5 Design Representations in Critical Situations of Product Development

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Introduction and Objectives

Industrial product development means complex problem solving by mostly interdisciplinary and sometimes even intercultural teams (see Pugh 1990; Ehrlenspiel 1995; Pahl and Beitz 1997). Thereby, the team members interlink various pieces of design information in a creative process to achieve a final product (Cross and Cross 1996). This exchange of information takes place in different types of design situations and includes different activities such as searching, analyzing, selecting, evaluating, emphasizing or the dropping of information. Of course, we can also distinguish among different types of content of information, such as test data, customer requirements, and performance numbers (see Hales 1987; Blessing 1994; Frankenberger 1997). Moreover, design information is transferred by various representations, including verbal, written, sketches, drawings, and electronic data. The chosen representation of design information has to suit many requirements of very different design situations in order to provide the necessary availability of information. This availability of information is revealed to be a central factor in the success of design work (Badke-Schaub and Frankenberger 1999). Consequently, the use of internal (in the designer's mind) and external representations, as well as switching between both types of representation, are the essential mechanisms of thinking and acting in engineering design (Dörner 1998; Hacker, Sachse and Schroda 1998).

The procedure of searching, furnishing, and evaluating information depends to a large degree on the situation itself, the type of information, and individual prerequisites such as knowledge and experience. In order

to support and improve design processes, we have to understand the central mechanisms that determine this complex process of information transfer. An approach limited to the needed content of information cannot be sufficient and we have to consider the representation of the design information, too. In this chapter we introduce selected results that are related to the external representations of design information. These results were derived from an empirical study of the engineering design processes in industry (Badke-Schaub and Frankenberger 1999). We concentrate on the verbal representations of design information transfer in critical situations of the design process.

Methods

Investigating the requirements of information representation in design necessitates a detailed analysis of the designers' activities. But there is more to compile than information on the activities that occur during the design process. The aim of a differentiated understanding of information representation in design practice implies dealing with a large number of dependent and independent variables from different fields. Thus we based our investigation on a general model of four central influences on the design process in practice: "individual prerequisites," "prerequisites of the group," "external conditions," and the "task" (see Figure 5.1, with examples).

The complexity of such an approach makes it impossible to investigate so-called "comparable groups" in several companies. On the contrary, the investigation has to focus on a very detailed observation of "single cases"

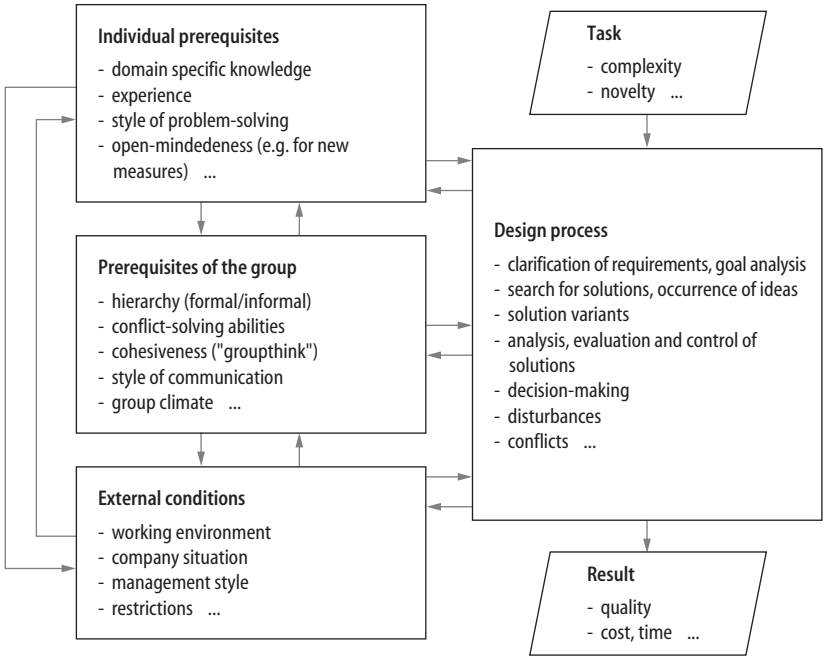

Figure 5.1 Factors influencing the design process and the result.