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Understanding Design Methods - Using Explanatory Videos for Knowledge Transfer in Engineering Disciplines

Nicolas Reiss[1*], Ann-Kathrin Bavendiek[2], Gunnar Diestmann[1], David Inkermann[2], Albert Albers[1], Thomas Vietor[2]

[1]*Karlsruhe Institute of Technology (KIT) - IPEK Institute of Product Engineering, Kaiserstr. 10, 76131 Karlsruhe, Germany*
[2]*Technische Universität Braunschweig, Institut für Konstruktionstechnik, Langer Kamp 8, 38106 Braunschweig, Germany*

* Corresponding author. Tel.: +49 721 608-45985; fax: +49 721 608-46051. *E-mail address:* Nicolas.Reiss@kit.edu

The application of design methods in engineering practice is improvable, although the use of methods is often seen as helpful and even profitable with regard to process efficiency and effectiveness. The main barriers cited to apply design methods in practice are the theoretical descriptions and the complexity of methods. Thus, this paper focuses on new media to provide method knowledge in order to overcome the above mentioned barriers. The approach presented is based on method videos to explain the aim and application of methods.

Keywords: Design Methods, Knowledge Transfer, Design education

1. Motivation

Considering the fact that knowledge generation, validation, and documentation are decisive aspects of product development, efficient knowledge handling throughout the entire product development process becomes a key role. Thus, systematic approaches within the design process will become increasingly important. Development and innovation management provide various methods to support the product development processes (PDP). The term “method” is often understood as a rule-based planned sequence of activities [1]. So far, some methods have been widely used in companies, but most methods are rarely known and thus only used to a restricted extent [2]. The reasons for a poor application in practice are, e.g., the lack of know-how regarding an effective integration into the product development process [3] or the missing adaption possibilities of methods to the company's situation, e.g. [4]. Hence, a demand and situation-specific supply of design methods in practice should be an important objective of methods research. Therefore, the preparation and tailor-made provision becomes a key role in the transfer of methods from research to practice [5].

2. State of the Art

2.1. Design Methods in Practice

Methods describe a goal-oriented procedure. Thus, they have a descriptive and instructional character and should support the user to achieve a certain goal. However, the outcome of the application of a method is open [1][6]. For instance, Lindemann [1] defines the term "method" as the description of a rule-based and planned action to perform certain activities according to its specification. Thus, methods provide a step by step procedure to solve a specific problem. A method can include the use of different tools in order to achieve the goal. They can comprise guidelines which tools should be used as well as the order in which they should be applied. Due to the diversified work within product development, numerous methods for different goals have been developed such as analysis method, idea generation/solution finding methods, evaluation methods and cost and economic methods.
In general, these methods use experiences already gained to solve repeating problem patterns. This refers not only to the support of the engineer and the management, but also to the

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support of facilitating organization, planning, and concept development [6][7]. Despite the wide range of support, methods have been insufficiently integrated into daily development practice so far and even in this context, have only rarely fully exploited in their potential [8]. Franke et al. [9] find that successful firms use methods during PDP more frequently. These methods are not only used in the idea phase but also during the conceptual design and later stages of the PDP. Yeh et al. [10] show that methods appear to be effective although engineers use them rarely in practice. By analyzing more than 400 development projects from practice, Graner [5] showed that an integrated method application can strongly support the engineer in the product development process. In these projects, the intensive method use was correlated to the success of the new product. In practice, however, methods are not regularly used and only a few of them are accepted [6][11]. Recent research on this lack of acceptance concludes that science is often too far away from reality, e.g. [12][13]. The individual needs abilities of the engineer as well as individual working, and thinking patterns have been taken into insufficient consideration [4]. In addition, the verifiability of improved results and decreased development effort due to the method application can only be revealed to a limited extent, meaning under specific conditions. Furthermore, there is mainly a missing expertise about how methods can be appropriately integrated into the PDP [14]. Another reason mentioned for criticism is that methods are often complex and theoretically described [2].

Two independently conducted studies on the methods application in practice showed that analysis, creativity, and evaluation methods are most applied in practice [15] and [16]. The focus of both studies laid on the use of methods along real ongoing product development processes. The additional finding was that, for example, creativity methods are used not only during the idea generation but also for the support of profile detection and modeling of principle solution and embodiment. Both studies show independently of one another that only a small number of methods is used in practice. Bavendiek et al. [16] report 4 to 5 methods on average being applied at least rarely. Albers [15] finds a small number of selected methods within a method category. For example, almost every engineer (98 %) uses brainstorming in the field of creativity methods, while other methods such as 6-3-5 (42 %) or brain writing (36 %) are less than half as often used. Regarding the evaluation of the suitability of methods, it is conspicuous that even the methods used infrequently are considered as successful. For instance, brainstorming, as one of the creativity methods, was by far the most frequently stated method, whereas the suitability of other creativity methods was evaluated constantly well. The results show that the variety of methods developed in the past and hence the subsequent potential is not yet sufficiently exploited in practice. Many designers see no improvement by using methods. Most of them are of the opinion that without the use of methods just as good results as without can be achieved in even less time. Thus, it happens rarely that an engineer independently accesses methods [15].

2.2. How to increase the Acceptance of Design Methods?

To meet the above mentioned problems of methods within industry projects, various approaches have been presented. Geis et al. [3] propose a method transfer framework which consists of four pillars (simplification, adaption, promotion and training of methods) as well as of the basis of daily routine in industry, knowledge of designers and experience in science. These aspects contribute to a better acceptance and successful usage of methods in industry [3]. Stetter and Lindemann [8] developed another transfer model for methods consisting of five steps from the initiation of a method implementation process up to the evaluation of the impact of the introduced methods [8]. In literature, there are further models and approaches to increase the acceptance of methods in industry, e.g. [17]. Many of those authors deal with the question how to provide knowledge about methods. Beside the descriptions in literature like Pahl/Beitz [18], there are special books or collections containing several design methods, e.g. the Delft Design Guide [19]. Another way to describe methods and to provide the necessary knowledge about how to apply them are online platforms or, more recently, applications. An example for an online platform like that is the “Methodos” portal which was developed at TU Braunschweig with the purpose of teaching methods to the engineering design students in a more attractive and interactive way [20]. Beside different options to search for adequate methods, there are already method videos, helpful tools and templates attached to the method descriptions. Via comments it is possible to share gained experiences with other users. The first method application designed for mobile devices called “InnoFox” was presented in 2014 by the Karlsruhe Institute of Technology [15]. It provides a huge catalogue of design methods and various possibilities to access methods which are suitable to the situation given by the company’s surroundings [21].

The approaches and tools mentioned to transfer knowledge about design methods into practice directly or via a lasting design education can already solve some of the problems of design methods in practice. A promising further step is the combination with explanatory videos of methods, like they are implemented in the Methodos portal yet.

2.3. Explanatory Videos for the Knowledge Transfer

Explanatory videos are defined as short animated videos to explain a complex issue. In this contribution, the focus lays on method videos that describe design methods used within the engineering design process. Videos are a commonly used medium for giving a short overview of the issue to be explained. With the aid of pictures and sounds, the audience is addressed visually and aurally. If used correctly, this combination leads to a better understanding and increased memory performance by the spectator. For example, Chirumalla et al. conducted a study to identify the influences of the medium on an assembly process. The process was described with text only, with drawings and text, with pictures only and with a video. The video was best rated to understand these instructions as the combination of pictures and sound was helpful to the participants [22].

Looking at websites like Youtube, both the demand and the supply of explanatory videos, seem to rise further. There are various explanatory videos on diverse topics available. Giving the example of the youtube channel "explainity" which has currently more than 100 explanatory videos on politics, economics and health care online, shows the enormous demand for explanatory videos: the channel has more than 80000