

COMPARING ACTIONS OF CREATIVE DESIGNING

U. Englisch, P. Sachse and J. Uhlmann

Keywords: human action, gestalt, artistic design process, technical design process

1. Preliminary remark

The action of designing is not only important for the arts, it represents an important aspect for the technical field of work as well – sometimes the meaning of this human action is extended to all areas of life.

The process of *designing* (in this paper as a summary for general principles of creative designing) and *forming* (in this paper emphasizing the changing object) has been attended to by multiple disciplines and for a long time. Nevertheless, a general, comprehensive theory to integrate all significant aspects of design processes is yet to be found. Based on the heterogeneity of conceptions to the process of designing, there is only little consensus relating to optimal conditions and supports for design processes in general.

Notwithstanding, the process of designing, including either technical or non-technical processes, could be described comprehensively as a demanding action of thinking, a constructive and complete “thinking in advance”, a “thinking designing”, and forming of a not yet existing, future object.

To ensure an appropriate understanding of the technical and the non-technical (artistic) design process, general principles of constructive design actions are presented and discussed in the next step. On the basis of the continuum of design processes – derived from those principles –, the discipline “*Technisches Design*” (Technical Design) is categorized. To study the design process in this discipline, the individual and complex action of designing is regarded as a multiple and complex problem solving process (consisting of so called sub-problems). Particular interest is given to various sub-problems: Each sub-problem could be characterized as belonging rather to the technical or the non-technical (artistic) pole of the given continuum. It is described where there are differences in dealing with these sub-problems – especially with regard to the conditions, the process itself, and the criteria to finish the design process. Furthermore, some approaches for the planned studies of design processes in the discipline “*Technisches Design*” are described. Finally, a preview with regard to the consequences of the results is given.

2. Thesis to technical and non-technical design processes

In context with a general conception to the technical and non-technical (in the course of the text called “artistic”) design process, both processes will be considered with regard to their distinctive features. On the basis of a qualitative analysis of the processes using established conceptions as well as the analysis and organization of experts’ statements and summarizing these results, the following criteria which are used to describe the technical and artistic design process could be derived:

- *Individual and external conditions*

Conditions necessary to trigger and to preserve the process of designing are summarized by this criterion. Individual conditions are, for example, knowledge [factual knowledge, procedural knowledge and heuristic knowledge; Dörner 1994], but motivation, emotion, and personality traits as well. In addition the task or the problem, the availability of necessary information and material is described as external condition. Furthermore, situational conditions are taken into account.

- *Importance of material and tools*

Further, it is regarded that changes on the object are carried out in the course of every particular design process / forming process: It is expected that not only visualization influences the origin of the work or product. The choice of the material and the tools may influence the design process as well.

- *Importance of artefacts*

Artefacts are seen as the sensory accessible part of the design process; therefore, they are “vehicles for thinking and acting” (including notes, sketches, physical models etc. for the design process). These materializations are results of the external part of the mental process itself (“Darstellungshandeln”) – they should be differentiated from externalizations without any fixation, e.g. gestures [cf. Sachse 2002].

- *Importance of cognitive and affective components*

There are not only distinctive features of the task or problem, tools, or personality traits important for each design process. Therefore, cognitive components of the designing person are considered to influence the constructive process as well. Cognitive effects could be proven by the observation sketching and use of sketches / physical models in the design process to be not only useful for the reduction of cognitive load. Further, they are necessary as so called “thinking tools” – the immediate support of individual thinking processes [cf. Sachse 2002].

- *Description of the process*

This criterion considers to what extent the course from the idea over the artefacts to the product / work is taken into account by different conceptions of the design process. Usually, there are conceptions describing the design process consisting of various phases or stages, which are reckoned as characteristic.

- *Criteria to finish the design process*

Based on this criterion, it will be considered to what extent there is an aim of the technical or artistic design process characterizing the end of each particular design process.

- *Characteristics of teaching and methodology*

This criterion includes the question if it is possible to teach various techniques which lead from the idea to the product / work in both technical and artistic design processes. The problems of verbalization and of a deliberate impart of techniques are discussed as well. In addition, a comparison between the methods of the technical and the artistic design process is given.

3. Selected descriptive results

At this point, merely the descriptive results to the criteria “individual and external conditions”, “description of the process” , and “criteria to finish the design process” are described in a short survey [for further results, see Englisch & Sachse 2006].

It should be considered that the following comparisons are made between the poles of the continuum to be described: only “extreme cases” from the technical and the artistic design process are used.

3.1 Individual and external conditions

By understanding the design process as a problem solving process, the beginning of the technical as well as the artistic process can be described by an undefined condition of start and aim. In the course of each design process and the work on the given task or problem, there is not only observable an intensive thinking process but a consideration with necessary rules and standards (e.g. DIN or the adequate use of material and tools) as well.

Problems in the technical field are complex; thus, they can be understood as so-called “ill-structured problems” [cf. Jonassen 2004]. The interaction of individual knowledge, experience, and heuristics in the sense of “productive thinking” [“produktives Denken”, Duncker 1963] directs the observable problem solving process. Therefore, knowledge (factual or procedural) is of high importance. Undoubtedly, factual and procedural knowledge is important for artistic design processes as well; however, individual experiences and abilities have a greater amount of influence. This so-called “implicit knowledge” stands out for difficult teaching / imparting. Hence, the term “intuition” is more often used than the term “knowledge” in this context. However, the described conditions, which are typical for the technical design process, are at the same time significant for the artistic design process; aspects of “intuitive knowledge” show also a great impact on the technical design process especially in the initial state. These observations correspond with the thesis of the continuum with its poles, the technical and the artistic design process.

In addition to the described individual conditions, external conditions are important for all design processes. They include on the one side orientation towards relevant rules and standards and on the other side orientation towards each particular task or problem (table 1).

Table 1. Comparison between the poles of the design processes using the criterion “conditions”

	technical design process	artistic design process
common features	<ul style="list-style-type: none"> - Orientation on cultural standards, rules, and symbolic systems - Importance of (factual, procedural, and heuristic) knowledge and abilities - Importance of personality traits (e.g. sensitivity, creativity) 	
differences	<ul style="list-style-type: none"> - Given problems with relatively straight definition of the aim / object or work - Restricted usage of material (guidelines) - Knowledge of different ways of solution strategies necessary 	<ul style="list-style-type: none"> - Given problems with relatively “open” definition of the aim / object or work - Relatively non-restricted usage of material possible - Knowledge of different artistic techniques necessary

3.2 Description of the process

Both in the technical and in the artistic design process, a subdivision of the general process in phases or stages is assumed. Therefore, it is possible to structure the course of technical and artistic design processes with the help of particular characteristics [for the technical field, cf. Pahl & Beitz 1997]. To what extent structural, sensory, or semantic changes are involved in the process, cannot be discussed at this point.

Nevertheless, a change between phases of individual activity or passivity of the individual can be demonstrated. In this way, common features between the technical and the artistic design process regarding the course of each design process are observable. For all stages of the design process (technical and artistic pole of the continuum) the importance of “externalizations” (sketches, notes, and physical models) should not be ignored (figure 1). These “externalizations” make an important contribution to problem analysis, reflection of ideas, and their realization and communication as well (cf. Sachse 2002; Buxton 2007).

One additional possibility to distinguish between the technical and the artistic design process is the description of the transformation from the idea to the object / work (forming process) as following a linear manner or not. Especially for the artistic design process there are less algorithms leading the course of the designing activity. In fact, it could be shown that the designing person tries and compares various ideas and solution strategies: this is described by the term “divergent course”. In contrast, the technical design process – based on unambiguous descriptions of the aim and known solution strategies – stands out for a comparatively algorithmic and linear (convergent) course.

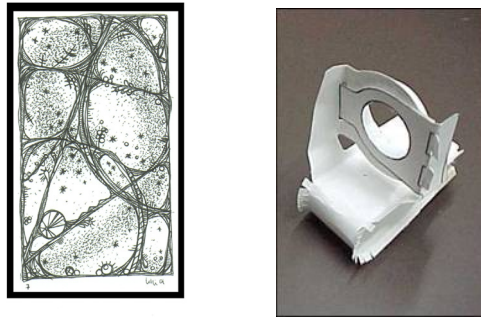


Figure 1. Artefacts in artistic (left side) and technical (right side, collection Styner & Bienz, CH) design processes

Thus, value has to be attached to individual influences and experiences (e.g. heuristics) whilst analyzing the artistic design process. Nonetheless, the initial state of the technical design process (e.g. design and construction of completely new objects) including the clarification of the task or the problem and first approaches to the design concept is not necessarily described by a systematic, goal-orientated, and linear course of planned actions; this process could rather be regarded as a so-called “opportunistic” problem solving process [Hayes-Roth & Hayes-Roth 1979]. Hence, knowledge found and characterized as being important for the solution is gradually integrated into the process of problem solving (table 2).

Table 2. Comparison between the poles of the design process using the criterion “process”

	technical design process	artistic design process
common features	<ul style="list-style-type: none"> - Differentiation from random actions - Course characterized by phases or stages changing from rather “active” to rather “passive” phases - Phases of the design process characterized by varying duration - Constant interaction between idea and action - interaction between internal and external action components - Gradual integration of knowledge in the problem solving process 	
differences	<ul style="list-style-type: none"> - Convergent and rather linear search for problem solution - Use of algorithms 	<ul style="list-style-type: none"> - Rather divergent search for problem solution - Use of heuristics

3.3 Criteria to finish the design process

In context with the technical design process, a condition can be assumed in which e.g. idea, material, task, or problem and the individual methods of working are combined satisfying objective goal conditions like functional demands or technical feasibility. Should this condition be reached, complex material models are created to anticipate the prototype (figure 2).

For the artistic design process, there is no objectively optimal aim in the sense of an optimal solution. Therefore, it has to be taken into account that the criterion to finish the design process in the artistic field is determined by an interaction of e.g. individual, external, and formally-aesthetic demands. At the same time, the course of the artistic design process itself is at least as important as the occurring object / work. As a consequence of the lack of objective criteria, the results of artistic design processes are difficult to compare. This is observable between works of various designing individuals as well as various works / objects created by one designing person (table 3).

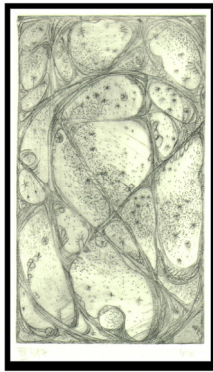


Figure 2. Artistic (left side) and technical (right side, collection Styner & Bienz, CH) realization of ideas

Based on the presented criteria, it is quite apparent that there are common features as well as differences between artistic and technical design processes. So, common features can be assumed characterizing a fundamental, general design process whereas the presented differences refer to the divergence of technical and artistic design processes (figure 3).

Table 3. Comparison between the poles of the design process using the criterion “criteria to finish the design process”

	technical design process	artistic design process
common features	- Existence of one criterion/ criteria ending the design process	
differences	<ul style="list-style-type: none"> - Existence of an objectively optimal aim - Importance of functional demands or technical feasibility - Given finality of the course 	<ul style="list-style-type: none"> - No existence of an objectively optimal aim - Importance of formally-aesthetic criteria (e.g. laws of Gestalt, “Gestaltgesetze”) - Orientation on the design process itself, finality of less importance

By the description of the technical and the artistic design process, it is apparent that the artistic design process contains technical aspects and the technical design process artistic aspects as well. These features can be found in the course of each particular process in various parts. Though the abstracted common features of technical and artistic design processes do not permit the conclusion that the same process is described, they rather describe the poles of a continuum of design processes.

With regard to the continuum, those disciplines and problems are of special interest, which could be characterized by both technical and artistic demands – and which in their course consist of artistic as well as technical phases / stages. Depicted on the continuum, these are disciplines arranged in various distances from the poles (technical and artistic design process). Among other disciplines, the design process observable in the discipline “Technisches Design” (Technical Design) can be described as such a “mixture discipline” containing features of artistic and technical design processes (cf. Uhlmann 2005).

For the discipline “Technisches Design” the following characteristics arise from the described criteria: To work successfully on a problem or task in the field of “Technisches Design” as well as in any other “mixture discipline”, there are various necessary conditions. Apart from the knowledge of cultural standards, rules, and symbolic systems, the use of knowledge (factual, procedural and heuristic) and

various abilities are as useful as individual characteristics like sensitivity or creativity. The design process is understood as working on a given problem or task which can be divided into various sub-problems. These sub-problems are related either to the technical or the artistic field by their characteristics. Depending on the sub-problem actually worked on, the process is experienced by the individual as rather structured and to be solved in a “linear” manner or relatively open and non-restricted (with regard to material, tools, and techniques). Therefore, a rather convergent course with linear search for the problem solution (use of algorithms) alternates with a rather divergent search for the problem solution based on heuristics. Finally, various criteria are used to end the work on the sub-problems: Functional demands or technical feasibility in connection with technical sub-problems and, on the other side, formally-aesthetic criteria (for artistic sub-problems) represent the criteria to finish work on each particular sub-problem.

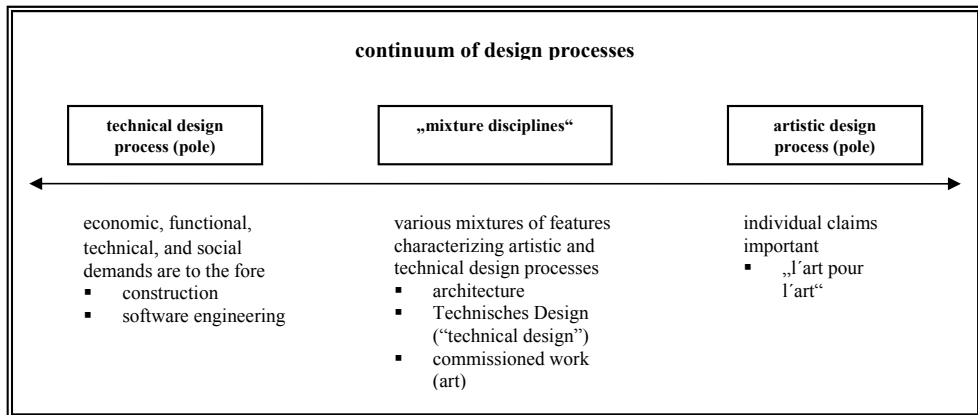


Figure 3. Illustration of the general design process

Although it might seem obviously, sub-problems and the working on these sub-problems can neither be seen as being independent from each other nor following a linear course. At the same time, it has to be taken into account that the sub-problems are dependent on the given (general) problem. As a consequence, the work on the general problem and all sub-problems will show a course extremely individual – depending, for example, on individual knowledge, abilities, and experiences. In accordance with these assumptions, it is obvious to assume not only the general problem influencing all sub-problems but the sub-problems affecting each other as well (e.g. solution strategy, working style).

In the following steps, it will be examined to what extent these characteristics – derived from the theoretical assumptions of the continuum of design processes – can be found in individual design processes in the discipline “Technisches Design”.

4. Description of the design process in the field of “Technisches Design” (Technical Design)

In the following section based on the assumption of the presented continuum, design processes in the field of “Technisches Design” (Technical Design) are seen as “mixture disciplines” and therefore showing characteristics of technical and artistic design processes.

The given general and complex problem is presumed to consist of various sub-problems. Hence, the design process is understood as a *multiple and complex problem solving process*. The different sub-problems could be classified as belonging either to the technical or the non-technical / artistic pole [cf. Uhlmann 2005] of the described continuum. These sub-problems – as well as the general problem – stand out for the indistinctness of the initial state and the aim, the impossibility to derive the solution

from known solution strategies, and the iterative course leading from the initial state to the aim. Furthermore, it is expected that the problem solving process will not follow a linear or hierarchical course; rather there will be an irregular course and at the same time extremely individual alternation between the different problem fields (or sub-problems) or various levels of abstraction [for the field of construction Hacker 2005]. This is accompanied by the thesis that there is an interaction not only between sub-problems and the problem solution processes but between the resulting solutions as well. These sub-problems and their solutions are not only interacting with each other but with the general problem or task, too. In dependence on diverse studies in the field of construction, it can be presumed that in relation to working on these sub-problems and the general problem an opportunistic and iterative but at the same time systematic course occurs as well [cf. Hacker 2005]. Hypothetical-intuitive but knowledge-based solution strategies are studied, external fixed and / or developed and at the same time assessed systematically. Once again the value of external procedures (e.g. in a verbal or graphic form) for decisions in context with the course itself should be emphasized. Based on the described external procedures or individual experiences additional and necessary knowledge is discovered. This knowledge influences the course of the strategy used to solve each particular sub-problem; however, it influences the transfer between the various problem fields (or the sub-problems) as well.

One possibility to differentiate between sub-problems relating rather to the technical or the artistic pole of the continuum is to use the described criteria. Therefore, the observation of necessary conditions or the course of the design process is conceivable. Additionally, it appears remarkable to differentiate between the sub-problems by the observable criteria to finish the particular process of a sub-problem: The point of breaking-off the work on a rather technical sub-problem is determined by aspects of functional demands or technical feasibility. In contrast, it can be suspected that rather individual and formally-aesthetical criteria (e.g. laws of Gestalt, "Gestaltgesetze") lead to the end of the work on non-technical, i.e. artistic sub-problems.

The object of the following efforts is to test the presented assumptions in the field of "Technisches Design" by various methods. To reach this aim, works / objects made or designed by students are examined. Additional results to this material are gained by field experiments, self-observations, and observations made by experts.

5. Importance of the results

The gained results can be used to draw conclusions to the course of design processes – in the view of multiple and complex problem solving and in the field of "Technisches Design" (Technical Design). These findings are not to be seen in contrast to the so-called "Vorgehensplanung Designprozess" [Uhlmann 2005] but as an enlargement of this theory.

The object of the efforts is to derive various suggestions for the support of individual design processes. These suggestions are on the one hand used to support each particular stage or phase of the design process but on the other hand the working on various sub-problems as well. This way it is possible to understand each design process as an individual course working on a special problem or task but to draft and to use possibilities to support the design process not dependent on the individual as well.

References

- Buxton, B., "Sketching User Experiences: getting the design right and the right design", Elsevier/ Morgan Kaufmann, Amsterdam, 2007
- Dörner, D., „Gedächtnis und Konstruktion“, *Psychologische und pädagogische Fragen beim methodischen Konstruieren: Ergebnisse des Ladenburger Diskurses vom Mai 1992 bis Oktober 1993*“, Pahl, G. (ed.), TÜV Rheinland Köln, 1994, pp. 150-160
- Duncker, K., „Zur Psychologie des produktiven Denkens“, Springer Berlin, 1963
- Englisch, U., Sachse, P., „Vergleich schöpferischer Entwurfstätigkeiten“, *Journal für Psychologie* Vol. 14, No. 3-4, 2006, pp. 331-347

Hacker, W., „Allgemeine Arbeitspsychologie. Psychische Regulation von Wissens-, Denk- und körperlicher Arbeit“, Verlag Hans Huber Bern, 2005
Hayes-Roth, B., Hayes-Roth, F., „A cognitive model of planning“, *Cognitive Science*, Vol. 3, 1979, pp. 275-310
Jonassen, D.H., „Learning to Solve Problems. An Instructional Design Guide“, San Francisco Pfeiffer, 2004
Pahl, G., Beitz, W., „Konstruktionslehre. Methoden und Anwendung“, Springer Berlin, 1997
Sachse, P., „Idea Materialis: Entwurfshandeln und Darstellungshandeln – Über die allmähliche Verfertigung der Gedanken beim Skizzieren und Modellieren“, Logos Berlin, 2002
Uhlmann, J., „Die Vorgehensplanung Designprozess für Objekte der Technik“, TUDpress Dresden 2005

Dipl.-Psych. Ulrike Englisch
Universität Erfurt, Zentrum für Lehr-, Lern- & Bildungsforschung
Saalestraße 4, 99089 Erfurt, Germany
Tel.: 0049-361-737-2756
Email: ulrike.englisch@uni-erfurt.de
URL: <http://www.uni-erfurt.de/LLBZ/Index.htm>