0 Approach

- ▶ Variable-speed pump drive Sytronix for demand-oriented power supply
- ▶ Integrated frequency converter with Multi-Ethernet connectivity (e.g. Sercos, EtherCAT, EtherNet/IP, PROFINET RT, VARAN)
- ▶ The frequency converter additionally serves as a sensor node and transmits all measured data to the machine control in real time
- ▶ Comprehensive condition monitoring for fast identification of critical conditions and comfortable analysis

i4.0 Solution Provider

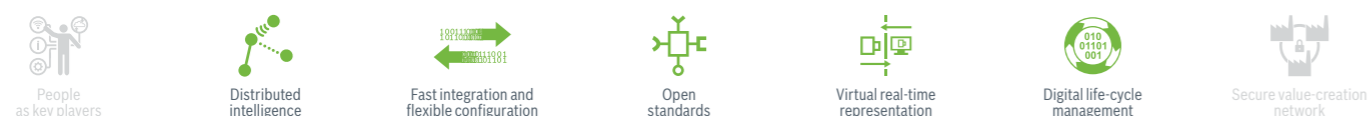
- ▶ Bosch Rexroth

Benefits

- ▶ Compact, energy-efficient and future-proof power unit with up to 4 KW
- ▶ Meets the requirements of the European Eco-Design Directive 2009/125/EC due to reduced power consumption and CO₂ emissions
- ▶ New design allows the integration into all machine designs
- ▶ Simple wiring reduces the space required in the control cabinet
- ▶ Reduced tank size due to optimized design for efficient degassing
- ▶ Low-noise operation
- ▶ Quick and early error detection and analysis of critical conditions
- ▶ Short delivery times

KPI

- ▶ CytroPac – the Hydraulic Power Unit Revolution
- ▶ Space-saving design, completely equipped and integrated
- ▶ Lack of space is no longer an issue: radically new design due to a new technical approach with heat pipes for integration into all machine designs
- ▶ CytroPac – the Power Unit Revolution. Saves space, energy and time



Link to products:

www.boschrexroth.com/abpac

Rexroth ABPAC Hydraulic Power Unit

New hydraulic standard power unit for the mid-range product line. With distributed intelligence and optional sensor-packages, the power units continuously record all operating statuses, show wear conditions, and communicate via open interfaces with higher-level controls or mobile devices.

i4.0 Approach

- ▶ Modular condition monitoring package including sensors and intelligent node for analysis and comparison with stored life-cycle models
- ▶ Comprehensive condition monitoring for fast identification of critical conditions and comfortable analysis
- ▶ WLAN connectivity and platform independent local visualization
- ▶ User-oriented aggregation of component & machine status corresponding to VDMA 24582
- ▶ Online configurator for fast layout of individual power units

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Scalable Condition Monitoring System increases machine availability through predictive maintenance and detects wear before it leads to a standstill. At the same time the maintenance costs are reduced through condition-based maintenance.
- ▶ The included decentralized intelligence perfectly integrates into vertical and horizontal networks.
- ▶ High efficiency through Sytronix variable-speed pump drives with Multi-Ethernet connectivity (e.g. Sercos, EtherCAT, EtherNet/IP, PROFINET RT, VARAN)

KPI

- ▶ Energy consumption reduced by up to 80 %



Link to products:

www.boschrexroth.com/ims

Rexroth Absolut IMS-A Integrated Measuring System

Highly precise and making no contact, integrated measuring system absolut IMS-A, a mechatronic modul with its own electronic evaluator unit, recognizes position in linear motion and transmits it to higher-level systems. The non-contact measuring system operates wear-free and is resistant to contamination vibration, and electrical interference fields.

i4.0 Approach

- ▶ Absolute, high-precision position measurement in real time increases processing reliability
- ▶ Easy integration within different automation environments,
- ▶ Access to measuring system parameters via higher-level control
- ▶ Digital life cycle management
- ▶ Fast access to diagnostic and service information

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Ready-to-install mechatronic modul for ball and roller rail systems without requiring additional space; fits into a variety of automation environments on various encoder interfaces
- ▶ Wear-free and resistant to contamination
- ▶ Highly precise position sensing for reliable processes and low life cycle costs due to being wear and maintenance free

KPI

- ▶ Repeatability $\pm 0.25 \mu\text{m}$
- ▶ Scale accuracy: $\pm 3 \mu\text{m/m}$
- ▶ Position resolution: $0.025 \mu\text{m}$



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network



People as key players



Distributed intelligence



Fast integration and flexible configuration



Open standards



Virtual real-time representation



Digital life-cycle management



Secure value-creation network

Link to products:

<http://www.boschrexroth.com/en/us/products/product-groups/tightening-technology/nexo-cordless-wi-fi-nutrunner/index>

Rexroth Nexo WIFI enabled cordless nutrunner

With their integrated control system, Nexo WIFI enabled cordless nutrunners work in networked environments, communicating with higher-level data systems via a browser-based operating system. Nexo cordless nutrunners are also suitable for safety-critical Class A tightening applications, in accordance with VDI/VDE2862.

i4.0 Approach

- ▶ Workpiece-dependent parameters for tightening operations support a wide range of assemblies, guaranteeing quality results
- ▶ Integrated control system with browser-based operating system allows for information sharing across multi vendor data systems
- ▶ Easy integration into assembly lines without any additional external controllers
- ▶ Ergonomically optimized tools that feature digital information and support functions

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Cost-efficient and safe tightening operations for low and high batch quantities
- ▶ Documentation of all processing parameters for digital life-cycle management
- ▶ Simple connection to higher-level data systems without additional hardware
- ▶ Ergonomically optimized display for user-friendly information and a high-precision measuring system for accurate torque and angle detection

KPI

- ▶ Suitable for safety-critical Class A tightening applications in accordance with VDI/VDE2862



Link to products:

www.boschrexroth.com/prc7300

Rexroth PRC7300

Mid-frequency welding control

PRC7300 welding control ensures process reliability and the highest quality welds for welding processes using different combinations of sheet thicknesses of steel or aluminum in automobile production and general industry.

i4.0 Approach

- ▶ System-internal real-time bus for connecting electric servo weld guns and peripheral devices as well as open interfaces for processing, robotic integration, and communication
- ▶ Storage of up to 10,000 welding programs for varied manufacturing
- ▶ Simplified operation with intuitive Windows and web-based applications
- ▶ Integrated web server also enables wireless operation and controller diagnostics using mobile devices

i4.0 Solution Provider

- ▶ Bosch Rexroth

Benefits

- ▶ Highest reliability and performance through adaptive controlling and monitoring
- ▶ Faster commissioning, visualization, and diagnostics through an intuitive user interface
- ▶ Highly flexible and future-proof modular system architecture with a built-in application layer
- ▶ The latest hardware technology for energy and cost efficiency

KPI

- ▶ Up to 90% reduction in commissioning time per weld spot
- ▶ Up to 30% less energy in terms of welding
- ▶ 80% less in stand-by mode



People
as key players



Distributed
intelligence



Fast integration and
flexible configuration



Open
standards



Virtual real-time
representation



Digital life-cycle
management



Secure value-creation
network



SERVICES AND CONSULTING AT BOSCH

Experience and expertise can only be replaced by more of the same. Bosch is a leading user of Industry 4.0 and we are ready to share what we have learned. We have also developed a variety of new business models. For example, we offer maintenance services that allow traditional, reactive maintenance to be replaced with condition monitoring and predictive maintenance. For this, sensors monitor and analyze operating conditions, recognizing wear and tear before it causes faults.

Our Industry 4.0 specialists are also ready to advise machine manufacturers, system integrators, and machine users and help them create new concepts. Industry 4.0 is more than just a technological challenge, it requires a new mindset that is characterized by openness and a willingness to collaborate. Bosch is ready for Industry 4.0.

Link to products:

<http://www.boschpackaging.com/en/pa/services/after-sales-services/remote-service/remote-service.html>

Remote Service

Remote Service stands for fast and efficient support for equipment installation, operation, maintenance and troubleshooting, including remote diagnosis, administration, software upgrade as well as software and parameter backup. It is based on the Remote Service Portal which establishes a connection between the machine and the Bosch experts and allows access to control components such as PLC, Motion Controller or HMI. Multiple protocols and technologies such as VPN, router and modem are supported to integrate different machines of various generations. Also other machine manufacturers can support their equipment through the portal.

i4.0 Approach

- ▶ Remote Service allows customers quick access to a Bosch expert network for fast and efficient service support, without travel time and costs. In the remote service portal, Bosch experts all over the world work together in defined solution groups to support customers remotely over the whole machine life-cycle. Remote Service also makes field service activities on customer sites more efficient, thanks to better preparation upfront and support during an intervention.
- ▶ When it comes to remote service, data security and privacy is of the utmost importance. Therefore, the Remote Service Portal is equipped with a broad range of safety features: secure VPN connection, certificate based encryption, full access control from the customer to enable and disable the remote connection, restricted access only for authorized, trained persons in the Bosch company network. The infrastructure is hosted on Bosch servers in Germany.

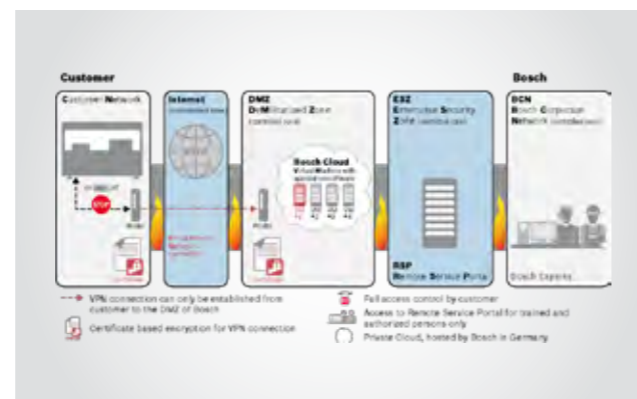
- ▶ Improved profitability
- ▶ Quick access to Bosch expert knowledge
- ▶ Improved field service efficiency (remote access as preparation)

Benefits of providing remote service through the new Remote Service Portal:

- ▶ Remote support for several machine generations
- ▶ Secure data connection according to Bosch security standards
- ▶ One remote service platform for various machines

KPI

- ▶ Globally available
- ▶ Unlimited parallel connections



i4.0 Solution Provider

- ▶ Remote Service is part of Bosch Packaging Services' product portfolio. Bosch Packaging Services is a subsidiary of Bosch Packaging Technology.

Benefits

The benefits of Remote Service:

- ▶ Reduced unexpected downtime
- ▶ No travel time and expenses
- ▶ Fast reaction times
- ▶ Increased availability of the packaging equipment



Produktlinks:

www.boschservicesolutions.com/en/service_solutions/solutions/building_and_infrastructure_services/building_infrastructure_services.html

Bosch Smart Monitoring

Bosch Smart Monitoring is a solution based platform derived from the Internet of Things. It offers a variety of possibilities for your international flow of goods, including higher predictability rates and improved security measures. Furthermore our 24/7 service desk is your first point of contact for all technical requests.

i4.0 Approach

- ▶ By tracking the logistics chain, the position of a vehicle can be located precisely at all times. An alarm is triggered as soon as an object is removed from a defined location or route. The recording of additional condition data in the cargo space is also supported.
- ▶ The data is sent to our certified monitoring center. We can provide 24/7 preventive action in the event of any discrepancies in the data and alert as well as coordinate the emergency services in an acute threat situation.
- ▶ The data is also sent to a login-based web portal. There you can check your vehicle and freight data at any time and use it e.g. for the purpose of just-in-time delivery. Apps are also available for remote surveillance including chat function.
- ▶ For your technical requests our 24/7 service desk provide support
- ▶ Consulting services for your Industry 4.0 solutions can be offered on demand.

- ▶ We provide innovative solutions, e.g. condition monitoring: temperature, pressure and fill level
- ▶ The freight data can be used for your own purposes, e.g. for the optimization of your supply chain
- ▶ Bosch Service Solutions is a reliable partner for all your individual requests regarding service solutions, e.g. we provide 24/7 service desk and consulting services for your industry 4.0 solutions

KPI

- ▶ Customer specific KPIs

i4.0 Solution Provider

- ▶ Bosch Service Solutions

Benefits

- ▶ The increase of efficiency and quality can be ensured by using Bosch Smart Monitoring
- ▶ We run one of Germany's biggest networks of monitoring centers. With our ongoing certification to the EN 50518 standard on monitoring and alarm receiving centers, you can be confident of receiving the premium-quality standards of service that Bosch is renowned for.



Link to products:

www.boschrexroth.com/odin

Rexroth ODIN Predictive Maintenance

The Online Diagnostic Network ODIN is a cloud-based service platform that collects operating information from hydraulic systems throughout their entire service life in order to detect wear as early as possible. In combination with maintenance contracts, the customer will receive regular status reports with recommended measures and scalable services.

i4.0 Approach

- ▶ Detection and evaluation of all operating data and cloud-based evaluation with big data software programs
- ▶ Digital Assistant function for the maintenance of facilities through predictive maintenance
- ▶ Diagnosis of virtual images of components and comparison with service life models

i4.0 Solution Provider

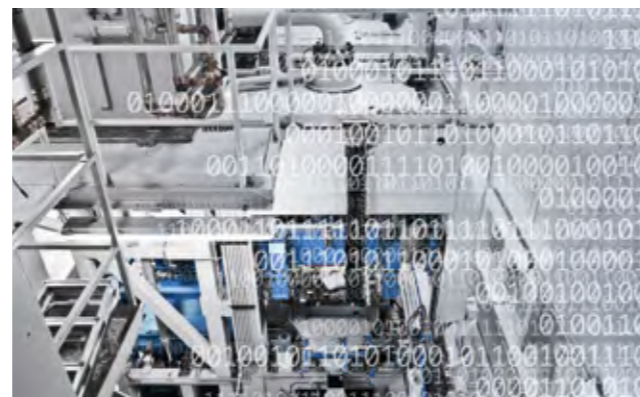
- ▶ Bosch Rexroth

Benefits

- ▶ Minimizes the risk of machine downtime, increases system availability through predictive maintenance, and reduces maintenance costs because it only replaces the parts that are worn out.
- ▶ Secure transfer and storage of data in conformance with Bosch Standards
- ▶ Scalable services portfolio

KPI

- ▶ Reduced downtime risk
- ▶ Reduced TCO



Smart Technical Service Solutions – PI-Kit

The PI-Kit is an independent tool solution for the specific collection of production data and incidents. Based on the collected data, a standardized analysis and visualization of production figures takes place. Thus, showing the reasons for production losses and defining the necessary optimization measures can be proceeded. The connection is possible without interfering the machine control of the customer. A connection to the Bosch network is not absolutely needed. Additionally the PI-Kit is suitable for the Remote Service support.

i4.0 Approach

- ▶ The PI-Kit is a platform independent solution
- ▶ Based on standardized i4.0 Shopfloor Solutions, production data are represented transparently
- ▶ The collection and analysis of production related figures is independent from machine producer or installed control system
- ▶ The PI-Kit can be configured flexibly according to the case of application and in only a few steps for different production processes
- ▶ The connection is possible by using machine-integrated or machine-independent sensors. The enter of failure or disruption reasons is for example possible over the HMI

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Connection possible without interference into machine control
- ▶ Flexible, fast configurable solution
- ▶ No provision of special infrastructure needed and applicable out of Bosch network
- ▶ Collection of production data objectively in the electronic shiftbook
- ▶ Standardized presentation of production figures
- ▶ Presentation of the loss reasons for the overall equipment efficiency

KPI

- ▶ Machine performance by analysis before and after the implemented measures



Smart Technical Service Solutions – Video Analysis System (VAS)

The Video Analysis System (VAS) was developed to analyze processes or process chains and optionally optimize them by a service expert of ATMO Services. A live stream remote service for an immediate technical support is also possible. Furthermore, the installed equipment can be optimized by detailed video analysis. As one result, a significant reduction of downtimes can be realized according to relevant optimization measures.

i4.0 Approach

- ▶ VAS enables the machine controller to look inside the machine even in areas which are normally not accessible during production mode
- ▶ Production responsables have the possibility to operate and change the settings of the camera after the machine is in production mode again
- ▶ VAS enables a real-time representation (live stream) of the machine video to an expert, without being on-site (Remote Service)
- ▶ Fast and easy installation and integration into all kind of machines without training, even under difficult conditions (e.g. wet stations, laser cabinet, etc.)
- ▶ By operating VAS with the provided tablet, technicians stay highly flexible and safe while observing the processes

i4.0 Solution Provider

- ▶ PA-ATMO Business Field Services

Benefits

- ▶ See invisible details
 - See process performance as never before
 - Reduced downtime of equipment
 - Find reasons for recurrent failures
- ▶ Analyze details
 - Create short clips for documentation
 - Present analysis by visual aids
- ▶ Define improvements
 - Define suitable improvements based on actual facts

- ▶ Analysis methods
 - Close up process surveillance in 4K
 - Process chain surveillance
 - Process in slow motion
 - Multiple hour loop surveillance
 - Picture by picture movement analysis
- ▶ Achieve Improvements
 - Define suitable optimization measures based on actual facts
- ▶ Advantages
 - Small equipment for reduced available space
 - Control of camera functions during ongoing production from outside the machine
 - View process during regular production
 - Low price solution
 - Easy to install and use
 - Live video stream of hidden processes to tablet
 - Live video stream via WebEx, BoCo ...



Smart Technical Service Solutions – Shopfloor Connectivity Services

Shopfloor Connectivity Services enables the connection of machines to the Shopfloor Management for the analysis of data and the process control. This is possible for equipment and lines with any control technology and can even take place without changing the software. The collection of relevant data from product and production establishes transparency regarding availability, OEE, cycle time and traceability.

i4.0 Approach

- ▶ Connection of machine with the Shopfloor Management
- ▶ Enables the transparency of production machines and equipment areas
- ▶ Transfer of equipment data to Mobile Devices
- ▶ Provision of data over standardized platform independent machine interfaces
- ▶ Flexibility due to configuration possibilities of interfaces
- ▶ Web service enables the access to data which are independent from the production network
- ▶ A virtual machine and process image is representable in real time

i4.0 Solution Provider

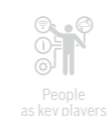
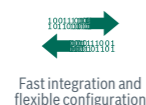
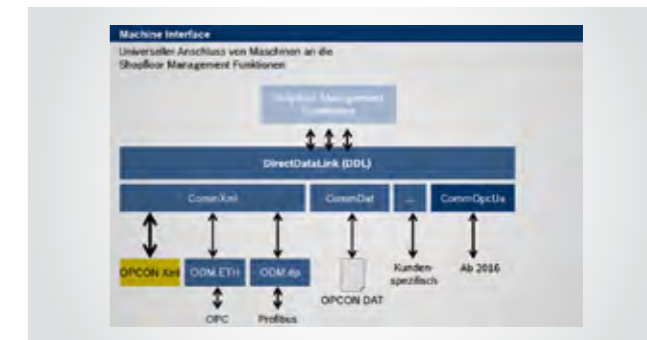
- ▶ PA-ATMO Business Field Services

Benefits

- ▶ Using the Shopfloor Connectivity Services we realize the connection to a Shopfloor Management which enables the overview and control of a production area
- ▶ Thus we reach a required transparency of the equipment and the production processes
- ▶ Additionally traceability of the products can be integrated
- ▶ Although any kind of equipment can be connected with integrated control technology, due to standardized platform independent machine interface
- ▶ Realizable in customer's production network
- ▶ Virtual presentation of machine and process data in real time available

KPI

- ▶ Machine performance by analysis before and after the implemented measures





Link to products:

www.boschrexroth.com/academy

Rexroth mMS4.0 Modular mechatronic training system

The mMS4.0 training system – a compact and complete Industry 4.0 production system. Ideal for mechatronic and Industry 4.0 Training. The system addresses a real-life cube assembly, from the removal out of a rack to processing with a pressing machine and through to storage in the high-bay storage. Assembled from standard industrial components, completely interconnected, programmable and extensively secured.

i4.0 Approach

- ▶ ERP/MES connection
- ▶ Serial- and single production possible
- ▶ RFID
- ▶ Cloud Computing
- ▶ Open Core Engineering
- ▶ Apps for operation and diagnosis via Smart Devices (Tablets/Smart Phones)
- ▶ ActiveCockpit integrated
- ▶ Augmented reality
- ▶ Use of open industry standards

i4.0 Solution Provider

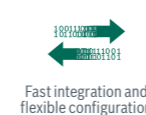
- ▶ Bosch Rexroth

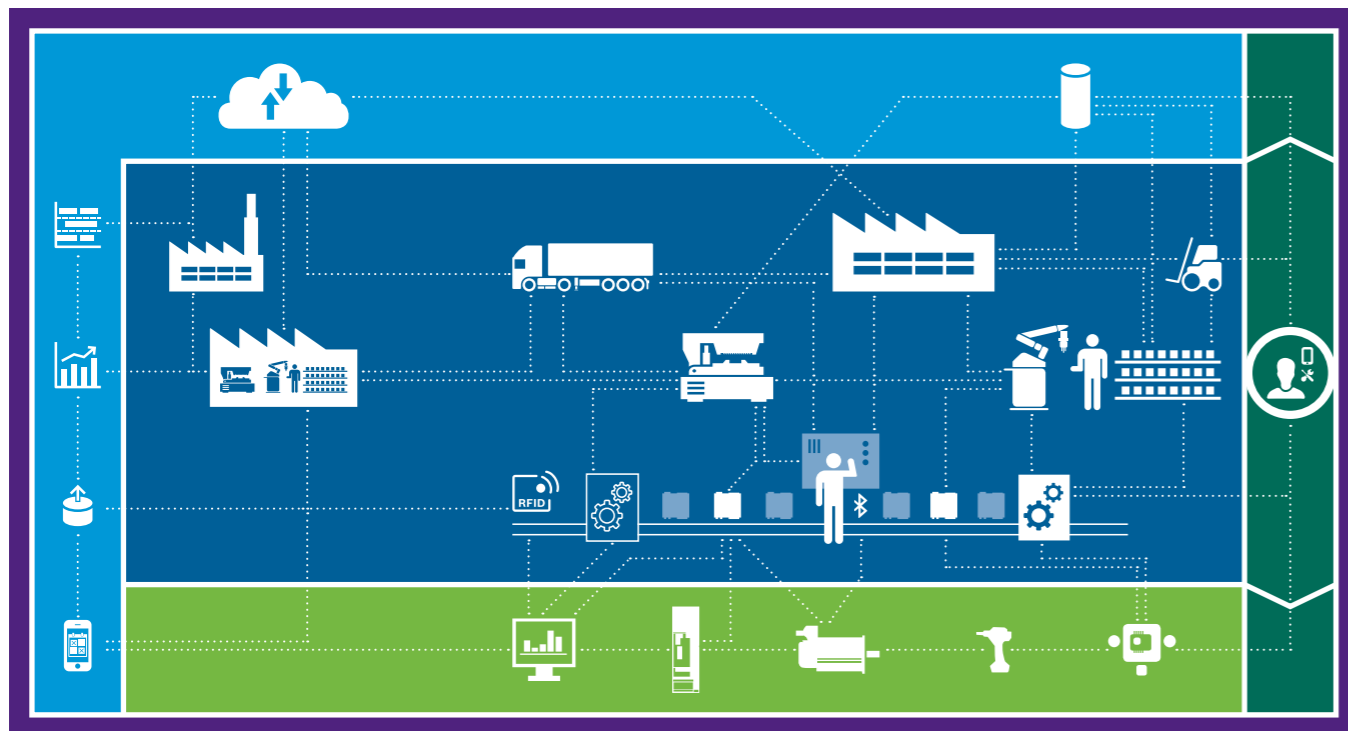
Benefits

- ▶ Training system for vocational education, further education up to university level
- ▶ Based on the experience in Bosch plants
- ▶ Modular system
- ▶ Industry standard components
- ▶ Exercises for mechatronic and automation up to i4.0
- ▶ Further development of APPs, ActiveCockpit functions, OCE programming and cloud computing
- ▶ Allows educational institutes new development of functions also together with industry partners

KPI

- ▶ Understanding Industry 4.0 and for further developing Industry 4.0 features





SOLUTION SETS AT BOSCH

In our own plants, we have discovered that the most efficient approach to introducing Industry 4.0 is to do so in a quick succession of small steps. We have also learned to think in terms of systems rather than single technologies and components. By combining off-the-shelf hardware and software modules from our various domains, we can configure customer-specific solution sets. Our Industry 4.0 specialists develop end-to-end solutions, helping you to turn Industry 4.0 into reality within a short period of time. Based on open standards,

these can easily be integrated into heterogeneous environments with machinery and software from various suppliers.

Our solution sets are as big or as small as you need them – and they always offer you added value compared to single components and modules. Step by step, Bosch helps you to transform your value stream into a value-creation network encompassing suppliers, logistics, and manufacturing – with your people as the key players.



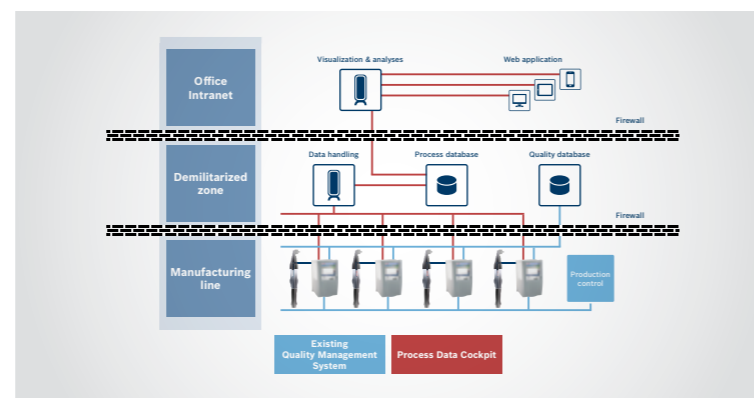
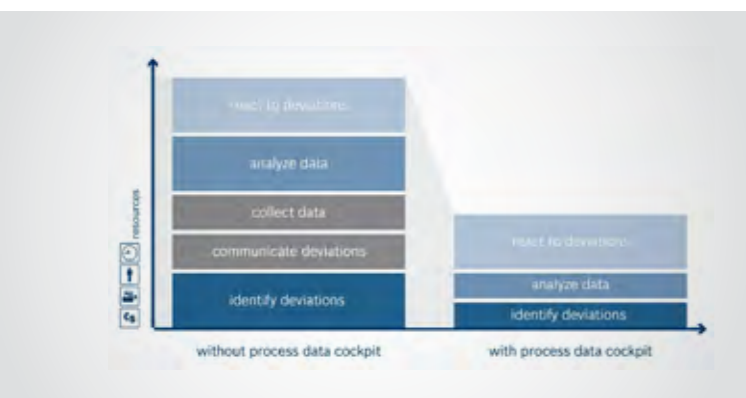
Link to products:

www.bosch-si.com/process-quality-manager

www.boschrexroth.com/en/xc/products/product-news/electric-drives-and-controls/nexo-cordless-wifi-nutrunner

Process Quality Manager with Tightening Systems

What do companies need to make Industry 4.0 production highly efficient and error-free? Two elements are essential: reliably carrying out safety- and function-critical tightening processes in industrial production, and keeping an eye on the virtual models of these processes so they can zero in on deviations and remedy them as quickly as possible. This is already an option today thanks to Bosch Industry 4.0 solutions: Bosch Rexroth's intelligent tightening systems in combination with the Process Quality Manager, a software solution that is the result of a collaboration between Bosch Rexroth and Bosch Software Innovations. The Process Quality Manager lets you monitor and document process data from multiple plants in real time. The Process Quality Manager cockpit visualizes the various performance indicators and tolerances so that you can identify and resolve problems more quickly. Thanks to analysis functions, definable rules for active notification in case of process deviations, and numerous reporting functions, you can continuously improve the profitability of your production process. Bosch Rexroth's intelligent tightening technology is remarkable for its integrated sensors for measuring torque and rotation angle as well as for regulating these process values. These features recommend it for use in safety- and function-critical tightening processes. A special role is reserved here for the NEXO smart cordless tightening system. All control functions and the high-quality measuring sensors are packed into the tool, which can be connected to a production hall network without requiring any additional hardware – minimizing infrastructure costs and complexity. NEXO's process data can then be used by the Process Quality Manager.



i4.0 Approach

- ▶ Transparent factory: overview of all tightening processes
- ▶ Centralized collection of all relevant process and quality data
- ▶ Processing and visualization of real-time data
- ▶ Expert as key player: being proactive instead of reactive in response to potential process deviations
- ▶ Web-based interface: access to data from wherever you are via PC or mobile device
- ▶ Open interface so that devices/controls can be connected regardless of the manufacturer
- ▶ Role-specific provisioning of information
- ▶ Workpiece-specific parameters for tightening processes support assembly with high numbers of variants and ensure quality
- ▶ Integrated control with a web-based operating system for high-level information exchanges with any manufacturer
- ▶ Easily integrated into assembly lines without additional control hardware
- ▶ Ergonomically optimized with digital assistance functions

i4.0 Solution Provider

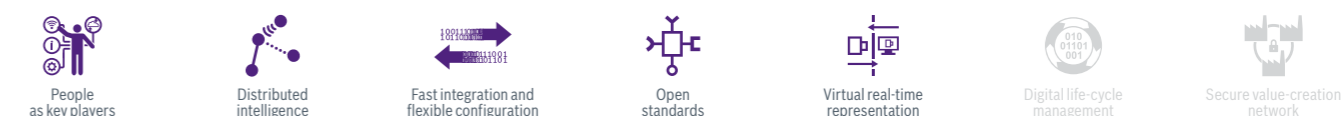
- ▶ Bosch Rexroth
- ▶ Bosch Software Innovations GmbH

Benefits

- ▶ Faster reaction to process errors
- ▶ Early detection of process risks
- ▶ Continuous process transparency
- ▶ Ensures cost-effective and reliable tightening processes for all batch sizes – even a batch size of 1
- ▶ Documentation of all processing parameters for digital lifecycle management
- ▶ Simple connection to higher-level systems with no extra hardware required

KPI

- ▶ Failure costs: 0-mileage complaints, scrap, rework
- ▶ Production output: cycle time, OEE, planned downtime
- ▶ Production costs: direct and indirect labour costs, investments



Robert Bosch GmbH

Innovation Cluster Connected Industry
i4.0-live@Bosch.com
Postbox 30 02 20
Germany

Visitors:
Leitzstrasse 47
70469 Stuttgart

www.bosch.com