TOWARDS A REDEFINITION OF PRODUCT DESIGN AND PRODUCT DESIGN EDUCATION

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ABSTRACT

Today product design and screen-based interface design merge increasingly in the product world. This requires a shift in product design education. But merely integrating usability into product design will not suffice. Product design and usability do share common goals, but they also differ in their methods. This paper illustrates the relationship between the two disciplines and will recall product design's long tradition of user-centred design and the contrasting misconceptions of design in the usability community. It documents a brief history of two design and usability approaches. Based on an analysis of how design disciplines have been defined traditionally, a redefinition of product design—based on user activity—is proposed and its relevance for design education is discussed.

Keywords: design disciplines, product design, use, user activity, usability, affordance, workflow

1 INTRODUCTION

Everyone would agree that telephones are products. On today's telephones however, hardware keys disappear and their functionality is replaced and extended by virtual interfaces. Most people would probably still consider a touchscreen-based telephone a product. Screen-based interaction is the very core of products like today's smart phones. Shape, colour and material of the hardware still have their relevance, but the quality of screen interaction has become increasingly critical for the success of products.

This raises the question of what products are today and how product design education is meeting these challenges. The solution could be easy. Why not just add some usability modules to the curriculum? This would be in the tradition of human factors engineering and ergonomics, but is probably no longer appropriate. To make matters even more complicated, both the design and usability fields claim to be experts in user needs. In order to understand the intersections and the delimitation of design and usability, this paper will take a closer look at the history of affordances and workflow optimization. This will illustrate product design's long tradition of user-centred design, but also highlight the contrasting misconceptions of design within the usability community. In the second part of the paper a redefinition of product design that comprises interaction and interface design is proposed. Up to the present, design disciplines have been defined based on the tools or processes used by the designers. Based on the author's experience in corporate user interface design and teaching experience in interdisciplinary study programs, a user-centric definition of product design that is founded on user activity is proposed, replacing traditional designer-centric definitions.

2 DESIGN AND USABILITY

Both design and usability are young disciplines with different origins and traditions, yet they have overlapping domains. Both plan, create, and shape interactive systems—but their views and methods differ. Usability has its origins in ergonomics and cognitive science, which again have strong roots in military research [1]. At least in the early days of this discipline, the aim was to fit machines to humans in order to be more efficient and effective at war [2]. This narrow focus on efficiency is still characteristic of many usability approaches today. It was only in the last ten years that usability professionals discovered "joy of use" and "hedonic qualities" [3] [4] and have empirically proven (!) that good-looking products are "perceived as being more usable" [5]. From a design perspective this does not sound new, but it is probably not true either. For instance, a clear and sophisticated layout is always both good looking and easy to use at the same time. If we assume that the user's experience is

the significant measure for ease of use, then a well-designed product is not only perceived as being more usable, it simply *is* more usable.

2.1 Misconceptions of Design in the Usability Community

The image of design suffers from multiple misunderstandings. Probably the oldest is confusing art and design. In his best-selling book *Designing Web Usability: The Practice of Simplicity*, Jakob Nielsen writes: "There are essentially two approaches to designing websites: the artistic ideal of expressing yourself and the engineering ideal of solving a problem for a user" [6]. Of course design is not about expressing yourself (probably even contemporary art is not about expressing yourself anymore). And of course the design community has to disagree here, it has been said that it is exactly the other way around: Designers are concerned with both the user *and* aesthetic quality [7]. Of course engineers have a great tradition of solving technical problems, but this is the domain of *utility*, and not usability. Especially the stereotypical software engineer is said to be content as soon as "it works". Nielsen has a background in computer science, and in essence he says that design is not only useless, but actually threatens usability: In his view it's either design *or* usability.

Coming from cognitive psychology, Donald Norman developed a different and more differentiated concept of design and its relation to usability. In his book *Emotional Design* [8], Norman argues against a narrow-minded focus on measurable efficiency. While stressing the relevance of design for the success of products is valid, at the same time he reduces design to the emotional stimulation of the user. Emblematic for this concept of design is the book's cover, which features Philippe Starck's infamous, hard to use lemon juicer, which fuelled a heated debate about the objectives of design in 1990. Norman basically says: We need usability (rationality) and design (affect) to sell products.

2.2 Origin of Misconceptions

Why do designers sometimes fail to create usable interfaces? The first designers who migrated into the emerging discipline of multimedia in the early 1990s were mostly trained as plain graphic designers. Whereas product designers were not proficient in software tools for creating interactive media, graphic designers could easily adapt to two-dimensional screen design. Furthermore, graphic designers are well trained in structuring content and presenting it appropriately. But what if media content is not composed of text and images but is based on user activities and interactive processes like transferring money, booking a hotel, selling used books, or writing messages? In these cases graphic design skills are not sufficient. In process-based types of media the design of interaction, workflow, navigational structures, affordances and feedback is also essential. A graphic designer lacking these skills will most likely create beautiful but ultimately unusable interactive media. This is what happened in the 1990s and it is the reason that many people today associate expertise in these domains with usability rather than design.

2.3 Two Examples for Common Ground

In some cases, the criticism of attractive yet unusable media may be justified. There is however a design discipline that is consistently forgotten in this discourse, one that has been concerned with user needs since its very inception: product design. The legacy of product design and the common ground shared by usability and design will be demonstrated by the following two examples: Affordances and workflow optimization. Cognitive psychologist James Jerome Gibson introduced the term "affordance" in 1977 [9]. Originating in psychology, the theory of affordances migrated to software design methodology and usability. In recent years it has also been discussed in product design circles [10] [11] [12]. This paper does not focus on the methodological aspects of affordances and workflow optimization, however, but rather on their history and on related approaches in product design.

2.3.1 Affordances

One important factor that contributes to a product's ease-of-use is its being self-explanatory to the user. A well-designed consumer product, be it an analogue artefact or a digital interface, should be usable without reading a manual in advance. Affordance is a paradigm that aids in the design of artefacts that tell users what they can do with them and how they can do it. The theory of affordances describes how we perceive our environment and how we anticipate possible uses of objects. Gibson's main merit was to overcome the strict split between subject and object, or mind and matter in the theory of perception: "[…] the information to specify the utilities of the environment is accompanied by information to

specify the observer himself, […] to perceive the world is to coperceive oneself." [13]. Thus affordance is neither an attribute of a thing in the world nor does it exist only in our minds. It is between the potential user and the object, determined by both and belonging to both. In *The Psychology of Everyday Things*, Donald Norman simplified Gibson's theory by shifting the focus to the pragmatic question of how to use affordances in order to make products self-explanatory: "When simple things need pictures, labels, or instructions, the design has failed" [14]. Norman presents some examples of well-designed doors, which communicate the way they are to be opened, and also some bad solutions with wrong affordances, which mislead the user. But like Gibson he focuses mainly on describing theory and principles.

The usability community widely acknowledges Gibson and Norman as fathers of the theory of affordances, and it has become one of the basic concepts in usability engineering and software design. With the migration of screen-based interaction into the product world, usability methods get adopted by product designers. Most of these are valuable and helpful, like the theory of affordances. But the concentration on psychological theories has almost eliminated people's awareness of the achievements of traditional product design in that area.

Several approaches have existed in product design and design theory that deal with affordances, even before Gibson introduced the term in 1977. As early as 1960, Klaus Krippendorf designed a chess game with chess pieces that visually express possibilities and constraints of moves. Hence form carries a meaning, which is relevant for understanding the rules of the game. Later Krippendorf elaborated his approach in theory, method, and practice and called it "product semantics". In his latest publication he states that design is not about form, but about meaning [15].

In 1976 Jochen Gros published an article about "*Sinn-liche Funktionen*" a hardly translatable pun— functions that are sensual, or perceived by the senses (*sinnlich*), and functions that make sense i.e. carry meaning (*Sinn*) [16]. Based on his theory of an "extended functionalism" he introduced several additional functions that complement the classic practical functions of a product. In the 1980s Gros and his colleagues at the design school HfG Offenbach published a series of books about what they called "product language". One of these volumes was about "indicator functions"—features of a product that indicate possible user actions, the product's "nature", its orientation, adjustability, and others. In contrast to the psychologists Gibson and Norman, Gros and his colleague Richard Fischer provided a rich collection of case studies and diagrams. By doing so, they did not only formulate principles and define requirements for the design of affordances, but they put them into practice and application, showing how theory can be translated to design method [17].

2.3.2 Workflow

In the classic functionalist approach the designer's task was seen as translating functions into simple, basic forms. This has been rightly criticized for not reflecting the origins and contexts of functions. Today we know that functions are not naturally given but are a collective construction, and that an objective one-to-one translation of function into form remains an illusion. Usability engineering has developed a series of methods to analyze and model user activity and workflows, thereby defining the range of functions of interactive products. Product designers can learn and profit from these approaches, but should not forget that their own discipline has a tradition of user-centred work and that this tradition has always comprised workflow and process design, even though these terms were not used by designers in the past.

One of the first examples of design that was based on workflow analysis is the Frankfurt Kitchen developed by Margarete Schütte-Lihotzky in 1926. Inspired by kitchens in railway dining cars, the Frankfurt Kitchen was to become the prototype of today's fitted kitchen. Influenced by Taylorist theory and using time and motion studies by Christine Frederick [18], the layout of the Frankfurt Kitchen is the result of what today is called workflow and process optimization. The aim was to improve the conditions of household work by minimizing working paths and introducing ergonomic heights and proportions [19]. Considered a milestone for the 1920s, the concept of applying industrial methods to kitchen work was later criticized as inhuman. By focusing too much on *work*-flows the social and communicative functions of the kitchen were neglected [18]. Today's discussion about usability and its traditional focus on efficiency and measurable error-rates repeats some of these arguments—but almost a century later.

3   THE DEFINITION OF DESIGN DISCIPLINES

3.1 The Physical View

The traditional definition of design disciplines has been based on the physical properties of what is to be designed. The physical output of graphic design or visual communication is usually two-dimensional, whereas hardware products are three-dimensional. Sticking to that classification scheme, interactive media is in some cases considered to be four-dimensional (virtual three dimensions, plus time). With today's convergent products, which combine virtual and physical interfaces, this category system becomes more and more problematic—and with it the traditional exclusive focus on 3D in product design education.

3.2 The Tools View

Today the physical output of designers' work often is different from the traditional one. Some product designers today use 3D tools to design screen-based interfaces. Windows XP Media Player skins, for instance, were modelled and rendered in 3D—by product designers whose daily work has been the design and engineering of traditional hardware products [20]. Still, designers using 2D tools design the majority of interactive media. Print and interactive design both employ 2D tools and therefore require common skills, like layout and image processing. It is probably this overlap of skills and tools that is the reason that many design schools have included interactive media in the discipline of visual communications or graphic design departments rather than in product design (see figure 1).
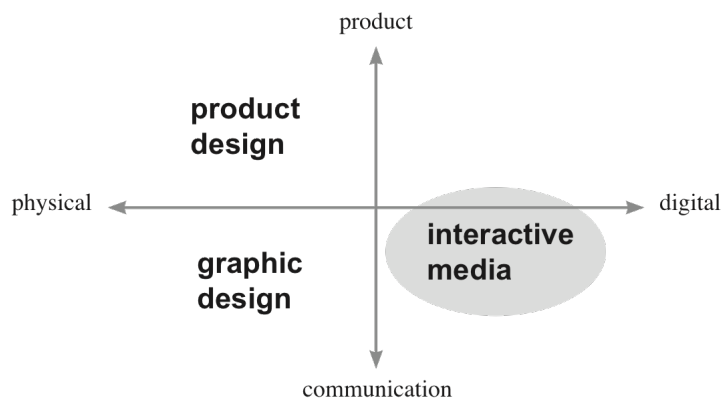

Figure 1. Location of interactive media in design education today

3.3 The Subject Matter View

What is the subject matter of design? Gui Bonsiepe claimed that "the domain of design is the domain of interface", i.e. all design can be defined as interface design, where the function of the interface is the structural coupling between user and artefact. This redefines product design as structuring the user's possibility-space of acts, and redefines visual communication as granting access to the information content, in both cases by providing an interface to do so efficiently [21]. I consider this a seminal definition, but its focus is the end product of the design process and not so much the process itself. The final outcome of the design process is the interface, and by defining the interface, possible user activity and interaction is fixed. But the design process is extensively concerned with modelling possible user activity and ways of interaction, or with structuring and processing content. The interface is "only" the materialization of these processes. This leads to the conclusion that the subject matter of product design is processes and interaction. The subject matter of graphic design is communication and accessibility of content. Therefore digital and physical artefacts can be categorised into two distinct classes: process-oriented and content-driven. (Of course this does not exclude hybrid forms)

3.4 The User Activity View

The physical view, the tool view, and the subject-matter view are all views from a designer's perspective. In order to construct a definition of the category "product" that is appropriate for today, we have to take the user's perspective and forget about the tools used and the physical condition of the product. If we look at user activity, there are artefacts that are used to inform and provide us with

content. In this case the user is rather passive, his or her activity is mainly selecting from the offered content and processing information. With the other type of artefacts users work, play, trade, communicate with someone, etc. These I consider to be *products*, regardless if digital or physical. Products are process-driven artefacts, their domain is *use*. The counterpart are content-based artefacts, their domain is *information*.

3.5 Product Design as design of processes of use

The subject matter view and the user activity view speak in favour of a product design definition that is based on the categories of process and use. In these domains the tools may in some cases be the same, but the conceptual skills - the way of thinking - differs strongly from content-driven design and communication. Figure 2 shows the topography of a redefined product design discipline, combining the design of physical hardware products with interaction and interface design of virtual products, all merged into a process-driven discipline with expertise in how to design for use.
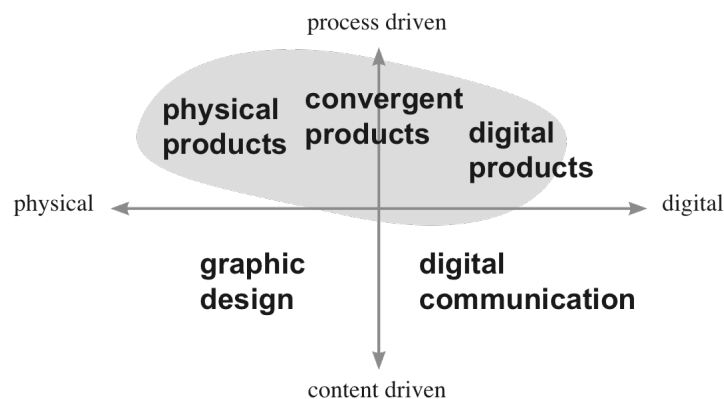

Figure 2. Process-driven product design merging physical, convergent and digital products

3.6 Relevance for Design Education

The methods and skills of traditional product design and graphic design differ significantly. But there are also many different types of expertise needed in the digital domain. Today a good graphic designer should be able to create content-driven corporate websites. Integrating interactive and online media into graphic design programmes has reflected this demand. But most product design study programmes lack interaction and interface design. Even if students focus on classic hardware design later, methods and principles learned in interaction design and usability are valuable for the design of easy-to-use products. This is not a proposal for a strict division of design disciplines, quite the opposite is intended: The first step would be an integration of interaction design into product design education; the second step would be establishing integrated design programmes that combine all these aspects in one programme. The idea of integration is not new at all, there are several integrated design programmes, but in most design schools product, graphic, and interactive design are still separate disciplines. When we take into account how the digital world has become ubiquitous in products and communication, integration has never been as necessary as today.

4   CONCLUSION

The traditional segmentation of design into two-dimensional and three-dimensional disciplines is no longer appropriate. Today a profile of product design can neither be based on dimensionality nor on designer's tools, but solely on the way artefacts are used. With the increase in screen-based interaction we can no longer reduce product design to three-dimensional shapes. Product design has to be redefined as the design of processes of use. Usability and design share some common approaches and can profit from each other. In order to create the innovative products of the future, product design education has to integrate interaction and interface design into its curricula. Otherwise usability specialists will dominate conceptual work and interaction design—leaving product design with the leftovers: the styling of the inert hardware shell, without any relevance for use and interaction. This could be easily avoided if product design rediscovered its strength in understanding user concerns and faced the challenge posed by digital and convergent products.

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