E3-production—sustainable manufacturing

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This photo shows the E3-Research Factory for resource-efficient production in Chemnitz. Credit: Fraunhofer IWU

Scarce and expensive raw materials, rising energy prices, climate protection and demographic shifts leave industrial production with a lot to contend with in the coming years. In the 'E3-production' lighthouse project, Fraunhofer researchers are laying the groundwork needed to achieve sustainable production. They will be at the Hannover Messe from April 7-11 to showcase the first project solutions (Hall 2 and Hall 17).

Industrial manufacturing is pivotal to Germany's prosperity. Not only does manufacturing account for a quarter of GDP, it provides a third of jobs as well. Yet rising raw material and energy costs, coupled with a demographic shift, pose significant challenges for industry. Keeping manufacturing operations in Germany will require a fundamental shift away from maximum profit from minimal capital investment toward maximum added value from minimum resources.

Initiating and effecting this change is what Fraunhofer's E3-production project is all about. The three "E"'s represent the areas of focus that bring together Fraunhofer scientists from 12 institutes. New machines, technologies and processes conserve Energy and resources – and pave the way for an Emissions-neutral factory. Ergonomics in manufacturing completes the set.

The question is, which new manufacturing techniques will help conserve materials and energy? What options are there for keeping emissions to a minimum? Fraunhofer scientists will be at the Hannover Messe to present initial ideas and solutions for a sustainable factory of the future in Hall 17, Stand F14.

Energy- and resource-efficient production

Producing a car body is currently an extremely elaborate process that requires a lot of time and energy because sheet metal components need to be individually press formed before they can be put together and mounted during the car body manufacturing process. Now researchers from the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz have managed to combine the two production stages – saving time, resources and money in the process. Researchers will demonstrate, for instance, how the manufacture of a hood, normally broken down into an outer section and several reinforcing parts, can now be combined into a single process.

"Combining joining and forming in a press line shortens the process chain. Not only is the speed of production greatly increased, it also uses less energy and materials," says Peter Scholz, researcher at Fraunhofer IWU. During testing, the cycle time for the benchmark car body component was successfully halved. Meanwhile, energy consumption was down 35 percent with a reduction of some eight percent in the materials required.

Making tools last longer also conserves resources. Forming tools used in processes such as the deep drawing of large components are particularly susceptible to rapid wearing at the edges. Together with Mühlhoff Umformtechnik GmbH and other partners, the Fraunhofer Institute for Production Technology has developed a laser technique that locally deposits protective layers on surfaces that come under particular stress. This means that costly tools last more than 2.5 times as long – an enormous saving in time and money.

Scientists from the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg will also demonstrate how to optimize energy consumption in production across a product's entire lifecycle. One of the presented solutions is an energy "QuickCheck" that enables companies to identify the first potential areas for energy savings on site.

Emissions-neutral factory

To keep the emissions generated by production processes to a minimum, you need to be able to detect harmful substances and document their levels over time and area. Now researchers from the Fraunhofer Institute for Production Systems and Design Technology IPK in Berlin have developed a mobile environment monitoring box to fulfill this function, allowing users to establish the levels of volatile organic compounds (VOCs), ozone, carbon oxides, nitrogen compounds, ammonia and methane in the surrounding air. A particle counter monitors fine dust

particles, meaning that the environment box also contributes to work safety and aids production workers.

Ergonomics in manufacturing

How can we make people part of an increasingly complex production process? One possibility would be to use smart devices such as the "Coaster" developed by the Fraunhofer Institute for Material Flow and Logistics IML in Dortmund. The device is also suitable for use as a human-machine Industry 4.0 interface.

Practical testing in the E3-Research Factory

These are just a few of the ways in which we can make production more sustainable. "In order to get potential E3-production solutions implemented sooner and to raise awareness of the issues involved in key sectors, we will be setting up demonstrators and pilot applications across four locations in Germany by the year 2016," explains Professor Matthias Putz from Fraunhofer IWU. In Chemnitz, one of these demonstrators, the "E3-Research Factory Ressource-efficient Production," is in the final ramp-up phase. It will be used to develop new technologies, techniques and factory planning concepts for sustainable production and to test them in collaboration with industry partners.

Among the things Fraunhofer IWU is researching is the shortening of process chains, for instance in the production of gear shafts. Scientists are also investigating how car bodies could be manufactured more flexibly and intelligently for increased sustainability. For instance, Volkswagen AG has helped build a full reference process chain for the assembling of a car door. This allows new technologies designed to conserve energy and resources to be tested under conditions close to those found in actual series production. Another of the E3-Research

Factory's areas of focus is energy self-sufficient production optimized to keep emissions as low as possible. Developing energy management solutions and incorporating modern forecasting and storage systems should allow us to cut factories' emissions and energy consumption drastically. Researchers at Fraunhofer IWU are also investigating strategies to involve people in the production process as well as new concepts for human-machine interaction. Researchers will be showcasing the E3-Research Factory for resource-efficient production at the Fraunhofer booth in Hall 2, Stand D18.

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