GENERAL LECTURE:

DIGITAL MOBILE MACHINES – FROM CLOUD TO EARTH

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The term „industry 4.0“ describes the transition from a classic value-added chain to dynamic value-added networks. It is driven by four main design principles:

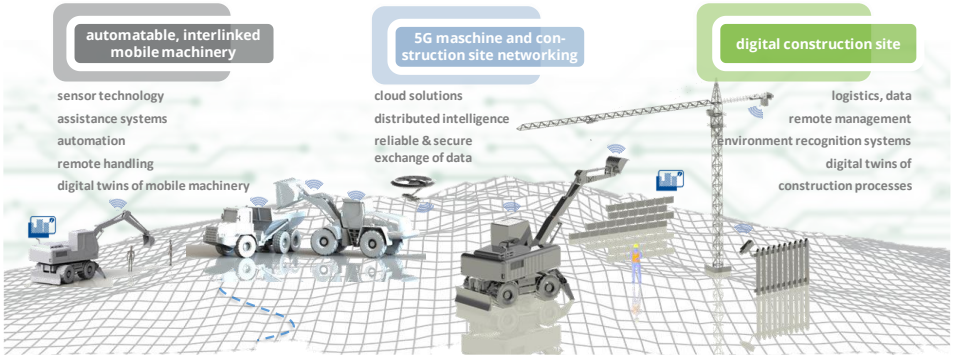
- interconnection of machines and humans
- information transparency
- technical assistance to support humans
- decentralized decisions

This approach and its connected technologies, like IoT or cloud computing, enhance in the context of industrial production further flexibility and an increase in productivity through growing self-organisation and interlocking with logistics and planning processes. Extensive activities can be recorded in this field.

Construction processes and the associated operations and logistics differ fundamentally from the conditions concerning industrial goods production. In a complex, locally and temporally changing environment, a large number of individual contractors, which are characterised by a diverse and inhomogeneous use of technology, act in a collaborative way. The unique character of construction projects, the massive fragmentation of the construction industry and the lack of standardized interfaces for the documentation and coordination of the current construction process mean that huge efficiency and quality potentials remain unused under classical conditions.

A powerful wireless communication based on 5G enables for the first time the consistent, digital mapping of all construction processes and participants due to massive availability of real-time information, which had not been possible with previous wireless communication and its technical restrictions. At the same time, 5G can act as an anchor of common standards for a heterogeneous building landscape. As a result, the construction progress becomes transparent for all involved parties. This is a prerequisite and basis for future automation and assistance systems, which will enable humans to act efficiently in a highly digital, self-organizing environment.

Increasing the efficiency of construction processes, especially concerning the handling of mobile machinery, requires extensive support from assistance systems. The increasing integration of planning and process data via suitable communication channels and the trend towards electrohydraulic control systems open up the potential for innovative assistance and automation solutions. Manufacturers and suppliers of mobile working machines and work equipment are now confronted with new, partly unexplored technological topics. In addition to



the development and adaptation of algorithms of mobile robotics, drive technology has to be refined in an appropriate way.

Against this background, the so-called digital twin is of central importance. In the field of digitalization of the construction site and its running processes, the construction project is represented as a digital twin, which allows the holistic simulation-based optimization of the process sequence. By mirroring the construction progress, the digital twin leads to transparency regarding adherence to schedules as well as in quality management and in case of unplanned process changes, it enables the evaluation of suitable, alternative construction process and workflow scenarios. The digital twin of the construction project is also a prerequisite for efficient interactions of all involved construction site actors.

This inevitably results in the necessity of digital twins of all the mobile working machines involved in the construction process, the mutual exchange of desired trajectories as well as the achieved work progress. The specific machine characteristics with regard to kinematics, loads, wear condition, thermal budget, degree of automation, suitability for attachment, which are represented in the digital twin of the mobile machinery, enable transparency and decision possibilities for necessary maintenance and repair cycles as well as for expected efficiency and quality.

The requirement or availability of digital twins has to be transferred in a hierarchical way to subsystems and components of the drive and control systems as well as to the attachment of the construction machines or leads automatically to comparable potentials and increasing knowledge for the components and supplier industry.

What all digital twins have in common is the necessity of highly developed, robust and secure communication technologies, which meet the requirements of low latencies for safety-relevant real-time applications, such as remote handling of mobile machinery in imponderable terrain.

Therefore, the survey lecture will highlight the diversity, hierarchy and some exemplary potentials of digital twins suited for mobile machinery. Furthermore, particularly significant use cases will be illustrated.