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E³ factory – efficient, emissions-neutral and ergonomic

Manufacturing in the future is energy- and resource-efficient, in a primarily emissions-neutral factory, with the ergonomic integration of humans into the production processes. Fraunhofer researchers will be demonstrating their initial approaches for E³ factories from April 8 to 12 at the Hanover Trade Fair in Hall 17, Booth F14.

Industrial production is facing major challenges, such as scarce and expensive raw materials, increasing energy prices, climate protection, high fluctuations on the job market and demographic changes. As a country with few natural resources, Germany, in particular, has to develop new approaches if it wants to continue to manufacture goods in the future. In many sectors the price of the end product is already today playing a significant role in determining the prices for materials and energy. One example is the manufacturing industry, in which materials account for almost 43 percent of its manufacturing costs. "The optimal use of all raw materials and the efficient use of the energy that is required are the decisive competitive factors for production in the coming years," emphasizes Professor Fritz Klocke, spokesperson for the Fraunhofer Group for Production. In addition, it is also important to better integrate humans in the production processes, and that is why the protection of health and ergonomics are becoming increasingly important.

But which new manufacturing processes will be needed to save materials and energy? How will production processes and factories have to be designed in order to be able to guarantee job performance and job satisfaction? What are the approaches to prevent emissions? Fraunhofer scientists will be presenting their initial ideas and solutions for efficient, emissions-neutral and ergonomic factories of the future at the Fraunhofer joint booth in Hall 17, Booth F14. With the E³ factory, researchers are overcoming previously existent technological barriers and creating new production systems and new forms of organization. In doing so, they go beyond the mere production and assembly of products. Instead, they take the process of product creation, from strategic product planning and development to the development of product systems.

Energy and resource-efficient production

Some important starting points to optimize the efficiency of production are to eliminate waste and reduce rework as well as improve processes and shorten the process chains. For example: solar cell production: Researches at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart are working on optimizing the

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handling of the sensitive cells. The precise pick-up and setting down of the cells plays an important role in preventing damage to the brittle and susceptible silicon disks.

Many of the production processes need to be optimized or even replaced to ensure energy and resource efficient production. For example, some machining production methods can be replaced by forming processes. This saves materials, energy and time. For example, the cold rolling of running gears for gearing mechanisms requires up to one third less material and cuts production time in half. Researchers at the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz rely on incremental sheet forming. In doing so, the desired components are easily produced for the forming process according to the CAD data using simple, specially designed tools.

The resource-friendly production process is an opportunity to operate efficiently at times when raw materials are scarce. However, Fraunhofer researchers are already thinking ahead. Their goal is to produce goods without using any new raw materials whatsoever. They are aspiring to achieve resource use instead of resource consumption, but this requires consistent recycling practices. Enormous amounts of natural resources can be saved by always reusing secondary raw materials in cascades and feeding them back into the production process.

Emissions-neutral factories

In light of rising energy prices, saving energy is becoming increasingly important for manufacturing companies. However, the companies must first accurately determine how much energy is required by the individual processing steps and the equipment. Experts at the Fraunhofer Institute for Applied Information Technology FIT in St. Augustin have developed a system to determine consumption based on the processing steps of an assembly line. The researchers will demonstrate how it works at the upcoming trade fair using the example of a production line in the automotive industry.

It is also a good idea to analyze the interactions of processes with upstream and downstream processes and to establish energy cycles. Thus, for example, the heat that is released into the surrounding area can be used in the subsequent work steps (such as for drying) or for the production of power. These shorter and networked process chains help reduce energy consumption. The significantly lower demand can be obtained from renewable energy sources.

Incorporating humans in the production process

Humans will be working for a longer period of time in the future. The retirement age was only recently raised to 67. A workforce that is getting older not only requires improved ergonomics, but also new forms of cooperation between humans and machines. For example, in the future robots can take over the heavy work from the

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workers. New control systems and sensors make it increasingly easier for robots to adapt to changing work conditions and work closely with humans. Researchers at the Fraunhofer Institute for Production Systems and Design Technology IPK in Berlin are developing cooperative robots (or COBOTS for short), which the Fraunhofer Group for Production will be demonstrating at the 2013 Hanover Trade Fair. The robots take over the physically challenging work, yet allow the workers to control the movements. Unlike the low-cost robots that are currently available, the cobots are easy to operate.

However, one of the main prerequisites for working with robots is occupational safety. Thanks to a tactile sensor system, which was developed for robots and production environments by the experts at the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg, the machines can accurately detect the approach of a human and the slightest touch and immediately respond to it.

With the iProductionAssistantDevice researchers at the Fraunhofer Group for Production want to make available a mobile tablet that can be used to accurately plan and control production processes in detail in the future, because it is very important, especially in the production process with its complex web of interactions, to maintain decision-making aids that are not bound by hierarchies by providing the right information to the right place – also for discussions with other decision makers. That is the only way humans can respond promptly to new production conditions and demands.

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For further information

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