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Robert Bosch GmbH
Postfach 10 60 50
70049 Stuttgart

Media und Public Relations
Leitung: René Ziegler
Presse-Forum:
www.bosch-presse.de



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Technology and innovation location **Bosch officially opens new research campus in Renningen**

Chancellor Merkel: “Research and innovation are the sources of our prosperity”

- ▶ Governor Winfried Kretschmann: “Impressive demonstration of faith in Baden-Württemberg as a location for innovation.”
- ▶ Bosch CEO Denner: “Renningen is Bosch’s own Stanford.”
- ▶ Applied industrial research for better quality of life
- ▶ Expansion of key competencies in microelectronics and software
- ▶ New work and office environment for innovators

Renningen, Germany – A completely new work environment for creative minds: with its Renningen research campus, Bosch wants to encourage interdisciplinary collaboration, and in this way further enhance its innovative strength. At the new center for research and advance engineering on the outskirts of Stuttgart, some 1,700 creative minds are doing applied industrial research. At a ceremony attended by Federal Chancellor Dr. Angela Merkel, Baden-Württemberg Governor Winfried Kretschmann, and many other guests from politics, business, and academia, the research campus has now been officially opened.

“With this research campus, Bosch is setting new standards,” said the Federal Chancellor Dr. Angela Merkel. She underscored the significance of applied industrial research: “Research and innovation are the sources of our prosperity.” She noted that Bosch has set itself the task of realizing ideas that nobody else has even had. “Bosch wants to stay one step ahead of developments,” the Chancellor said.

Governor Winfried Kretschmann said that the new research campus is “an impressive demonstration of faith in Baden-Württemberg as a location for innovation.”

“Like a university, our campus brings together many faculties. Here, we want our researchers to do more than just think about what the future could bring. We

want them to be successful entrepreneurs as well. Renningen is Bosch's own Stanford. And at the same time, the center is an expression of our faith in Germany as a technology location," said Dr. Volkmar Denner, chairman of the Bosch board of management. The company has invested some 310 million euros in the new location. The research campus, whose motto is "Connected for millions of ideas," is the hub of Bosch's global research and development network. The supplier of technology and services also intends to strengthen the spirit of entrepreneurship there. It is precisely here that Denner sees Germany at a competitive disadvantage. "In Germany, there are neither the opportunities nor the willingness to establish companies. Especially among its young university graduates, we need more start-up spirit. In this respect, universities have to do more than prepare their students for exams in highly specialized fields."

Innovations for better quality of life

The hope for the future is that even more innovations will be created in Renningen that improve quality of life. The campus brings together many disciplines from science and technology. Whether electrical engineering, mechanical engineering, computer science, analytics, chemistry, physics, biology, or microsystems technology – in Renningen, a total of 1,200 associates in corporate research and advance engineering, plus 500 PhD students and interns, are now working on the technical challenges of the future. Up to now, these researchers were spread over three locations in the greater Stuttgart area. Chancellor Merkel was clearly impressed by the innovative research institute: "What you have managed to achieve here is the networking not only of research locations, but also of scientific disciplines." On a campus such as this, she said, it will be much easier to keep an eye on the big picture.

Governor Winfried Kretschmann wished the research campus a successful future: "Our hope for this campus is that it will create decisive stimuli for the development of automated driving, succeed in facilitating a breakthrough for electromobility, and drive forward ideas for connected industry. The research center wants to create the right conditions for such work – an environment in which creativity and productivity can thrive. Our wish is that this research campus will be the seedbed for many future innovations – innovations that are not just technically outstanding and economically successful, but also continue to live up to the company's sense of social and ecological responsibility."

Technological breadth in research and advance engineering

In the special campus atmosphere, Bosch's pioneering minds will work on both new products and innovative manufacturing methods. Their work will focus on areas such as [software engineering](#), [sensor technology](#), [automation](#), [driver assistance systems](#), and [battery technology](#), as well as on improved automotive

powertrain systems. One area that is becoming increasingly significant is software expertise – particularly for IoT connectivity. “For Germany to stay technologically on top of its game in connectivity, it has to preserve and extend the key competencies of microelectronics and software. If it fails to do this, German industry will be left behind. We have no reason to fear competition with IT companies. But for our industrial enterprises, this competition will not be a walk in the park,” Denner said.

As for Bosch itself, Denner believes it is well prepared for the connectivity trend. For example, the company is not only the global market leader for micromechanical sensors, but has also been extending its software competence for some years now. The Bosch Group now employs more than 15,000 software engineers. Three thousand experts are working on the internet of things alone. Bosch especially sees huge business potential in the services that will arise as a result of connectivity. “If we do not want to let others seize these opportunities, then we have to be even faster and less risk-averse than before,” Denner said. “At an earlier stage than ever before, our engineers have to think like businesspeople. The things that are technically feasible should not only excite our researchers, but our future customers as well.”

Germany has to learn to be daring

Denner added that large enterprises such as Bosch have to create the space in which enterprise and entrepreneurship can flourish. Bosch is leading by example. The company has set up its own start-up platform for new business fields. Denner stressed that if the “Silicon Valley model” really is to be the way forward for Europe, “we have to learn to take risks.” Bosch Start-up GmbH helps Bosch researchers become successful businesspeople. For example, it takes care of things such as premises, financing, and other administrative tasks. In this way, new businesses can focus right from the start on their product and bringing it to market. The [Bonirob agricultural robot](#) is one of the first products to emerge in this way. The Bosch start-up Deepfield Robotics developed this robot, which is the size of a compact car, as an aid for plant breeding and crop farming.

The best working conditions for creative ideas

On the expansive research campus, there is plenty of space to test the agricultural robot. Apart from the main building, eleven laboratory and workshop buildings, and two buildings for site maintenance, there is also a modern proving ground for testing driver assistance systems. A networking matrix was used to determine who should occupy the individual buildings. It was based on analyses of how intensively individual disciplines exchange information with each other: The closer units work together, the shorter the physical distance between them on the new campus.

Quiet corners, collaboration zones

Bosch paid particular attention to working conditions in Renningen. Whether inside or out, the researchers will encounter a modern work environment. Essentially, the entire campus is a workplace. “Brainwaves in the fresh air, technology at the water’s edge – all this is possible here in Renningen,” Denner said. Wifi connections are available in every building and everywhere on the grounds. Laptops, tablet computers, and voice over internet mean that work can be done in every corner of the campus. Explaining the idea behind this, Denner said: “In Renningen, we offer our innovation team both quiet corners and zones for collaboration.” Office layouts have been designed on the basis of a comprehensive analysis of the innovation process. When they are exploring ideas, researchers need to have peace and quiet. Later on, exchange and collaboration with others take on more importance. These phases, as well as associates’ wishes, were considered when planning the complex. “Associates want more freedom to use their creativity in research and development – and fewer administrative duties. This is something the employee representatives actively supported,” says Alfred Löckle, chairman of the central and combined works councils. “The days when the design of workplaces was decided from above are over. Our associates spend a lot of time at their workplaces. It’s only right that they should also have a say in their design.”

The result of the joint consultation with everyone involved was a completely new office concept. Apart from individual workplaces, 270 meeting rooms of various sizes are the salient characteristic – meaning that there is sufficient room for both focused activity and teamwork. On average, each associate is just ten meters away from the nearest meeting room, and thus possibly also from the next innovative breakthrough.

[Link to a fact sheet about the new research campus](#)

[Link to press releases about specific areas of research](#)

[Link to research and development at Bosch](#)

[Link to the Bosch Renningen website](#)

[Link to article about Renningen in the Bosch annual report](#)

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Contact person for press inquiries:

René Ziegler, Phone: +49 711 811-7639

The Bosch Group is a leading global supplier of technology and services. It employs roughly 360,000 associates worldwide (as per April 1, 2015). The company generated sales of 49 billion euros in 2014. 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 subsidiary and regional companies in some 60 countries. Including its sales and service partners, Bosch is represented in roughly 150 countries. This worldwide development, manufacturing, and sales network is the foundation for further growth. In 2014, Bosch applied for some 4,600 patents worldwide. The Bosch Group's strategic objective is to create solutions 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.

Additional information is available online at www.bosch.com, www.bosch-press.com, <http://twitter.com/BoschPresse>

**The sales figure disclosed for 2014 does not include the former joint ventures BSH Bosch und Siemens Hausgeräte GmbH (now BSH Hausgeräte GmbH) and ZF Lenksysteme GmbH (now Robert Bosch Automotive Steering GmbH), which have since been taken over completely.*



Current examples of robotics research

May 4, 2017

RB Cwi/KB

Whether at work, in the car, or at home – robotics has the potential to improve people's quality of life. In industry, robots will reduce the burdens placed on people by taking over hazardous and physically arduous activities. They can also support people in their private lives – but will not replace them.

In its research, Bosch focuses on the foundations and basic technologies for future generations of robots.

APAS

- ▶ **What is it?** APAS stands for automatic production assistant. It was developed to work safely with people.
- ▶ **Features** The APAS systems (APAS assistant, APAS inspector) reduce the burdens placed on people by taking over hazardous, arduous, and monotonous activities. The robot is equipped with a sensor skin and stops if a person comes too close to it.
- ▶ **Tasks** The APAS assistant can perform palletizing tasks, load heavy objects onto machines, or carry out packaging work. The APAS inspector can perform quality checks and has artificial intelligence. It can learn new tasks intuitively and rapidly. Both systems can be flexibly adapted to a wide variety of workspaces.
- ▶ **Research aim** To further develop a robotics system that can flexibly, intelligently, and safely master the challenges of connected manufacturing (industry 4.0), such as situations where there are more variants in a smaller batch, all the way to one-off production.



Dual-arm robot

- ▶ What is it? The dual-arm robot is made for industrial applications. Modeled on the human torso, it has two arms.
- ▶ Features Thanks to its “physique,” the dual-arm robot has capabilities that are similar to those of a human. It can, for example, grasp objects with great precision. The dual-arm robot can be deployed in human workspaces without the need to make changes to these spaces.
- ▶ Tasks Unlike APAS, this robot assumes tasks where putting its arms around an object or grasping objects with precision are required. This means it can hold an object with one arm, say, and work on it with the other. The two-armed robot is very light and can lift smaller loads.
- ▶ Research aim Movement coordination will be further enhanced on the basis of the dual-arm robot. Furthermore, machine learning methods will be tested by having the robot learn new manufacturing tasks through simple imitation.

ITA

- ▶ What is it? ITA is an intelligent transport assistant.
- ▶ Features The robot adapts flexibly to changes in its environment. It can also immediately adapt to new tasks. If it encounters people as it moves around, ITA signals the direction it wants to take, warning people if they need to get out of the way. At a doorway, ITA decides whether to make way for people or go through itself first.
- ▶ Tasks ITA is a robot that can be deployed in human environments such as office buildings or factory shop floors. Its purpose is to transport small objects, such as tools.
- ▶ Research aim ITA prototypes are used to test and further enhance machine learning methods for a variety of robotics applications.

Spencer

- ▶ What is it? Spencer stands for social situation-aware perception and action for cognitive robots. This means that Spencer has



artificial intelligence and is able to learn from experience and develop social skills.

- ▶ Features Spencer can find its way around in crowds of people. It knows its destination and how to get there. In doing so, it perceives people in its surroundings and takes social norms into consideration, such as keeping a minimum distance between itself and a person. At Schiphol Airport in Amsterdam, an experiment was carried out for two weeks in March 2016, in which Spencer took passengers for connecting flights to their gate. On its way, it updated them constantly regarding how far they were from the gate. It also provided this information to the airline.
- ▶ Tasks Safely and quickly leading people from A to B.
- ▶ Research aim Developing key technologies such as artificial intelligence, which allow robots to learn and to acquire social skills. This is important for all robots that are deployed in a human environment, whether in the workplace or the home.

Kuri

- ▶ What is it? Kuri, the adorable home robot, was developed by the Bosch start-up Mayfield Robotics in the U.S.
- ▶ Features Kuri is not a trendy tech gadget. Rather, it is able to learn to memorize certain faces and integrate with the people in its surroundings. Through head and eye movements, forward motion, and its light-up “heart,” it can communicate emotion. Kuri can capture film footage and take photographs, and has speech recognition technology (camera, loudspeaker, microphone, sensors). If it is alone in the house, it can alert the absent residents to a window left open by mistake, and in the evenings it can read a bedtime story to children. Kuri can be linked to a smartphone via an app.
- ▶ Tasks Entertaining people, housekeeping, providing company, complementing the family (but it does not replace people).
- ▶ Research aim Finding answers to the question of what robots need to have in order for people to accept them – and like them – in their most intimate personal spaces.



► Further information: www.heykuri.com www.spencer.eu

Contact person for press inquiries:

Christiane Wild-Raidt,

phone: +49 711 811-6283

The Bosch Group is a leading global supplier of technology and services. It employs roughly 390,000 associates worldwide (as of December 31, 2016). The company generated sales of 73.1 billion euros in 2016. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. 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. 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 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 nearly every country in the world. The basis for the company's future growth is its innovative strength. At 120 locations across the globe, Bosch employs some 59,000 associates in research and development.

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 upfront 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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Bosch campus for research and Advanced engineering in Renningen

May 2019

- ▶ Amount invested Roughly 310 million euros
(of which 217 million euros for construction work and 93 million euros for machinery and technical equipment)
- ▶ Start of construction work June 2012
- ▶ Inauguration October 2015
- ▶ Plot 100 hectares in total, of which currently 43 hectares are developed
- ▶ Buildings 14, including main high-rise building (60 meters high, 12 stories), 11 laboratory and workshop buildings (between 10 and 19 meters high, 2-3 stories), and 2 service buildings
- ▶ Associates on site Roughly 1,900 associates (including Böblingen satellite facility)

Research and Development at Bosch

- ▶ Associates Some 68,700 researchers and engineers worldwide, 1,700 of them in the corporate sector for research and advance engineering
- ▶ Locations International research network of the corporate sector for research and advance engineering comprises 12 locations in 8 countries (Sunnyvale, Pittsburgh, Boston, Hildesheim, Renningen, St. Petersburg, Moscow, Bangalore, Tokyo, Shanghai, Singapore and Tel Aviv); other engineering activities related to the development of products and production projects at some 130 locations worldwide
- ▶ R&D expenditure 7.3 billion euros (roughly 9.3 percent of Bosch Group sales) were invested in research and development in 2018