

GENERAL DISCUSSION

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What role do existing product forms play in the generation and development of new product forms? How can this role be influenced by means of design techniques and –tools? And how can these tools and techniques be augmented by means of a design support system? In the preceding chapters these three research questions have been addressed through a number of studies, using a variety of methods, techniques and experiments.

In this final chapter the results of the research presented in this thesis are now discussed on a more general level in four areas of interest: design education, design practice, design methodology and design support systems. Research as multi-faceted as this also almost inevitably leaves several aspects to be undiscussed or less well worked out. Rather than seeing them as flaws, they are considered opportunities for further, more detailed research. Thus for each of the four areas possible implications and applications, as well as with directions for future research, are presented in sections 7.1 to 7.4.

7.1 On design education

In general, design students tend to show reservation when it comes to studying existing products. All of them want to create 'new' and 'original' designs, which, of course, is a goal worth pursuing. They therefore regard the qualities of design precedents as to be avoided, since they are considered representatives of 'the old' and 'the usual'. Although they do see the need to acquaint themselves with what has been designed in the past, they usually do so in a rather superficial and unstructured way by browsing through magazines or design books, looking in

shops, watching television etc. However, in order to break with the rules, one has to know them first.

As stated in the introduction of this thesis, besides having new characteristics that make it stand out from the crowd, a new product form also has to reflect certain characteristics that make it recognizable as a member of its class. These latter characteristics can be made apparent through a typological organization of examples of the product class. Moreover, besides exposing the commonalities between the members of a class, such an organization also shows the variations that are still possible within the specific boundaries of the class. By organizing products from this specific class with products from other classes on super-ordinate and sub-ordinate levels, design knowledge can be accumulated which is not specific for a class of products. Through its typological character this design knowledge can be applied into the design task at hand, thus offering possibilities to bring in new and original design elements.

The typological approach thus offers a methodological structure for teaching the qualities of existing products to students. Elements of it have already been applied in several design courses of the Industrial Design Engineering program in Delft. The results of this thesis provided empirical support for their application. They showed that organizing design precedents into product types can be a meaningful design activity and that the results of it can have a beneficial effect on the design process. Design students demonstrated a natural ability in organizing products on a sub-ordinate level. They were able to pick up on the design knowledge that was embedded in product types provided to them in a design task and to integrate this knowledge into their own designs. By doing so, they also managed better to break away from their preconceived ideas, which are partly based on previous experiences with existing products.

Supporting the study of design precedents by means of a computer tool facilitates their acceptance as valuable sources of design knowledge, as the use of ProductWorld in an educational setting indicated. The specific design qualities of the tool, such as dynamics, interactivity and aesthetics, were found appealing by students. It motivated them to use the tool, through which they implicitly got confronted with the relationships between products regarding function, form and meaning. It is felt therefore that by using the program students might overcome

their reluctance towards studying product examples and integrating elements from them into their own designs.

Furthermore, it would provide students with insights about what kinds of knowledge can be elicited from existing products. The large variety of groups and names that were observed in the organization experiment of chapter 5, seems to indicate that design students, at least those from the faculty where this research was conducted, are missing a shared vocabulary which enables them to describe and discuss products in terms that are relevant for their design process. A version of ProductWorld, which explicitly contains such a vocabulary and examples of it's elements in the form of pre-structured organizations of products, might therefore train students in developing a common language to communicate and assess their designs. Further integration of ProductWorld and the techniques underlying it along these lines in design education, is therefore encouraged.

7.2 On design practice

How valuable are the results of this thesis for design practice, where the competition is hard and the 'time is money' gospel therefore so heavily preached? The main research questions that were addressed in this thesis were directly derived from design practice, through a series of interviews with professional designers in their work environment, indicating the relevance of precedents in design for this community. However, although all interviewees reported to be influenced in their design process by existing products, they did not appear to have any structured methods or tools in place to direct this influence. The results of this thesis are intended as a first step in providing them with both.

Grouping design precedents into product types was established as a method to organize design knowledge in a meaningful and applicable way, while a visual database was developed as a computer tool to structure and support this method. Rather than trying to assist designers by speeding up things or making them visually more attractive, efforts were thus directed to make them more aware of the knowledge they could generate and use while conceptualizing. By defining a designer as an active organizer of knowledge in a design context, the emphasis was shifted from tools that support the presentation of these

knowledge organizations, towards tools that integrally assist the designer in the actual formation of these organizations. The proposed visual database is therefore not a pre-determined collection of design precedents, but an environment which facilitates and encourages the designer in creating his own structured body of design knowledge. Through it the designer enriches his understanding of existing design solutions; their mutual relationships, similarities and differences, details and nuances etc.

Will design professionals pick up on and invest in these ideas and apply them in their own design process? Building up a database of design precedents requires a substantial investment from the designer. Other methods to acquire knowledge on existing products, such as browsing through magazines or surfing on the Internet, might at first seem therefore more appropriate, but they are less in-depth and usually contain a lot of noise (misinformation, dead-ends and distractions). Their looseness has the advantage that it supports the free-flow of thoughts and ideas, without having to make clear-cut judgments or decisions. At the same time, however, the results from such methods are usually very project-specific and momentary, which makes their application in other situations difficult. A typologically organized archive of design precedents bypasses this problem, which makes its application more general and permanent. Moreover, its structured-ness induces a mind-set different from the more explorative methods, having the designer looking at more detailed and fine-grained levels. Thus the two approaches could supplement each other well, each having its own specific value in the design process.

In a design office the database can have multiple functions. It can act as a central archive base, to which each designer in the office can contribute his own organizations. Having a structure such as the proposed three typologies in place to guide these organizations, enables the creation of a shared knowledge base, in which expertise from different people and disciplines is stored. Such a knowledge base would create a mutual understanding within the design office by providing materials for discussion as well as a language for debating about them. Besides knowledge of existing products the database might also hold visual information on user environments, target groups, lifestyles etc, which, if linked to the products, could enrich the database's applicability. Indexing products into the

database could also be done as a self-standing design technique within a team of designers. Collecting and selecting the products to be indexed, debating and determining possible criteria to assess them on, as well as the activity of organizing them, all provide valuable insights and food for thought.

Finally, a database of products can also facilitate the communication between designer and client. Because of its specific character the dialogue with the database proceeds through tentative suggestions rather than hard prescriptions. This makes it possible for the designer to address in a discussion statements from the client like "I want something like this" or "Our product should be different from those". Thus designer and client together could explore the solution space of the product to be designed, building up a shared understanding which might prevent lack of clarity later on in the process.

7.3 On design methodology

In this thesis considerable attention has been devoted to the actual outcome of a design process: the actual physical product or artifact. In design methodology such attention is rare, its focus having been mainly directed towards analyzing the nature of the design process. This has resulted in the development of several prescriptive design methods, which aim to organize and manage the process by breaking it up into smaller steps, implicitly suggesting that by dedicatedly following these steps the quality of outcome of the process will improve. However, in its enthusiasm to describe and organize the process of design, design methodology seems to have neglected the establishment of criteria to measure its quality other than process-oriented ones. A well-managed process seems to automatically imply a 'good' process, independent of the quality of the resulting design.

Kroes (2002) therefore states that design methodology has to start addressing questions concerning the nature and the quality of the products to be designed if it wants to keep up its normative stance. In his view products have a dual nature: on the one hand they are physical objects, designed to perform a certain function, on the other hand they are intentional objects, which have to communicate this function within a context of intentional human action. It is the

job of the designer to translate these functional intentions into a physical structure that makes it possible for the user to realize them. The question of how designers are able to bridge the gap between functional and structural descriptions should thus have a prominent place on the research agenda of design methodology. Furthermore, Kroes argues that the design process and the designed product are so closely related that a better understanding of the first can only be achieved by acquiring more insights into the latter, and vice versa.

Thus, instead of the organization of the design process, the development of the designed product should become more the focus of research. This thesis provides support as well as some openings for this. The nature of products has been addressed through the establishment of three product typologies, which together make up a framework for describing products in terms of design knowledge. The connections between these typologies enable the designer to identify relations between forms, materials and certain kinds of functions, as well as between forms, materials and socially and culturally determined uses of products. In doing so the framework even goes beyond the dual nature of Kroes, in that it is not limited to a product's primary function but also takes into account its secondary functions, which realize a product's social and cultural intentions. As such, the typological framework provides design researchers with a possible instrument to describe how designers move from these functions to a structural description of a physical artifact.

The research in this thesis suggested that this transition might come about through the 'displacement of concepts'. According to this process, designers alternate between different levels of organization in order to bring problem-independent design knowledge into the process of generating and developing new product forms. Organizing precedent designs into product types would facilitate such a displacement and the results of chapter 4 indicated that designers, who were provided with such product types, were indeed able to pick up on and apply such pre-organized knowledge into their own design situations. Moreover, they appeared to be better able to break away from their preconceived ideas than designers who received randomly organized product examples. Making typological organizations has therefore been identified as a valuable design

technique, and the results of chapter 5 showed organizing products on a sub-ordinate level to be a natural activity for designers.

The research also introduced the construct of a pre-concept, defining it as the mental representation a designer has stored in memory for a product. In a pre-concept a designer's existing, preconceived ideas regarding a product's function, form and meaning, are organized on a basic-level. According to the theory, pre-concepts can thus function as points of departure in the development of new concepts. However, the high degree of typicality of a pre-concept might also have a restricting effect on the designer, in that it presents such an 'obvious' solution to the problem at hand that the designer is unable to move away from it. This adherence to pre-concepts has been defined as a 'fixation' effect. In the design experiment of chapter 4, pre-concepts have been made operational by having designers create a visual, non-linguistic representation of a product in a limited period of time. It was expected that under these conditions the subjects would externalize their most typical representation of the product. The results of the experiment showed a high correspondence between the pre-concepts and the concepts that were created in the design task. Thus pre-concepts seem to play an influential, yet barely understood part in the design process. Further research is therefore needed to shed more light on the nature of pre-concepts and to develop techniques to overcome their possible limitations.

Finally, throughout this thesis designers have been regarded as active organizers of design knowledge in a design context, who manipulate a geometrical form into a solution for the design problem at hand. This perspective thus has the organization of the design product as the focus of attention, instead of the organization of the process. Several questions can be further addressed to elaborate the findings of this thesis, in which this perspective can be used to guide experimentation and analysis. Do designers exhibit certain patterns in switching from basic-level to super-ordinate or sub-ordinate levels and how do these patterns reflect themselves in the actual product form? Do certain patterns result in products of a better quality? Will having designers make typological organizations of products themselves result in similar, maybe even stronger, effects on their designs? Does the perceived naturalness of organizing products

also hold true when assessing products from multiple product classes? And what is the role of the designers preconceived ideas regarding the product form in its actual development? Besides the fact that the answers to these questions would contribute to the demystification of the creative process, they could also direct the development of new design techniques and tools.

7.4 On design support systems

This research started out from the observation that the computer tools currently on the market were falling short in supporting designers in the form-creation phase of the industrial design process. Ten years later this observation still holds true for the most part. Although computers have become much more powerful in terms of speed and memory, their capacities are still largely applied by designers to do things faster, more efficient and with less failure, rather than more innovative and explorative. Thus computer tools today are still not integrated into the creative process to the same extent as traditional tools, such as pencil and paper, whose qualities might be less easily apparent, but much more suited to the idiosyncrasies of this process.

Initiated by the results of a contextual inquiry of the form-creation phase and supported by theoretical considerations, a visual database of design precedents was developed as a tool to support designers in the generation and development of new form concepts. Following the 'research through design' approach a number of user interface prototypes of the database were built. Their richness both in design quality and user experience has turned out to be an important factor in acquiring feedback and acceptance from designers. Not surprisingly, designers are sensitive to qualities like aesthetics and expressiveness, which were therefore given more weight in the interface design than processing power, storage capabilities or presentation possibilities. The high degree of interaction provided by the new indexing and retrieval techniques, as well as their visual character, were also valued highly by designers. It makes the tool immersive, requiring an intense level of active involvement from its users.

This involvement is considered crucial, since the design knowledge that is embedded in the database only presents itself to the designer through a series of

(inter)active engagements. ProductWorld could provide more opportunities for having such engagements by becoming more merged into the whole experience of designing. Currently ProductWorld is an interface to a self-standing application, which means that its use requires a dedicated effort by the designer. By integrating some of its functionality's with other, even non-design related, activities, the design knowledge could be presented to the designer in less prominent ways. For example, ProductWorld might act as a kind of screen saver, showing random organizations of product samples when the user is not active for a certain period of time. Or it could be further developed into a collage making tool, in which previously-made organizations of products, people, environments, etc., act as possible templates to structure the composition of the collages. ProductWorld has been designed primarily as an implementation of and support for a typological approach that only takes complete products into consideration. It could also, however, with some modifications and in a less formal way, be used to categorize other design resources, such as parts of products (knobs, buttons, panels etc.), color-samples, material-samples, etc. Currently Ianus Keller, a member of the ID-Studiolab, is conducting research into some of these aspects (Keller and Stappers, 2001). His work concentrates on those collections of visual materials that are created by designers, sometimes without conscious thought (folders with images, boxes with material samples, etc.), aiming at identifying the value of these collections in the design process and supporting their creation with new tools and techniques.

Overall the development of ProductWorld has provided valuable insights in designing computer tools for designers, indicating the followed approach to be fruitful, though intense. Designing and implementing prototypes that are rich in terms of realism, interaction and aesthetics enables the researcher to integrate criteria, considerations and experiences from theory, experiments and practice into one coherent and balanced design. Thus the prototypes become research instruments, in that they act as platforms for testing ideas, concepts and hypothesis. However, the actual building of these prototypes is a time-consuming process, which requires access to design qualities and capacities as well. Thus the approach is probably best suited for designers with an interest in and feeling for research, or vice versa. Otherwise an infrastructure should be in place which

encourages the integration of research and design. The ID-Studiolab, in which context this research was conducted, provides such a structure. In its short history it has already proven to be a stimulating environment for this kind of research.

THE END!