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IOSB

FRAUNHOFER INSTITUTE OF OPTRONICS, SYSTEM TECHNOLOGIES AND IMAGE EXPLOITATION IOSB

INFORMATION TECHNOLOGY FOR THE MECHANICAL ENGINEERING INDUSTRY OF THE FUTURE

REVENUE INCREASE POWERED BY INFORMATION TECHNOLOGY

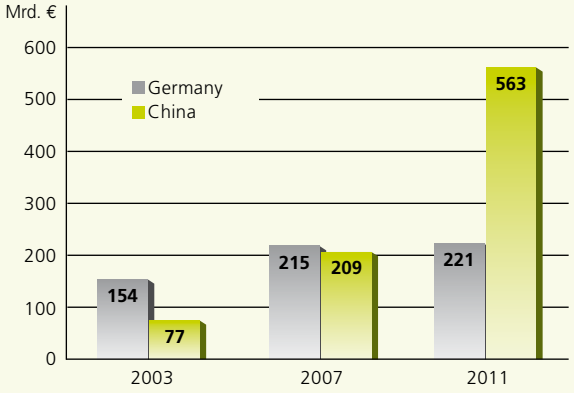
The German mechanical and plant engineering industry is successfully equipping manufacturing facilities and factories around the world. For decades now, the label "Made in Germany" has been a warranty for the high quality of German engineering. It is true, however, that German manufacturers of machinery and equipment and their engineers are facing increasing international competition – resulting in the well-known pressure with regard to costs and/or price, time and quality.

More service – more benefits

Providing highly productive, reliable machinery and equipment capable of producing high-quality products on a global scale will not suffice to ensure the business success of the mechanical and plant engineering sector in the future. Rather, customers tend to purchase benefits, which, in an extreme case, might just be the product manufactured by the machinery and equipment. As a consequence, complimentary services relating to the machine itself are gaining increasing attention. According to a survey performed by ifo institute[1] on behalf of the European Commission, these additional services boost the global competitiveness of Germany's mechanical and plant engineering sector as they add value and thus create jobs for highly skilled staff.
In addition, services relating to machinery allow for new business models which are less susceptible to variations in sales and investment cycles.

Revenues for machinery in Germany and China

(Source: German Engineering Association VDMA: Maschinenbau in Zahl und Bild 2012)



Upgrade for machines

Information and communication technologies (ICT) are the key to these kinds of new, product-related services. They increasingly penetrate the traditional mechanical and plant engineering sector and open up potentials for innovative services. Many suppliers of machinery and equipment, however, are not systematically prepared for the new ICT-based services yet. A survey by Fraunhofer IAO[2] has shown that merely 25% of mechanical engineering enterprises have an explicit strategy regarding the Internet-based services they want to establish and enhance. Just 20% of these enterprises have an appropriate business model in place. Consequently, there is still need for action, particularly because software will evolve into a full-fledged part of the product portfolio in the future, including the associated challenges ranging from a professional software engineering process, quality assurance for software, models for software maintenance and professional services to the adaption of a sales organization capable of selling ICT products and their benefits.

ICT competence is key

Fraunhofer IOSB has many years of experience in the design, development, roll-out and implementation of complex software systems in the manufacturing industry. In a large number of projects for the production sector, we have repeatedly proved that the underlying architecture of software is a decisive factor for the performance and service life of an IT solution. Software components such as portals for the remote access to machinery and equipment are complex solutions today which, therefore, have to be designed in a professional way, with the coding of the mere software program playing a minor role only.

[1] Vieweg, H.-G. (ed.): An introduction to Mechanical Engineering: study on the Competitiveness of the EU Mechanical Engineering Industry. Munich: 2012.

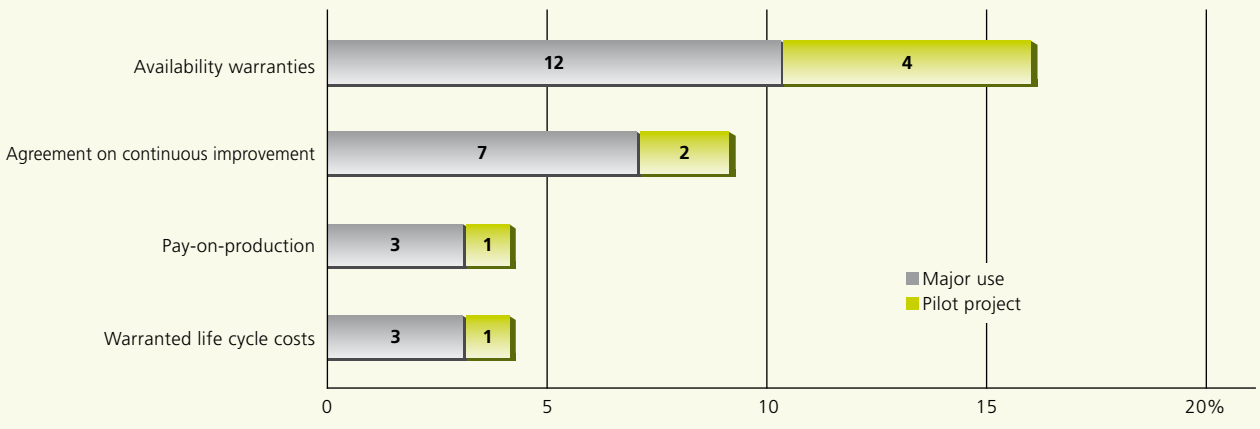
[2] Münster, M.; Meiren, T.: Internet-basierte Services im Maschinen- und Anlagenbau. Stuttgart, Fraunhofer-Verlag, 2011.

"Production and information technologies are getting more and more integrated, which requires interdisciplinary cooperation between automation and IT specialists as well as classical engineers. The resulting dynamics open up potentials for product and process innovations. In cooperation with partners from research and industry, we develop and enhance these innovations until they reach market maturation; in our model factory, we can even test and demonstrate them. This is how we strengthen the competitiveness of the German mechanical and plant engineering sector and the related industries."

Prof. Dr.-Ing. Jürgen Jasperneite, Head of the Institute of Industrial Information Technology (inIT) and the Fraunhofer Application Center Industrial Automation (IOSB-INA)

Examples of product-related services demanded by customers today

(Source: Fraunhofer ISI, Modernisierung der Produktion: Nutzen statt Produkte kaufen)



OUR SPECIFIC PRODUCTS AND SERVICES FOR THE MECHANICAL AND PLANT ENGINEERING SECTOR

In order to generate more and new service business, suppliers of machinery and equipment have to make professional use of information and communication technology. On the basis of IOSB's ICT competences, we provide the following services designed specifically for the mechanical and plant engineering industry:

Shopfloor-related IT systems which provide order sequences to machinery and equipment in operation and which receive data input from the machines evolve into data hubs for the factories of the future. Machinery and equipment have to be linked to those systems, as quickly and efficiently as possible. For manufacturers of machinery and equipment this means that their own shopfloor-related visualization has to be designed in a way that allows for a quick integration with a higher-level systems and enhancements as necessary. IOSB has extensive expertise gained through the standardization of interfaces, our own visualization tools and intelligent data storage for PLC components. We provide specific support to manufacturers of machinery and equipment to link their machines to higher-level monitoring and control and MES^3 systems, to design control systems for production lines or to integrate their own machine-related control systems with the MES environment of their customers. We have been able to show, for example, that the major part of the machine-related and higher-level visualization can be generated automatically, reducing setup times and errors.

Adaptivity is one of the challenges of the factory of the future – not just on a physical level; rather, it increasingly refers to software as well. In this context, the basic idea is that, just like in the office environment, self-describing devices are used in factories by means of standard interfaces ("USB mechanisms"), for example to add new components, machinery or equipment to a production system or to account for software-relevant changes in production. Today's ICT architectures used in manufacturing enterprises, however, have not been designed to fulfill these requirements. We support suppliers of machinery and equipment in developing methods and tools based on existing standards such as OPC-UA or Automation ML™ and designing information and software architectures that allow for consistent and secure data processing. As soon as there is a change anywhere in production, the other parties involved in the factory, e. g. field devices, machinery and equipment or IT systems, are notified. This ensures that machinery and equipment can go live faster as they are "plugged together" from self-describing mechatronic components, as it were. In addition, we provide a testing system for AutomationML which enables you to test whether your own AutomationML models comply with the specification.

Gesture recognition and control allow for new intuitive approaches to interaction with machinery and production lines. Thus, the use of a mouse or a keyboard will be soon superseded in full or in part, so even users without IT skills will be able to operate the machines intuitively. In factories, the new interaction technologies open up great potentials as well. Take the feedback procedure, for example, which has to be completed for manufacturing results on the shop floor. Rather than going to a remote operational data logger or QA terminal and entering the feedback there, the feedback can be transmitted right from the work station, at the very work piece, using a camera that recognizes the gesture. This saves time and reduces errors.

State-of-the-art measurement and control technology implies that the relevant process parameters and product features are captured in line, i. e. in pace with the current process using appropriate sensor technology. They are used to monitor machinery and equipment and to improve processes. This is based on the precondition that the applied sensors are appropriate for the process and the product and are interconnected so the data can be evaluated.

In measurement technique, we support you by deploying image-based measurement technology for process intelligence and product-related quality assurance in your manufacturing operations, for instance. To inspect (partially) reflective surfaces, we have enhanced deflectometry so it can be applied as an inspection technology in industry, capable of inspecting large and small object in line with a high degree of precision. Depending on your specific requirements, we advise you even in the design phase of a new manufacturing installation to support you in integrating state-of-the-art visual inspection methods in your system so you can achieve full quality and productivity right from the start. Our neutrality as a research institute ensures that you receive the inspection and measurement technology that is just right for your requirements, independent of suppliers.

In control technology, we model your process in an analytical, knowledge-based or data-driven way. The resulting models can then be used for process improvement, monitoring and control. Data-driven models are based on data mining methodologies capable of identifying connections even in complex processes. We also use these models for the early detection of process anomalies for the purpose of condition monitoring.

Machine-to-machine (M2M) communication is another focus of our projects for the mechanical engineering sector. In this context, the term "machine" in the broadest sense means a device equipped with logic that takes the form of software. As a result, the machine can respond to commands and fulfill tasks largely independently. What is more, it can interact with other devices. This is why the term "Internet of Things" is frequently used in this context. This includes the remote control of a heating system by means of a mobile device while on the move, the access to energy consumption data of a production plant or an infrared transmitter acting as a motion detector automatically activating specific monitoring systems and providing observations to the security staff. Against this background, the "Internet of Things" opens up new opportunities for applications in mechanical engineering such as condition monitoring, remote maintenance or decentral energy management. In addition, it will call for new approaches to architecture, communication and information management. To this end, Fraunhofer IOSB is working on open, i. e. standard-based solutions, taking into account non-functional requirements such as security, reliability or access control.
The key to productive systems is the intelligent evaluation of large data volumes with a heterogeneous structure ("big data") captured by the sensor technology of the production plant.

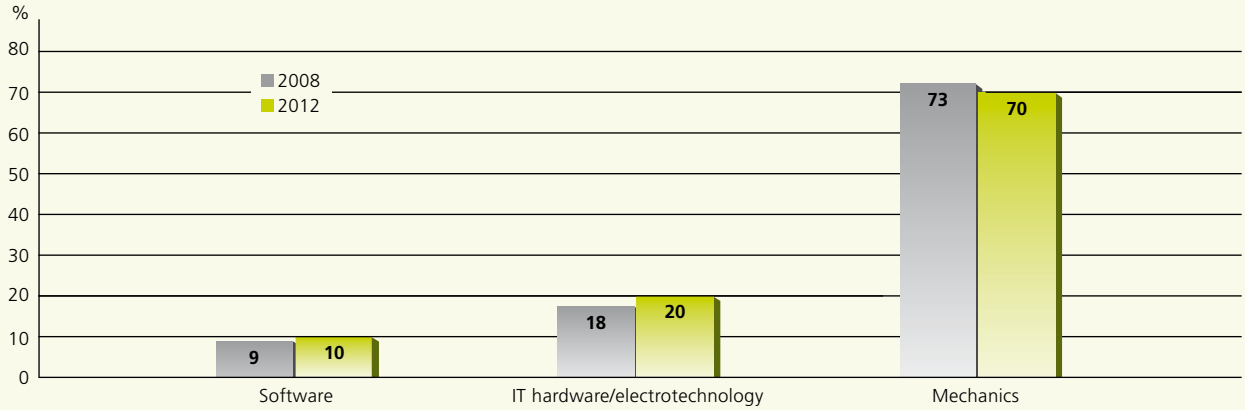
The **proportion of software and automation** in a machine is increasing continuously, whereas the share of mechanics is decreasing in terms of value. We advise manufacturers of machinery and equipment in the creation of future-oriented IT architectures as well as the selection of suitable IT technologies, tools and functionalities.

Yet our experience has shown that this does not suffice. Just like the development of a machine, software development requires an engineering-related process including well-defined phases, release mechanisms, project management and documentation. For this reason, we support you in tailoring the management of professional software engineering to the specific needs of your enterprise.

[3] MES = Manufacturing Execution Systems (also see the VDI 5600 standard by the Association of German Engineers)

Average Percentage of Components/Competences in Products

(Source: VDMA German Engineering Association – ForumIT@Automation: 2012 business trend survey – significance of information and automation technology in mechanical and plant engineering products)

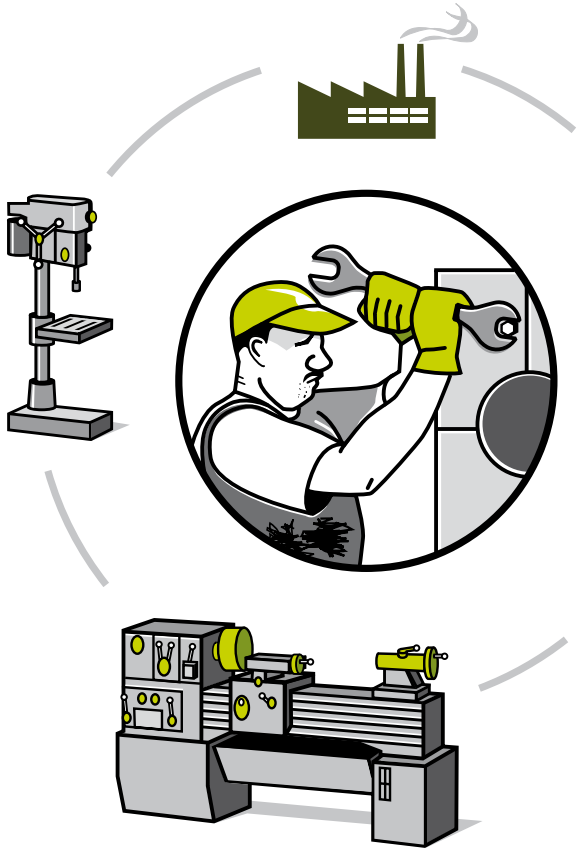


13% of organizations: "The share of mechanics in manufacturing costs accounts for less than 50% in today's products."

THE MECHANICAL AND PLANT ENGINEERING SECTOR HAS TO REINVENT ITSELF

Unlike many other industries, digitalization is still at an early stage in manufacturing. In the future, factories will rely on realtime-compliant software that can be interlinked spontaneously. This will have major consequences for the structure of added value in the mechanical and plant engineering sector. All our efforts are aimed at maintaining and strengthening the mechanical and plant engineering industry in Germany. Germany needs a strong industrial basis for future economic turbulences.

Yesterday



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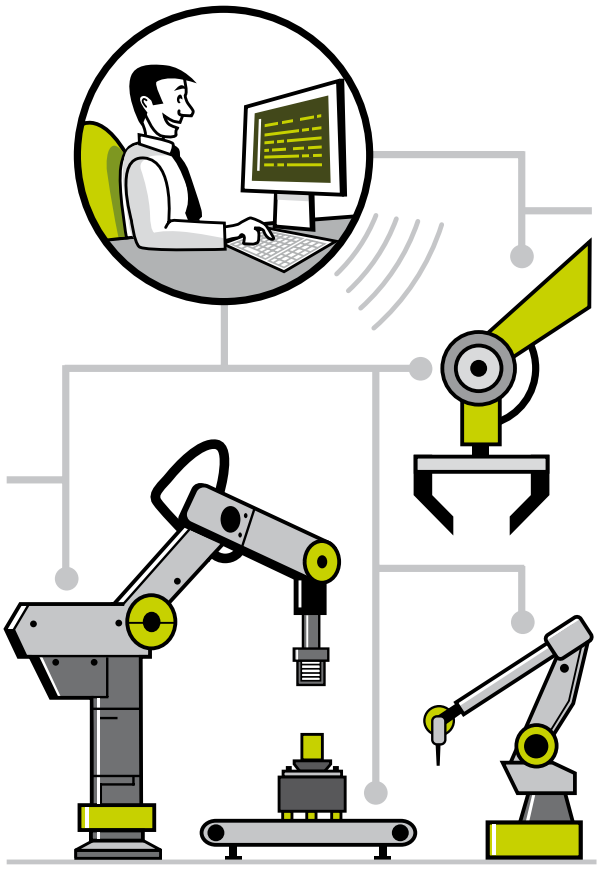

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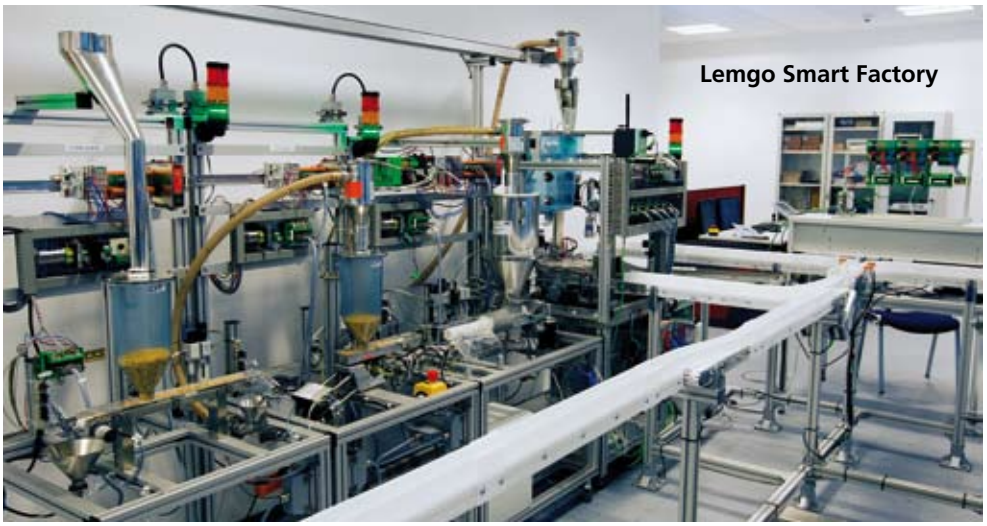

Lemgo Smart Factory

In cooperation with the Institute of Industrial IT (inIT) of the OWL University of Applied Sciences we use the Lemgoer Modellfabrik (Lemgo Smart Factory) to study, test and demonstrate future information and communication technology (ICT) solutions in the field of automation. For example, we could actually give you a live demonstration of adaptive and energy-efficient up and running production systems. This will illuminate the concept of integrated ICT ranging from the field level to the monitoring and control level including the potential visualization in a genuine control room or the reliable remote control/maintenance of disparate systems using the internet and mobile communication technologies.

Layout: atelier-bruns.de, pictures: Daimler AG (p. 1), Fraunhofer IOSB (p. 4, 5, 8), Volkswagen AG (p. 3, 4, 6)