Fraunhofer IWU

E³ KONKRET

FRAUNHOFER INSTITUTE FOR MACHINE TOOLS AND FORMING TECHNOLOGY IWU

1 *iMAIN – A cloud-based solution for predictive maintenance of industrial machines*

THE PRODUCTION MACHINE 4.0

The E³ concept puts the view of interactions among the levels of technologies and equipment, logistics and factory processes, and the integration of the human being into production in a new analytical-methodological context. This change in perspective opens up new opportunities for specific solutions to address key manufacturing engineering requirements by using and implementing synergy effects.

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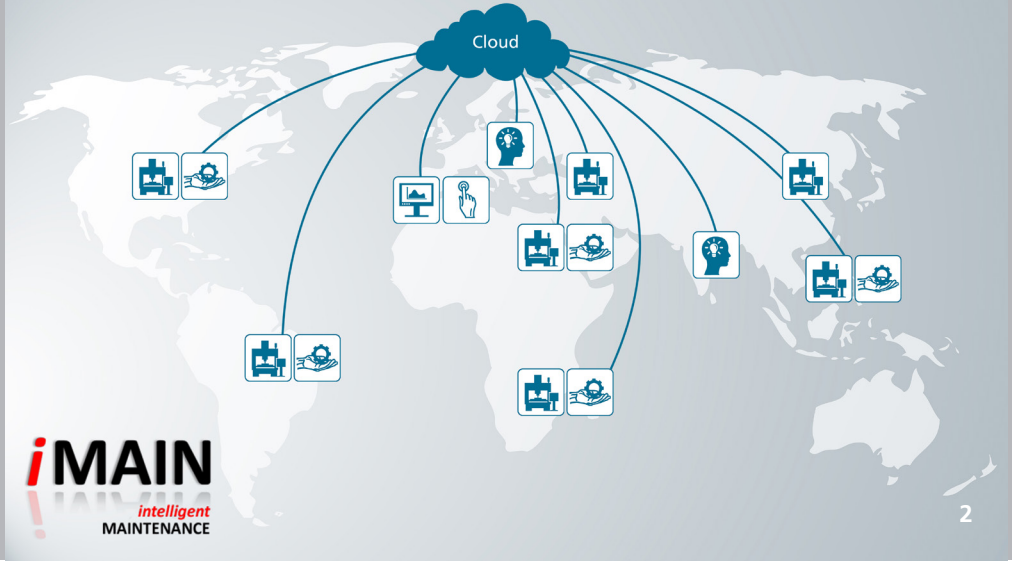
The challenge

As a result of globalization, production equipment is frequently designed and manufactured far from the place in which it ultimately will be used. As a result, knowledge of maintenance, trouble-shooting and repair is also diversified globally. In this context, the repair and servicing of ever more complex industrial machinery and equipment is difficult: unforeseen down-times caused by machines awaiting repair, as well as damaged tools, significantly limit the productivity of manufacturing plants, on the one hand. On the other hand, it is frequently still necessary to "import" personnel with the necessary expertise and technical trouble-shooting know-how. High costs and expensive service contracts are the result. Predictive maintenance is aimed at detecting an impending defect before a component, machine or system fails, and this information has to be made available via a remote maintenance platform in multiple locations.

When equipped with this information, companies can plan more precisely to service their systems or exchange special components. To do this, a large amount of machine-related data and information has to be linked with expert knowledge:



combining sensors with cloud-based platforms can provide a solution to bring the data, the technical know-how and the machines together in an overall system.

The approach

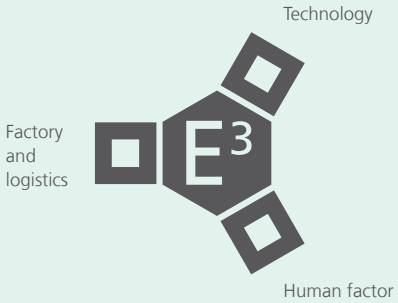
Since September 2012, technologists, industry clients, computer scientists and engineers have been collaborating in the iMAIN project funded by the European Community in order to achieve an entirely new technological level for maintenance systems to be applied to industrial machines. Together they have engineered the prototype for a system that can predict the moment at which a system or unit will probably fail. The core of this technology is an innovative combination of real and virtual sensors with powerful data analysis software. Real sensors have been used before by some manufacturers; however, their installation and monitoring is expensive and time-consuming. Also, stresses are measured only at the points at which they actually occur. Models of holistic stress scenarios can be mapped in combination with virtual sensors, based on algorithms, simulations and mathematical models.

These representations are supplied by computer-aided machine models, on the one hand; on the other hand, information about stresses occurring in individual components is provided via real sensors and continuously matched. Thus it is possible to simulate stress scenarios for the entire machine in a realistic manner and in real time, which, in turn, enables a new quality of predictive maintenance. Up to now, maintenance has mostly either been performed regularly or on an ad hoc basis in reaction to failures. Making use of a company-internal cloud, it is now possible to integrate stress histories and maintenance plans into the production schedule. Information about machines and equipment is brought together in a centralised manner and can be output through various interfaces, such as smartphone, tablet or laptop, in various locations.

E³ effect

The integration of real and virtual sensors into the production equipment, as well as the specific analysis of the data captured inside a company-internal "maintenance cloud" creates entirely new opportunities to generate maintenance-relevant information. Bringing together expertise and technical know-how to record and evaluate data and to analyse errors makes it possible to perform maintenance on and predict the remaining life of almost any industrial machine or system at a new level of quality.

2 *Bringing together technical know-how and machine data within one complete system*



The E³ concept
The production machine 4.0

Energy and resource-efficient production
Integration of information and communication technologies I Innovative technologies I Efficient production systems

Emissions neutral factory
Zero error production I Process monitoring I Quality cycles I Energy and material cycles

Embedding of the human factor into the production
Knowledge and information I Human factor as creative problem solver I Production assistance I Motivation

Photo Acknowledgment
Picture 1: Photothek.de