Modular Data and Calculation Framework for a System-Based Mapping of the Manufacturing Process in Connection with the Value Stream Management Approach

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Abstract: The term Value Stream Management (VSM) describes a methodology to map, analyze and improve end-to-end supply chains from a company’s perspective. The value stream map is a visual model of the entire value stream and forms the core of the methodology. Based on the map of the actual value stream, an analysis is applied to identify non-value adding wastes. During further processing, the identified wastes are eliminated according to their priority by designing an improved target value stream. Therefore, material and information flows are considered. Furthermore, not only internal conditions but also suppliers and customers are taken into account. The traditional procedure of this methodology is driven by a manual pen-and-paper recording, requiring several production cycles to ensure a valid data quality. During these cycles, different qualitative and quantitative indicators, e.g., WIP stocks, durations, availability, and utilization, are measured and averaged. The whole process of data gathering and data structuring is time-consuming and effort intensive. These characteristics lead to high inflexibility in dynamic environments caused by shorter innovation cycles, decreasing lot sizes, higher variety, and similar factors. For this reason, in several publications, the traditional VSM is mentioned as static VSM. Following the recent researches, two approaches, mentioned as dynamic VSM respective VSM 4.0, can be distinguished. The first approach proposes the enhancement of the traditional documentation by technology-orientated information, e.g., storage media and usage, but the procedure itself remains unchanged. The second approach foresees the utilization of data provided by different information and communication technologies, e.g., sensors, positioning systems, and also business application systems. But a concrete data model for an application study is missing. The paper at hand provides a data framework for improving the traditional VSM by automating the mapping procedure with a focus on the manufacturing process. Therefore, the information content of the traditional VSM is analyzed. Based on the model’s requirement, related data objects of an enterprise resource planning (ERP) application systems, e.g., production orders, work centers, and more, are identified. For modelling the value stream map and enriching the model’s elements by indicators, necessitated for further analyses on the value stream, master data, and transaction data are taken into consideration. Furthermore, for insufficient raw data, calculation rules are derived from the model’s indicators. Finally, the data framework is validated by a use case, processed in a training environment of SAP S/4HANA. Further fields of research and design potentials are provided in the outlook. By the proposed data framework, an innovative approach is followed, which takes advantage of the increasing availability of data in supply chains. On the one hand, the procedure related manual efforts can be reduced by automating the information gathering based on the utilization of data. On the other hand, the application of a data model opens opportunities which impacts the strategic management of single companies and entire supply chains. In this context, process mining for monitoring and wastes analyses, simulations of value stream improvements, but also artificial intelligence driven forecasting and planning are mentioned, for instance.

Keywords: lean management 4.0, value stream management (VSM) 4.0, dynamic value stream mapping, enterprise resource planning (ERP)

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