PROCEEDINGS

53. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

Faculty of
Mechanical Engineering

PROSPECTS IN MECHANICAL ENGINEERING

8 - 12 September 2008

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Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

Published by
Impressum

Publisher Herausgeber	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c. Peter Scharff
Editor Redaktion	Referat Marketing und Studentische Angelegenheiten Andrea Schneider
	Fakultät für Maschinenbau Univ.-Prof. Dr.-Ing. habil. Peter Kurz, Univ.-Prof. Dr.-Ing. habil. Rainer Grünwald, Univ.-Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. mult. Gerd Jäger, Dr.-Ing Beate Schlütter, Dipl.-Ing. Silke Stauche
Editorial Deadline Redaktionsschluss	17. August 2008
Publishing House Verlag	Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16, 98693 Ilmenau

CD-ROM-Version:

Implementation Realisierung	Technische Universität Ilmenau Christian Weigel, Helge Drumm
Production Herstellung	CDA Datenträger Albrechts GmbH, 98529 Suhl/Albrechts

ISBN: 978-3-938843-40-6 (CD-ROM-Version)

Online-Version:

Implementation Realisierung	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau

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3rd Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
08 – 12 September 2008

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C&CM as a supporting modell in designing activities exemplified through an industrial example

Abstract

In this paper is shown, how the Screw Fastening Technology Department at Hilti AG in Liechtenstein managed to revolutionize a fifty-year-old product in the field of screw fastening. The designers succeeded although they had sparse knowledge and experience in this field.

As often in time-critical design tasks, also in this project the first way to proceed was very much intuitively rather than systematically and methodically. The basic concept for the realization of the innovation was in mind and thus gave the impression that the process of designing (as the process of form giving and material determining) could be done fast and successfully. This false estimation made the engineers disregard that “the invention and the acting of the designer […] is not only based on science and craft, but also on intellectual exercise, which have to be defined as being art” [1].

The approach of the engineers based on intuitive acting failed because the design team had no experience in the field of screw technology itself (i.e. developing screws and production of screws). Thereby the negligence of science could not be replaced by engineering experience. Consequently the design process turned out to be more difficult than assumed. Today there are rare adequate methods or models available to support the process of designing. This coherence between science and art as a result of experience was already known by Redtenbacher: “Since it is not possible relying only on art and pure scientific approach being way to time-consuming and unproductive, the only way of adequate designing is the combination of both” [1].

Thus, the goal of design methodology must be to provide a tool to combine the art of designing with science in designing. The evidence that this goal has not been reached yet is widely shown in literature: “The poor diffusion of the design methodology […] in industrial approach, that it still has not the performance, which would be necessary for a practical and successful application. Especially the transfer of the methodology on

specific problems causes huge difficulties" [2]. This led to a low impact of development methods in design projects nowadays [3].

To support the application of development methodology, the engineer's way of thinking and problem solving has to be understood. "Every cognition is cognition in models or through models and any perception is generally based on models" [4]. Stachowiak assumes that the only way humans can capture the environment is by means of models. Cognition always takes place through models. Thus, everybody is using models to make the environment ascertainable.

But this approach of capturing environment or especially technical systems leads to problems, because the more specialized and complex problems get, the more individual models turn out to be - especially designing as the activity of giving functions shape and their technical features. Humans cannot gather all coherences for the objective questioning. Thus, for the problem solving task the approach of reducing the negligible and concentrating on the gist, enables being successful in solving problems [5]. The second part of the citation predicates, that models are always required for general communication (e.g. language). Thus the development methodology has to provide a tool to supports capture, describe, communicate and according to that analyze and synthesize.

The C&CM enables the user through the following principals [6]: The C&CM

- counteracts complexity with simplicity
- is contrary completeness, but problem-oriented
- is dynamic in abstraction, level of detail and time
- supports the design process by connecting form and function

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