German Committee for Steel Construction Reports from Steel

DASt
FOSTA Forschungsvereinigung Stahlanwendung e. V.

Issue 2023/1

Construction planning-oriented production management in steel construction 4.0 – BauFeSt 4.0 | AiF No.: 21690N

Summary of the research project AiF No.: 21690N

The steel construction industry is facing a significant shortage of skilled workers in the coming years, which represents a potential economic risk. The BauFeSt 4.0 project aims to create a basis for overcoming the challenges in steel construction, including skilled labor shortages, cost and time pressures, through the use of flexible automation systems in assembly. The integration of robot systems can be crucial for competitiveness. The application of robots with static path planning and precise repeatability, but without extensive sensor technology, leads to, among other things, fitting errors, welding defects and production rejects. The handling of unavoidable component tolerances currently requires complex measuring and information processing systems. In existing systems, tolerance processing is carried out exclusively in closed post-processing, which limits compatibility with other systems and restricts the use of partial automation solutions. To overcome these challenges, flexible process control through efficient tolerance detection and processing is required when using industrial robots but also with existing machines. This makes it possible to play back the information and integrate the recorded deviations for subsequent processing steps.

Building on the DSTV-NC interface for controlling computer-controlled machines in steel construction, the BauFeSt 4.0 project focuses on the definition of information required for seamless cooperation between different machines in steel construction production. The focus of this work is on measurement and tolerance information as well as process feedback. First, the requirements from the current processes are recorded and the processes that need to be taken into account in this context are explained. The developed system must be applicable to existing machines and measuring techniques as well as to robotic systems and laser-based measuring methods. In order to be able to compare the measured values not only with the planned data, but also to relate them to the defined product and process tolerances, the tolerances must be digitized. Machine readability and automated information analysis is possible. The DSTV-NC format is widely used in steel construction, but was developed solely for unidirectional data exchange and does not provide space to store additional information from the manu-

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facturing processes. Therefore, alternatives for storage and cross-border exchange are being investigated. The project will examine approaches based on the Industry Foundation Classes (IFC) and the Web Ontology Language (OWL). With reference to the defined DSTV processes, it is explained which information is required for the various production processes of the individual parts and for the assembly for transfer to the machine. For the bidirectional flow of information, feedback that is drawn from the processing and saved is also considered. These can then be used for quality control as well as for evaluations and optimizations. As part of the project, the developments were implemented using real demonstrators to test the developed concepts. The developed DSTV Ontology enables the drilling of two holes by an IFC-controlled robot and the plasma cutting of three notches .

With IFC and its OWL version IfcOWL, it is possible to link the steel construction manufacturing processes to the higher-level construction planning. The interfaces provide a link between planning and production data. The focus of future work is on the further validation and progression of the developed system for the holistic description of information and processes in steel construction production. The Ontology-based approach offers the possibility to integrate and link additional concepts and information sources to the context. Cooperation to standardize information transfer and data storage is sought. These findings lay the foundation for future developments in the field of automation and digitalization in steel construction. The implementation of automation in steel construction production not only creates additional occupational safety and productivity, but also offers incentives for employees. The digitalization of manufacturing processes opens up new perspectives in planning and quality assurance. The networking of digital information along the entire construction value chain, from construction planning and design to operation and demolition of a building, creates significant added value. The continuous recording of information such as material quality, weld seam inspections and production tolerances enables a sustainable improvement in the performance and durability of structures.

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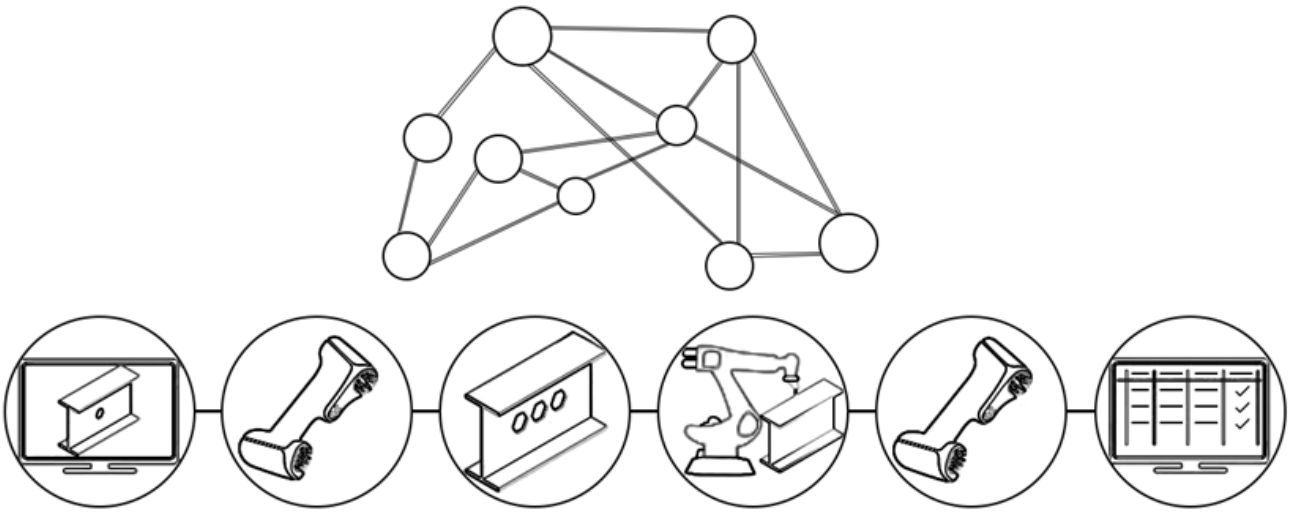

Image 1: Representation of the individual processes linked to the central model

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

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