Simply.
Connected.

Industry 4.0 at Bosch

Product Catalog

BOSCH
Invented for life

bosch.com

TABLE OF CONTENTS

SOFTWARE SOLUTIONS

LOGISTICS AND MANUFACTURING

FIELD LEVEL EQUIPMENT

SERVICES AND CONSULTING

THE PACE OF CONNECTIVITY IS ACCELERATING

**2020
7 billion
connected
people**

1995
15 million
people have
access to the
internet

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 internet of things: computers and smartphones, vehicles and household appliances, as well as industrial machinery and forklifts, 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.

CLOUD TECHNOLOGIES

Cloud technologies use the internet to provide IT infrastructure and IT services such as memory, computing capacity, and software as a service (SaaS) applications which do not have to be installed on a local computer. Users do not have to provide and maintain their own systems configured for rare peak loads. Cloud technology forms the stable IT infrastructure that can be used at any time for all applications and services relating to the internet of things in all branches of industry and economic activity.

In production, fully or partly storing and processing data in the cloud is gaining acceptance and will eventually be the norm. The collected data from the control systems and sensors facilitate, for example, the algorithm-based evaluation of wear states and warns against faults before they lead to machine failures. In logistics, it also offers the opportunity to completely track all goods and their transport conditions.

For mobility applications, smart homes, and other spheres of life too, cloud-based applications analyze very large volumes of data from which algorithms then derive well-founded recommendations for action. The Bosch IoT Cloud consistently uses open standards. It is expressly geared towards collaborative models and works together with other clouds, even integrating services and software of third-party suppliers. This enables users to develop and implement IoT services and applications in no time at all. The Bosch IoT Cloud satisfies the highest IT-security standards in compliance with Bosch standards in order to protect customer data.

THE INTERNET OF THINGS

Simply. Connected.

The internet of things is already a reality. It is both the driver behind and the target of our business activities. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected industry. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. Bosch is not only a leading user of Industry 4.0 but also a leading provider. We are currently focusing our activities on our Bosch Connected Industry. Equipped with a view of the bigger picture as well as the expertise that comes from our own manufacturing activities in more than 270 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 internet-enabled and IT-enabled controls as well as network-ready automation components. Our Bosch Packaging Technology division builds entire packaging machines for the food and pharmaceuticals industries. With IT Shopfloor Solutions, Bosch Connected Industry offers intelligent and intuitive automation and management solutions for the connected factory. Moreover, IT solutions for production information and evaluation systems are available, which stand the test every day in numerous Bosch facilities. The APAS production assistants, in turn, raise the contact-free and connected human-machine collaboration to the next level.

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 foot-print.

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

Mechanization
Industry 1.0

Electrification
Industry 2.0

1750   1800   1850   1900

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: at the end of the 1960s, the development of programmable logic controllers (PLCs) and of increasingly powerful microchips paved the way to digitalization and the first use of software in manufacturing. This made machines more

Digitalization
Industry 3.0

Connected Industry
Industry 4.0

1950   2000   2050

productive, precise, and flexible, and led to an increasing degree of automation. Machines took over increasingly dangerous and straining tasks from humans. The first networks were set up by pooling several machines 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 on the following pages.

SEVEN FEATURES OF INDUSTRY 4.0

Distributed
intelligence

Secure value-creation
network
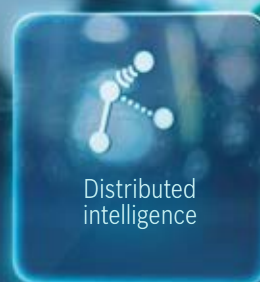
Based on the experience we have gained in numerous pilot projects and the changes we have implemented in our more than 250 plants worldwide, Bosch has identified the seven key features of Industry 4.0-ready equipment, software, and solutions. They form a solid framework for future-proof architectures 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.

Fast integration and flexible configuration

Open standards

People as key players

Virtual real-time representation

Digital life-cycle management

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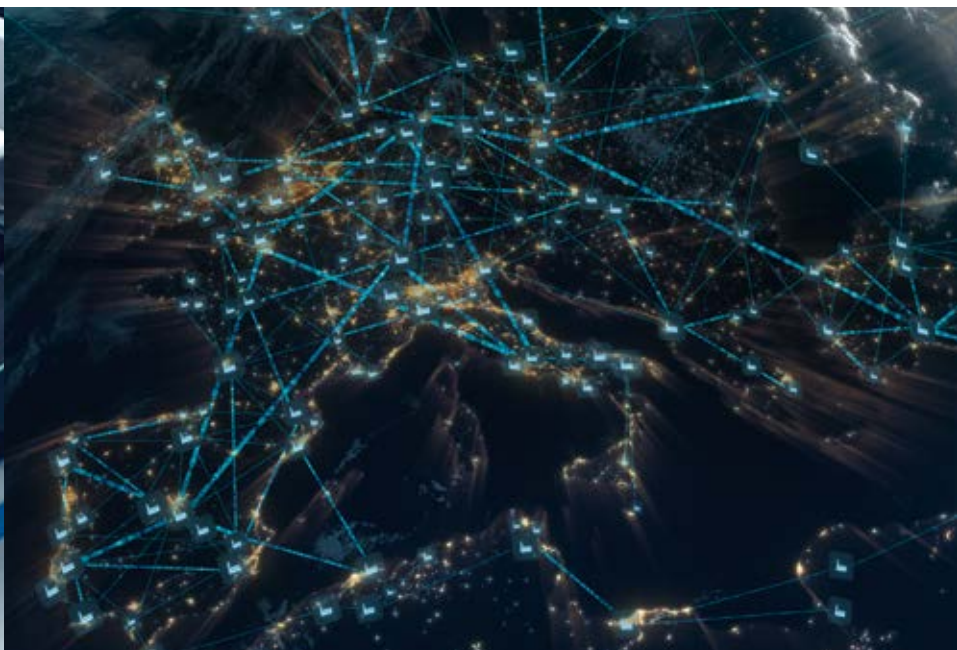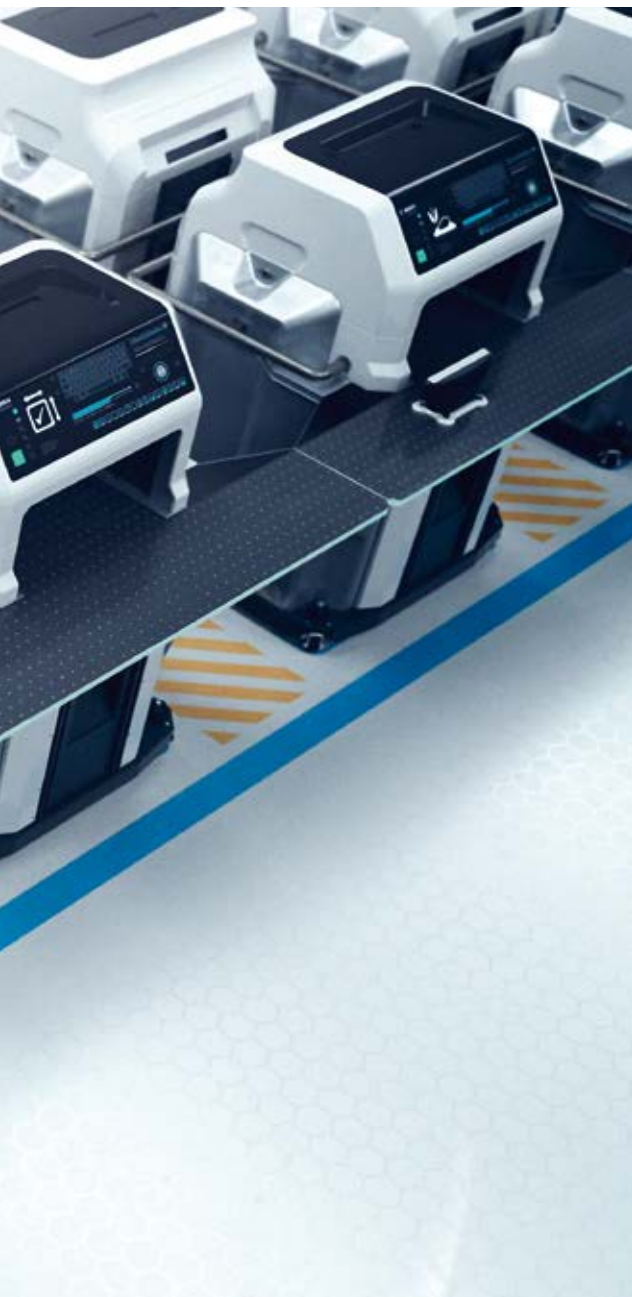
line adapts the workflow to the new product automatically. Specially developed apps enable changeovers to be made with just a few finger taps.

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.
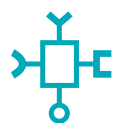
OPEN STANDARDS

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. To this end, Bosch itself initiated the Production Performance Management Protocol (PPMP) in 2016. This allows the easy integration of systems, machines, and components into heterogeneous system environments and the development of value-creation networks across company boundaries. The PPMP is being further developed in the Eclipse open source community and can be used by anyone free of charge.

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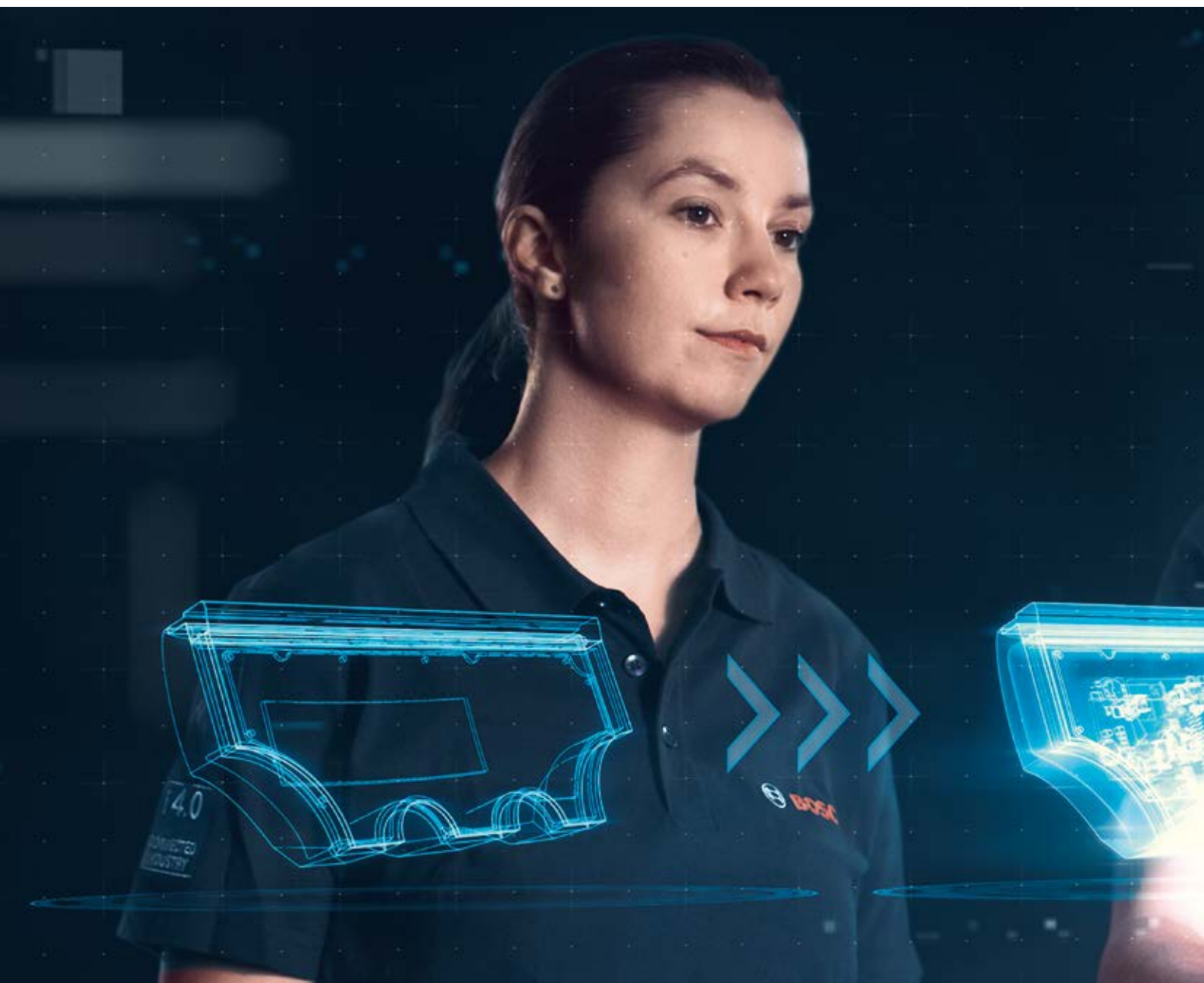
Aggregating and analyzing all the available data during the complete life span of a product helps to continuously improve the design and manufacturing processes.

DIGITAL LIFE-CYCLE MANAGEMENT

All of a product's relevant data are collected over the course of its life span – 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 life span for products.
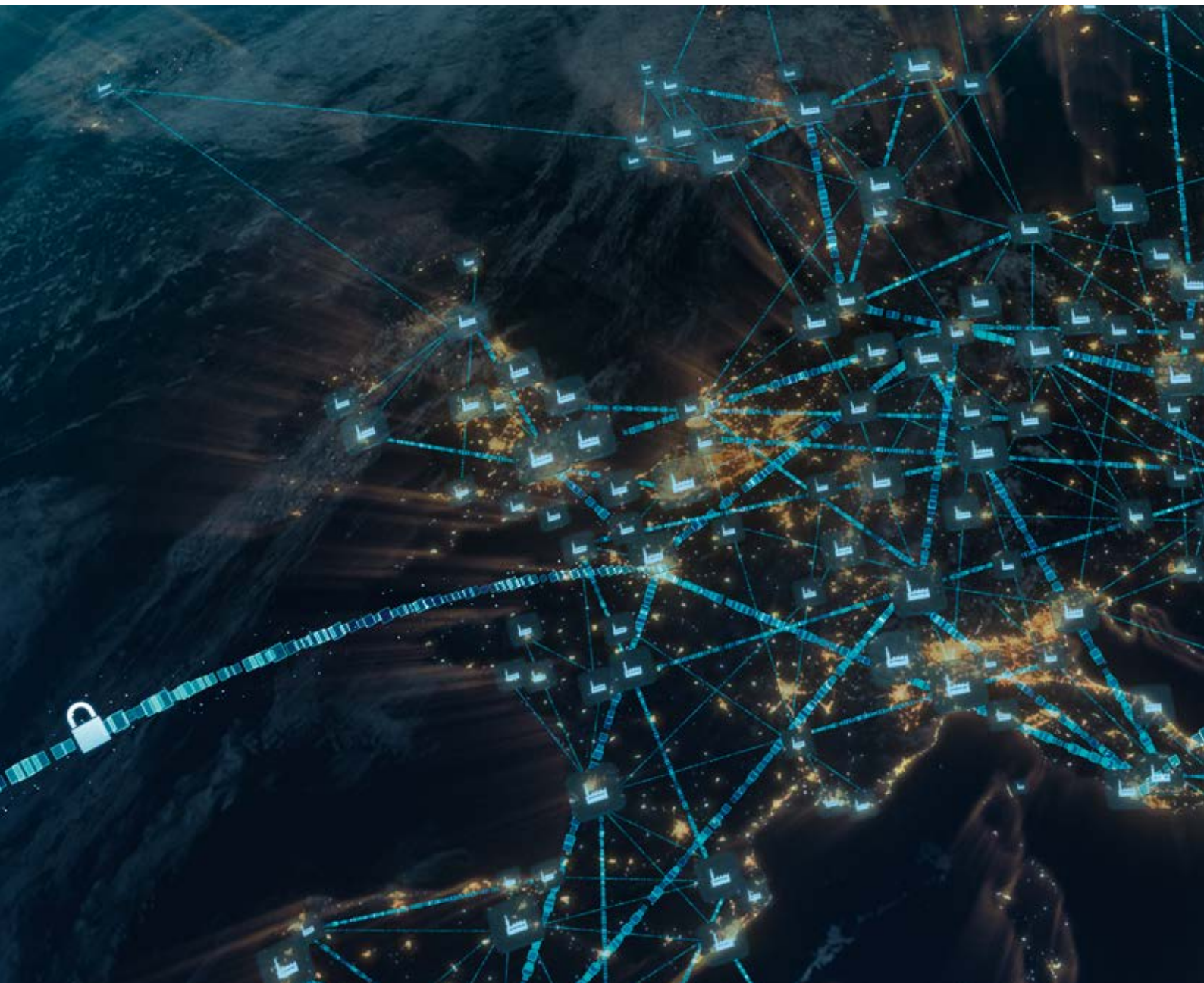
SECURE
VALUE-CREATION NETWORK

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 intercompany and interregional 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.
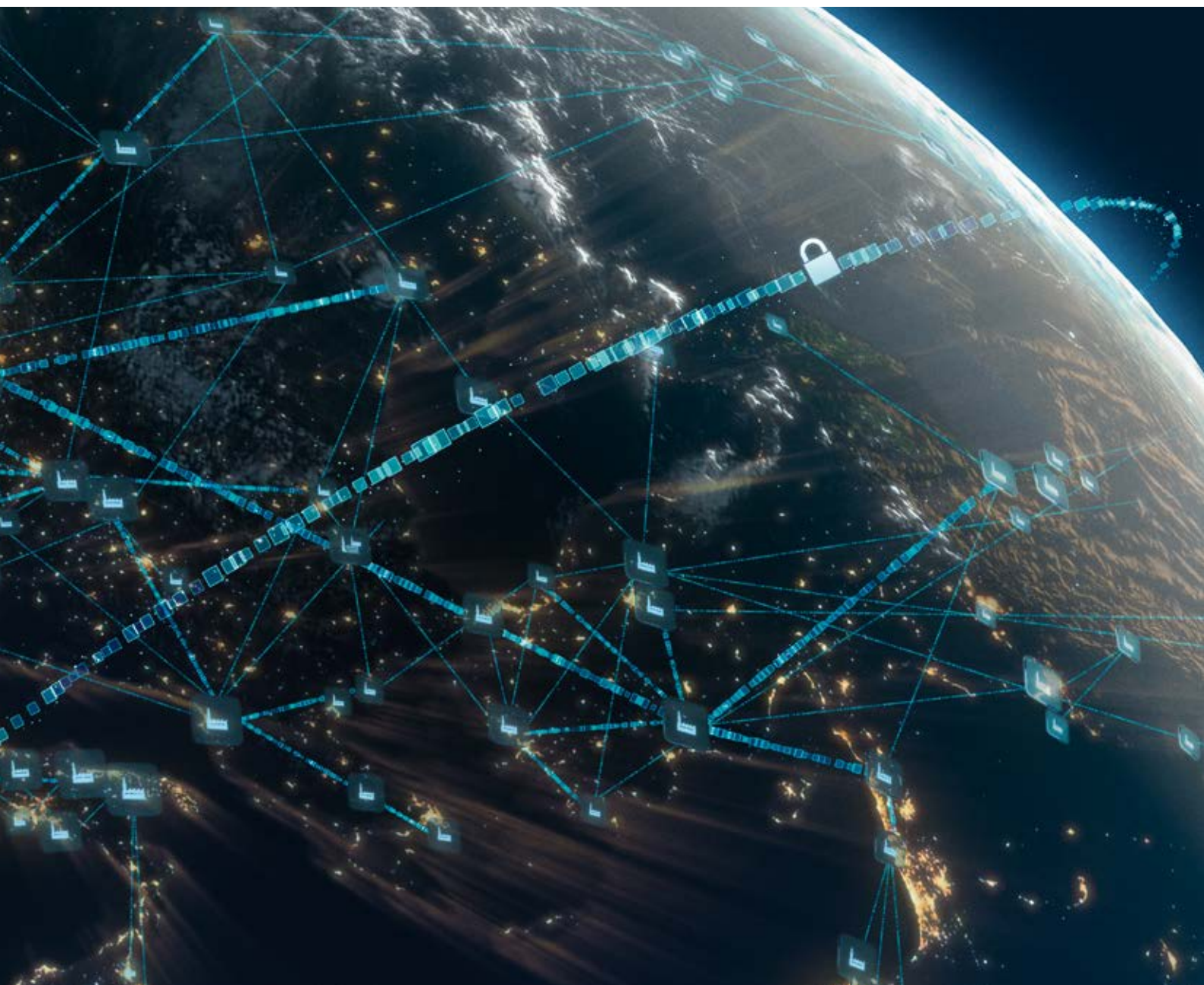
Bosch is a working member of all major initiatives dealing with these issues and is participating in defining necessary standards. These results are continuously implemented into all components, systems, and solutions Bosch provides.
At Bosch, Security Engineering is an integral part of the product life cycle, and ensures the best possible IT security from the beginning.

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.

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.

3 The APAS production assistants enable a direct, safe, and contact-free collaboration of humans and machines.

OUR PORTFOLIO FOR YOUR FUTURE

Bosch already has all the relevant enablers for Industry 4.0 in its portfolio in the form of ready-to-use products, systems, and software, from single sensors and automation components on the field level to holistic solution-combining hardware and software for manufacturing and logistics. Based on our firsthand 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.

SOFTWARE SOLUTIONS

Bosch software solutions are forged in the daily routines of more than 270 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 30

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 68

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 78

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 108
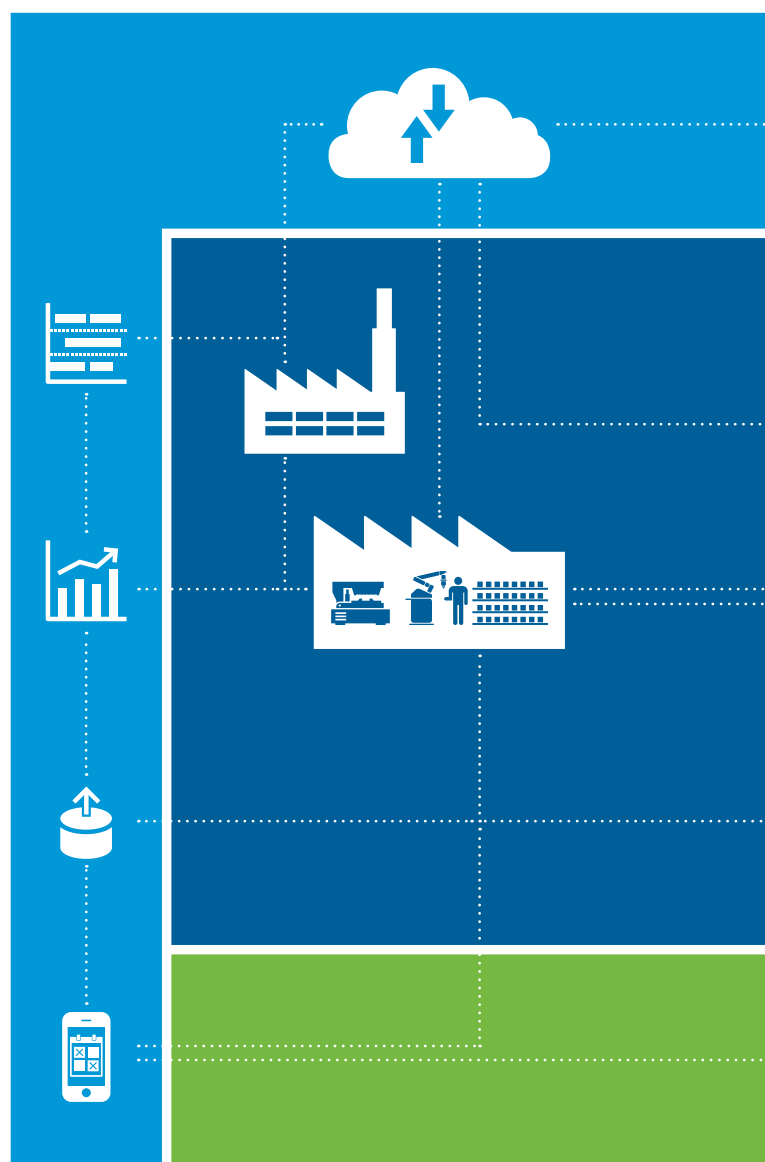
On the factory level, Bosch solutions for complete machines as well as for interior and exterior logistics are connected horizontally and vertically. Software solutions based on our daily manufacturing experience enable users to monitor relevant KPIs in real time in order to improve productivity and 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.
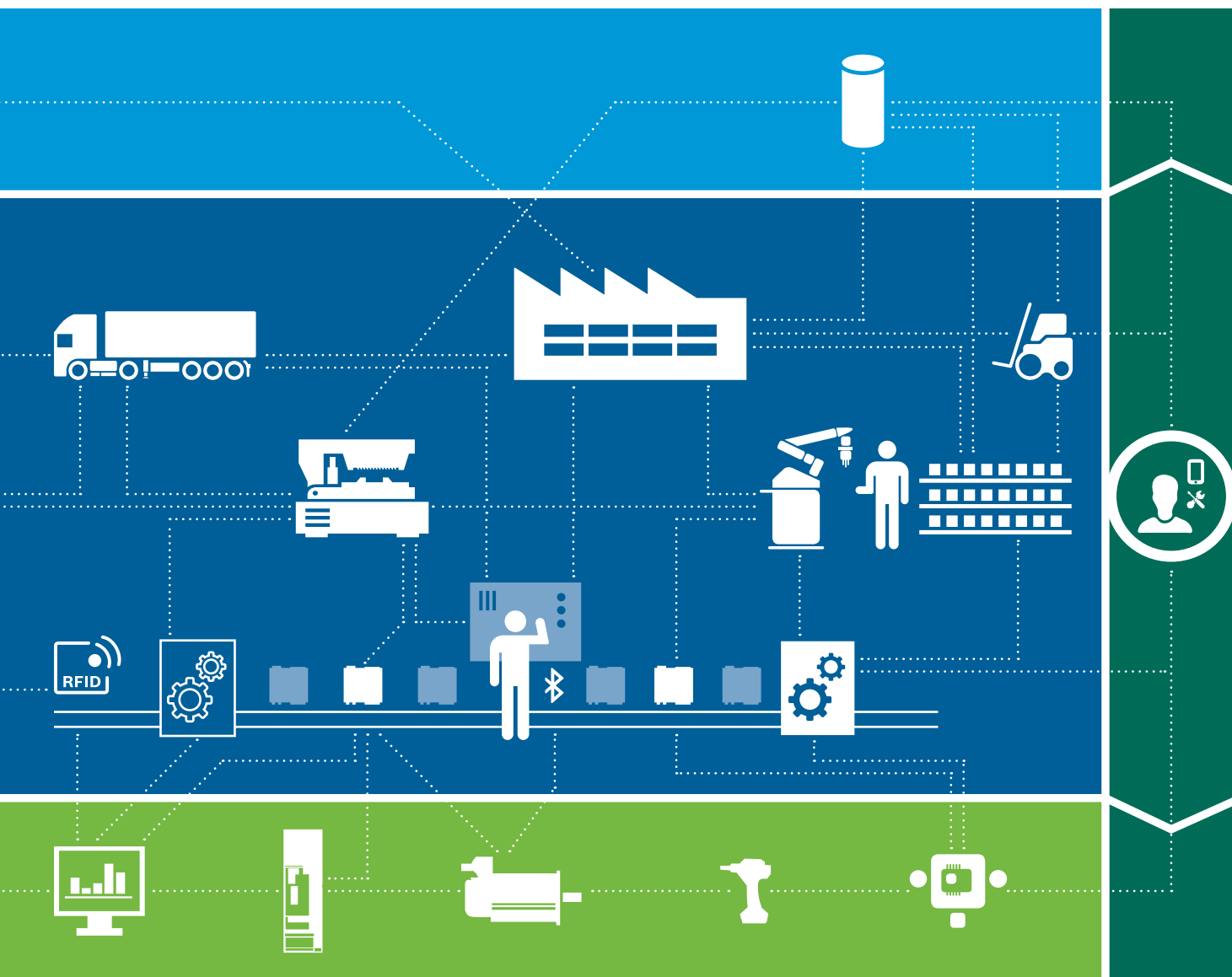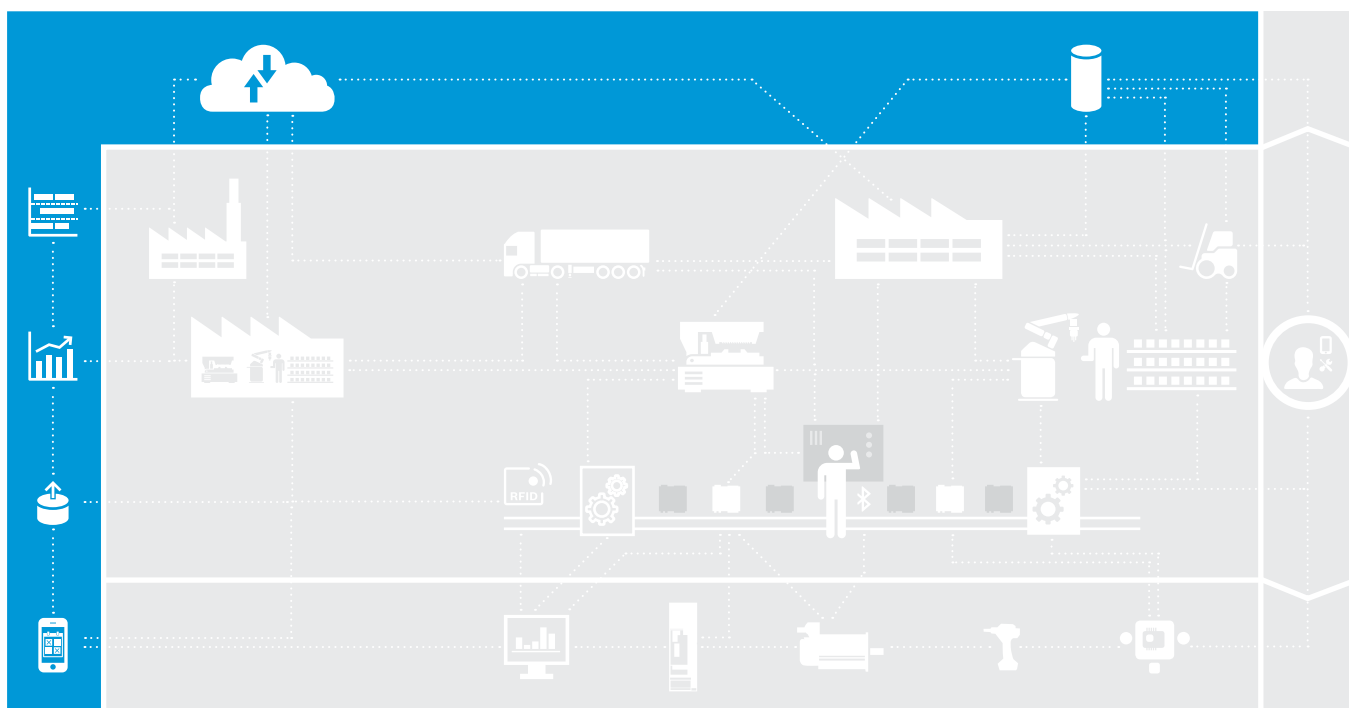
SOFTWARE SOLUTIONS AT BOSCH

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 a 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 offer modular and scalable software and hardware solutions for the intelligent factory – from the sensor to the cloud. The focus is on an intuitive interaction of humans, machines, IT, and processes. The Production Performance Manager is a production information and evaluation system. It collects production, machine, and environmental data like temperature and humidity. In near-real time, the rule-based evaluation recognizes defined events and forwards the information to the respective employees. Both solutions are equally qualified for the greenfield approach with completely new production lines, as well as for brownfield projects with machines already installed.

IT Shopfloor Solutions

IT Shopfloor Solutions offer modular and scalable software and hardware solutions for the connected, intelligent factory. The optimal interaction of humans, machines, and processes has top priority. From solutions for efficient production planning and control to scalable automation offers for mechanical and plant engineering, or visual inspection systems to monitor product quality and production processes – all IT Shopfloor Solutions building blocks can be configured individually and are available as a stand-alone or fully integrated solution.

i4.0 Approach
- Connectivity within the production facility supports staff in their daily work. They can access, analyze, and visualize data at any time. This enables operators to react quickly in case of a defect and to prevent downtime. The user-friendly and intuitive IT Shopfloor Solutions require hardly any specialist knowledge
- From the sensor to the cloud: machines, services, equipment, display instruments, and apps are easy to configure and seamlessly connected. They feed their data to a central system, which staff can access via different applications whenever required
- Manufacturer- and product-independent standards allow for a fast interaction of systems, machines, and components
- Real-time visualization of machine conditions, troubleshooting instructions, as well as analyses and reporting functionalities make processes more efficient and more transparent
- Open, flexible, and safe interfaces enable reliable data transfer and monitoring

i4.0 Solution Provider
- Bosch Connected Industry

Benefits
- Software solutions from the sensor to the cloud
- Intelligent interaction of humans, machines, and processes
- From standard solutions through to tailor-made developments
- Hardware and software from a single source
- Scalable thanks to variable configuration
- Tried and tested at Bosch facilities for more than 15 years

- Control and connectivity independent of product and manufacturer
- Immediate access to centrally administrated data
- Efficient and transparent production processes

KPI
- Increased performance, availability, and productivity
- Higher output at higher quality
- Less rejects
- Higher availability, less downtime
- Faster project implementation thanks to standardized platform
- Increased staff productivity
- Seamless system platform from a single source
- Global know-how and services

| 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-shopfloor-solutions.com

IT Shopfloor Solutions – MES Starter Kit

The MES Starter Kit offers an introductory package for efficient planning and control of discrete production, independent of machines and products. The basic set includes all functionalities required for an efficient production process. The flexible machine interface, the user-friendly planning and monitoring instruments, as well as the simple alarm mechanism for fast error localization and troubleshooting provide a comprehensive production overview.

i4.0 Approach
▶ Based on real-time data, members of staff receive information about the machine condition and are able to react quickly. The MES Starter Kit facilitates their daily work and offers them a good production overview
▶ Thanks to universal, open interfaces, the MES Starter Kit can be flexibly connected with existing machinery – independent of manufacturer and product. Moreover, it can easily be expanded by further functionalities
▶ All relevant data is automatically stored and depicted in real time. This way, disruptions can be resolved faster and processes optimized

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ Higher production transparency
▶ Increased output and productivity
▶ Real-time depiction of machine and process data
▶ Fast introduction of optimization measures and success monitoring
▶ Automatic documentation of production events
▶ Expandable by further MES functionalities at any time

KPI
▶ Fast availability
▶ Expandable platform solution

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
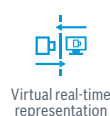
IT Shopfloor Solutions – Production and Machine Data Acquisiton

The MES product Production and Machine Data Acquisition (PDA/MDA) bundles and analyzes production and machine data in real time – from disruptions and setup events through to quantity information – and depicts them clearly in different evaluations and Pareto analyses. Exact machine data helps to reveal weak spots in the production process, to deduct targeted measures for increased efficiency, and to measure their success. The data can be collected manually or automatically. It is also possible to analyze data from several production sites all over the world based on the same calculations.

i4.0 Approach
- ▶ Thanks to clear and comprehensible visualization of production and machine data, staff is able to continuously optimize processes and to introduce countermeasures faster. Quick reaction systems (e.g. Andon) help staff to have an eye on machine utilization
- ▶ PDA/MDA can be easily and flexibly connected to existing equipment, independently of the manufacturer, thanks to universal, open interfaces with production facilities
- ▶ Automatically generated data is processed in real time and represented in reduced complexity. Combined with the Shopfloor Dashboard, PDA/MDA offers individual visualization possibilities

i4.0 Solution Provider
- ▶ Bosch Connected Industry

Benefits
- ▶ Increase of output and productivity
- ▶ Higher transparency thanks to automated recording of quantities, downtime, setup times, rejects, etc.
- ▶ Bottleneck analysis reveals shortages in detail
- ▶ Fast reaction to disruptions thanks to online monitoring of current machine condition
- ▶ High time saving and very low error rate in automated visualization
- ▶ Fast introduction of optimization measures and success monitoring
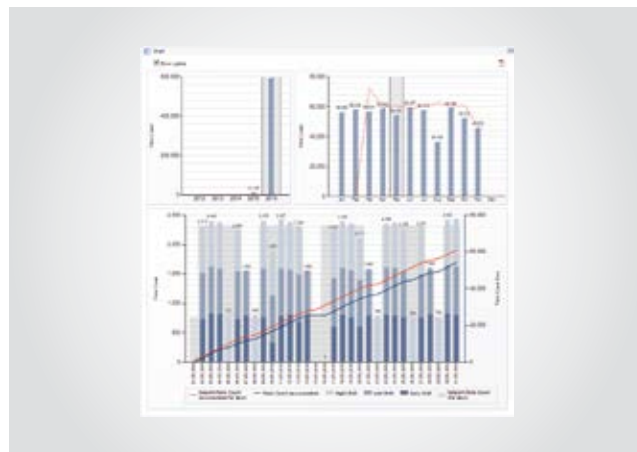
- ▶ Manual recording possible without any connectivity
- ▶ Comparison of different production facilities with optional Management View

KPI
- ▶ Increased machine availability and productivity
- ▶ Optimized output
- ▶ Increased degree of utilization/OEE
- ▶ Efficient identification of plan/actual deviations

| 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-shopfloor-solutions.com

IT Shopfloor Solutions – Shopfloor Management Cycle

The MES product Shopfloor Management Cycle (SMC) is a management tool for the flexible factory. With effective planning, visualization, and escalation systems, it supports companies in sustainably improving their output, recognizing bottlenecks earlier, and implementing measures. SMC contains the following MES products: Andon, Shopfloor Dashboard, Shiftbook, PDA/MDA, and Management View. Typical fields of application are the analysis of cycle and fault times, downtime, OEE, and futher KPI.

i4.0 Approach
▶ The SMC provides both managers and staff with a compre-
   hensive view of their production, enabling them to react to
   deviations quickly and to optimize processes
▶ The flexible configuration facilitates the adaptation to
   individual requirements regarding analyses and visualization
▶ Different visualization solutions provide a virtual depiction
   of the production status and enable fast intervention
▶ Repair and maintenance tasks can be reliably determined
   thanks to the real-time display of tool usage and plant
   condition

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ Higher transparency and productivity
▶ Recurring cycle analogous to PDCA cycle
   (plan, do, check, act)
▶ Escalation mechanisms for fast problem detection and solving
▶ Management View: fast overview of current global production
   status
▶ All production events completely documented thanks to
   electronic Shiftbook
▶ Usage of different visualization systems (e.g. Andon)
▶ Shopfloor Dashboard for depiction at a glance
▶ PDA/MDA: real-time visualization of production and
   machine data

KPI
▶ Higher machine availability and productivity
▶ Optimized machine output
▶ Higher degree of utilization/OEE
▶ Efficient detection of target/actual deviations

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 – Maintenance Support System

The MES product Maintenance Support System (MSS) was created to support operators and maintenance engineers in order to increase the speed, effectiveness, and sustainability of corrective, preventive, and autonomous maintenance. Once a problem is detected, a service order containing all relevant information for the service personnel can be sent directly via tablet. In addition, the availabilty of spare parts can be checked immediately. The maintenance engineer can view all corresponding documents, images, and videos of the machine on his/her mobile device. When the job is finished, the order can be closed via smartphone.

i4.0 Approach
▶ Based on real-time data, operators receive information about the plant condition on their mobile devices and are thus able to react faster. This saves time, costs, and resources. Above all, the MSS supports operators in their daily work and helps them in completing their tasks efficiently
▶ The MSS is available as a stand-alone solution and with optional machine connection. Via mobile devices, operators are able to carry out maintenance activities, partly without special expertise, or to place maintenance orders
▶ Based on the Bosch Shopfloor Management System, the MSS is equipped with open and secure standards and can integrate data from different sources, such as ERP or MES
▶ The MSS provides a virtual real-time depiction of machine conditions and required maintenance measures

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ All relevant functionalities available for real-time and data-based services
▶ Time and cost savings thanks to optimized maintenance processes
▶ Short reaction times due to automatic alarm mechanisms
▶ Situational maintenance instructions
▶ Mobile spare parts management

▶ Intuitive, easy-to-operate user interface
▶ Paperless documentation system
▶ Recording and reproduction of images and videos
▶ Less downtime thanks to support in predictive maintenance

KPI
▶ Shorter walking distances
▶ Shorter repair times
▶ Less technical OEE losses
▶ Increased machine performance (OEE)

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-shopfloor-solutions.com

IT Shopfloor Solutions – Condition Monitoring

Condition Monitoring enables the intelligent real-time control of machines and processes. It identifies errors before they lead to downtime. Based on predefined alarm and error tolerances, such as temperature, speed, or cycle time, deviations can be detected and resolved in a timely manner thanks to effective alarm mechanisms. This way, cost-intensive downtime is reduced and the life span of machines is increased.

i4.0 Approach
- Employees receive all relevant production data directly at the machine or via an app and are thus able to immediately evaluate and analyze it, which significantly facilitates their everyday work
- The service-oriented software architecture with its modular software solutions can be easily integrated into production, connected with other building blocks and configured for individual usage
- Condition Monitoring is available as a stand-alone solution or can be integrated into the Bosch MES
- Live data, for example, number of items, can be visualized in real time with the Condition Monitoring app for the optional Shopfloor Dashboard – either at the machine, on a tablet, or on other mobile devices

i4.0 Solution Provider
- Bosch Connected Industry

Benefits
- Basis for preventive and predictive maintenance
- Transparent production thanks to real-time monitoring of machines and processes
- Scalable, dynamic, and flexible: from the single machine through to complete production facilities
- Less cost-intensive downtime, longer life span of equipment and machinery
- Early fault diagnosis enables fast and targeted intervention
- Short reaction times thanks to automated alarms via e-mail or text message

- Individual adaptation of alarm mechanisms
- Clear, user-friendly live visualization on optional Shopfloor Dashboard

KPI
- Early detection of deviations in the production process
- Higher transparency along the value chain

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
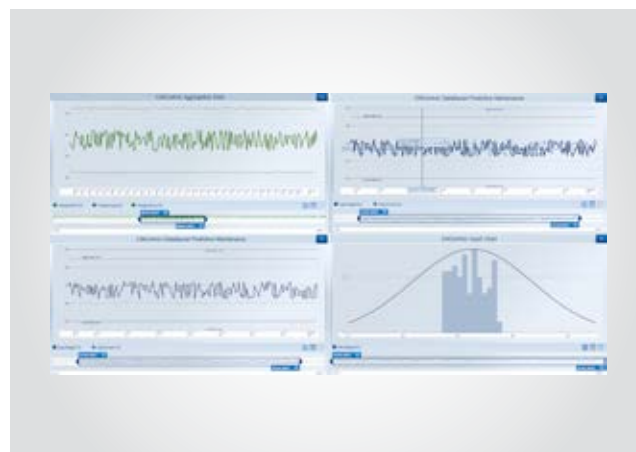
IT Shopfloor Solutions – Energy Monitoring

Thanks to Energy Monitoring, data of electricity or cooling water is collected and stored in a data repository, which is optimized especially for energy consumption data. Users can access and analyze the data at any time. Current consumption figures are displayed comprehensively; they are evaluated and visualized individually in an app for the Shopfloor Dashboard. This way, fluctuations, peaks, and irregularities can be identified. Operators can react quickly and reduce cost-intensive downtime and energy consumption. Moreover, they can identify potential for future energy optimizations.

i4.0 Approach
▶ Operators have transparent access to all relevant consumption data from the production environment. This enables them to react quickly and reduce energy consumption
▶ Energy Monitoring can be easily connected with machines and configured for individual applications. Thanks to individual visualization options, each user receives exactly the depiction required for his/her tasks
▶ Energy Monitoring not only enables the evaluation of energy consumption for individual machines. Consumption data can also be linked to type data, providing for detailed diagnosis of consumption for specific production types, variants, and batches
▶ The Shopfloor Dashboard app provides all consumption data at a glance and enables operators to compare the data of different machines

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ Transparent energy analysis as basis for energy optimization
▶ High potential for cost reductions
▶ Reduction of energy costs and consumption
▶ Early detection of variations or defects (e.g. leakages)
▶ Exact consumption analysis at a glance
▶ Comprehensive, individual visualization options

▶ Longer equipment and machine life span
▶ Data connection to Energy Platform from Bosch Energy and Building Solutions possible

KPI
▶ Reduced energy costs and consumption

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
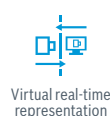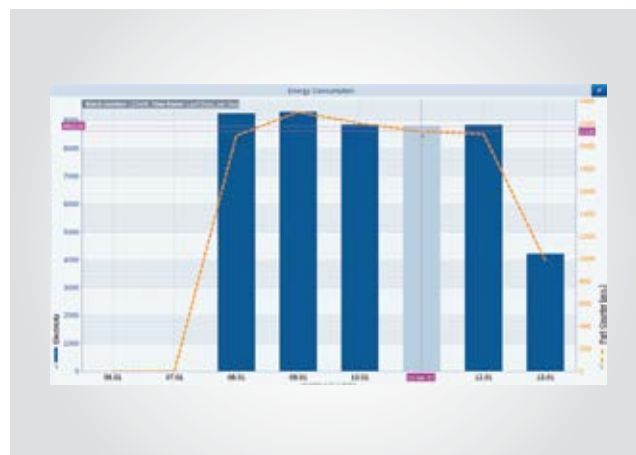
IT Shopfloor Solutions – Shopfloor Dashboard

The Shopfloor Dashboard offers a clear and individually adaptable visualization of complex production information at a glance. Thanks to the easy integration of personalized Shopfloor apps, the depiction of machine, quality, and further production data can be flexibly selected. Apart from real-time data, users can also retrieve relevant historical data, for instance, for shift planning. The Shopfloor Dashboard is available as a stand-alone client or as a client/server operation.

i4.0 Approach

▶ Thanks to the clear visualization of all relevant data in real time, the Shopfloor Dashboard enables personnel to optimize production processes continuously
By adapting the Shopfloor Dashboard to their individual requirements and integrating Shopfloor apps, employees are optimally supported in their daily tasks

▶ Products, software, and apps can be integrated into the Shopfloor Dashboard without special programming skills and connected to further applications in the production facility

▶ The Shopfloor Dashboard provides operating staff with a virtual depiction of relevant production data, enabling them to conduct a systematic analysis of the production process

▶ Depending on the application (stand-alone or client/server operation), the configuration of the Shopfloor Dashboard is either filed locally or centrally

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Higher production transparency thanks to visualization of production data
▶ Integration of current data from different sources
▶ Discussion of relevant topics on site in the production facility
▶ Efficient and clear depiction of KPIs
▶ Easy and intuitive user interface with reduced complexity thanks to graphical depiction
▶ Integration of individual apps for easier handling
▶ Free and easy adaptation without special knowledge

KPI

▶ Need-oriented visualization of production data
▶ Higher transparency across the value chain

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
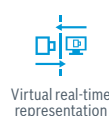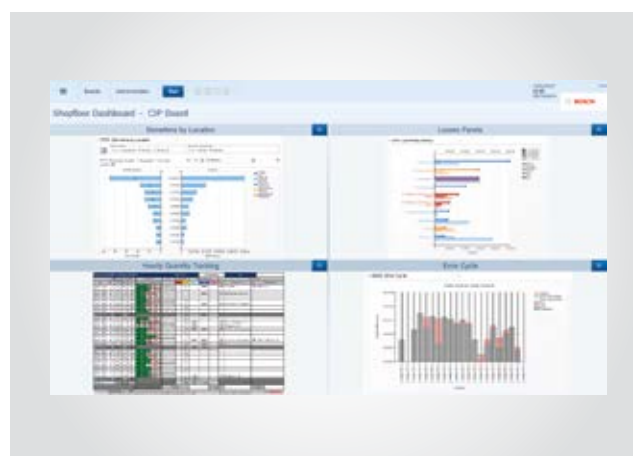
IT Shopfloor Solutions – Quality Data & Traceability

The MES product Quality Data & Traceability ensures product quality. It enables seamless and consistent traceability of materials and processes, and serves as a basis for quality assurance and analytics in the production environment. Moreover, production faults can be localized, recalls avoided, and targeted improvement measures taken thanks to the storage and visualization of quality data such as part, batch, or process information. The add-on Global Traceability is designed for global, cross-facility traceability of products across the entire production chain. Detailed installation and logistics information from the different IT systems (MES, ERP, further databases) is merged and stored for a long period of time.

i4.0 Approach

▶ Employees receive quality data in real time. This enables them to intervene early and in a targeted manner, to correct potential production faults, and to optimize both process and product quality at an early time

▶ Product quality can be monitored and analyzed from the single machine through to several lines. Material and processes are seamlessly traceable

▶ Quality Data & Traceability is manufacturer-independent; it can be used for different machines and expanded by third-party applications (e.g. qs-STAT from Q-DAS)

▶ The Global Traceability system uses the freely accessible standard EPCIS for the collection of all information with common message format

▶ The Global Traceability system can be integrated flexibly and independently and is compatible with existing systems in production and logistics

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Increase of product quality thanks to fast and reliable detection of production problems

▶ Seamless documentation of the entire production process prevents product liability causes and reduces return costs

▶ Long-time archive for production data

▶ Subsequent analyses provide deep insights and potential for optimization

▶ Defined quality gates increase process safety

KPI

▶ Product-independent traceability within production

▶ Quality improvement

▶ Reduction of failure costs

▶ Cross-facility traceability

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-shopfloor-solutions.com

IT Shopfloor Solutions – Smart Replenishment Service

With the Smart Replenishment Service (SRS), production lines are automatically provided with the required material, while material stock close to the lines is reduced to a minimum. Before the production materials are used up, a new order is triggered in the ERP system by comparing the data of production planning and the bill of materials, as well as remaining quantity and production progress. If required, staff receive optimized "shopping lists" for their itinerary. The lists can be displayed on tablets or PCs and enable faster reaction times.

i4.0 Approach
▶ Material replenishment is triggered automatically
▶ Thanks to mobile real-time information about material requirement and procurement, employees are always informed about the actual status and can react in a timely manner
▶ The material orders contain the exact time and place of requirement. This way, deliveries can be prioritized and transport media selected

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ On-demand replenishment
▶ Higher transparency in material management
▶ Lower replenishment time
▶ Reduced stock levels
▶ More space in the production area
▶ Shorter delivery times, less effort
▶ Less capital lockup

KPI
▶ Less capital lockup thanks to reduced material stock
▶ More space in the production area
▶ Less manual effort
▶ Shorter delivery times
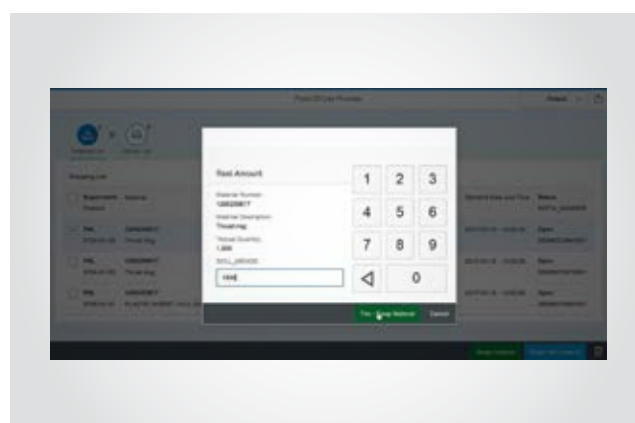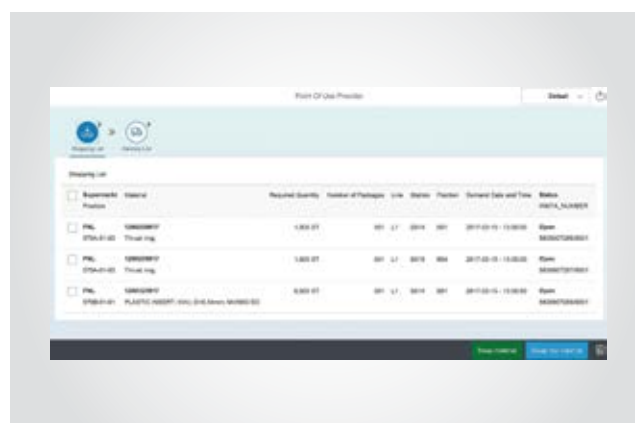
People as key players

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 comprises run-time components (software and hardware) as well as development tools (engineering). Scalable automation solutions for assembly, inspection, and process technology are complemented by comprehensive software libraries, for instance, for drives, measuring instruments, and robots. The basic system includes standard functionalities of state-of-the-art control and drive technology. Add-ons, for instance, for cycle time diagnosis or event recording, enable users to expand the platform step by step. Apps, which are integrated in the HMI, provide for simple data evaluation.

i4.0 Approach

▶ The automation platform offers a uniform interaction with the machines for service staff and operators alike
▶ Standardized interfaces allow for a seamless integration of machines and equipment with the IT production infrastructure
▶ Process and machine date, such as consumption rates, error and alarm notices, are provided and can be visualized, diagnosed, and evaluated via HMI apps, on the dashboard, on tablets, or via external software systems
▶ Standardized and open interfaces offer numerous possiblities to expand and integrate the platform into production

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ High flexibility through modern service-oriented architecture
▶ Clearly defined interfaces and transparent overall system
▶ Flexible and user-oriented configuration of software modules
▶ Operation without special programming expertise
▶ Software libraries and add-ons for consistent expansion
▶ Unique visualization concept for a seamless and transparent view of production
▶ Reduced development expenses and overall costs across the entire machine life cycle
▶ Scalable thanks to hardware-independent software concept

KPI

▶ Fast and consistent project execution
▶ Machine availability maintained across the entire life cycle
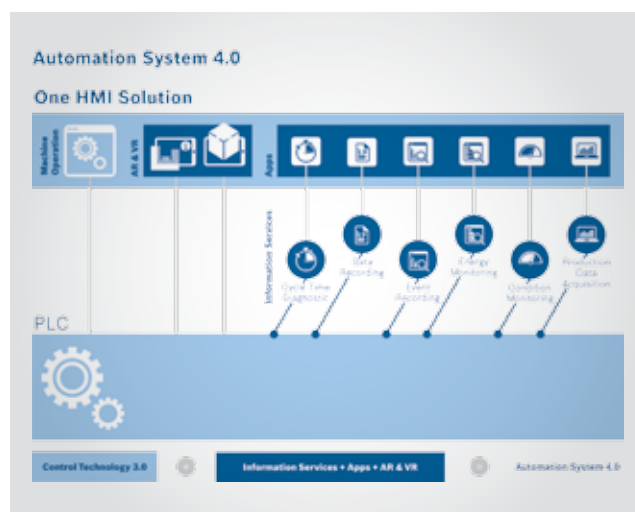
People as key players · Distributed intelligence · Fast integration and flexible configuration · Open standards · Virtual real-time representation · Digital life-cycle management · Secure value-creation network

IT Shopfloor Solutions –
Cycle Time Diagnosis

The integrated Cycle Time Diagnosis of the machine makes it possible to issue ad hoc recordings of production processes and their cycle times based on real-time data. Reference cycles are easy to predefine and to compare with the actual cycle time via the intutive HMI app. Target/actual comparisons are provided right down to the single component (appliance) in a transparent manner. This enables machine operators to quickly identify deviations, for instance, due to age, wear, or defect, to react accordingly, investigate the reasons, and implement countermeasures.

i4.0 Approach

▶ Operators are able to conduct analyses and implement measures quickly, which makes their daily work a lot easier
▶ The data from superposed systems such as the MES are provided via open interfaces. This data can be visualized directly at the machine, on mobile devices, or on the HMI app
▶ Standardized and open interfaces enable the provision of process and machine data
▶ The reqired data is recorded and visualized in real time

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Secured output and productivity thanks to direct analyses results
▶ Flexible control of cycle time fluctuations (centrally, at the machine, via mobile devices, or apps)
▶ Optimization of cycle times in the run-up phase by supporting staff during start-up
▶ Intuitive analyses thanks to HMI app
▶ Fast results, easy realization of required measures
▶ Easy operation and usage thanks to high degree of integration

KPI

▶ Optimized machine output
▶ Short training time for staff
▶ Faster time to market
▶ Low investment costs

| People as key players | Distributed intelligence | Fast integration and flexible configuration | Open standards | Virtual real-time represetation | Digital life-cycle management | Secure value-creation network |

IT Shopfloor Solutions – Part Counter

The Part Counter enables operating staff to collect and store information about the number of items and good/bad parts fully automatically. They can access the historical course of production results transparently at any time. Pareto analyses and evaluations, such as top ten bad parts, can also be clearly displayed with the HMI app. The data can be visualized in relation to shift and process analyses.

i4.0 Approach

▶ The intuitive HMI app facilitates daily work for machine operators and enables them to conduct analyses quickly and, if required, implement corrective measures

▶ Thanks to the connectivity possibilities, the data is made available from superposed systems such as the MES via open interfaces. This data can be displayed transparently at the machine, on mobile devices, or on the HMI app

▶ Process and machine data are made available via standardized and open interfaces

▶ The required data is collected and visualized in real time

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Continuous monitoring and direct visualization of all machine events

▶ Transparent depiction of production capacity and production events

▶ Safeguarding productivity goals

▶ Fast access to faulty parts, immediate implementation of countermeasures

KPI

▶ Achievement of production targets
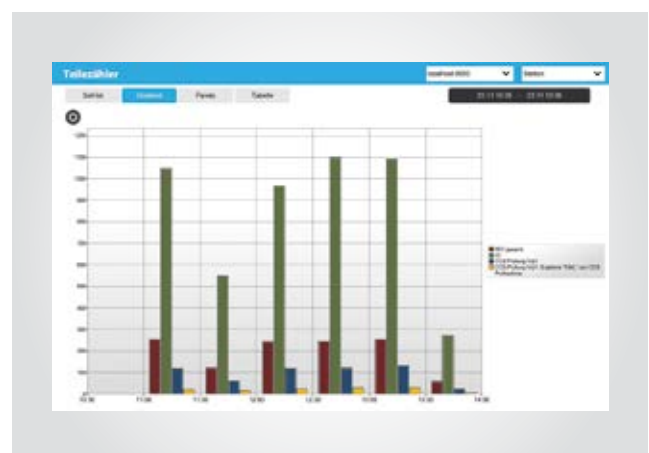
People as key players | Distributed intelligence | Fast integration and flexible configuration | Open standards | Virtual real-time representation | Digital life-cycle management | Secure value-creation network

IT Shopfloor Solutions – Event Recorder

The Event Recorder collects and stores errors, alarms, and further information from the machine fully automatically and in real time. Access to the historical course of events makes it possible to issue evaluations via the HMI App, such as the top ten fault analysis or error frequency over a certain period of time. The basis of this generic recording consists in different machine and process parameters, which deliver data uniformly to superordinate systems such as the MES.

i4.0 Approach
▶ Analyses can be conducted and measures implemented quickly by the machine operator via the intuitive HMI app
 This way, he/she is optimally supported in his/her daily work
▶ The data is provided via open interfaces and can be visualized transparently either directly at the machine, on mobile devices, or the HMI app
▶ Relevant process and machine data are provided thanks to standardized and open interfaces
▶ Recording and visualization of the required data takes place in real time

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ Continuous monitoring of all machine events
▶ Unambiguous identification of error frequency and patterns
▶ Transparent allocation of process- and type-related fault causes

KPI
▶ Precise fault analysis
▶ Low downtime
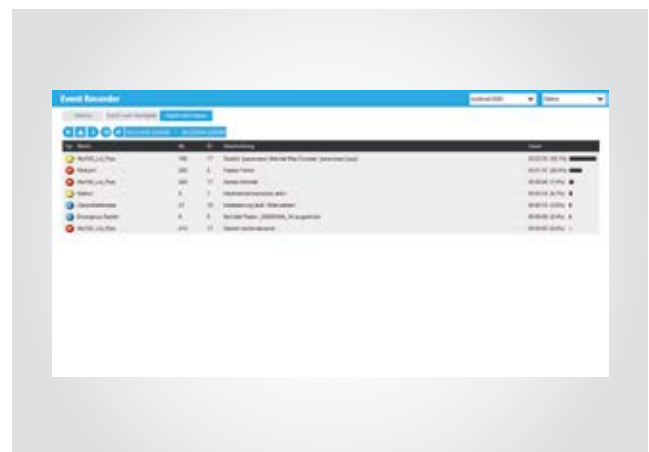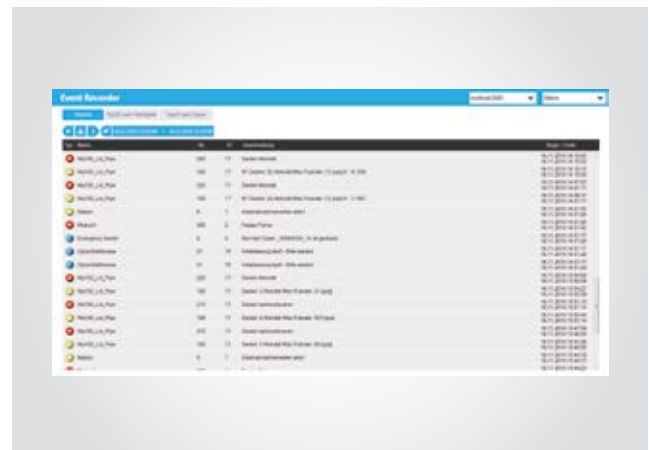
People as key players | Distributed intelligence | Fast integration and flexible configuration | Open standards | Virtual real-time representation | Digital life-cycle management | Secure value-creation network

IT Shopfloor Solutions – i4.0 HMI

The user-centered Human Machine Interface i4.0 HMI offers different possibilities to integrate humans into the data and communications flow of intelligent machines. Augmented Reality (AR), apps, and 3D depictions are amongst the many functionalities. Thanks to its intuitive operation, the HMI is also easy to handle for staff without additional expert knowledge. Location- and context-sensitive data is visualized immediately and enables operators to interact more easily with the machine. This leads to more effective maintenance scenarios, which contribute to higher machine availability.

i4.0 Approach

▶ Thanks to its intuitive handling, the i4.0 HMI facilitates the direct interaction between operator and machine. Humans are at the heart of production and are enabled to perform tasks faster and more intuitively, while contributing to higher machine availability

▶ The fast configuration and connection with machines and mobile devices, as well as the usage of apps and AR extend classic operation concepts by merging the operator's real world with virtual, computer-generated elements

▶ Visualizing live machine data in real time speeds up error localization and maintenance activities

▶ The i4.0 HMI is a central element of the connected factory and serves as an interface for communication between humans, machines, and superordinate IT

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Intuitive operation, even without expert knowledge

▶ More effective maintenance scenarios thanks to AR, apps, and 3D visualization

▶ Higher machine availability thanks to fast error localization and troubleshooting

▶ Support for staff with difficult tasks

KPI

▶ Less machine downtime

▶ Higher availability of maintenance and assembly instructions

▶ Shorter training period for staff

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-shopfloor-solutions.com

IT Shopfloor Solutions – Image Processing Construction Kit

The Image Processing Construction Kit is a complete construction kit consisting of compatible, proven building blocks and services for industrial image processing. Different camera technologies, lighting techniques, image processors, as well as algorithms and procedures implement robust image processing solutions in industrial environments.

i4.0 Approach
▶ The user-friendly HMI with clear visualization of the current inspection process enables a direct interaction with the machine operator
▶ The special software concept facilitates flexible and easy configuration for fast setup and training of different inspection types
▶ Thanks to the open architecture, further local building blocks or standards can be added
▶ All processes in the production line are visualized in real time

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ Fast implementation of industrial image processing applications
▶ Access to proven, high-quality components and processes
▶ Fully integrated service package including consulting, implementation, setup, training, and services
▶ High compatibility of all components, also usable as a complete system

▶ High degree of automation and production of small series
▶ Automated analyses and monitoring of quality parameters for the early identification of process deviations
▶ Parameter calibration possible outside of 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

Sensor Cloud
Full service: from business modeling up to implementing your sensor-based solution

Sensor Cloud is your partner for designing, building, and running cloud-based sensor solutions.

Co-creating your sensor-based business model	Designing the complete system from sensor to solution	Verifying the technical aspects (PoC) as well as the business value (MVP) of your ideas	Building, implementing, and operating your sensor-based solution
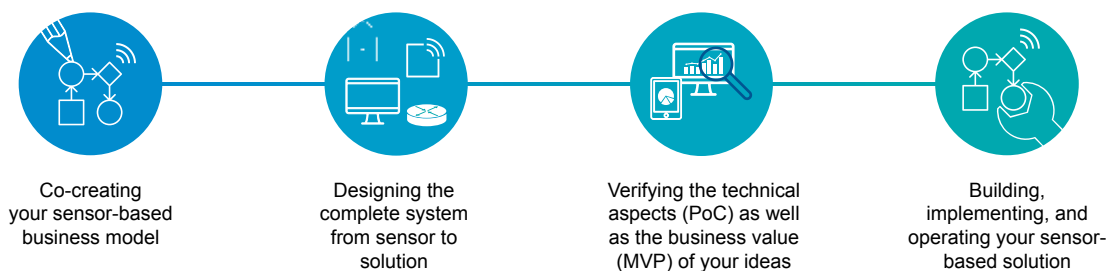
Sensor Cloud
Blueprint integration architecture

Solutions based on Sensor Cloud, e.g.

Asset Utilization | Tool Tracking | WPC Monitoring | ...

APIs from Sensor Cloud services

Sensors

Wi-Fi/LAN

OPC-UA
IO-Link
Bluetooth
USB
PPMP

Gateway

Sensor Cloud

Secure Data receiver

Threshold recognition

Pattern recognition

Data forwarding

Data history

Device management

Data visualization

Tagging

Management of sensor network
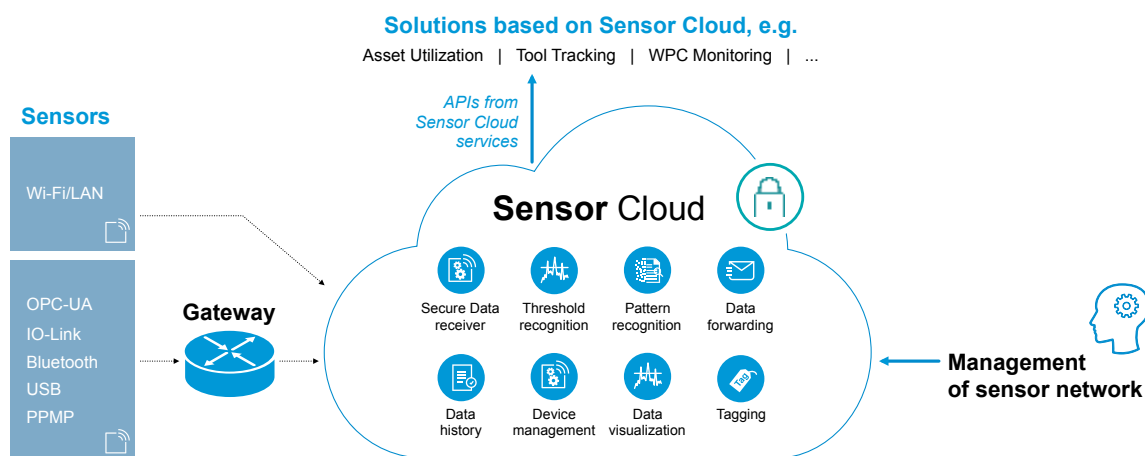
Link to products:
www.bosch-si.com/sensor-cloud

Sensor Cloud:
for wireless connected production

Whether you are connecting your tools, machinery, and products and equipping them with intelligence, or you want to develop new services with the help of modern technologies, the Sensor Cloud is the ideal basis for cloud-based sensor networks. Bosch Connected Industry will support you every step of the way, from analyzing your requirements to designing and implementing your tailored solution in manufacturing and logistics – giving you sensor systems as well as hardware and software expertise from a single source. The Sensor Cloud lets you use existing standards and protocols to integrate sensors quickly and easily as a new data source. This secure, high-performance platform helps you consolidate, evaluate, and visualize an astounding range of data, for instance, so you can keep an eye on the status, performance, and location of your valuable tools in the field – even without connecting to your MES.

i4.0 Approach
▶ Benefit from user-friendly management, configuration, and evaluation of sensors and sensor data
▶ Mature technology supported by standards (e.g. IO-Link, PPMP) enables a fast time to market for your sensor-based logistics and manufacturing services
▶ New services can be hosted in the Sensor Cloud, the Bosch IoT Cloud, or a third-party environment
▶ Bosch infrastructure guarantees the highest security standards
▶ You can choose to integrate sensors securely and powerfully with the Sensor Cloud either directly or via a gateway
▶ User-based pricing model gets you off to a cost-effective start when implementing new business models

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ You can equip your systems with intelligence and create value by connecting existing data sources and integrating new ones
▶ The concept is suitable both for new sensor-based logistics and manufacturing services and as a white-label solution for sensor manufacturers

▶ This complete solution covers everything from requirements analysis for your cloud-based sensor network to implementation of your tailored solution, for example, for predictive maintenance, seamless supply management, or to ensure your tools deliver the highest standards of manufacturing quality in operation
▶ Use our workshop to derive your use cases and start your sensor-based project
▶ Our solution can be combined with implemented industrial sensors, for example, as a starter kit to make getting started easier

KPI
▶ Maintenance and repair costs
▶ Logistics and warehousing costs
▶ Production output: quality losses
▶ Failure and warranty costs: waste

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

Production Performance Manager

The Production Performance Manager is a production information and evaluation system. In near-real time, it collects production and machine data, combines it to produce a visual representation, and communicates defined events to the production worker, who may be involved directly or indirectly. The Production Performance Manager provides a snapshot of the current status of individual machines, and of the production system as a whole. This new availability of data and direct feedback provides optimum support for your continuous improvement process. Optional additional modules and add-ons augment this software solution with specialist functionalities.

i4.0 Approach

▶ The focus is on people: users can use any device, wherever they are, to proactively receive the data that is relevant to them
▶ Provision of open standards: the generic interface enables the integration of machines, data sources, and third-party systems, using the Production Performance Management Protocol to transmit the data
▶ Flexible configuration: production experts can independently configure the system for their daily work
▶ Virtual real-time mapping: all devices, machines, and their data are presented as a virtual image in near-real time

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ **Less downtime** thanks to the centralized live analysis of data and faster service processes
▶ **Improved use of expert knowledge** thanks to improved data input and centralized data analysis
▶ **Flexibility without IT know-how,** as experts can autonomously apply use cases for machine monitoring
▶ Software solution for **systematic production improvement**

KPI

▶ Maintenance and repair costs
▶ Error costs
▶ Production output: with an emphasis on technical downtimes 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 – Process Quality Module

The Process Quality Module for the Production Performance Manager visualizes, monitors, and documents process data across factories and in real time. It automatically detects process deviations and trends, and helps experts optimize production processes directly and on an ongoing basis. This module is instrumental in achieving zero defects, transparency, and the best-quality production output.

i4.0 Approach

▸ Transparent factory: overview of all production processes
▸ Central collection of all relevant process and quality data
▸ Processing und 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 to connect devices/controls regardless of the manufacturer
▸ Role-specific provisioning of information

i4.0 Solution Provider

▸ Bosch Connected Industry
▸ 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 labor costs, investments
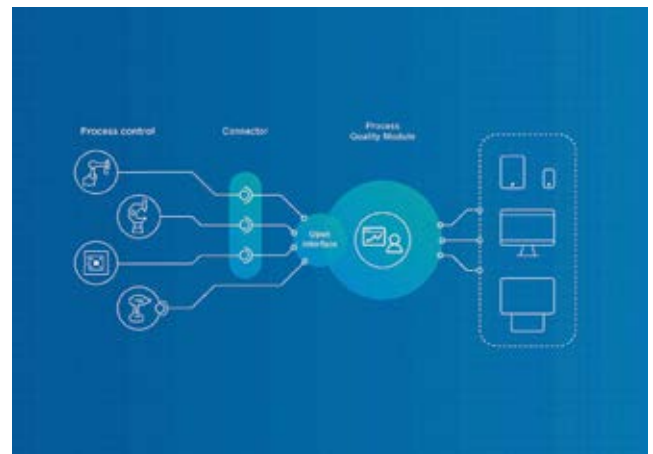
People as key players

Distributed intelligence

Fast integration and flexible configuration

Open standards

Virtual real-time representation

Digital life-cycle management

Secure value-creation network

Production Performance Manager – Ticket Management Module

The Ticket Management Module for the Production Performance Manager optimizes service processes through tickets specific to a field of expertise, allowing experts in that field to make a fast and targeted response to events such as machine failure. When a disturbance occurs, the system draws on aggregated machine notifications to automatically issue a ticket, which is added to a Kanban board overview. Tickets are assigned based on the situation: this means that only those employees with the appropriate skill set and the necessary responsibility for the affected machine receive the ticket. In addition to automatic delegation, every ticket also comes with an escalation mechanism.

i4.0 Approach

▶ People are always the focal point: users can use any device, irrespective of location, and are proactively provided with the relevant maintenance data

▶ Provision of open standards: the open "generic interface" enables the integration of machines, data sources, and third-party systems

▶ Flexible configuration: maintenance technicians can independently configure the system for the day's work

▶ Virtual real-time mapping: all devices, machines, and their data are presented as a virtual image in near-real time. The maintenance tickets contain a description of the disturbance and the source of their data

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Intelligent repair and maintenance management

▶ Needs-based maintenance thanks to the integrated delegation process

▶ Knowledge database for the maintenance and repair service

▶ Possibility to store recommended solutions in the regional language

KPI

▶ Maintenance and repair costs

▶ Error costs

▶ Production output: with an emphasis on technical downtimes 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

Production Performance Manager – Production Rules Configurator

The Production Rules Configurator is an add-on to the Production Performance Manager. This software can be tailored to the specific needs of each individual user in their production environment. Users can easily 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 software allows for a thoroughly transparent production process and improves production output at the same time.

i4.0 Approach

▶ Rapid and seamless implementation for data collection
▶ Software for flexible, rules-based analysis of production data
▶ Automatic analysis of process and machine data (24/7)
▶ Simple graphic modeling of the rules by a production expert
▶ Centralized repository for gathering expert know-how
▶ Tailored configuration and scaling

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ **Early detection of deviations:** takes measures to safeguard the production process
▶ **Support of dynamic maintenance intervals:** allows for machines to be serviced as soon as the production data indicates it is necessary
▶ **Simple, tailored implementation:** the production expert compiles and updates the rules model

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

Production Performance Manager and IoT Gateway

Production Performance Manager and IoT Gateway provide you with a simple and cost-effective way of networking your machinery and systems. You can then use the new information you gain to improve your production processes and product quality. With the IoT Gateway, it is easy to connect to Industry 4.0 environments – without intervening in the automation logic. The precisely coordinated combination of control hardware and software for realizing IT applications collects sensor and process data and transmits it to the Production Performance Manager.

i4.0 Approach

▶ Networking of existing systems and production and logistics facilities with the world of IT
▶ Web-based configuration to reduce commissioning times of the IoT Gateway by up to 90% compared to conventional systems
▶ Connecting third-party control units to the IoT Gateway to gain access to the entire shop-floor infrastructure
▶ Coordinated, preconfigured, and validated hardware and software modules
▶ Users can use any terminal, irrespective of location, and are proactively provided with the relevant data
▶ Production experts can independently configure the system for the day's work
▶ All devices, machines, and their data are presented as a virtual image in near-real time

i4.0 Solution Provider

▶ Bosch Rexroth
▶ Bosch Connected Industry

Benefits

▶ Simple data exchange between production machines and applications in the IT world, such as MES systems, analysis, database, and cloud applications
▶ No intervention in the machine program thanks to the parallel operation of the IoT Gateway and machine control
▶ Web-based configuration and handling without the need for extra programming

▶ Less downtime thanks to the centralized live analysis of data and faster service processes
▶ Improved use of expert know-how thanks to optimized data input and centralized data analysis
▶ Flexibility without IT know-how, as experts can autonomously select application cases to monitor machines
▶ Software solution for systematic production improvement

KPI

▶ Maintenance and repair costs
▶ Error costs
▶ Production output: with an emphasis on technical downtimes 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

Manufacturing Analytics tools & services

Manufacturing Analytics is our portfolio for your manufacturing data analytics project. Our team, composed of IT and data science experts and Manufacturing Analytics engineers, helps you analyze your production data and generate added value from it. Use our multistage services all the way up to the automated deployment of predictive models, such as predictive analytics for predictive maintenance. In addition, we develop tools that help you solve typical issues that arise in manufacturing environments (e.g. for reducing test times).

i4.0 Approach
- Two-day workshop to extrapolate your use cases and start your analytics projects
- Customized data analytics services in three phases: Initial Insights, Advanced Intelligence, and Automated Analytics
- Predictive analytics (e.g. for predictive maintenance in your factory)
- Iterative approach that quickly yields useful analytics results
- Service project methodology compliant with Cross-Industry Standard Process for Data Mining (CRISP-DM)
- Focus on an expert-level understanding of your problem in the manufacturing process as opposed to a purely data-oriented approach
- Integration of data from all sources and of all formats
- User-friendly, browser-based self-service tools for typical analytics tasks in your manufacturing context
- Added value for machine and component suppliers thanks to integrated analytics functions
- Service goes beyond handing over your algorithm: life-cycle management with maintenance and support for your implemented analytics models

i4.0 Solution Provider
- Bosch Connected Industry

Benefits
Use Manufacturing Analytics to:
- **Improve quality:** achieve this with analyses 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 (predictive analytics)

KPI
- Failure and warranty costs: 0-mileage complaints, scrap, rework
- Output: quality losses, performance losses, technical losses, set-up time losses
- Costs of maintenance and repair
- Costs of logistics and inventory
- Product development costs
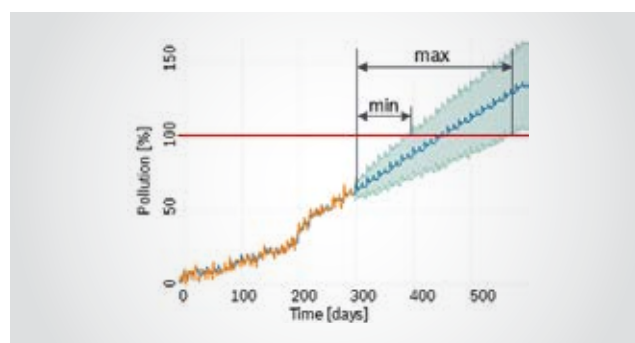
Predictive maintenance: prediction of pollution level for a device in order to schedule replacement at optimum time.

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

Without process data cockpit   With process data cockpit
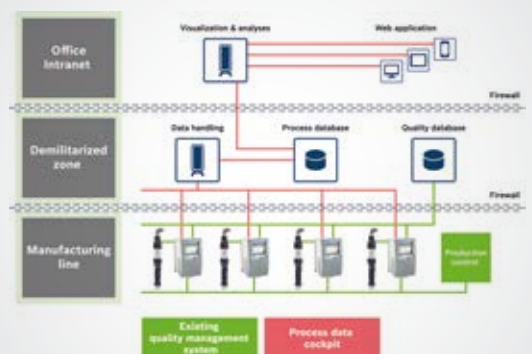
Link to products:

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

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 Connected Industry. The Process Quality Manager lets you monitor and analyze process data from multiple plants in real time at once. 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, an active notification in case of process deviations, and numerous reporting functions, you can continuously improve the efficiency 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 controlling these tightenings. These features recommend it for use in safety- and function-critical tightening processes. A special role is reserved here for the NEXO intelligent cordless nutrunner. All control functions 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 tightening result 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 data
▶ Processing and high visualization of real-time data
▶ Expert as key player: being proactive instead of reactive in response to potential process deviations
▶ Web-based software: access to data from wherever you are via PC or mobile device
▶ Open interface to connect devices/controls regardless of the manufacturer
▶ Role-specific provisioning of information
▶ Assembly with high numbers of variants supported and quality ensured thanks to workpiece-specific parameters for tightening processes
▶ Integrated control for deep-level information exchanges with any manufacturer
▶ Easily integrated into assembly lines without additional control hardware

i4.0 Solution Provider

▶ Bosch Rexroth
▶ Bosch Connected Industry

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 one
▶ Documentation of all processing parameters
▶ 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

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

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 system
▶ Easily scalable: extra systems or equipment can be added at any time

i4.0 Solution Provider
▶ Bosch Connected Industry

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-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/her 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 highly 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 CO_2 emissions
▶ Avoidance of blackouts by power quality transparency

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

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.escrypt.com

Embedded Security Solutions for Connected Automation

Connectivity and decentralization of production processes enable self-regulating processes and transparent optimization. But increasing autonomous machine communication leads to new IT security risks: hackers may try to access and manipulate production processes and data. Thus, it is clear that security is one of the key success factors of Industry 4.0. But machines and automation systems require dedicated security solutions. The underlying technology, however, (mostly embedded systems) usually does not allow implementing traditional IT security solutions. ESCRYPT offers embedded security products, services, and holistic solutions to fulfill the special requirements of the relevant industrial applications.

i4.0 Approach

▶ The state-of-the-art cryptographic Key Management Solution is perfectly tailored to the requirements of embedded systems and corresponding device software in order to identity management and communication protection

▶ Production Key Server (PKS) ensures that cryptographic material is securely implemented during device production. It enables corresponding end-of-line security testing and subsequent product return analysis

▶ Comprehensive Security Services: security analysis, security concept, implementation support, security testing services, certification support, security trainings

i4.0 Solution Provider

▶ ESCRYPT GmbH – Embedded Security

Benefits

▶ Risk-appropriate, cost-effective key management solutions to protect against data manipulation and IP theft

▶ Service package, including design of customized security solutions

▶ Customized implementation (process, software, hardware)

▶ Security solution, including maintenance as a managed service

▶ Training and support for security certifications

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/oce

Rexroth Open Core Engineering

With Open Core Engineering, manufacturers establish a uniform connection between machine automation and IT or IoT software solutions. Using the Open Core Interface technology interface, users can create their own individual functions in a wide range of IT and internet high-level languages that run in parallel with the PLC application directly in the controller or external devices. In addition to the Microsoft C languages, Open Core Interface also supports the programming of controls in Java and Lua. It is also possible to seamlessly connect engineering solutions such as LabVIEW, MATLAB/Simulink, or Modelica-based tools such as CATIA into overall automation. Direct networking of MES solutions or cloud services based on Bosch IoT Cloud, Oracle IoT Cloud, or Microsoft Azure is limitless thanks to the Open Core Interface.

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 protocol standards such as OPC UA
▶ Use of 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 automation with technology-oriented toolbox components with easy adaptation to machines and processes
▶ Scalable control solutions with decentralized intelligence with automation controls and drives from an extensive portfolio
▶ Combined machine control and IoT applications via Open Core Interface
▶ Multi-Ethernet-based communication and support of standardized IT and IoT technologies

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 IoT Gateway

The IoT Gateway, consisting of embedded control hardware and an installed software package for IoT applications, connects existing machines or closed systems with the IT world's infrastructure. Usually no changes to the existing automation solution or PLC programming knowledge are necessary. The system collects sensor and process data and transfers it to higher-level, IT-based solutions such as MES, cloud applications, systems for local monitoring of machine states, or the analysis of process data.

i4.0 Approach
- Networking of existing plants, production, and logistic properties with the IT world
- Web-based configuration to lower the commissioning time of the IoT Gateway by up to 90% compared to conventional systems
- Connection of third-party controls to the IoT Gateway to include the entire shopfloor infrastructure
- As an OSGi-certified product, the IoT Gateway combines real-time critical applications from the production environment with the IT world
- Simple to expand with further apps to connect sensors and IT systems via open interfaces

i4.0 Solution Provider
- Bosch Rexroth

Benefits
- Simple data exchange from existing production machinery with IT world applications, such as MES systems, analysis applications, database applications, or cloud applications
- No intervention in the machine program through parallel operation of the IoT Gateway and machine control
- Web-based configuration and handling without any programming effort
- Matched, pre-configured, and validated hardware and software modules
- Robust, reliable, and durable IndraControl XM control hardware
- Simple, secure, and quick process signal integration with the IndraControl S20 I/O modules
- Flexibly expandable with customer-specific software applications

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
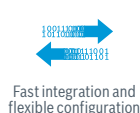
Link to products:
www.boschrexroth.com/webconnector

Rexroth WebConnector universal translator for the IoT

Web-based HMIs are key for platform-independent visualization of information and data with the aim of creating a cost-efficient and flexible manufacturing environment. The WebConnector communication interface enables universal data exchange between controllers and Web-enabled end devices. Embedded in the Open Core Engineering solution portfolio, HMI applications can be developed on a manufacturer-neutral basis, regardless of the target device. Using the open Industry 4.0 communication standard OPC UA and the internet languages HTML5, CSS, JavaScript, and Node.js, the interfaces are programmed freely or simply projected using the new engineering software WebComposer.

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 third-party components
▶ Integrated Web server: for displaying HTML5 websites on a standard browser
▶ Independent: ability to run on all operating systems accessible from Java Virtual Machine, for example, Linux, Windows, Raspbian, etc.
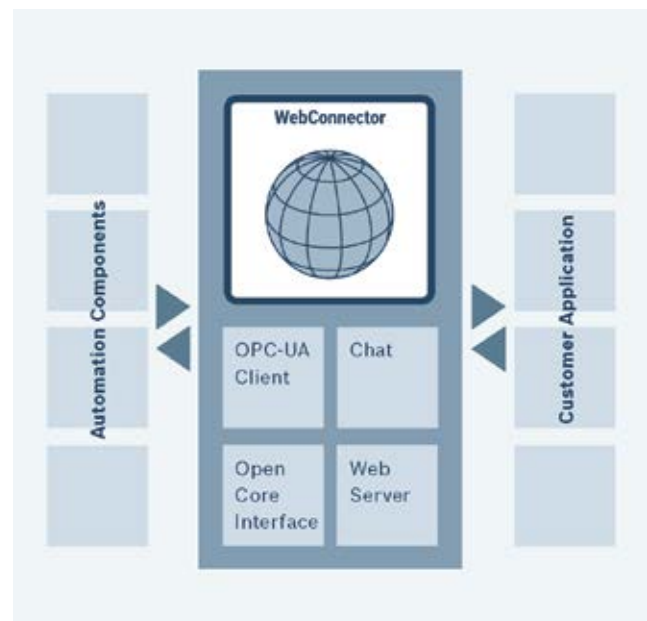
WebConnector is as a process data gateway: the connecting piece between the Web client and automation world.

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/activecockpit

Rexroth ActiveCockpit
interactive communication platform

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
▶ Intuitive Web-based software and openness for third-party applications via Web frame
▶ 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
▶ Extensible funcionalities via an app library (e.g. StaffManager, DeviationManager, AppFrame)

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
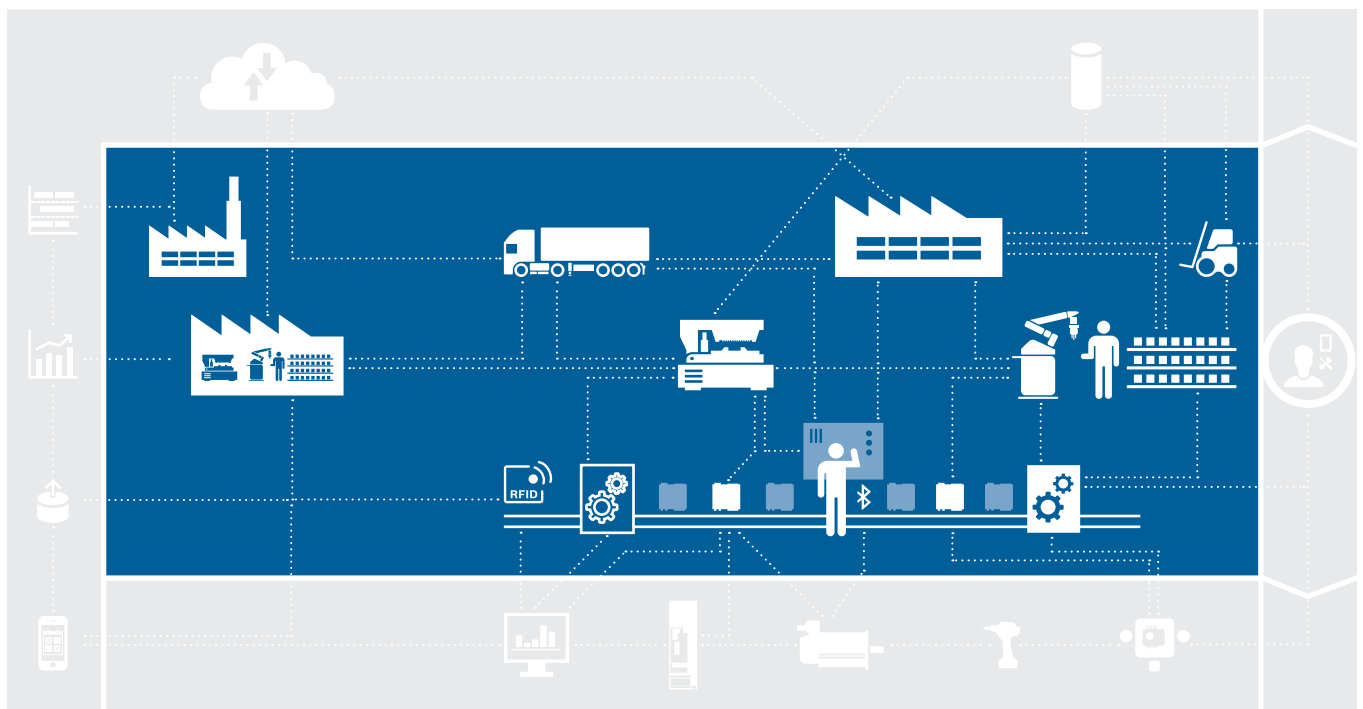
LOGISTICS AND MANUFACTURING AT BOSCH

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.bosch-connectivity.com/TDL110

Transport Data Logger

The Transport Data Logger (TDL) makes the supply chain transparent. Once attached to the shipment, the Transport Data Logger measures and records temperature, humidity, tilt, and shock, with the data visualized through a mobile application. The limits of each parameter can be individually configured, and any violation is traceable throughout the entire supply chain.

i4.0 Approach

▶ The TDL is a cost-effective, simple, and reliable way to bring transparency to the entire supply chain
▶ The TDL is individually configurable and easy to use without prior knowledge
▶ The TDL gives indication about irregularities within the entire supply chain. In case any parameter threshold is exceeded, the TDL provides verifiable proof. If there is no parameter violation, the TDL provides evidence of a carefully conducted and failure-free transport chain
▶ The TDL can be used in any businesses and provides environmental conditions clearly for a deeper analysis

i4.0 Solution Provider

▶ Bosch Connected Devices and Solutions GmbH

Benefits

▶ Leads to transparency within the entire supply chain
▶ Manifold capabilities
▶ Delivers crucial data for the optimization of logistics processes
▶ Fosters a deeper trust between partners

KPI

▶ Monitoring of crucial parameters such as temperature, humidity, tilt, and shock
▶ Up to two years battery lifetime
▶ Cost-effective, simple, and robust
▶ Free and user-friendly mobile application

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, for example, for 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

▶ Export of serialization/aggregation data in different or customer-specific formats
▶ 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

▶ Track & Trace solution allowing us to enter the IT business for packaging and grow with future customer requirements
▶ Machine modules and MES software applications from a single source
▶ Experience from other Bosch divisions

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
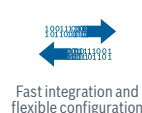
Rexroth ActiveAssist assistance system for varied assembly

ActiveAssist brings together people, equipment, and processing, through decentralized intelligence. The software and standardized interfaces precisely identify workpieces and support employees in a varied assembly. At the same time, ActiveAssist monitors the quality of the process and initiates corrective action.It is also modularly expandable.

i4.0 Approach

▶ ActiveAssist is a configurable platform for intuitive worker guidance and secure process control, and is especially suited to a wide 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 workpieces take place in real time. The worker receives the corresponding 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 workstation are individually tailored to the 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 for easy commissioning and integration with MES/ERP systems

▶ Intuitive user interface and optimized ergonomics for high worker acceptance

▶ Quicker and more productive manufacturing of customized products

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:
Home page: www.bosch-apas.com
YouTube: APAS Channel

APAS automated production assistants

APAS production assistants enable the safe collaboration of humans and machines. When inflexible boundaries are overcome and safe human-robot cooperation is made possible, this results in new collaborative models. Focusing on the operators' needs, APAS production assistants support their human colleagues with simple, monotonous, or ergonomically challenging tasks. As a combination of mobile platform and variable process modules, they are easy to integrate and to adapt to the specific requirements of any production facility.

i4.0 Approach

- ▶ Safe and direct human-robot collaboration without the need for a safety fence, thanks to comprehensive safety technology for each process module
- ▶ User-centered approach: focus on the operator's needs
- ▶ Standardized connections between the individual APAS systems for the transfer of workflows between systems and support of effective remote maintenance
- ▶ Flexible and needs-oriented usage thanks to various possible combinations of process modules and platforms

i4.0 Solution Provider

- ▶ Bosch Connected Industry

Benefits

- ▶ Support of humans in the production process by taking over simple, monotonous, or ergonomically challenging tasks
- ▶ Extremely flexible for a broad range of applications
- ▶ High scalability and reusability
- ▶ Suitable for small-batch production, sample testing, prototype manufacturing, process validation, etc.
- ▶ Agile engineering with rapid results
- ▶ Modular design

KPI

- ▶ Productivity
- ▶ Quality

| 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 |

APAS assistant

The APAS assistant is a collaborative and intelligent robotics system for the direct, safe, and contact-free collaboration of humans and machines without a safety fence. Equipped with a highly sensitive sensor skin, the system responds the moment an employee approaches it. Before any contact between human operator and robot takes place, the assistant stops immediately, and only resumes its work once the person has left its vicinity. Depending on the customer's requirements, it can be employed as a mobile assistance system or as safe kinematics in own machines.

i4.0 Approach

▶ Certified, comprehensive safety concept for direct human-robot collaboration
▶ Intuitive control and interaction concepts for user-friendly operation
▶ Easy to configure for new tasks
▶ Standardized connectivity for rapid and seamless integration into typical production settings
▶ Network interface for easy remote access and for communication between different machines
▶ Different platform variants for flexible and needs-oriented operation

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Multistage safety system for close human-machine collaboration
▶ Support of production staff with monotonous, simple, or ergonomically challenging tasks
▶ Space-saving automation: no additional safety equipment needed
▶ Certified safety based on a patented sensor skin
▶ Increase of efficiency and productivity

KPI

▶ Productivity
▶ Quality

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:
Home page: www.bosch-apas.com
YouTube: APAS Channel

APAS inspector

Thanks to innovative technologies, the APAS inspector offers rapid and reliable support with visual and quality inspection in production processes. Its advanced 3D imaging methods deliver dependable, high-precision testing results, even in rough production environments. Exchangeable testing modules, variable parts feeding, and the flexible software concept allow the APAS inspector to accommodate different tasks, and facilitate fast usage while keeping investment costs low. From testing of matt or glossy surfaces to completeness, microfracture, or dimension testing, the system offers a wealth of options. Depending on the customer's requirements, the APAS inspector can be employed on a mobile basis or integrated into the customer's own equipment.

i4.0 Approach
- Modular and flexible: interchangeable testing modules and flexible software concepts for a broad range of tasks
- Standardized connectivity for quick and easy integration into typical production settings
- Network interface for easy remote access and for communication between different machines
- A range of platform variants for flexible and needs-oriented operation

i4.0 Solution Provider
- Bosch Connected Industry

Benefits
- Robust 3D imaging technologies for excellent reliability

- Virtually unlimited possibilities thanks to different camera and illumination modes
- Variable testing modules for different contexts (deflectometry, photometric stereo, spectroscopy, interferometry, and customer-specific tasks)
- Rapid refitting for new tasks thanks to interchangeable testing modules
- Manual or automatic parts feeding on a flexible planar stage for a wide range of procedures
- Learning vision for continuous optimization of recognition capabilities

KPI
- Productivity
- Quality

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:

Home page: www.bosch-apas.com
YouTube: APAS Channel

APAS workstation

Where humans and machines can seamlessly and safely interact, new avenues for the design of working environments are opened up. The result is a collision-free space, where humans and robots can work together, and not merely in parallel. With the APAS workstation, we offer you the first workplace with integrated, collaborative robot kinematics, providing employees with direct support in the accomplishment of their tasks. Innovative operation and interaction concepts provide for a unique user experience, as well as excellent and attractive working conditions for members of staff.

i4.0 Approach
▶ Intelligent, connected, and ergonomic workstation, focused on operator needs
▶ Integrated collaborative robot kinematics as support for employees
▶ Innovative user guidance thanks to light and image signals
▶ Individually adaptable and height-adjustable tabletop
▶ Novel diagnosis systems for an efficient production process
▶ Open interfaces

i4.0 Solution Provider
▶ Bosch Connected Industry

Benefits
▶ Efficient workplace design for maximum productivity
▶ Shared working space for human operator and robot
▶ Robot offers support with monotonous, simple, or ergonomically challenging tasks
▶ Unique, contact-free safety technology
▶ Certified, comprehensive safety concept for intensive collaboration between man and machine

KPI
▶ Productivity
▶ Quality

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
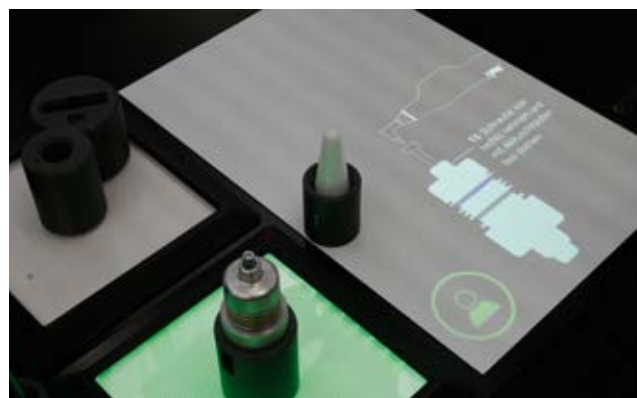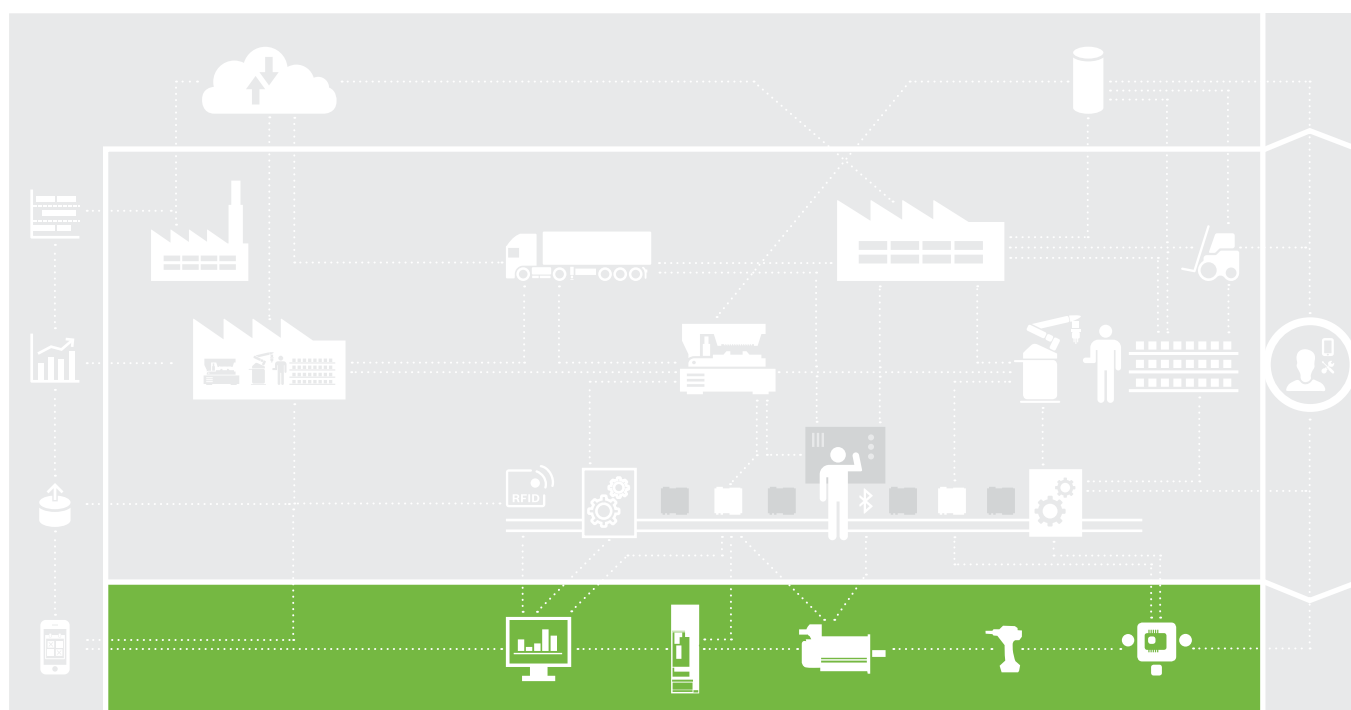
FIELD LEVEL EQUIPMENT
AT BOSCH

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

As the leading automation provider, Bosch Rexroth 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, for example, OPC UA and all common Ethernet communication protocols, as well as support from standardized Web and IT technologies

▶ Consulting and 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, for example, 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

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/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. The motion logic system is ideal for operation of electric and hydraulic as well as hybrid drives.

i4.0 Approach

▶ PLC and IT Automation 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 tool kits

▶ 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 run-time 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

▶ Support of the control hardware XM21, XM22, CML75 controllers, industrial PCs IndraControl VPx as well as S20 two-axis module for connecting hydraulic axes

▶ Auto-tuning and automatic path identification for quick hydraulic axis start-up for the position control

▶ Enhanced synchronization functionality

▶ Rotary axis support (SSI/incremental encoders)

▶ Certified overall solution for marine applications and explosion protected areas based on IndraControl XM22

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 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 lifetime 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-specifc 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 five-axis machining

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 platform

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
▶ Compact control components 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
▶ Extended temperature range from -25°C to +60°C
▶ Certified overall solution for marine applications and explosion protected areas based on IndraControl XM22

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 IndraControl FM cabinet-free PLC control

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
▶ Multi-protocol-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

Rexroth IndraControl PR and VR

With its consistent hardware design, the new product family of industrial PCs and displays provides scaled performance, high system availability, and a variety of configuration options. The IndraControl PR performance-graduated box PCs are available in conjunction with the IndraControl DR multi-touch displays (connected at distances of up to 100 m) or combined as IndraControl VR panel PCs.

i4.0 Approach

▶ High system availability and data security through the use of SSDs, also in a RAID system and Windows 10 embedded and security features
▶ High performance thanks to the latest Intel ATOM and Core i processor generations
▶ Energy-efficient design with lower power losses
▶ High flexibility thanks to a multitude of extension options and high interface variance
▶ Real-time-capable Ethernet communication via synchronous Intel i210 chipsets
▶ Security by design by means of the integrated TPM 2.0

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ High performance thanks to the latest Intel ATOM and Core i processor generations
▶ Energy-efficient design with lower power losses
▶ Extremely service-friendly and zero maintenance
▶ Maximum compatibility for long-term use, even in tough ambient conditions
▶ Long-distance display interface CDI+ as a single-cable solution with Direct Boot for distances up to 100 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

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 for 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 LabVIEW 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

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-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 for the 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 LabVIEW or MATLAB/Simulink with direct access to the drive

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ Up to 90 % lower wiring costs
▶ Less space required for machines thanks to removal of the control cabinet
▶ Reduction of cooling loads in the control cabinet by up to 100 %
▶ Independent assembly and operation of modules by machine manufacturers for the realization of economically 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 modules with continuous power from 1.5 kW to 7.5 kW and a maximum power of 15 kW

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/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 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 additional data of mounted components (e.g. gearboxes or pumps) to be recorded

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ Powerful – less space or more power, higher productivity, process quality, and reduced operational costs
▶ Maximum torque of 3.8...360 Nm
▶ Cost-optimized and flexible configurations – shaft option, degree of protection, forced ventilation, or water cooling
▶ 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...214 Nm
▶ Encoder options with certified safety according to SIL2 PLd

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 Nexo
Wi-Fi-enabled cordless nutrunner

With their integrated control system, Nexo Wi-Fi-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
▶ Decentralized intelligence due to an integrated controller
▶ Bar code scanner for an intelligent program selection
▶ High networkability, wireless communication
▶ Extensive data collection
▶ Variable production with a great number of product variants including a batch size of one

i4.0 Solution Provider
▶ Bosch Rexroth

Benefits
▶ Measuring system for accurate torque and angle detection
▶ Cost-efficient and safe tightening operations for low and high batch quantities
▶ Wireless transfer of tightening data
▶ Simple integration into higher-level data systems also without additional hardware
▶ High-quality resolution, user-friendly display
▶ High movability due to cordless tool

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

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/prc7000

Rexroth PRC7000 mid-frequency welding control

PRC7000 series welding controllers ensure process reliability and maximum quality in resistance welding processes. Welding controllers PRC7300 for steel applications and PRC7400 for aluminum sheet combinations are used in automobile production and in 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 for 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

▶ 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 standby 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

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 freely 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

▶ Freely scalable system
  – Carrier size and weight scalable (1 kg to 1,000 kg)
  – Configurable track layout
▶ Flexible and individual carrier control, all information available for use within Scada Systems
▶ Simplifies machine concepts
▶ Maintenance-free
▶ Freely 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 to replace handling application axis
▶ High transport velocities and acceleration
▶ Simplifies machine concepts
▶ Cable-free carriers
▶ Velocity up to 5 m/s
▶ Carrier weight 1 to 1,000 kg
▶ Vacuum-proof
▶ Positioning repeatability up to 10 µm
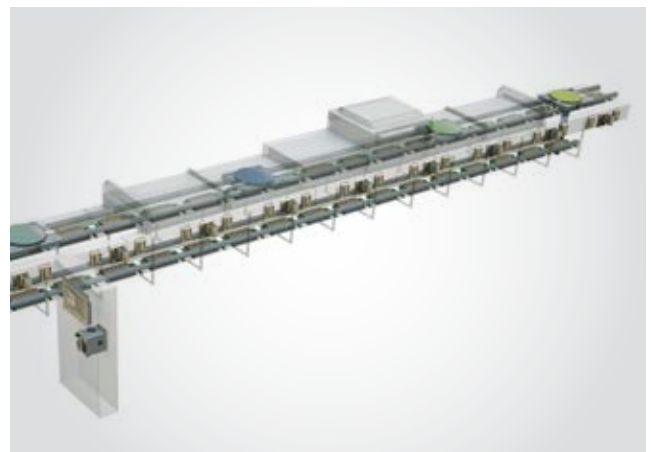
People as key players | Distributed intelligence | Fast integration and flexible configuration | Open standards | Virtual real-time representation | Digital life-cycle management | Secure value-creation network

Link to products:
www.boschrexroth.com/ims

Rexroth IMS-A integrated measuring system absolute

The integrated measuring system absolute IMS-A, a mechatronic module with its own electronic evaluator unit, uses induction to accurately recognize the position during linear movements and transmits it to higher-level systems. The non-contact measuring system operates wear-free and is resistant to contamination, vibrations, and electrical interference fields.

i4.0 Approach

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

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ Ready-to-install mechatronic assembly for Ball Rail and Roller Rail Systems without requiring any additional space, and different encoder interfaces enable it to fit into a variety of automation environments
▶ Wear-free and resistant to contamination, vibrations, and electrical interference fields
▶ Highly precise position detection for reliable processes, low life-cycle costs due to being wear- and maintenance-free

KPI

▶ Considerably reduced "Total Cost of Ownership" through protection class IP 67

| 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/activemover

Rexroth ActiveMover
linear motor-transfer system

The linear motor-transfer system ActiveMover from Rexroth is the solution for short-cycle applications with quick workpiece pallet changeover time from 0.1 seconds. Linear motors on a closed track with integrated measuring system carry out highly precise positioning of solid workpiece pallets with a powerful drive of up to 160 N. The workpiece pallets of the ActiveMover can stop at any position with a high repeatability of +/-0.01 mm. The ActiveMover is equally suitable for applications with large quantities and a high degree of variance, as well as for delicate materials that require very gentle transport.

i4.0 Approach
▶ Open standard interfaces for simple integration of any application structures
▶ Simple configuration and fast commissioning
▶ Free programming and control of each individual workpiece pallet for the flexible implementation of process sequences

i4.0 Solution Provider
▶ Bosch Rexroth

Benefits
▶ Exact positioning of the workpiece pallet through the integrated measuring system without additional indexing
▶ Shorter cycle times through high speed and acceleration, faster pallet changing
▶ Powerful drive up to 160 N per pallet plus a solid design – for the simplest process integration and a wide range of applications
▶ Any controls can be connected, every pallet is freely programmable and quickly convertible

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/cytropac

Rexroth CytroPac small power unit

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 a 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)
▶ Frequency converter serving additionally as a sensor node and transmitting all measured data to the machine control in real time
▶ Comprehensive condition monitoring for fast identification of critical conditions and comfortable error analysis

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ Compact, energy-efficient, and future-proof power unit up to 4 kW
▶ Meets the requirements of the European Eco-Design Directive 2009/125/EC due to reduced power consumption and CO_2 emissions
▶ New design for the integration into all machine designs
▶ Less space required by control cabinet thanks to simple wiring
▶ 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

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
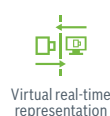
Link to products:
www.boschrexroth.com/abpac

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
▶ Integrated condition monitoring for fast identification of critical conditions and comfortable analysis
▶ WLAN connectivity and platform-independent local visualization
▶ Online configurator for fast layout of individual power units
▶ User-oriented aggregation of component and machine status corresponding to VDMA 24582

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 is provided by Sytronix variable-speed pump drives with multi-Ethernet connectivity (e.g. Sercos, Ether-CAT, EtherNet/IP, PROFINET RT, VARAN)

KPI

▶ Energy consumption reduced by up to 80 %

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/sha

Rexroth SHA40
servo-hydraulic linear axis

*When Rexroth creates a new electrohydraulic axis using proven hydraulic and electric serial components, something great happens: a self-contained, completely preassembled servo-hydraulic linear axis for a variety of uses up to 2,500 kN.
It has a modular and scalable design. The axis can be quickly installed and easily started up thanks to a single power socket and a single communication socket. All with outstanding energy efficiency and low noise.*

i4.0 Approach

▶ Connectivity with Sercos and multi-Ethernet (PROFINET, EtherNet/IP, EtherCAT, POWERLINK), CANopen and PROFIBUS
▶ Pressure, temperature, efficiency condition monitoring
▶ The IndraDrive controller with the latest Sytronix Position Force Control (PFC) technology package supports all common fieldbuses. The hydraulically optimized PFC software comes ready to use and performs all control tasks

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ Modular and optimally scalable: thanks to standardized components
▶ Energy-efficient and noise-optimized: thanks to partial-load speed reduction and standby mode
▶ Easy start-up: completely preassembled and filled, easy control with IndraDrive, and special operating software; electrical and mechanical interfaces only
▶ Self-contained and rugged: virtually wear-free operation; decentralized, closed fluid circuit

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/sytronix

Rexroth Sytronix SvP 7020 and DRn5020/7020 for p/Q control

The latest generation SvP 7020 control unit gives Sytronix new, future-proof possibilities, such as Industry 4.0, remote maintenance, and Open Core Engineering. Take advantage of these customized, compact solutions that are easy to install and get running in the smallest of spaces, for not only less noise, but also for greater dynamics at up to 80% less energy.

i4.0 Approach

▶ Connecting to the Open Core Interface or integrating easily into i4.0 environments to query actual values from Excel or control Sytronix from Matlab has never been easier than with the new Sytronix control unit

▶ Connectivity with Sercos and multi-Ethernet, PROFIBUS, and CANopen

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ High power density, even in smaller machines

▶ More energy efficient and dynamic

▶ Fully preassembled motor-pump assemblies for various applications

▶ Easy installation and start-up

▶ Pressure control possible thanks to new DRn5020/7020

▶ Energy savings through the retrofitting of existing systems

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/sytronix

Rexroth Sytronix DFE

The Sytronix DFE system sets each consist of an electrohydraulically controlled axial piston pump driven by a variable-speed servo as well as asynchronous motor. What this means to you: combining standard motors up to 315 kW with the proven, highly robust SYDFE pressure and flow rate control systems can produce an outstanding price/performance ratio up into the high performance range.

i4.0 Approach
▶ Connect to Open Core Interface or easily integrate into i4.0 environments to query actual values from Excel or control Syntronix from Matlab
▶ Connectivity with Sercos and multi-Ethernet (PROFINET, EtherNet/IP, EtherCAT, POWERLINK, and VARAN)
▶ Consistent engineering with the IndraWorks engineering tool: faster and easy start-up of all components and support from a single source

i4.0 Solution Provider
▶ Bosch Rexroth

Benefits
▶ **Advanced performance – high power and high dynamics**
Less load on the motor when maintaining pressure with Sytronix DFE. This means electrical components can even be made smaller than in classic drives. The system can be operated using one of two functions: "Teach-in" mode, in which the cyclical pressure and flow rate profiles are saved in the electronic system once to accelerate the system in time for an increase in delivery rate. "Real-time" mode can be used in non-cyclical machines (e.g. for wood processing/metallurgy). In this mode, the control unit calculates the optimal combination of motor speed and swivel angle in real time. For maximum energy conservation

▶ Spend less with simple retrofitting
▶ Good price/performance ratio in upper performance range by downsizing electrical components
▶ Versatile: available for A10 and A4 pumps
▶ High performance

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 IAC
Multi-Ethernet control valve

Rexroth has expanded its IAC Multi-Ethernet product range with new pilot-operated control valves with integrated axis controller. IAC multi-Ethernet valves are robust and user-friendly, support all key bus systems using the "Connectivity with Sercos and multi-Ethernet" strategy (including POWERLINK), are individually scalable, and feature hydraulics-optimized controller structures. The IndraWorks engineering environment offers intuitive control for fast and easy start-up, parameterization, and diagnostics.

i4.0 Approach

▶ Connectivity with Sercos and multi-Ethernet (PROFINET, EtherNet/IP, EtherCAT, POWERLINK, and VARAN)
▶ Whether connecting to the Open Core Interface or integrating easily into i4.0 environments to query actual values from Excel or control from LabVIEW
▶ Consistent engineering with the IndraWorks engineering tool: faster and easy start-up of all components and support from a single source
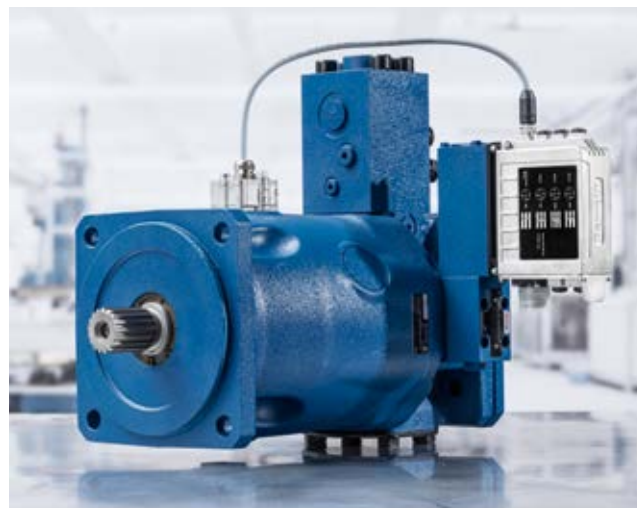▶ Wizard-supported configuration (with recommended values)

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

Rexroth has acquired specialized know-how when it comes to understanding the interplay between hydraulics and motion control technology.
This is the basis on which the control strategies for hydraulic and hybrid drives are optimized and translated into ready-to-use software. The result: highly precise, highly flexible, best-in-class hydraulic controllers. With a wide range of valve and axis control functionalities, you can individually address the needs in your applications. Maximum precision and functionality minimize your technical risk while reducing start-up costs. It doesn't get much more efficient.

▶ Integrated digital axis control functionality with position, force, and pressure control, plus alternating position/pressure or position/force control
▶ Flexible scalability: large selection of different valve types for greater operational flexibility
▶ Robust and reliable: enhanced temperature and vibration range

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/hpc

Rexroth HPC
hydraulic pump control

Better control quality, better hydraulic energy efficiency – with the new cabinet-based HPC control electronics, these are now standard. The best-in-class pump controller gives you one tool for every engineering task: simple, open for networking via numerous bus communication interfaces and flexibly scalable for your needs. In short: intelligently future-proof.

i4.0 Approach

▶ Connectivity with Sercos and Ethernet connection to existing control architecture, simple diagnostics, quick service thanks to Ethernet-based TCP/IP service interface

▶ Simple to take on any engineering task with a single tool (IndraWorks)

▶ Scale functionality and communication with ease in the software

i4.0 Solution Provider

▶ Bosch Rexroth

Benefits

▶ **Multi-Ethernet connection:**
   simpler control of A4 axial piston pumps
   Automation made easy: the best-in-class HPC pump controller can be incorporated into any structure using a multi-Ethernet interface – for creating open, future-proof machine concepts. Project planning, visualization, or diagnostics, you can do it all with the cross-technology IndraWorks engineering environment. You have never had easier access to your digitally controlled pumps. With these intelligent HPC controllers, you can even reduce installed power, peak loads in power consumption, and even average energy consumption. Could it get any better?

▶ Easier, faster start-up, better dynamics

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/hmc

Rexroth VT-HMC hydraulic motion control

The new VT-HMC motion controller is a digital control system featuring a built-in axis controller and programming in accordance with IEC61131-3. A motion controller specially optimized for electrohydraulic axes – accessible programming and interfaces, future-proof scalability, and consistent ease of use.

i4.0 Approach
▶ Whether connecting to the Open Core Interface or integrating easily into i4.0 environments to query actual values from Excel or control from LabVIEW
▶ Connectivity with Sercos and multi-Ethernet (PROFINET, EtherNet/IP, EtherCAT, POWERLINK) and PROFIBUS
▶ Simple connection to higher-level PLC: new PLC function modules for Siemens S7 (Step7, TIA Portal) and Beckhoff (TwinCat) for drive-controlled positioning
▶ Programming according to IEC61131-3
▶ The axis interface bundles PLCopen motion function modules into an easy-to-use interface for drive functionality: less programming code and more powerful commands to speed up the program development of applications

i4.0 Solution Provider
▶ Bosch Rexroth

Benefits
▶ **Best in class — simple, open, scalable:**
"Simple" is the keyword with the VT-HMC: simple, highly dynamic control in all aspects (position, speed, pressure/force control, alternating control [position/pressure/force], and state feedback). Simple, seamless engineering. Simple communication and programming via open interfaces and all commonly used bus systems for control, servicing, and diagnosis. Simply better control of electrohydraulic axes

▶ Support for additional positional transducers: analog position transducers (current/voltage), binary SSI encoders, rotary encoders (incremental or SSI)

KPI
▶ Practical initial parameterization wizard: menu-based drive start-up, including setting of controller parameters for faster hydraulic axis start-up

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.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 are 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
▶ Convenient algorithm library and sample applications for first-time programming
▶ XDK can be used as a prototyping platform and as a programmable sensor device enabled for 24/7 usage

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

Link to products:
www.bosch-connectivity.com/CISS

Connected Industrial Sensor Solution CISS

The CISS is a multi-sensor device detecting motions as well as environmental conditions. The robust housing and the small outline makes it perfectly suitable for industrial retrofit applications. The firmware enables the customer to address a broad variety of use cases by interpreting the sensor data through the use of smart algorithms.

i4.0 Approach
▶ The CISS is a robust, small outline sensor solution which easily connects machines or tools by wireless data transmission to a manufacturing network or to a cloud
▶ By using a multi-sensor concept, the CISS creates valuable additional context to the customers machine data which often enables significant productivity enhancement
▶ It supports real end-to-end solutions by connecting the CISS to the Bosch Rexroth IoT Gateway and the Bosch IoT Cloud or to a third-party gateway and back end
▶ The CISS offers remote change of configuration and firmware (OTA)
▶ The Sensor Solution is scalable and therefore supports a fast and cost-effective integration into the customers infrastructure

i4.0 Solution Provider
▶ Bosch Connnected Devices and Solutions GmbH

Benefits
▶ The small outline, the high enclosure protection design for harsh environment, and the easy mounting concept makes the CISS fit to a broad range of different applications and conditions

▶ By providing eight different sensor signals, the CISS is a one-device solution for a broad range of condition monitoring and predictive maintenance use cases
▶ Visualization of the data is possible via PC, app, or on cloud level
▶ The growing library of algorithms enables the customer to quickly implement solutions to specific use cases by only changing configurations remotely by smartphone app or via the Web

KPI
▶ The CISS provides communication via Bluetooth low energy (BLE) or via USB cable
▶ A 32-bit ARM microcontroller enables smart algorithms for KPI-related data interpretation
▶ The CISS device includes a MEMS accelerometer, magne-tometer, and gyroscope, as well as humidity, pressure, temperature, acoustic, and light sensors
▶ Available with rechargeable battery or as battery-less variant with higher temperature range
▶ Available as IP67 version
▶ Uses 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
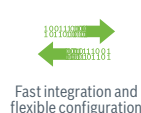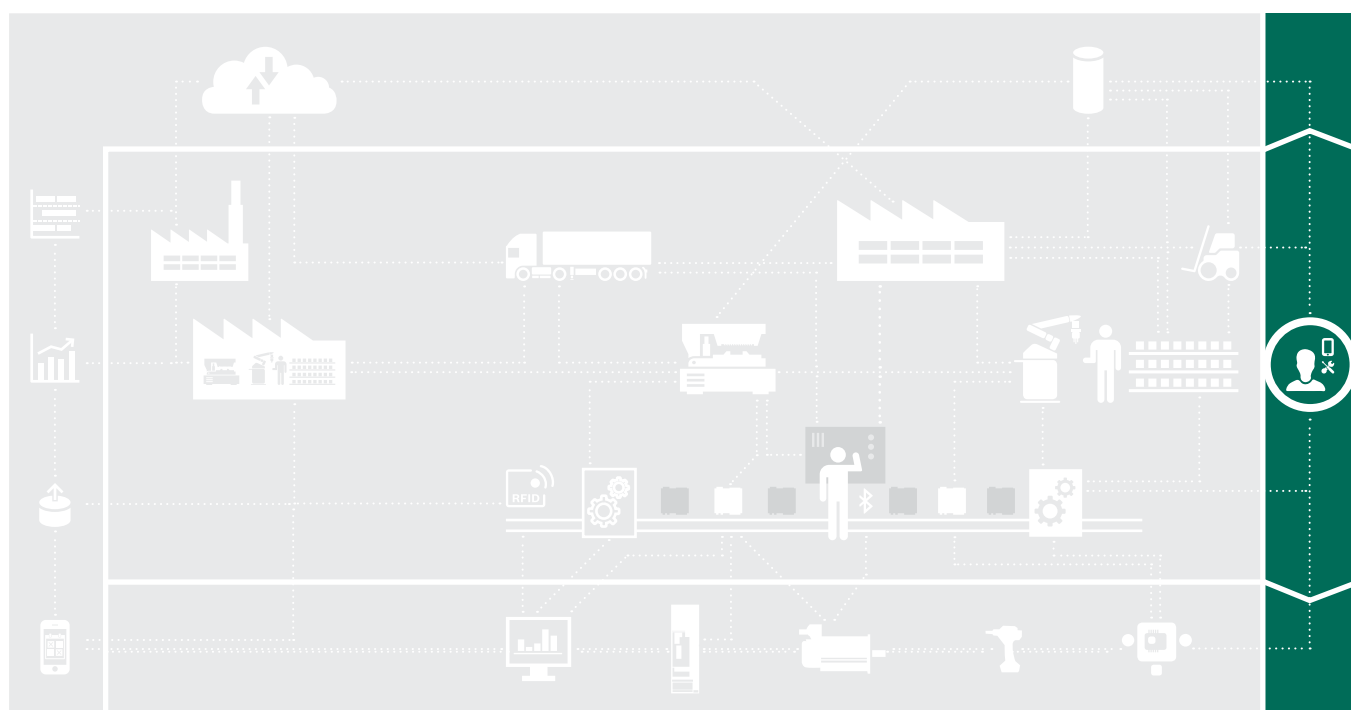
SERVICES AND CONSULTING AT BOSCH

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 mind-set that is characterized by openness and a willingness to collaborate. Bosch is ready for Industry 4.0.

Bosch Connected Industry
Consulting Services

First Insights (Strategy)	Selection (Direction)	Deep Dive (Analysis)	Proposal (Solution)
▶ Maturity Assessment for Industry 4.0 on site	▶ Develop criteria for use cases selection	▶ Analysis of processes for selected use cases on site	▶ Define processes for digital solutions
▶ Identify potentials and use cases for digital solutions across the whole value chain	▶ Select use cases according to company goals and characteristics	▶ Requirements analysis for digital solutions	▶ Align solutions with company prerequisites and IT infrastructure
	▶ Demo in Bosch plants		

Content / **Result** / **Implementation**

▶ List of potentials and use cases	▶ Company-specific use cases assessment	▶ Process documentation	▶ Concept for digital solution
▶ Value stream overview	▶ Clear focus areas with selected use cases	▶ Requirements documentation for use cases	▶ Technical specification for implementation

Phase 1:	Orientation	Phase 2:	Concept

Consulting Services

The consulting services of Bosch Connected Industry offer a holistic approach to clarify the big picture of Industry 4.0 and derive specific solutions for your particular needs. This includes strategic decision-making and planning as well as operative suggestions for the implementation of solutions. The end result: a connectivity concept for your smart factory.

i4.0 Approach

The implementation of Industry 4.0 solutions is no box-moving business. On the contrary: it requires an individual approach for every production environment. Therefore, the adaption and adjustment of solutions to your individual needs and conditions is key to the successful transition into a connected and smart production. We provide a deep understanding of Industry 4.0 across all layers. From sensors to software to support: we have the expertise to find the right solution for you.

Our holistic approach considers the whole range of solutions across the entire value chain to create the largest benefit for you. You will profit from our experience as a Lead User in over 270 plants, which are being constantly improved towards a more connected production. Our consultancy service is not just offering visions – the benefits of our solutions are validated and quantifiable.

From the initial strategic alignment to planning and finding the right solution to actual implementation: we support you along the way to becoming a smart factory.

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Holistic i4.0 approach: we offer solutions for the entire value stream from source to delivery – from strategy to implementation
▶ Our solutions are implemented in over 270 Bosch plants. We're constantly pushing the envelope in hundreds of pilot projects: we provide an abundance of user know-how, expertise, and experience
▶ We adapt our solution to your specific need
▶ We are a tech company, not a consultancy: not just guidance but actual solutions

KPI

▶ Faster and solid implementation
▶ Solution-reliant KPIs

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/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 up front and support during an intervention

▶ When it comes to remote service, data security and privacy are 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

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

▶ 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
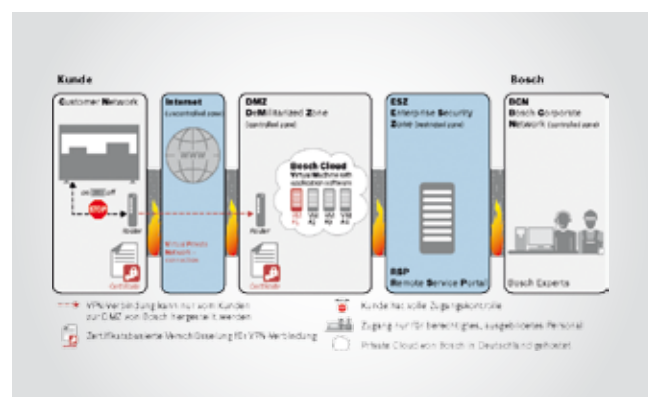▶ Unlimited parallel connections

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.boschservicesolutions.com/en/service_solutions/industries_1/travel_and_transportation/logistics/logistics_1.html

Monitoring solutions for connected logistics

Monitoring solutions for connected logistics are a cloud-based IoT solution which allows consistent tracking and tracing of cross-border flows of goods. Sensors are installed to control objects in terms of geographic location, condition, or estimated times of arrival. Our monitoring center network ensures 24/7 real-time monitoring as well as immediate intervention in case of detected irregularities.

i4.0 Approach
▶ Through integrated GPS sensors, the position of monitored objects 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 such as temperature or humidity in the cargo space is also integrated
▶ The data is centrally consolidated in a login-based Web portal, where you can track your fleet in real time and use the data according to your individual needs, for example, for the purpose of exact ETA forecasting, vehicle disposition, or freight condition control
▶ Additional apps are available for remote surveillance including chat function and an SOS button
▶ In the event of a deviation from defined target parameters, an alert is automatically generated. In order to ensure 24/7 immediate reactions, our monitoring center network alerts as well as coordinates required intervention partners and emergency services in acute threat situations
▶ Consulting services to tailor Logistics 4.0 solutions to your individual needs are offered on demand
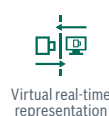
i4.0 Solution Provider
▶ Bosch Service Solutions

Benefits
▶ Real-time fleet visibility facilitates fleet management, vehicle disposition, and route management as well as predictive maintenance

▶ Monitoring solutions for connected logistics ensure highest security standards, increasing supply chain resilience and prevent costly production stops through delayed deliveries
▶ Freight damage is reduced due to remote surveillance of quality parameters and automatic alerts
▶ Exact ETA forecasts facilitate planning, make handling processes more efficient, and increase utilization rates, resulting in cost and time savings
▶ With our networks of monitoring centers certified to the EN 50518 standard, you can be confident of receiving the premium-quality standards for which Bosch is renowned

KPI
▶ International solution available in more than 30 different languages
▶ Prevention of freight theft, damage, or delays
▶ Increase of vehicle utilization rates
▶ Less repair-related idle times through predictive maintenance
▶ Transparent customer reporting and complete documentation of processes, events, and intervention

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/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 by only replacing worn-out parts
▶ Secure transfer and storage of data in conformance with Bosch Standards
▶ Scalable services portfolio

KPI
▶ Reduced downtime risk
▶ Reduced TCO

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

Shopfloor Services 4.0 – Performance Improvement Kit (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 an absolute must. 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
▶ Robert Bosch Manufacturing Solutions GmbH

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

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

Shopfloor Services 4.0 – Video Analysis Services (VAS)

The purpose of our Video Analysis Services (VAS) is to visualize and analyze processes or process chains. VAS supports videotaping up to the implementation of optimization measures – customized! Therefore, we offer professional video equipment that allows the recording of machine processes in order to detect any deviations or optimization potentials. As a result, preventing downtimes makes it possible to significantly increase OEE as well as reduce costs.

i4.0 Approach
▶ VAS equipment allows machine operators to have a look inside the machine—even in areas which are normally not accessible during production mode
▶ Machine operators have the possibility to remotely operate and change the settings of the camera after the machine is in production mode again
▶ VAS equipment allows real-time consultation via live stream-ing, without the expert being on site (Remote service)
▶ Fast and easy installation on and integration into all types of machines without prior training—even under difficult circumstances (e.g. wet stations, laser cabinet, etc.)
▶ By operating VAS equipment with the provided tablet, technicians are highly flexible and safe while observing the processes

i4.0 Solution Provider
▶ Robert Bosch Manufacturing Solutions GmbH

Benefits
▶ See invisible details
  – Experiencing process performance as never before
  – Gain insights into spaces which are difficult to access
  – Process monitoring and camera adjustment during regular production mode
  – Live video streaming of hidden processes via tablet

▶ Analyze details
  – Close-up process surveillance in 4K/UHD
  – Processes in slow motion (240 fps)
  – Multiple hour-loop surveillance
  – Picture-by-picture movement analysis
  – Presenting results of the analysis by visual aids
  – Creating short clips for documentation purposes
▶ Achieving improvements
  – Finding reasons for recurring faults
  – Defining suitable optimization measures based on actual facts
  – Reducing machinery downtimes
▶ Low price solution, incl. easy installation and use

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-shopfloor-solutions.com

IT Shopfloor Solutions – Shopfloor Connectivity Services

Shopfloor Connectivity Services (SCS) connect production from sensors via control to MES. Manual workplace, semi-automated machine, or fully automated line – thanks to long-term experience and expertise of the Bosch specialists, customers receive a tailor-made complete solution from a single source, adapted to the respective demands and production requirements.

i4.0 Approach

▶ Fully connected shopfloor: sensor or control; manual, semi-automatic, or fully automated – the connection with the Bosch MES or any other MES provides for transparency in production
▶ The portfolio of the Bosch Connectivity Services holds the ideal solution for any kind of requirement. A broad range of sensors, software, and hardware connectors, also from third-party providers, can be integrated into the production network
▶ Flexibly connectable, platform-independent interfaces provide for comprehensive connectivity
▶ Machine and process data of the entire production network can be displayed clearly and in real time

i4.0 Solution Provider

▶ Bosch Connected Industry

Benefits

▶ Everything from a single source: from concept through to realization
▶ Transparency in the entire production thanks to connectivity to the Bosch MES or any other MES
▶ Fast optimization of production sequences with effective use of resources
▶ Tried and tested: shopfloor expertise for more than 15 years
▶ Support all over the globe

KPI

▶ Fast machine connectivity
▶ Independent of manufacturer and control system
▶ Broad area of usage: from the manual workplace through to fully automated stations
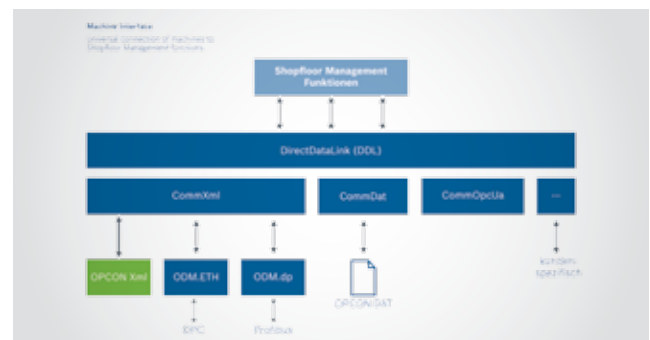
People as key players | Distributed intelligence | Fast integration and flexible configuration | Open standards | Virtual real-time representation | Digital life-cycle management | Secure value-creation network

Link to products:
www.boschrexroth.com/training/industry4-0

Real-world Industry 4.0 – Rexroth Training Program i4.0

Experts all agree that Industry 4.0 will quickly and permanently change the work content in production and logistics. This also has an effect on the learning content and equipment for technical training and further education. The Bosch Rexroth Drive & Control Academy supports companies and educational trainers as well as universities by providing training courses, training systems, and modern media on the topic of Industry 4.0.

i4.0 Approach
▶ Getting started with Industry 4.0: using tablets and smartphones in an industrial environment
▶ Learning about integrated augmented reality
▶ Using apps for status information and error detection
▶ Operating the system (production line and robots) using apps via OCE (Open Core Engineering)
▶ Identifying opportunities for the use of RFID in manufacturing
▶ Adjusting of manual workstations using RFID or other identification possibilities
▶ Understanding an industrial system (from production to the MES and ERP systems)
▶ Understanding horizontal and vertical communication using the ActiveCockpit
▶ Installing, setting up, and using communication via open standards
▶ Understanding approaches to decentral intelligence and analyzing communication between systems

Learning goals
▶ Rexroth Open Core Engineering (OCE): data transfer from a control to analysis software, without use of a PLC program
▶ Receiving and storing data from the machine by means of the PLC, especially with OCE
▶ Using big data for analyzing information and presenting on the ActiveCockpit (e.g. energy efficiency, production deviations)

▶ Setting up and understanding predictive maintenance
▶ Setting up and understanding automatic service alarm

KPI
▶ Application-oriented knowledge about Industry 4.0 through a comprehensive training program
▶ Competent implementation of i4.0 topics

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/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 production and single production possible
▶ RFID – the product controls the production
▶ Cloud computing
▶ Open Core Engineering – interface to the IT world
▶ Apps for operation and diagnosis via smart devices (tablets/smartphones)
▶ ActiveCockpit integrated – interactive communication platform
▶ 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
▶ Integration of robot control via industrial PLC

KPI
▶ Understanding Industry 4.0 and for further developing Industry 4.0 features
▶ Training and visualization of system knowledge in 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

Rexroth training system with i4.0 hydraulic power unit

For its WS 290 hydraulic training system, Rexroth has developed a new i4.0 hydraulic power unit, with which universities and technical vocational schools as well as educational departments can practice the topic of hydraulics in connection with Industry 4.0 in a practical way. The system consists of a power unit with sensors and a control system, whereby condition monitoring is carried out. Using the open-core interface of the PLC, the data can be displayed in PowerPoint or Excel, for example. Transfer of the data to a simulation software is possible in connection with the OPC server of the PLC. The temperature of the oil at different points, the filling level of the tanks, and pressures can be displayed. Using the data in higher-level systems is possible without any problems.

i4.0 Approach
▶ Recording of temperatures, pressures, filling level
▶ Forwarding of the data via the open-core interface or OPC server
▶ Visualization of the status of the power unit in MS Office programs
▶ Integration of the status of the power unit in a higher-level MES system
▶ Automatic information to necessary maintenance
▶ Quick access to diagnostic and service information

i4.0 Solution Provider
▶ Bosch Rexroth – Drive & Control Academy

Benefits
▶ Best suited for use in vocational training and further education up to university level
▶ Complete hydraulic power unit integrated in a training system
▶ Complete package, all sensors connected with PLC
▶ Connection to PLC via LAN (or Wi-Fi) necessary in order to connect the PC with the PLC
▶ Data recording via the PLC every 250 ms
▶ Automatic maintenance instruction

KPI
▶ Understanding of Industry 4.0 in hydraulics

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

Predictive Maintenance

Predictive maintenance is a cloud-based solution for elevator manufacturing companies. Bosch Service Solutions is developing an electronic lift diagnosis system connecting elevators to an IoT platform. The system is used to conduct regular remote functionality checks, analyze, and qualify detected malfunctions and prepare maintenance work according to individual demands.

i4.0 Approach
▶ Real-time remote access to elevator condition, including detailed reporting on parameters such as distance traveled by the lift cabin, door cycles per building floor, number of start and stop processes as well as emergency stops
▶ Regular remote checkups and diagnosis of maintenance or repair requirements
▶ Central consolidation, qualification, and processing of malfunction reports via e-mail or text message and integration into service orders facilitate targeted preparation of technicians' on-site assignments
▶ Coordination of routine maintenance in adequate, individual intervals on single-elevator level, depending on wear parameters and operational performance
▶ Elevator emergency call service in our redundant, EN 50518-certified alarm receiving center structure and coordination of our nationwide partner network for immediate intervention or rescue

i4.0 Solution Provider
▶ Bosch Service Solutions

Benefits
▶ Transparency about asset condition and functionality at any time
▶ Regular remote functionality checks reduce on-site inspections to an inevitable minimum
▶ Maintenance issues are detected before they occur so that repair work and replacement parts can be prepared up front

▶ Early detection of wear components before the actual end of their life cycle enable timely replacement and thus prevent elevators from getting stuck in their shafts
▶ Optimized maintenance intervals tailored to individual needs on elevator level
▶ Transparent and complete documentation to identify problem areas and critical assets

KPI
▶ Reduction of maintenance charges, technicians' on-site visits, and travel cost
▶ Efficiency increase of technicians' work
▶ Prevention of technical malfunctions or operational interruptions

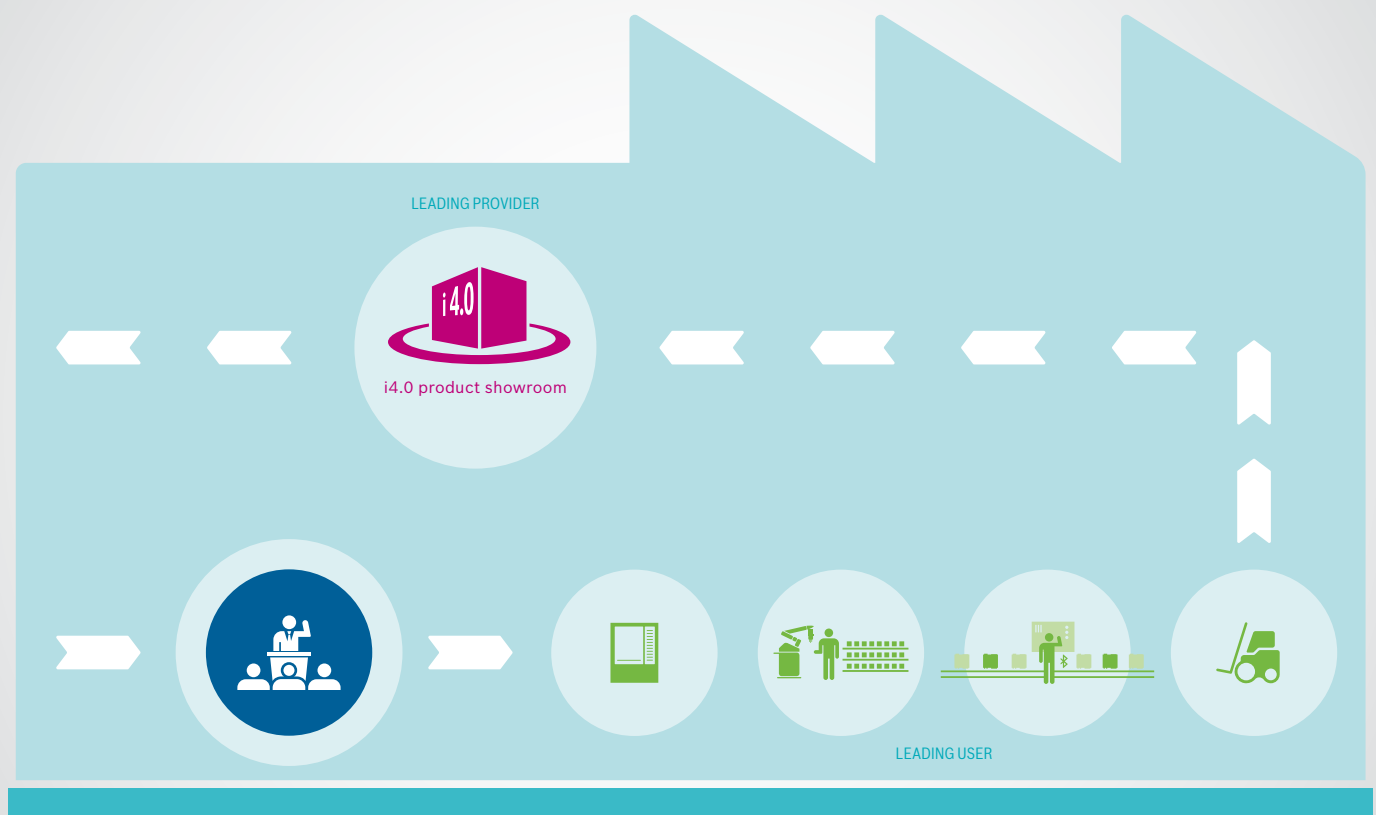| People as key players | Distributed intelligence | Fast integration and flexible configuration | Open standards | Virtual real-time representation | Digital life-cycle management | Secure value-creation network |

i4.0 guided tours

Industry 4.0 will have a lasting impact on the industrial value added. Go on a guided tour through one of our selected Bosch plants in Reutlingen, Feuerbach, Homburg, or Blaichach and find out today how the work of the future will look like. Experience Industry 4.0 in practice and learn how processes and structures in manufacturing and logistics are changing. In addition, you can visit our specially designed showrooms on your guided tour and see how Bosch, as the leading provider, shapes Industry 4.0 with marketable products and solutions.

Our guided tours demonstrate the benefits of networking physical productions with the world of software and the internet. Bosch proves that the smart factory is not a future concept but a reality. Machines, sensors, software, and people seamlessly exchange information in real time. Digital assistants support people in their work better than ever before. Real-time availability of all important data improves processes, increases productivity as well as transparency and reduces costs. At the same time, factories become more flexible and can economically produce small batch numbers even down to batch size of one.

An important message: there are no off-the-peg solutions.

The most important finding: people remain the key players in our networked future.

Make an appointment today:
E-mail **i4.0.guidedtours@de.bosch.com**
or call us: **+49 (39) 183229675.**

| 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 |