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What will the factory of the future look like?

Well, this is not easy to describe. All of us have different visions, but one thing is clear to me: The factory of the future will not be a factory without people. Rather, it will be a factory where humans receive less information in a more aggregated fashion to improve Overall Equipment Effectiveness (OEE) and to optimize the entire product in its relation to its production process. Furthermore, this data will help improve the procurement of necessary resources, such as energy and water, in addition to enabling a closer integration of the supply chain and customer in a life-long relationship.

What role does the Internet of Things play in this age of integrated industry?

From a research perspective, the Internet of Things (IoT) in Germany was the first initiative before Cyber Physical Systems (CPS) / Industry 4.0 and mostly applied to intralogistics. From my point of view, IoT is a prerequisite for CPS as well as Industry 4.0. The fourth industrial revolution will be the application of CPS and IoT in the domain of machine and plant manufacturing.

Please describe one or two of the most interesting research projects that you are currently working on.

It is not easy to select just two of the most interesting projects. Therefore, I will name two from different research areas: the first one addresses the challenge of innovation management. Innovative technical systems (both consumer products and automation systems) do not fall from the sky. They are based on teamwork and the creativity of team members from different disciplines (e.g., mechanical, electrical/electronic, and software engineering). In the Collaborative Research

Center SFB 768,¹ we are investigating together with other research groups in Munich how complex innovation processes can be managed by coupling different, heterogeneous views (mechanical engineering, computer and economic science as well as psychology and sociology). As one approach, ontologies are used for keeping different models of the technical system consistent.

In the second project, software evolution is the focus. As we all realize in our daily lives – while using our mobile phones, smart devices, or cars – we get and need software updates in order to increase functionality or security. The management of software evolution in industrial plants, which operate over decades in a safe manner, is a much more difficult challenge. In the Priority Program SPP 1593,² we are hosting the demonstrator for automated production systems. We are working together with 13 other groups on this topic of software evolution, which is a prerequisite to Industry 4.0. Industry 4.0 will require changeable, adaptable, and self-aware plants; therefore changes in mechanics, electronics, and software are necessary in a continuous manner under the prerequisite that any change will be consistent with the entire plant to avoid hazardous conditions or downtime.

How will human-machine interaction change as a result of this fourth industrial revolution?

Human-machine interaction is already continuously changing: primarily because of consumer products, i.e., smart devices and today's state of constant connectivity. We or our youth are getting used to always being connected to our networks, sharing our experiences, and having access to many databases and vast amounts of knowledge on the web. All of us expect this permanent information availability and sharing of experiences to also occur on the shop floor. Additionally, we will need more intuitive ways of interaction, which include emotions, and a better pre-processing of the widely available data for faster and more reliable decision-making.

What conditions position Germany to become a lead market provider of Industry 4.0 solutions and services in the future?

Germany has one real advantage, namely, its many small and medium-sized innovative companies in the machine and plant manufacturing industry as well as more than one leading company in the automation market. The foundation is laid; the main risk we face is that we will not be fast enough.

¹ <http://www.sfb768.tum.de/index.php?id=5&L=1>

² <http://www.dfg-spp1593.de/>