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A Software Tool for Observation and Analysis of Design Activity

For identification of successful design strategies we observe individual heuristics of experienced professional designers within a cross sectional laboratory study. To cope with some typical problems of observing complex cognitive activity, a software tool for observation and analysis of individual design procedures has been developed.

This software tool allows real-time data capture, automatically processes fundamental data-analyses and therefore increases the efficiency of empirical research. The tool is expected to be easily customised for use with other types of research based on the observation and analysis of complex cognitive activity in a laboratory or a field.

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Task Design and Task Analysis for Empirical Studies into Design Activity

In many laboratory studies, design activity has been investigated by observing individual designers or design teams dealing with standardised design tasks. The results are valuable for a better understanding of design thinking and acting and for further development of design theory. However, there is a lack of comparability – and often of validity – of these studies.

Our contribution focuses on the design and standardisation of design tasks to be used in laboratory studies and proposes a more systematic approach to task design in this area of research. Two task designs are described, which have been applied and verified in an empirical study into the applicability of design methodology in early phases of the product development process.

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An Approach to Verification and Evaluation of Early Conceptual Design Solutions

In the early phases of the design process the evaluation and the following decision-making are based on limited amount of information, nevertheless the decision will determine the direction of the remaining design process. The objective with this paper is to present a way of representing the conceptual solutions, which facilitate an enhance utilisation of the available information. Based on the systems theory, a widening and more nuanced definition of the conception of relationship is being established, which implies an increased possibility of describing properties origin from the interaction between elements. The proposed representation should be considered as a first step towards a more elaborated methodology.

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Perspectives on Similarity in Design

New designs are examined in the context of existing designs. General features of similarity are outlined. Similarities are distinguished according to both the type of design activity and the type of design description. Five layers; component, manufacture, product, process and knowledge are identified. Similarities on individual layers and those induced between layers are analysed. This analysis contributes to planning design as well as the use of designs and associated processes in product development.

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A Study of the Effects of Different Types of System Architecture on the Development Process

To minimise development cost and time different system architectures require different development processes, in this paper the impact on early phases is addressed. Three types of system architectures are identified, integrated, distributed and mixed, (partly integrated and partly distributed). It is shown that the type of interfaces defines the type of architecture. Integrated systems have more interfaces, which furthermore are vaguely defined. Distributed systems have fewer and well-defined interfaces. To develop an integrated system focus has to be put on enhancing necessary iterations, in distributed systems focus has to be put on possible parallel development, mixed systems needs both approaches and also requires sequential development.

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An Analysis of Design Decision-Making in Industrial Practice

This paper describes research that confronts a generic decision-making model with design strategies employed by experienced designers. The relationship between the decision-making activities proposed by the model and the eight design strategies identified by an empirical study of design work is examined.

The analysis led to a deeper understanding of the decision-making activities undertaken by engineering designers in industrial practice. The decision-making episodes undertaken by individual designers were supported by design strategies, not by formal decision-making methods. This implies that designers in practice do not rely solely on methods to support their decision-making process, but also on the use of relevant design strategies.

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Understanding the Phenomenon of Modularization

Many companies experience significant problems in coping with modularization and we interpret this as an incomplete and fragmentary understanding of the phenomenon of modularization. The paper introduces a research framework aiming at creating a more comprehensive understanding of the phenomenon of modularization. The research framework includes a view of the influences or impacts of modularization in three perspectives.

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The Application of Design Management Theory to a Real Design Projects

It is proposed that the theoretical models of design management have now moved from being too shallow to being too complex. As a result, they are not being used.

Furthermore, they do not include an appreciation that people who are experienced, or even expert, in a particular field do not need to pass through every stage of the process.

There needs to be a new approach that is flexible enough to capture particular experiential knowledge but also work when used by the less experienced. Theoretical design management process models were compared to those stages undertaken in a real design situation and elements of a modified system that was found to work is described.

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Specialized Design Sciences - Questions for the Future

The scope and organization of knowledge about design engineering and the technical systems being designed is presented in Design Science in a general form. The goal of designing is and should be to develop an optimal technical system for the envisaged conditions of use. This may (or may not) involve innovation and creativity.

In order to achieve individual properties (and their interactions and relationships) of specific technical systems, the knowledge about these specialized systems must be collected and categorized, preferably according to the master presented by Design Science. This can lead to applicable knowledge for designing – design for X (DfX). The leap from the abstract theories to application in engineering practice should be made as small as possible. Understanding and gradual introduction of the knowledge into engineering practice should be an important aim.

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Product Modelling in Early Phases of the Design Process

Product modelling help the designer to communicate about the design problem with his/her colleagues. Models help also the designer to understand entirely the problem to be solved. Aims of the designer is to capture the needs of the customers and the desired behaviour of the product in to the models, which generate and maintain the bridge between the product specifications and the final solution. Object-oriented methods offer new possibilities to capture the requirements of a mechatronic products. Modelling the user interfaces and making scenarios for typical users (use cases) of the system helps to refine the needed transformation processes. I am going to present and discuss ideas on formal methods for modelling the product during the definition and the specification phases of the design process.

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Physual Designing - Approaching Design through the Interaction Space

Engineering designers utilize and depend on both their physical surroundings and different technology-based generic and engineering-specific tools, in order to be effective. Hence, they “orchestrate” the design process using the wide array of tools and contextual factors that are available at their disposal. In this paper a conceptual framework, physual designing, is discussed. This combines the advantages of using the physical domain for unconstrained visualization, with the increased flexibility offered by virtual media.

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Simplifying the Design of Product Families Using a Segmented Design Network

The Active Semantic Design Network supports the designers by various means from the first rough outlines to the finished CAD and rating model. This tool is being extended to allow for the design of product families. To create a product family, one master model is developed from which the other models are derived. The designers can either change parameters of parts of the existing model or replace parts by other ones, either picked from a built-in catalogue or newly created. An important aspect are suitable parameter gradations. The tool supports the designers in finding standardised decimalgeometric parameter values as well as in scaling the master model correspondingly for each model of the family.

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Representation of an Architectural Design Process; Between Formal and Functional

This article describes one of the research studies carried out by LEMA, the Laboratory for the Study of Architectural Methodology, on the representation of the design process in architectural design. On the basis of an experiment, described here by the comparison of two complete examples, we describe which characteristics can enable us to distinguish a formal approach to the design (the architectural concept is the basis of the process) of a functional approach (the concept is formed by the process).

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Product Development Processes Ontology

Numerous empirical studies of various product development processes are initiated each year. Most of these rely on vocabularies that have merged partly within their local research community. Though there are some commonalities in the vocabularies applied the 'incompatibilities' between the studies are astonishing.

In this paper we shall discuss the advantage of applying an ontological approach to overcome some of the difficulties, and also, present a tentative ontology. An ontology can be defined as the specification of a conceptualization. That is, an ontology is a description of the objects, concepts, entities, and relationships that can exist in some area of interest. The goal is to communicate consistently in a domain of discourse without necessarily operating on a globally shared theory

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A Classification of Matrix-based Methods for Product Modeling

In the development of complex products considerations of the product structure and relations within the product are crucial. Matrix-based product modeling methods can support this activity by, for example, visualizing the relationships in products.

This paper proposes a classification of matrix-based methods with respect to scope and content. With respect to scope, element-level matrices, product-level matrices and matrix methodologies are distinguished. With respect to content, the classification considers what element types and relations are captured in the matrix. A number of methods are positioned according to the classification and areas for future work identified.

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A Study on the Design Thinking Process With Difficult Keyword

We focused on designer's drawing to know how designers made images of design object from given keywords. We thought that difficult keyword would give us good clues to know thinking path of designer. An experiment was held to examine designers' creative thinking. The subjects were assigned a task to design 'a chair which gives sad image'. Subjects' drawings were evaluated and words on sketches were structured into meaning hierarchy. From the results, we found that when the design goal was difficult to convert to the forms, designer tried decomposing the meaning of design goal into the adequate level to be able to image forms. Based on this study, we presented a model of thinking path for understanding the creative thinking process of design.

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A Study on the Thinking Path Model of Creative Design Process

In next step of our research, we had another experiment to know designer's inner process of creative thinking by tracing dynamic relations of designer's behaviors and drawings using two video cameras. The subjects were assigned to design "beautiful tape dispenser" and then to make it soft imaged. As the experimenters had experiences of design works, the inner thinking processes of subjects could be easily inferred from their behaviors. We call this "dwell-in" observation. As the result, it was found that creative thinking progressed in some kinds of thinking paths composed with several searching modes.

Based on the results, we presented a general thinking path model for understanding the creative thinking process of design.

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Ethics in Industrial Product Design (Good, Goods and Gods)

In mythology, semi-god, semi-human Prometheus was a designer and the fire he brought to humans was the design ability, the ability to create good goods like gods. Today he is ashamed to feel semi-this and semi-that, that he is bringing the fire back to gods with a job application in his hands. By sacrificing the human side, he thinks that he will be accepted among gods. It's no good!

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Towards a Flexible and Adequate Use of Methods in Product Development

Design methodology has become a major part of research in the field of engineering and offers a large variety of methods in order to establish effective and efficient product development processes. A problem yet is that methods are barely used in practice or used in a wrong way. Reasons for this situation are discussed with a focus on an apparently wrong understanding of methods and their meaning, which may be determined in their design. First approaches for a more flexible use of methods are presented. Finally, we would like to propose another, more appropriate view on methods and point out the consequences for their design (elementary methods, constituents), teaching, and industrial use (methods as products), including science itself.

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Redesigning Product Programs Focusing On Variety, Complexity and Commonality

Market demands have increased, and products' market life spans get shorter. New products or new variants must be introduced more frequently than they used to. Thereby product assortments in companies are growing, which often leads to increased internal complexity.

To handle this we are focusing on what we call a product program. A product program is a planned product portfolio for a company, which considers both internal and external impacts on the products.

The intention is to keep or improve positive variety in the market, while changing negative variety into commonality to achieve internal benefits. A model to improve and redesign an existing product program has therefore been developed, and will be presented.

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Development and Application of Modular Function Deployment

Modular Function Deployment (MFD) is a method, which is based on the well-known Quality Function Deployment (QFD) method. The QFD is more and more used because of its orientation on customer requirements on technical products. It is assumed as one of the best Total Quality Management (TQM) method. The goal of QFD is to ensure optimal fulfillment of customer requirements on a single product only. The MFD enables above to ensure the same task by optimal modular product or maybe its part composed only from the selected modules if required. This is considerably more effective both for the producer and the customer.

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Strategic Design: a Design Method to Manage the Design Framework

In engineering design, it is thought that the designer repeats two steps: to establish the problem framework for generating the design solution and to search for and generate design solutions within the problem framework generated in the former. In this study, we suggest a method of strategic design which changes the problem framework dynamically in the design process. As the first step, in this paper, we verify the efficiency of changing the evaluation criterion of the design solution in the design process through a computer simulation. For the knapsack problem, changing the problem framework dynamically is found to lead us effectively to a solution. Furthermore, it is also suggested that there are specific patterns for changing the problem framework for searching for solutions effectively.

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Including Sketching in Design Idea Generation Meetings

Designers commonly apply brainstorming meetings. In such meetings the primary mode of expressing ideas is written language. In contrast, when involved in unstructured design meetings, designers tend to make extensive use of sketching when generating design ideas. Design researchers have often connected this activity of sketching to creativity in design. As both sketching and brainstorming meetings are regarded to be tools for stimulating creativity in design, perhaps combining them can provide an even better tool. The objective of this study is to explore whether various ways of introducing sketching into brainstorming meetings do actually enhance the brainstorming process within a product design context.

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Context Indicators for Determining Links Between Design Ideas

Linkography [Goldschmidt 1995] is a promising method for analyzing idea generation processes. When using linkography, the researcher limits him- or herself to assessing whether there is sufficient evidence for a link between each possible combination of ideas to be present (or not). We attempted to strengthen the linkography approach by investigating the potential for using situational -or context- evidence, in addition to similarities in subject matter. This could enhance the reliability of linkography as a method for data analysis. The first objective of this paper is to understand the nature of context indicators for links. The second is to understand their relative importance for determining links between ideas.

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From Function to Form Using Physical Reasoning

The goal of engineering design is to design a product, which fulfils a required function. The Domain theory and chaining of physical laws (way to synthesise solutions) offer a possibility to propose a framework of how to carry out functional reasoning. The proposed framework consists of mental objects (i.e. problem, function, physics, structure, design) and operations (i.e. synthesis, view, abstraction) between them. Functional reasoning based on the engineering designer's knowledge about physical laws is known as physical reasoning and it is identified in the framework among the ways from function to form. Twisting of knowledge is also identified and explained.