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Classifications and conventions structure the handling of models within the Digital Factory

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Abstract

Today, the realization of the Digital Factory is the strategic goal of many manufacturing enterprises for the coming years. Up to now, the work has focused on the technical linkage of various planning tools. Now, the goal is to integrate aspects of the Digital Factory into the planning processes. Therefore, it is necessary to define a semantic correlation between the distributed models as well as the associated databases. Furthermore, a suitable presentation method has to be selected which is appropriate for the application within a specific task and for a specific target group.

This article presents an approach, which introduces modelling conventions based on a common world view of its users by applying the metaphor of the Electronic Catalogue as well as a well-defined workflow in order to simplify the work with Digital Factory models as a substantial step towards the application of the Digital Factory to meet practical requirements.

Keywords: Planning process; Logistics; Production; Virtual factory; Digital Factory

1. Introduction

Present changes in the planning and operation of production and logistic plants are characterized by value-adding partnerships, which aim at the joint use of resources to meet customer requirements in the best possible way. This applies as well for the relationship between customer and supplier of companies as partners in a production network as for the cooperating departments of a company.

A *continuous* planning and operation of these complex structures and processes – in line with the fulfilment of growing requirements for detailed and profound planning – can only be achieved with suitable IT-tools. It is the information and communication technology, which allows for

- the direct use of all relevant information and data at any time;

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- a close cooperation between system providers and the future operators of a plant already at the beginning of planning so that the results of the joint planning and operation can be exchanged; and thus,
- the order handling, feasibility studies and changes become more efficient and reliable.

These circumstances call for a modern, web-based collaboration network of all – possibly decentralized, interdisciplinary – teams participating in the planning and operation processes (cf. [1]). Such an information and communication (I+C) infrastructure for an interdisciplinary inter-company collaboration – over several organizational units and even beyond company borders – constitutes the Digital Factory. It aims at the connection of the single planning and management steps to reduce the planning and development times, to improve the production processes, to enhance the quality of the results of the plant planning and operation and, last but not least, to save costs (cf. e.g. [1–4]).

All structures and processes relevant for production and logistics are filed in this I+C basis in the form of digitally linked models for a flexible use according to the task at hand. In this I+C basis the user has access to the models he needs for his activities and to the relevant information and data. The basis also offers a continuously updated information basis and standardized processes for the avoidance of media breaks during the application and of redundancies in the data filing. Portals to the distributed information and data have to be defined for each user. Furthermore, model changes and their consequences have to be detectable and quantifiable in a series of models (e.g. errors in the ergonomic design of a workplace can affect the operational throughput). A linked creation, use, and maintenance of models can only be guaranteed with their consistent interoperation. In this context, the consequent realization of adequate data management is of great importance (cf. e.g. [5]).

2. A general framework

2.1. The Digital Factory – definition and models

Today, neither in research and development nor in industry does a harmonized definition of the Digital Factory exist. The committee "A5 Modelling and Simulation" of the "Verein Deutscher Ingenieure Fördertechnik Materialfluss Logistik (VDI-FML)" has recognized this deficit and established – in cooperation with the "VDI-ADB Produktionstechnik" – a professional committee "Digital Factory" where the methodological and instrumental aspects of the Digital Factory are discussed. The authors of this paper are convinced that – according to the definition given by this committee – the Digital Factory is the entirety of models, methods and tools for the sustainable support of factory planning and factory operation, including the respective processes (workflow), based on linked digital models (in connection with the product model). This definition implies, on the one hand, the cross-linkage of necessary models and tools, considering static characteristics and systems dynamics and, on the other hand, the consideration of the modelling workflow and the model using them.

As in simulation, the models within the Digital Factory are simplified images of a given or planned reality. Concerning the relevant aspects, these behave in accordance with the reality. The focus of each study and thus the aspects thereof differ from model to model. The Digital Factory (cf. Fig. 1) may thus include purely descriptive models, e.g. on the basis of network structures or process chains, but also experimental and thus dynamical models such as simulation or ergonomic models. In the latter case, the time behaviour is part of the model, which provides systematic experiments with parameter and structure variations.

Each model is characterized by the object to be mapped (the given object of investigation), the applied modelling method, the task and the know-how of the model developer (subject). The respective objects of investigation in the models refer to physical aspects within the factory, including product specifications, logistic and technical processes, but also to non-physical aspects like organizational structures, business processes or existing and used know-how. At the same time, production-related and logistical aspects are linked within the Digital Factory.

The desired result of the task is of importance for the mapping accuracy of the model. For this reason, the purpose of the model has to be considered carefully. This includes the task, the object of investigation, the field of application, the time of use as well as the user of the model, who is not