

Chapter 17

Factory Planning Based on Environmental Information: Concept and Prototype Evaluation

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ABSTRACT

The high complexity and a multitude of constraints in today's industrial manufacturing require a detailed planning of techniques as well as processes even before the building of production plants. Apart from technique- or process-related planning parameters, environmental aspects are separately considered in the task of planning. The approach of an integration of environmental information into a tool for planning production processes pursues the combination of both points of view. As a result, the expected generation of substances causing environmental hazards during production can hereby be uncovered even before an industrial plant is built. In this way actions for protecting employees and environment will early be considered and later high-cost conversions of plants are avoidable. The described concept is related to business practise by the development of a prototype in connection with a case study and shows the potential of the integration of both planning views.

INTRODUCTION AND MOTIVATION

A steady increasing competitive pressure in connection with the target of cost savings in companies requires a development of innovative solutions for products, plants and production methods in manufacturing industry. To achieve an efficient handling of the high complexity of the developed

new methods and techniques, a detailed planning has to be processed already before realization.

According to the definition of REFA, the term of planning involves the systematic search and determination of targets as well as tasks and resources to reach these targets (REFA, 1985). The procedure of planning is supported by several specific software solutions (Beck, 1990; Fischer, 1990). In this connection the virtual product (Gausemeier, Ebbesmeyer & Kallmeyer, 2001) is developed in the task of Digital Manufactur-

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ing and Production (Walter, 2002). The virtual product exists in the form of a realistic, integrated computer model. Depending on the respective context, it may represent a singular part up to an entire assembly and includes all required functions for the support of design, engineering, planning, simulation, production as well as service. Apart from this definition, the term of Digital Manufacturing and Production is described as a realistic, integrated computer model of a production site containing singular processes up to the entire factory. It further includes all necessary functions for the support of planning, simulation, engineering, production as well as control and maintenance (Walter, 2002).

Task of production planning is to develop not only the product itself. Production planning further concerns the development of the production process (Gausemeier, Ebbesmeyer & Kallmeyer, 2001). Several existing regulations are valid for running production plants and even have to be considered in the state of planning (Schmigalla, 1995): Plants requiring monitoring, for instance, are defined in trade regulations. Furthermore, regulations related to the prevention of accidents are specified by the Association of Commercial and Industrial Workers' Compensation Insurance Carriers. A consideration of significant constraints of these regulations is even possible in the state of planning plants and business units. Further, several regulations concerning the operation of electrical plants or the use of inflammable liquids influence the planning of plants and production processes (Schmigalla, 1995).

Apart from the mainly technical view, production planning over and above that proceeds referred to environment, taking related laws and regulations into account. In this respect the German law "Bundes-Immissionsschutzgesetz" represents an example, as a significant part of this act contains the aspect of building and running plants that require official authorization (Marx Gómez, Grünwald, Griese, Petri, Rosenau-Tornow & Eppers, 2004; von Blumenthal, 2002). Further fields of applica-

tion constitute the usage of hazardous substances or water-polluting substances that are regulated by specific environmental laws as well: Typical examples are the German regulation concerning hazardous substances (GefStoffV) and the regulation for plants concerning water-polluting substances (VAwS). Requirements related to industrial safety and health care additionally have to be considered in the planning process. The term of industrial safety contains all the actions for protecting life and health of the working employees, to preserve their working capacity as well as to organize the work in a human way. A main target in this connection is the prevention of accidents at work as well as occupational illness that can especially be achieved by a safe design of the technical equipment and precautions in employing. Precautions concerning dangerous plants, material or radiation represent examples in this case (von Blumenthal, 2002; Frolov, 2003).

BACKGROUND

Point of Origin for the Conception

The task of planning plants and production processes before their realization represents the point of origin for the idea of integrating environmental information into a tool for the task of planning. In this point of view plants are the objects in the focus. On the one hand these objects are related to the technical form of their realization, on the other hand the regarding plant is involved in a certain manufacturing process. Figure 1 shows the fundamental correlation of the views of operating technology and factory planning being the foundation for the integration of environmental information into factory planning.

In view of the aspect of factory planning a manufacturing plant embodies a resource or a tool. As described before, it is directly related to a production process. Furthermore, a manufacturing plant is always bound to a specific requirement

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