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## Hannover Messe 2016 – Bosch at booth C18 in hall 7 **Connected sensors, machinery, and software: Bosch offers Industry 4.0 from a single source** Data analysis for greater efficiency and transparency

April 25, 2016  
PI 9248 RB Res/Na

- ▶ Bosch demonstrates benefits of connected manufacturing
- ▶ Increased productivity, optimized quality control, reduced energy needs
- ▶ TTIP negotiations provide opportunity to shape the digital economy
- ▶ Werner Struth: “Industry 4.0 benefits from free trade”
- ▶ Bosch has operated for 110 years in the U.S., trade fair’s partner country

Hanover/Stuttgart, Germany – Is Industry 4.0 just a buzzword? Far from it. At the Hannover Messe trade fair, Bosch is showing that the connected factory is finally a reality. Machinery, sensors, and software are combined to form a digitally connected factory at the company’s booth. The result is a wide range of benefits across the value chain: greater productivity, quality control in real time, and lower energy needs. “We provide coordinated components and concepts for Industry 4.0 from the same source, thereby enhancing transparency and efficiency in manufacturing. As a result, we create competitive advantages for our customers,” said Bosch board of management member Dr. Werner Struth, whose responsibilities include manufacturing coordination at Bosch’s approximately 250 plants worldwide. The company has successfully implemented more than 100 projects for Industry 4.0. “We are a leading user of Industry 4.0, which means we are intimately familiar with the needs in this field. Our experience also benefits our customers, for whom we are a leading supplier,” Struth said. While hardware and software expertise plus experience are indispensable, they are not enough on their own. “We need open standards. Too many proprietary systems impede the progress of Industry 4.0 moving forward,” Struth added.

### **Making the case for the swift conclusion of TTIP**

In light of the above, Struth made the case for swiftly concluding the negotiations for the Transatlantic Trade and Investment Partnership (TTIP) free trade agreement. “Together with the United States, Europe can actively shape the structures

of global commerce. If we miss this opportunity, the weight the EU wields with regard to trade policy could decrease. Industry 4.0 benefits from free trade,” Struth said. TTIP is also a key issue for U.S. President Barack Obama, who opened the world’s leading trade fair for industrial technology on April 24. “We need a comprehensive agreement. This is Europe’s opportunity to create an essential framework for the digital economy and for the protection of intellectual property. Otherwise, regions elsewhere could wield greater influence in shaping global commerce through different agreements,” Struth added.

### **Bosch active for 110 years in the U.S., the trade fair’s partner country**

Bosch has operated in the U.S., the trade fair’s partner country, since 1906, and it employs around 17,600 associates there. “In 2015, we invested 340 million euros in the U.S., and we are planning to invest a similar amount in 2016,” Struth said. Bosch is driving connectivity in manufacturing forward in the U.S. as well. The associates at the plant in Anderson, South Carolina, for example, were the first at Bosch to use smartwatches to monitor production.

### **Quality control: goal of zero defects is getting closer thanks to connectivity**

With an exhibition titled “Industry 4.0 live at Bosch,” Bosch is demonstrating how manufacturing can be connected along the value stream and across company boundaries from April 25–29 in Hannover. One example is the continuous quality control of safety-critical screw connections, such as those in the automotive industry. The connected Nexo cordless nutrunner from Bosch records the torque during the screw-tightening process, among other things, and transmits this data to the Process Quality Manager software. The software recognizes in real time whether the screw-tightening process was carried out correctly. Deviations are immediately apparent, and the appropriate experts are notified directly. The data generated by the cordless nutrunner can be shown on the ActiveCockpit, which is an oversized display in the production hall. Thanks to the clear charts and diagrams, associates are informed in real time of the current production progress.

### **Sensors improve logistics through information in real time**

Information provided in real time also helps to improve logistics. The sensor solution known as “TraQ” (for “track quality”) monitors supply chains. To this end, sensors in the packaging or on the product itself record quality-relevant information during transport – such as temperature, vibration, light, and humidity levels – and send it to the [Bosch IoT Cloud](#). A Bosch software application in the cloud compares the readings from the sensors with permitted levels. If there is a deviation from one of these, customers, suppliers, and service providers are notified and alerted in real time. This benefits the transport of sensitive goods, such as semiconductors and delicate laser technology. The connected transport box

detects vibrations that are too strong and reports them to the owners and insurance companies. As a result, it is possible to directly determine the point at which the damage occurred and what caused it. If the delivery of machine parts is delayed, the customer can still make other arrangements. The benefit: timely notification minimizes costly downstream consequences, such as production stoppages, in case of damage to goods.

### **Data analysis boosts competitiveness**

Data from connected manufacturing harbors valuable information. Used correctly, it can optimize production processes and ensure greater competitiveness. Bosch's Manufacturing Analytics Tools & Services software provides support in this matter. It analyzes the data defined by the customer using algorithms specially designed for production. The intelligently analyzed and prepared information helps with predictive machinery maintenance, among other things. Predictive maintenance prevents unplanned manufacturing downtime.

### **Intelligently connected workstation ensures faster familiarization**

Bosch also boosts productivity in industrial manufacturing with its APAS family. The production assistants are easy to program and can be used flexibly. The new APAS workstation is now joining the family as its latest member. The intelligently connected workstation combines a work surface, a collaborative robotic arm, and a monitor that displays work instructions. Thanks to sensitive sensor skin, the robotic arm immediately stops whenever someone gets too close. People and machines can therefore work together without a protective barrier. As a result, the system creates new possibilities for teamwork between machines and associates. The employers' liability insurance association has certified the APAS as safe for direct collaboration with people.

### **Bosch's two-pronged strategy: leading user and leading supplier**

Through its solutions presented in Hannover, Bosch is demonstrating its two-pronged strategy for Industry 4.0. The first part of the strategy is to be a leading user of connected technology. The second part is to offer customers many different solutions in this field. "Our dual role as a leading supplier and leading user gives us an edge over the competition. We apply our experience to the products and services for customers. Throughout it all, our focus is on people. A wide variety of data analysis tools, algorithms, and software support people better than ever before," Struth said. This is how Industry 4.0 is helping to ensure that companies are able to compete effectively.

## **Struth: “The digital economy needs open standards”**

Struth issued a word of warning against a large number of siloed solutions that undermine the opportunities presented by Industry 4.0: “Only a truly global approach that knows no company or national borders will allow connected industry to develop to its full potential unimpeded by various sets of technical regulations. That is why we are a proponent of open standards, as it is the only way to allow equipment and software made by different manufacturers to easily connect to each other across companies and countries. Standardization is essential to a smoothly functioning digital economy, both nationally and internationally.” To date, the lack of a common language has, in many cases, hindered the smooth international coordination of manufacturing, logistics, and building and energy management.

Struth therefore welcomed the recently agreed partnership between the German Industry 4.0 platform and the international Industrial Internet Consortium. Both organizations coordinate their reference architecture (RAMI4.0 in the case of the Industry 4.0 platform, IIRA in the case of the IIC) with each other – and thus their technical bases. As a global company, Bosch is a member of both organizations. This combination of the two approaches allows the exchange of data between central areas of connected industry, including in practice. In Bosch’s Homburg plant, a number of connectivity solutions are now combined to manage and optimize manufacturing so that it avoids consuming electricity at particularly expensive peak times. This reduces manufacturing costs and increases competitiveness, while protecting the environment at the same time.

## **More information**

### **1) Details**

Bosch IoT Cloud: <http://bit.ly/1RQY07q>

Bosch partnership with the IIC and Industry 4.0 platform: <http://bit.ly/1Wb2FIS>

### **2) Presentations by Bosch experts**

Presentations by Bosch experts at Hannover Messe in the forum entitled “Industrial IT meets the industrial internet – HANNOVER MESSE 2016” staged by ZVEI e.V., VDMA e.V., Plattform Industrie 4.0, and the Industrial Internet Consortium (hall 8, D19):

**April 26, 2 p.m.** News on the reference architecture model Industry 4.0 (RAMI4.0), Martin Hankel, Bosch Rexroth

**April 28, 12 p.m.** From hype to reality – Industry 4.0 @ Bosch  
Dr. Stefan Aßmann, Bosch

**April 29, 1 p.m.** Driving interoperability in the industrial internet

Dirk Slama, Bosch; Richard Soley, IIC

### 3) Details about Industry 4.0 at Bosch

- Selection of Bosch exhibits:  
<http://www.bosch-presse.de/TBWebDB/en-US/PressText.cfm?id=7606>
- Bosch combines the standards of the Industry 4.0 platform and the Industrial Internet Consortium for the first time: <http://bit.ly/1Wb2FIS>
- How Bosch is increasing its competitiveness through Industry 4.0:  
<http://bitly/22WALA>

### 4) Additional Bosch booths

Hall 17, booth B38: Bosch Rexroth

Hall 17, booth D04: Connected Shopfloor Solutions with APAS

**Press photos:** 1-RB-19624, 1-RB-20863-e, 1-RB-20864-e, 1-RB-20994,  
1-RB-20995, 1-RB-21910, 1-RB-21911, 1-RB-21912, 1-RB-21913, 1-RB-21915,  
1-RB-21916, 1-RB-22118, 1-CR-21639, 1-PA-22196

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*The Bosch Group is a leading global supplier of technology and services. It employs roughly 375,000 associates worldwide (as of December 31, 2015). According to preliminary figures, the company generated sales of more than 70 billion euros in 2015. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiaries and regional companies in some 60 countries. Including sales and service partners, Bosch's global manufacturing and sales network covers some 150 countries. The basis for the company's future growth is its innovative strength. Bosch employs 55,800 associates in research and development at roughly 115 locations across the globe. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life."*

*The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as "Workshop for Precision Mechanics and Electrical Engineering." The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant up-front investments in the safeguarding of its future. Ninety-two percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.*

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Hannover Messe 2016 – Bosch at booth C18 in hall 7  
**Variety of options for connected manufacturing:  
Bosch presents Industry 4.0 solutions**  
From a single source: software, sensors, and machinery

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- ▶ People and machinery work together safely and flexibly
- ▶ Software detects deviations and ensures quality
- ▶ Connected transport crate minimizes production stoppages
- ▶ Industry 4.0 has become broadly established in practice

Hannover and Stuttgart, Germany – Bosch is presenting a large number of solutions for connected manufacturing at Hannover Messe 2016 (hall 7, booth C18). The exhibits at the booth are digitally connected and exchange data. The benefits to customers along the value chain are clearly evident, and include continuous quality control and reduced energy demand.

Here are a few selected examples:

**Sensors use real-time information to improve logistics**

The sensor solution known as “TraQ” (track quality) uses real-time information to improve logistics. During transport, sensors in the packaging or on the product itself record information that is relevant for quality – such as temperature, vibration, light, and humidity levels – and send it to the [Bosch IoT Cloud](#). A Bosch software application in the cloud compares the readings with permitted levels. If there is any deviation, an alert is triggered that informs customers, suppliers, and service providers in real time. In this way, the connected transport box detects vibrations that are too strong and reports them to the owners and insurance companies. The point at which the damage occurred and what caused it are immediately known, which benefits the transport of sensitive goods, such as semiconductors and delicate laser technology. If the delivery of machine parts is delayed, notifying the customer at an early stage may mean that they are still able to make alternative arrangements. The benefit: timely notification minimizes downstream costs, such as production stoppages, in the case of damage to goods. The sensors are scheduled to go on sale beginning in mid-2017.

### **High degree of process reliability: ActiveAssist guides workers through production**

The modular ActiveAssist manufacturing system, which can be flexibly adapted, is especially useful for simplifying the assembly of multi-variant products. Step by step, it guides workers through the individual manufacturing phases on a monitor. Using RFID (radio frequency identification), the system identifies the workpiece to be machined and provides information about the necessary process steps. For example, the system uses light signals to mark the storage containers that contain screws and other parts for the next process step, thus ruling out incorrect hand movements or the use of incorrect parts. This leads to greater process reliability and helps reduce workload. The system can be customized in line with the worker's level of knowledge, experience, and preferred language. The workstation can also be quickly converted to accommodate new products.

### **Real-time control with the Process Quality Manager enhances quality**

The Process Quality Manager software solution records and analyzes data from assembly processes in real time, and identifies trends and deviations. Workers are immediately notified of potential problems. As a result, they can take corrective action at an early stage, and in this way ensure consistent quality. One application is the continuous quality control of safety-critical screw connections, such as those used in the automotive industry. The Bosch Nexo connected cordless nutrunner records the torque applied during the screw-tightening process, among other things, and transmits this data to the Process Quality Manager software. The software recognizes in real time whether the screw-tightening process was carried out correctly. Deviations are immediately apparent, and the appropriate experts are notified directly. The data generated by the cordless nutrunner can be shown on the ActiveCockpit, which is an oversized display in the manufacturing shop. Thanks to the clear charts and diagrams, workers remain up to date on the current state of the manufacturing process at all times. Workers and companies alike benefit, because a problem with screws that are slightly too small or too large, for example, is immediately identified. In turn, downtime is reduced, the quality of the products increases, and potential recall costs are avoided. Details about Process Quality Manager: <http://bit.ly/1RyDjR8>. Details about Nexo: <http://bit.ly/1RyDjR8>.

### **Intelligently connected workstation ensures highest possible productivity**

The mobile production assistants of the APAS family are making a further contribution to greater productivity in industrial manufacturing. They are easy to program and can be used flexibly in production. The family is welcoming a new member at the Hannover Messe: the APAS workstation. This intelligently connected workstation combines a work surface, a collaborative robotic arm, and a monitor that displays work instructions. Thanks to its sensitive sensor skin, the robotic arm immediately stops whenever someone gets too close. People and machines can therefore work together without guards. As a result, the system



creates new possibilities for teamwork between machines and workers. The employers' liability insurance association has certified the APAS as safe for direct collaboration with people. The other family members: The APAS inspector is an optical inspection system that uses automatic image processing to examine surfaces and check workpieces for completeness and correct dimensions. The APAS flexpress is the perfect helper for joining, stamping, shaping, or punching workpieces. Like the other members of its family, the APAS assistant can also be quickly adapted to meet new tasks without requiring users to have programming skills. Together with the sensor skin, its robotic arm is also offered individually as APAS safekin, allowing customers to use it in their own applications. Thanks to the APAS family, the customer benefits from quickly adaptable automation for the smart, flexible factory. Details about APAS: <http://bit.ly/1LFWHJw>, APAS booth in hall 7, D04.

### **Sensor kit is the “midwife” for new Industry 4.0 applications**

What if someone has an idea for an internet of things (IoT) or Industry 4.0 application, but does not yet have the technical means to implement it? With the XDK development kit, Bosch is offering precisely that: a comprehensive hardware and software platform featuring different types of sensors as well as Bluetooth and wi-fi connections. Bosch is helping its customers get their own IoT or Industry 4.0 business ideas ready for full-scale production as quickly as possible. It features a range of components, including an acceleration sensor, a yaw-rate sensor, a magnetometer, and sensors for measuring atmospheric pressure, air temperature and humidity, noise levels, and light. Proprietary software helps with processing and displaying data, and the XDK community is there to help with questions. Details: <http://bit.ly/1U7w3Me>.

### **Energy platform uncovers savings potential**

Energy costs are a significant factor affecting competitiveness, and this not only in manufacturing. Bosch's energy platform provides a comprehensive overview of energy consumption in buildings and production processes. The platform is managed with a browser-based user interface, and energy consumption and costs can be evaluated quickly and intuitively thanks to customizable graphs and diagrams. It is possible to display the energy requirement for any machine on a shop floor, providing a real-time overview of the heat, cooling, or compressed air needed. Based on this information, the consumption levels of individual machines can often be reduced, resulting in cost savings. Bosch provides a one-stop solution with its energy platform software and hardware.

Details: <http://bit.ly/1ivU5jr>.

### **Data analytics boosts competitiveness**

The data from connected manufacturing contain huge amounts of information. Used correctly, it offers great potential for optimized production processes and enhanced competitiveness. Bosch's manufacturing analytics tools and services software addresses precisely this objective, lending support in data collection

and analysis, otherwise known as data mining. As a result, it can reduce production-related costs. Bosch is specialized in problems that arise in manufacturing and provides analysis tools and predictive models. Customers can take advantage of this without their own analytics expertise. Details about manufacturing analytics tools and services: <http://bit.ly/1VDz1Yw>; details about data mining at Bosch: <http://bit.ly/1j9bPC4>.

### **Fewer instances of unplanned downtime: software triggers machine maintenance**

Many machines are equipped with their own software or sensors that are already able to provide information about the machine's condition or a given production step. With the help of the Bosch Production Rules Configurator software, it is possible to quickly and conveniently create rules for analyzing this data in a useful way and for initiating activities for improvement. For example, a rule can prompt a maintenance cycle if a wear trend has been identified, thereby avoiding unplanned downtime. The software helps to convert people's experience into rules for connected manufacturing. Details: <http://bit.ly/1VDAzSo>.

**Press photos:** 1-PA-22196, 1-RB-21912, 1-RB-21913, 1-RB-22118

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**Hannover Messe 2016**  
**Good business prospects for Bosch in the U.S.**  
An overview of activities in the country

April 25, 2016  
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Hanover/Stuttgart, Germany – Bosch is perfectly positioned in the United States to leverage the potential of this promising market. The international supplier of technology and services has been operating in the country for 110 years and currently employs some 17,600 associates there. When calculated on a comparable basis, Bosch's sales in the U.S. most recently amounted to 8.7 billion euros\* (2014). According to preliminary figures, the company succeeded in increasing its sales in North America by more than 20 percent in nominal terms in 2015, primarily due to favorable business development in the U.S. The world's largest economy as measured by gross domestic product is a driver of innovation for Bosch and plays a decisive role in the company's aim of offering connected solutions for improving the quality of life for people worldwide.

Extensive manufacturing expertise: The United States is a key part of Bosch's global manufacturing network. The company manufactures products at 23 plants in the country for its four business sectors. Components for industrial manufacturing are created at around seven of these. Bosch is driving connectivity in manufacturing forward in the U.S. as well. The associates at the plant in Anderson, South Carolina, were the first at Bosch to use smartwatches to monitor production. Bosch is a proponent of open standards in Industry 4.0, as they allow equipment and software made by different manufacturers to easily communicate with each other across companies and countries. Bosch therefore welcomes the recently agreed partnership between the German Industry 4.0 platform and the international Industrial Internet Consortium, based in the U.S. The company is represented in both associations and is helping to drive the cross-border implementation of standards forward.

Expansion of activities/capital expenditure: In 2015, Bosch invested some 340 million euros in the U.S. and is planning a similarly high level of expenditure this year as well. The company acquired the U.S. [start-up Seeo Inc. \(Hayward, CA\)](#), a specialist in battery development, in 2015. Bosch sees potential in combining its own expertise in this field with the newly acquired expertise of Seeo

Inc. to more than double the energy density of batteries for electric cars by 2020 and to once again significantly reduce costs. In addition, Bosch acquired the Michigan-based company [Climatec](#) last year. Climatec is a leading supplier of energy efficiency, building automation, and security solutions. Bosch also expanded its U.S. activities in the field of packaging technology in 2015 through its acquisition of [Osgood Industries Inc.](#) in Florida and [Kliklok-Woodman Corporation](#) in Georgia.

Research and development: Bosch employs more than 2,000 engineers in the U.S. In 1999, Bosch's corporate research and advance engineering department opened its first branch outside Germany, the Research and Technology Center in Palo Alto, California. Today, some 100 highly qualified associates conduct research there on promising trends. These include web technologies, automated driving systems, and robotics. The Bosch experts also collaborate with leading U.S. educational institutions, such as Stanford University.

**Press photos:** 1-INT-21376, 1-INT-21377, 1-INT-21378, 1-INT-21379,  
1-INT-22205-en

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*\*Figures for 2014 are stated on a comparable basis, including Robert Bosch Automotive Steering GmbH and BSH Hausgeräte GmbH.*



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## **Bosch is using Industry 4.0 to increase its competitiveness**

More than 100 projects worldwide

- ▶ Data mining and RFID increase productivity in ABS/ESP braking-system manufacturing by one-quarter
- ▶ Data mining cuts hydraulic-valve testing time by 18 percent
- ▶ Inventory 97 percent shorter thanks to RFID

Berlin and Stuttgart – Bosch is making its manufacturing connected, with more than 100 projects already successfully running worldwide. Among other benefits, this increases the availability of its machinery – and hence also its productivity and competitiveness. Here are a few selected examples:

### **One production line, 200 different hydraulic modules**

On its multi-product assembly line in Homburg, Germany, Bosch can manufacture 200 different hydraulic modules from more than 2,000 different components. Thanks to connectivity, these components are automatically ordered in time. The modules control the work and driving hydraulics in trucks or tractors, which help do things such as incline loading surfaces or lift a plow. The production line's nine stations are connected by a smart network. Thanks to an RFID chip attached to the workpiece, the stations know how the finished product has to be assembled and what steps are necessary. This facilitates efficient production, even for small batch sizes. That flexibility is important, since some modules are requested more often than others. What is more, Bosch can produce different types of module simultaneously on the multi-product line. This cuts tooling times on machinery, which increases productivity. The work plans required for assembling the hydraulics components are automatically called up and shown on the monitors as a photo or video. The display is customized to each associate's level of training, and shown in their native language. The aim is to offer associates the best possible support in their work. This is an example of how Bosch is successfully putting multiple core elements of Industry 4.0 into practice: distributed intelligence, rapid connectivity, contextualization in real time, and autonomous behavior. Details: <http://bit.ly/1TOCbsh>

### **Industry 4.0 boosts productivity in ABS/ESP braking-system manufacturing**

Award-winning success: in less than one year, Bosch improved its productivity in the manufacture of ABS/ESP braking systems by nearly one-quarter by deploying Industry 4.0 solutions throughout its international manufacturing network. In recognition of this achievement, the Blaichach plant – which spearheaded the initiative – received the prestigious Industry 4.0 Award in 2015. One reason for this productivity increase is that Bosch collects data from the thousands of sensors that are installed along the plant’s production lines. Sensors record the movement of cylinders, the cycle times of grippers, and the temperature and pressure levels in the manufacturing process. This wealth of information is entered into massive databases, with a clear structure. And thanks to RFID (radio frequency identification) technology, Blaichach can also digitally map its internal flows of goods. The result is a computer-generated virtual representation, or “digital twin,” of the actual factory. This digital representation facilitates transparency across the entire value stream. And in turn, this transparency makes many more I4.0 solutions possible.

One of these solutions is applied in machinery maintenance: software analyzes machinery performance to spot deviations from the target state and indicate in good time when maintenance is necessary. The system helps associates detect and deal with errors by offering them instructions on how to carry out these repairs. On their tablets, for instance, associates can call up videos showing them how to replace parts. If they encounter a problem they cannot solve immediately, they can use a wireless video link to speak with experts who then assist in solving the problem remotely. All this reduces unplanned downtimes as well as increasing productivity and hence also competitiveness.

### **Data mining cuts the time needed to test hydraulic valves**

By evaluating manufacturing data from its own facilities, the Bosch plant in Homburg, Germany, has managed to cut the time taken to inspect hydraulic valves by 18 percent. Given the frequently high level of optimization in modern manufacturing, such huge savings represent a major advance. Assuming an annual rate of production of 40,000 valves, the savings add up to 14 days per year. An analysis of the production data relating to 30,000 manufactured hydraulic valves showed that certain subsequent testing steps in the inspection process are unnecessary, provided the results of several earlier steps are positive. The outcome of those subsequent steps can be reliably predicted by analyzing the earlier steps. Pinpointing such correlations – which are generally much more complex than the example given here – saves time and money. When the number of parts runs into the millions, even savings of just a few seconds can soon add up to days, turning a few cents into millions of euros. The

search for new correlations (a process called data mining) requires that, over a long period of time, companies collect and appropriately evaluate the data they generate. Bosch has been doing this for many years.

Details: <http://bit.ly/21G5ZsG>

### **Predictive maintenance of machine tools**

One of the items Bosch manufactures at its plants in Stuttgart-Feuerbach (Germany) and Jihlava (Czech Republic) is high-pressure pumps for injection systems. Part of the manufacturing process for the aluminum housing involves precise drilling of holes and milling of other parts. Large machine tools are deployed in the process, whose motorized drive units are referred to as “spindles.” Each spindle weighs some 50-70 kilograms and spins at a rate of 30,000 to 40,000 rpm. Sensors record vibrations in the operation of these spindles, and software stores and evaluates the data. Whenever the system registers that the intensity of vibrations exceeds a set limit, it sends a signal to the service associate in charge. The technician can then decide if and when to replace the spindle. Maintenance becomes easier to plan, machine availability improves, and productivity rises. Continuous monitoring of machine parts such as these spindles is also referred to as “condition monitoring.” Planned servicing is called “predictive maintenance.”

### **Ultrasound gloves for quality assurance**

The Reutlingen plant is involved in electromobility, among other business areas. Manufacture of the necessary power electronics involves many manual activities. To support its associates in this work, Bosch introduced a system that records their hand movements. The system is based on special gloves worn by the associates. Ultrasound technology helps determine the position of these gloves. In turn, this indicates if associates have carried out a hand motion correctly, and which work step is being performed at any given moment. The entire work process is displayed step by step on a screen until it has been completed. This helps improve quality assurance.

### **Radio signals create transparency in the flow of goods**

In many of Bosch’s more than 250 plants worldwide, the company has equipped plastic crates for the internal transport of parts and finished products with RFID (radio frequency identification) tags. RFID readers are positioned at all the doors to the manufacturing shops. When a transport cart goes from one shop to another, the reader registers its tag automatically and without any need for physical contact. The result is a digital map of the flows of goods in that particular plant. At any time, the company can determine when parts will most likely arrive on the production line, when and how many finished products have to be packaged, where a specific part is located, and what the inventory levels are.

The system also knows how many packaging boxes are required and can reorder these as needed. RFID technology ensures transparency in the flow of goods, as well as reducing manual effort and keeping inventory levels low. It simultaneously increases reaction speed and productivity. This is how Bosch achieves leaner logistics processes. Thanks to its use of RFID, Bosch was able to boost productivity in its Homburg plant's intralogistics by ten percent, and reduce storage in production by nearly one-third.

### **China: RFID cuts inventory time by 97 percent**

In the Bosch plant located in the Chinese city of Suzhou, the yearly task of taking machine inventory used to be a major undertaking. Plant 1 has four manufacturing areas, each with up to 2,500 machines, test benches, and items of measuring equipment. For ABS manufacturing alone, the inventory process used to take up to a month in some cases. Sometimes associates printed out lists to help them manually record machine inventory. Now, thanks to smart connectivity, inventory takes just four hours. All the machines and equipment items have been fitted with RFID (radio frequency identification) transponders. This allows objects to be identified without physical contact. Now, associates push RFID trolleys fitted with a laptop and antennas through the manufacturing shop. As they move along, the trolleys use RFID technology to automatically identify machines and devices. It cuts the time needed for inventory by 97 percent, or 440 man-hours.

### **Transporters with swarm intelligence**

Engineers in Bosch's Nuremberg plant have developed and successfully tested an AutoBod – a driverless, self-navigating transport system equipped with swarm intelligence. The two-wheeler AutoBod, which is equipped with four additional stabilizer wheels, knows when to pick up production materials that have previously been automatically ordered. It then takes these materials to the production line. Using a laser sensor, the system navigates by following a map drawn up during its first drive. It recognizes and evades obstacles, then wirelessly transmits information about them to the other AutoBods. This collective behavior relies on data about the location, electric drive charge level, and maintenance status of the various transporters. This means requests are routed to the AutoBod that is closest to the pick-up point, that is not already busy with another request, and that has enough battery charge. This kind of intelligence sets the AutoBod apart from other driverless transport systems, which are incapable of deviating from their programmed route. In contrast to conventional driverless transport systems, AutoBods do not require the installation of expensive in-plant infrastructure. The deployment of AutoBods reduces the time and effort spent on transport, frees up space, and considerably decreases inventory.



**Press photos:** 1-RB-21936, 1-RB-21910, 1-RB-21911, 1-RB-21913,  
1-RB-21915, 1-RB-21916, 1-RB-20864-d, 1-RB-20863-d, 1-RB-20994,  
1-RB-20995, 1-RB-19624, 1-CR-21639

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*The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as "Workshop for Precision Mechanics and Electrical Engineering." The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant up-front investments in the safeguarding of its future. Ninety-two percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.*

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## Hannover Messe 2016 **Connected Shopfloor Solutions: hardware and software solutions for Industry 4.0** Robert Bosch GmbH, Hall 17, Booth D04

25 April 2016  
PI9242 RB Res/Sekr

- ▶ User-centered automation: it's all about people
- ▶ Robots without safety guards: people and machines working hand in hand
- ▶ The APAS family continues to grow: collaborative robotics are on the rise
- ▶ The APAS workstation: intelligently connected workplace with integrated robot
- ▶ IT Shopfloor Solutions: scalable automation system for the production and logistics chain

Stuttgart/Hannover – At the 2016 Hannover Messe, Bosch presents combined hard- and software solutions for the flexible, networked factories of tomorrow. These Connected Shopfloor Solutions are the essential link at the heart of Industry 4.0, and are already in use today, at Bosch and elsewhere: mobile assistance systems work side by side with their human operators and without the need for safety fences, while modular automation systems analyze, report on and control a wide range of production processes.

Yet people remain at the center of it all: “Given the spectrum of work processes in today’s manufacturing, people are now needed more than ever as decision-makers and overseers,” explains Volker Hartmann, Deputy Vice President Business Unit Assembly Systems and Special Machinery at Bosch. “Our robots are there to free human operators from tasks that are potentially unsafe, overly simple and monotonous, or ergonomically challenging.”

### **A fresh face: the APAS workstation**

Accordingly, when it comes to developing new solutions, Bosch consistently adopts the perspective of the operator. The most recent example of this user-centered automation: the **APAS workstation**, which will first be unveiled in Hannover. The APAS is the first standardized workstation to offer direct and safe man-machine collaboration. Offering a truly versatile solution, it integrates a col-

laborative robot kinematics system (APAS safekin) and further automation components. The APAS workstation takes advantage of new collaborative models that place the focus squarely on the operator. Successfully combining human beings' inimitable problem-solving skills with the tirelessness and precision offered by robots, they deliver more efficient processes and higher productivity. The integrated robot kinematics system supports the operator, lending him or her a "third hand." Yet the operator remains the focus, and can enjoy an individually tailored, ergonomically optimized work setting: the worktable height and lighting automatically adjust to the operator, while the adjustable see-through digital display allows them to see all essential production data at a glance. The flexible APAS workstation can be used with or without an integrated robot, and can network with further assistance systems as needed.

### **APAS safekin: seamless integration**

The robot kinematics system, dubbed **APAS safekin**, can also be used independently of the mobile APAS base or an APAS workstation – then recommended as a fixed installation in a dedicated production segment. The new automation component can be easily integrated into IEC61131 applications that conform to the standard international norm for programming languages. This allows projects to be rapidly implemented, humans and machines to work together safely, and existing facilities to be readily upgraded. No robotics programming is needed for the creation of individual robot movements; the jobs can easily be prepared, configured and managed using the graphic interface.

### **APAS family: constantly growing**

In addition to the newly introduced APAS workstation, the APAS family includes three other mobile, collaborative assistance systems. The **APAS inspector** is equipped with a high-resolution, high-speed camera and innovative 3D mapping technologies. Thanks to interchangeable testing modules, the station can be used in various production contexts – like high-precision surface inspections or completeness testing.

In turn, the **APAS flexpress** is the candidate of choice for highly flexible, high-precision joining – which, by the way, is one of the most common work steps in production lines. Its integrated safety features ensure that it can seamlessly support its human operator. The same is true for the **APAS assistant**, which features a six-axis industrial robotic arm, sensitive three-finger gripper, and 3D camera system. The APAS assistant was the first assistance system to be certified by the German occupational health and safety agency. Thanks to its specially designed sensor skin, it can collaborate directly and contact-free with its human operator without the need for further precautions.

As an available option, the **APAS speedswitch** can be set to vary the APAS assistant's operating speed, depending on whether or not human beings are nearby. The extended vicinity is monitored by the speedswitch interface and, provided no employees are nearby, the kinematics system operates at maximum speed. If someone approaches the APAS assistant, it automatically drops to a safe speed. The result: increased productivity without sacrificing workplace safety.

### **IT Shopfloor Solutions**

Meanwhile, behind the scenes Bosch's IT Shopfloor Solutions deliver safety, flexibility and transparency throughout the production chain. For more than 15 years now, the modular and scalable software solutions have been continually refined within the Bosch Group and used to manage hundreds of production facilities around the globe. Thanks to a broad range of software modules for Shopfloor Management, machinery can be networked regardless of the product or brand, product defects and the need for maintenance can be recognized early on, and production data can be analyzed in real-time.

Thanks to intuitive, graphic tools, operators can more quickly recognize critical situations, more easily localize errors, and more promptly respond to them. The focus is on user-friendliness, and here, too, the collaboration of man and machine reduces complexity. Further, maintenance-relevant parameters can be viewed at any time on a wide range of devices. Depending on the application, a central dashboard can also gather all essential information at a glance. All IT Shopfloor Solutions are based on a shared control platform and standardized software concept, helping to ensure that work processes can be made not only faster and more efficient, but also significantly more flexible and operator-friendly.

**Press images:** 1-PA-21574, 1-PA-21575,1-PA-21049, 1-PA-21050, 1-PA-22196

For further information about APAS family visit [www.bosch-apas.com](http://www.bosch-apas.com).

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## Hanover Fair 2016 – Bosch in Hall 7, Stand C18 **Bosch Connected Devices and Solutions presents Transport Data Logger and IoT Development Kit** For more security in the logistics chain and faster IoT developments

April 25th 2016  
PI 9231 DF/Ho

- ▶ Transport Data Logger (TDL) provides transparency along the entire supply chain
- ▶ Use of the TDL does not require prior knowledge, and can be visualized through a mobile application
- ▶ Cross-Domain Development Kit XDK facilitates efficient development of sensor-based products and services for the Internet of Things (IoT)

Hanover/Reutlingen – With the launch of the Transport Data Logger (TDL) at Hanover Fair, Bosch Connected Devices and Solutions brings transparency into the entire supply chain. By being attached to the shipment of sensitive industrial goods, e.g. industrial machines, and recording relevant measured parameters such as temperature, humidity, tilt, and shock, the TDL makes the delivery process visible and traceable. These measurements are then documented and visualized through an app for smartphones and tablets. Since the limits of each parameter can be individually configured, any parameter that exceeds its limit is traceable thereby ensuring that the appropriate stage of the supply chain is held accountable. In the event that a parameter exceeds its limit, the TDL provides verifiable proof and a reliable indication for possible primary and secondary damage. In the case that no limits are exceeded, the TDL is the evidence of a carefully conducted and failure-free transport chain. Thus, the TDL provides an added value for every logistical effort. It creates trust between relevant partners and provides important data for the optimization of logistics processes.

### **User-friendly, durable application**

The TDL is individually configurable, intuitive and easy to use. It can be integrated with little effort and without prior knowledge of the processes of a logistics chain. The device makes use of reliable and precise MEMS technology, developed by

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Corporate Communications,  
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Bosch, and stores the data thanks to a battery with up to two years lifetime. Moreover, the TDL features an industry proven design with IP54 class enclosure protection.

### **Cross Domain Development Kit XDK for IoT applications**

Bosch further presents the prototyping platform XDK, providing the technical requirements to develop sensor-based applications for the Internet of Things (IoT). Also on show in Hanover is a connection to the Bosch-owned IoT cloud. The platform consists of hardware and software components and features both Bluetooth and Wi-Fi connectivity. It includes various sensors for measuring acceleration, rotation and magnetic fields, as well as humidity, pressure, temperature, acoustic and digital light. The XDX prototyping platform can be easily installed and adapted to any application. Professional users and software developers are thus enabled to rapidly turn new IoT business ideas into series production. Members of the XDK online community share knowledge about features and functionalities, gather ideas and present new projects.

**Press photos:** 1-BCDS-22134, 1-BCDS-22135

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*Bosch Connected Devices and Solutions GmbH was founded in 2013 and is a fully owned subsidiary of Robert Bosch GmbH. The company was set up to design, develop and market innovative connected devices and tailor-made solutions for the Internet of Things. Our competency in electronics, sensor technology and software enable new business models for global markets. Bosch Connected Devices and Solutions is headquartered in Reutlingen, Germany. In 2015 Bosch Connected Devices and Solutions opened offices in Chicago, USA and Shanghai, China.*

For more information, go to [www.bosch-connectivity.com](http://www.bosch-connectivity.com)

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