INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
8 & 9 SEPTEMBER 2011, CITY UNIVERSITY, LONDON, UK

AESTHETIC, STRUCTURAL AND FUNCTIONAL TRANSPARENCY IN DESIGN

Bente Dahl THOMSEN and Klaus MADSEN
Department of Architecture, Design and Media Technology, Aalborg University

ABSTRACT
Aesthetic, structural and functional transparency has proven to be highly suitable triggers in creative product development, where the aim is to achieve clear articulation of the promotional values. During the analysis of competing products, the three transparencies are usable for focusing on form, structure and function as a basis for clarification of the design specification. Such decoding of product values is supplemented by considerations about what subtle leading feature can foster an integration of structural and functional aspects into an aesthetic form that can capture the potential buyers' attention and since help the user to benefit by owning the product.
Through comparison of the results of five fifth semester terms, we have observed that the three transparency terms play different roles depending on in which product category the design is created.
This article illustrates and discusses the use of aesthetic, structural and functional transparency as a mean of clarifying the articulation regarding which qualities a product achieves.
Before it was made clear that the goal for the product development was to achieve aesthetic, structural and functional transparency the argument for the aesthetic qualities was usually unclear and it was very much up to the partner himself or together with his marketing people to clarify what qualities the product should be marketed on.

Keywords: Aesthetic, structural, functional and transparency, zen aesthetics

1 INTRODUCTION

The purpose of presenting aesthetic, structural and functional transparency as a decoding model in the analysis of existing products' qualities are that such an analysis together with user studies, can serve as a basis for clarification of what qualities the product category is expected to have. Transparency analysis also opens the students' eyes to the fact that aesthetic as well as structural and functional aspects must be clarified and put into perspective for their own solution.
In the architecture and design area analysis and synthesis puts the form, structure and function into the centre of attention with the three transparencies as the starting point. This classic division of the analysis has its roots in the Roman architect and engineer Vitruvius. His division of architecture into form, structure and function are also central to the modern architecture and design theory, which emerged in the wake of industrialism and its new requirements for manufacturing, engineering and standardization, where matters related to product's and building's form, design and usability have been discussed. We can prioritize venustas, utilitas and firmitas differently, but all three aspects have to be regarded [1]. Thus the aim is that design teams can come from transparency analysis of masterpieces to new proposals of artefacts with transfer through establishment of the design specification for the integration of an aesthetic expression. A clear structure and well-chosen functions in an entity, which clearly differentiates itself from the profusion of products. A product only has artistic merit – qualifies as an artefact - if it has significant aesthetic qualities, according to Søren Kjørup [2].
When the design team focuses on aesthetic, structural and functional transparency from the beginning of the design process a dilemma emerges. Partly due to the fact that analysis and the clarification of design parameters are naturally divided by the type of transparency and partly due to the fact that the generation of ideas is divided into sketching regarding aesthetic expression, structure and functionality to reduce the complexity of the initially treated issues. Also the division provides an opportunity to base sketching on different means such as clay to quickly clarify ideas for aesthetic expression, rods and orbs to determine principal structures and cardboard models to test ideas for functionality. The

result of such separated sketching processes often leads to an aesthetic expression, structure and functionality which on their own might seem ideal solutions but rarely form a unified expression when brought together. This entity dilemma triggers most teams as they have set up the ideal goal for both aesthetic expression, structure as functionality in the design specification and want to fulfil them, but the team must recognize that the integration of the ideal solutions into an entity is contingent upon a prioritisation of the goals.
Through five project courses with five external partners and with approx. 25 students per semester, it has been found that especially in the design processes regarding products for which the aesthetic qualities are essential for sales promotion of the product category, the use of the three transparencies have an innovative effect. Given that only the team, which from the beginning of the process has clarified the aesthetic idea manage to develop a product with aesthetic qualities.
The external partners came with the following tasks to the students: In 2010 NJA furniture Ltd wanted a proposal for a multifunctional storage furniture for young people who have just bought a small city apartment. In 2009 VTI Ltd, who produce edge glued panels, wanted a proposal for use of their products in regards to cheap furniture and suggestions for improving the image of edge glued panels. In 2008 Karup Partners Ltd, who produce futon sofa beds wanted a proposal for a sofa bed which directed the attention of new buyer groups to their furniture. In 2007 KEBE Ltd, who produce cold foam furniture, wanted a proposal for dining / lounge chairs with comfort. In 2006 A. P. Furniture wanted a proposal for cheap and ergonomic chairs with footrest for the elderly people.

2 TRANSPARENCY TERMS

The transparency term can be divided into phenomenon bound, literal and meaning-bearing. Phenomenon bound [3] allows users to get a quite ambiguous insight into the product through analysis of the occurring phenomena which interact with each other without the individual phenomenon disappearing. A product with transparency in the sense of phenomenon bound has a metaphysic characteristic which is lucid and the product is able to appear in various states or with varying expressions. Forms or shapes can either be perceived as being added or subtracted depending on the solid angle, movement or illumination we experience them in [4].
Transparency in the sense of the word literally is physical ‘see-through’ and that allows the viewer to ‘see’ through the product or through its surfaces. We also talk about the literal aspect when material allows transmission of electromagnetic waves, sound waves or other natural phenomena.
Transparency in the sense of meaning-bearing [5] is linked to how readable a product is, i.e. how clearly the product communicates its identity in all aspects. Louis Sullivans, ideal about ‘form follows function’ is an ideal of modernism, which is based on the fact that function, construction and the material itself generate the expression of the product. Mies van der Rohe formulated the quality of transparency in the sense of meaning-bearing as: ‘Simplicity of construction, clarity of tectonic means, and purity of materials reflect the luminosity of original beauty’ [6].
In relation to aesthetic, structural and functional transparency the previous division of the transparency term can sometimes help to facilitate the analysis. The phenomenon bound aspect would then be central to the aesthetic transparency, the literal aspect to the structural transparency and the meaning-bearing aspect to the functional transparency.
Within a given attention pattern, we also talk about cognitive weak transparency if it is only transparent for the design team, but not for others, which categorical properties ones attention should point at and that the team can explain whether the product actually possesses these properties. ‘The development of the attention pattern begins in early childhood, where Western parents typically draw their children's attention to objects: objects and their categorical properties, while Eastern parents draw more emphasis on areas: social structures and feelings, as the centre of the child's attention’ [7]. Similar we talk about cognitive strong transparency when both people who have and have not been part of the design team can explain the product's categorical properties.

2.1 Aesthetic transparency

Aesthetic transparency implies that it is immediately possible to acknowledge the aesthetic qualities of a product [8]. The aesthetics must consist of fixed properties of the product or its interaction with the user / viewer. Peer F. Bundgård justifies this as follows [9]: ‘There is nothing in the matter with the fact that there are other laws, stability and consistency principles than the purely predictable. For as long as there are fixed properties of aesthetic objects, if in a way the existence of these properties can

be inferred from a description, and so far it is possible to ascribe the term ≈property↔ or ≈structure↔ a real categorical content, then one can easily speak of objective knowledge'. The Architecture & Design education at Aalborg University prioritize the products aesthetic properties just as much as the structural and functional properties, thus the students are encouraged to make their statements about the products' aesthetic qualities so clear that the statements really outline the properties of the design. The choice of aesthetic properties is limited to design qualities that represent positive experiences. Similarly, the students are delimited from using properties that give rise to wonder, as a consequence of the result being weird and does not live up to Raymond Loewy's old motto 'most advanced, yet acceptable'.

2.2 Structural transparency

Structural transparency is occurring when users understand the product's structure. This kind of transparency is especially necessary for products which the users themselves must be able to assemble and for products where the functional changes are dependent on the users capability to modify the structure, typically multifunctional tools with one driver and several pieces of accessories such as multi-tools that can drill, screw, saw and sand. Structural transparency generally refers to the organization of elements and it is necessary to get information about the interrelationship between the internal parts. When the functional transparency ensures that the user understand how a machine works, the structural transparency ensures that the user can decode the construction of the machine and its parts [10].

2.3 Functional transparency

A product is functionally transparent when the user can determine how it works and possible how its elements are controlled. Cognitive ergonomic products are thus functional transparent.
The transparencies relate to the one and same entity, but in the design process they are divided into smaller parts which are assigned to a form structure which is often identical to the structure of the construction, while generally the structure of the pattern of movement only concerns a small grouping of elements. The prototypes the students have produced can be divided into two external groups represented by upholstery or covered organic forms and by the non-upholstery geometric shapes. Aesthetic and functional transparency are central to the design of the first group and structural and functional transparency for the second group.

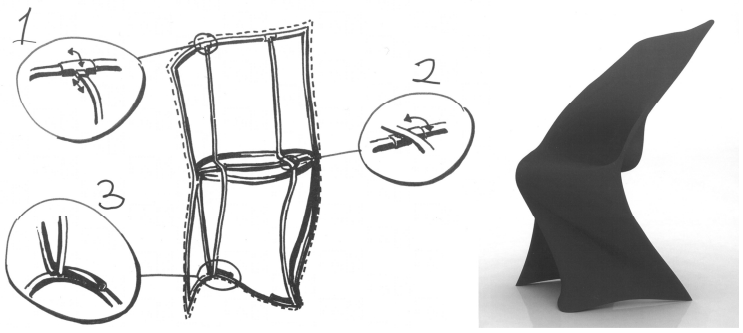

Figure 1. Structure and design of the product 'Stray' [11]

A chair representing the first group is seen in Figure 1. It is asymmetrical, appears to have a certain degree of simplicity which is caused by the fact that the chair is made in one piece and of one material. The sublime is attached to the chair's body which is as thin as the comfort permits, since the body (cold foam upholstery) is foamed over a steel frame. The design team has refrained from using artificial effects like a patterned cover and lets the foam appear with its natural body - but dyed. The whole chair waves in the short and long arcs along the edges, which gives the chair a refined lift from the floor and indicates its lightness. The base and the upward sides of back of the chair achieve a tension and the back's upper edge strikes a wave motion without fluttering. The design exceeds the rule-bound by the joining of the dynamic and dormant. The dynamic expression is seen either when we experience the phenomenon that occurs when a force enables a moving object or when something reminds us of a movement such as the phenomenon that occurs when two or more frozen movements of a movement pattern is experienced simultaneously. The idea behind the chair in Figure 1 is that a

piece of fabric is blown around a seated body and then frozen in one position. The seat's and backrest's size and their position articulate the function and make the chair functional transparent while the upholstery hides the frame so that its structure is not transparent.

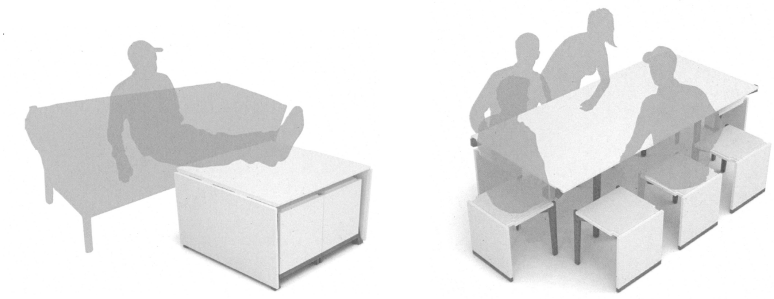

Figure 2. PLIKA - a table that can transform from one state to another [12]

The table and stools in Figure 2 represent the second group. According to the design team the table, when a coffee table, articulates: the closed and heavy and when a dining table: the open and light so that it visually takes up minimal space when it occupies most floor area. Minimalism, functional and structural transparency are prioritized during development. The operation of the lock mechanism appears even clearer than the team had wished. The mechanism's size was determined by the fact that it is a part of the table's stabilizing system - its structure. The stools asymmetry reflects the dualism between the open light and the massive closed expression. This creates cohesion with the table in both situations.

3 INTEGRATION DILEMMA

The aim is first and foremost that the students examine and discuss whether and in what extent aesthetic, structural and / or functional transparency is desirable in relation to a given product. For example we will typically prefer that a tip mechanism in an office chair seat is hidden i.e. encased, since the user are comfortable by sitting on the chair and can operate the tip mechanism without getting ones fingers caught. Office chairs' main construction can usually be decoded and are therefore structural transparent. Not all office chairs' setting options are cognitive ergonomic, but the control handle makes the features partly visible – office chairs thus has a degree of functional transparency. Instead the chairs tend to indicate the user's position in a company's hierarchy through the amount of upholstery rather than through the degree of aesthetic quality. However consultants, lawyers, financial firms and similar use aesthetic qualities to indicate prestige. Office chairs are a typical example of products where there is a possibility to vary the aesthetic, structural and / or functional transparency dependent on what the target group wants and what the producer profile is.

Design teams who have to communicate with a partner and his/her marketing people have an opportunity to get a lot of influence on what qualities the product should be marketed on, if the articulation regarding these qualities has great impact. In relation to this the articulation particularly about aesthetic quality causes problems for both students and producers.

With the purpose to train the articulation regarding aesthetic quality, we take basis in different sources of inspiration. In regards to the aforementioned furniture projects the articulation about the aesthetic qualities have been inspired by Zen aesthetics, because Shin'ichi Hisamatsu [13] expressed these in seven parameters or characteristics which are an ideal basis to provide a variation of the expression of aesthetic quality on equal terms as functional, structural and technical qualities. Hisamatsu is acknowledged for studying and identifying the essential aesthetics of a cultural expression that emerged in China, Korea and Japan. Similarly architect Jens Hvass has seen Zen aesthetics as an opportunity to renew the Danish architecture. In regards to this Hvass states that: If occasionally we managed to ask ourselves and each other what we want with our forms, what drives our work, why we do as we do when we work and what content we consciously or unconsciously incorporate into our work, there would be a large potential for change in considerations like these' [14].

Shin'ichi Hisamatsu's attention pattern was more directed towards the design process than the artefact however with the same holistic aesthetic entirety as Western designers are working with, even though the individual characteristics are assessed. According to Zen aesthetics, designers may strive to bring

means as asymmetry, simplicity, sublimity, naturalness, subtlety, freedom and tranquillity in play. The intention is that all means must at least be tested. Zen aesthetics go behind the cultural phenomenon and by this they are attached to transparency in the sense of phenomenon bound. On the basis of Zen aesthetics, the students have experimented with Hisamatsu's means in a way that they strive towards:

1. Asymmetry - by working with the irregularity that is obtained by deforming a perfect symmetrical form.
2. Simplicity – by using as few tranquil means as possible to reach the uncomplicated.
3. Austere sublimity - by reducing the object and its coherence to the essence.
4. Naturalness - by avoiding the artificial and the strange.
5. Subtle profundity or deep reserves - by working with the curious and small sophisticated differences or details in complex interplay.
6. Freedom from attachment - by making ourselves familiar with all regulations and laws.
7. Tranquillity – by using elements of a figure which directs one's mind to rest.

There have not yet been opportunities to investigate if these interpretations of Hisamatsu's parameters are quite adequate to Western customer's attention pattern. The intention by using Hisamatsu's aesthetic qualities was only to exemplify how the aesthetics may be articulated and how a parameterization can be performed.

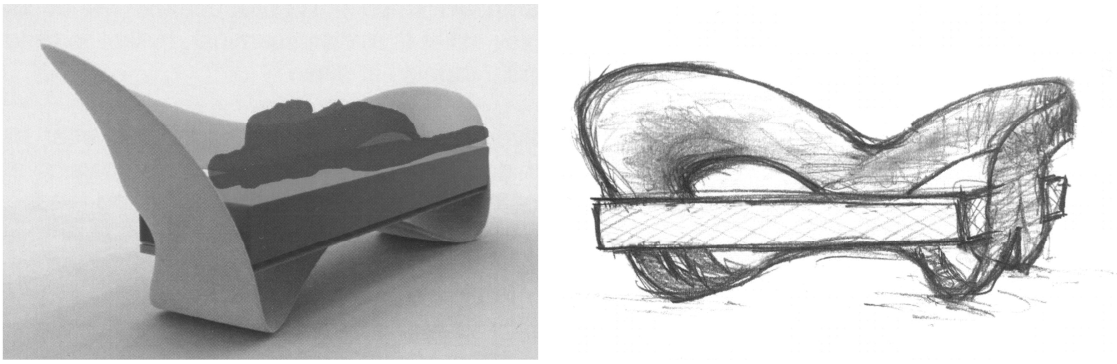

Figure 3. Semiotic sketching - a dynamic ribbon on a static mattress [15]

The furniture that students have prepared in the referenced course of term ought to differ from the archetypal furniture and have an aesthetic expression, therefore the students were also encouraged to make semiotic sketching, which together with material studies may promote a unique form and texture. The design team behind the sofa bed in Figure 3 worked with the aesthetic characteristics: asymmetry, dynamics, organic form (inspiration a butterfly), simplicity and subtlety. Furthermore, the form was adapted to the themes contrast and lightness. The structure is partially hidden in the upholstery. For a multifunctional furniture such as a sofa bed it is obvious to communicate functionality directly to the user, but the team found that it would put too much focus on the sofa bed function and that it would destroy the 'AHA' experience that lies in the fact that the extra function is hidden.

If the design process seeks to clarify the potential in achieving aesthetic, structural and functional transparency, and balance the desirability of achieving one or more transparencies in relation to other requirements and desires for the product, it will lead the design team to articulate the design specification's parameters so clearly that the goal is clear to all. Not surprisingly, it was the teams that were able to prioritize their wishes and carry out a systematic selection, that reached the most clarified products. Which teams had the best ideas may be coincidental, but the teams who got the transparency dilemmas set up experienced a synergistic effect since the goal was clear, and even a weak idea of the main function then developed into a clarified product. It obviously implies that the team does not reverse their priorities because of time pressure, because another solution seems immediately easier to realize. The team behind the sofa bed in Figure 3 skipped their idea for the aesthetic expression and ended up with a good but less innovative design.

4 EXPERIENCE GATHERING

Whether the transparency analysis and the following idea generation, divided into three sections, clarify the articulation about the qualities and whether the analytical knowledge was an asset, is judged

on the basis of, respectively, the students' arguments for aesthetic qualities and on whether the prototype expression reflects the argumentation. Some of the students try to reduce the transparency requirement by equate the meaning-bearing aspect with aesthetic transparency and by doing so forget that a product can easily communicate that it is a chair without having any aesthetic qualities. As mentioned the prioritizing of aesthetic, structural and functional transparency may depend on the product type. Frequently the students more or less consciously deselected one transparency. The reason why the students chose to deselect a transparency was:

- For the multifunctional storage furniture in 2010: Because the 'AHA' - experience was based on a hidden functionality.
- For the cheap furniture in 2009: The aesthetic qualities was confined to the materiality and surface treatment of edge glued panels, so only subtlety.
- For the futon sofa bed in 2008: Because the functional transparency would put too much focus on the bed function.
- For the dining / lounge chairs in 2007: The structure was absent or hidden in the cold foam upholstery.
- For the cheap and ergonomic chairs in 2006: The structure was partly hidden in the upholstery.

Designs from 2009 and 2010 had strong structural and weak functional transparency, designs in 2008 had weak aesthetic and some weak structural transparency and designs from 2006-2008 had weak aesthetic and functional transparency.

For future works it can be pointed out that it would be obvious to carry out a clarification of whether the essential aesthetics in the Western and Eastern cultural expressions are sufficiently similar so that the Zen aesthetics' seven parameters are readily translatable to the Western attention pattern and can be used as an assessment criteria, or only used as a source of inspiration for designers compiling their own assessment criteria as in this study. Likewise the content of the means designers must strive to bring into play should be clarified, since it is clear that the present interpretation is not adequate since such a concept as simplicity in both cultures embraces the duality between simple and bearing of meaning at the same time.

REFERENCES

[1] *Arkitektonisk Helhedssyn* Temagruppe 7, Projekt Hus, 2000 By- og boligministeriet, http://www.statensnet.dk/pligtarkiv/fremvis.pl?vaerkid=12582&reprid=0&filid=0&iarkiv=1 (accessed 2011-01-25)

[2] Kjørup, Søren 'Kunstens Filosofi – en indføring i æstetik' 2000 Roskilde

[3] Rowe, Colin & Robert Slutzky, (1971) Transparency: Literal and Phenomenal Perspecta no 8

[4] vhttp://web.mac.com/davidrifkind/fiu/library_files/rowe%20slutzky%20transparency.pdf

[5] Forty, Adrian *Words and buildings*, 2000 New York p 288

[6] Neumeyer, Fritz *The Artless Word: Mies Van Der Rohe on the Building Art* 1991London p 314

[7] Brinkmann, S. (2004) *Rejseberetning The 28th International Congress of Psychology*, p. 27 http://www.psy.au.dk/fileadmin/site_files/filer_psykologi/dokumenter/CKM/NB36/beijing.pdf (accessed 2011-01-25)

[8] www.wikipedia.org/wiki/transparency_%28philosophy%29 (accessed 2011-01-25)

[9] Bundgård, P. F. *Kunst semiotiske beskrivelser af æstetisk betydning og oplevelse,* 2004 Copenhagen p 11

[10] Bueket, H. (2005) 'Internet, E-Government and Information Access' Statement Fachkonferenz, KAS-Länderbüro China

[11] Sort, M, &, C. Kæseler, H. Hjort, A. Nikolova *Stay,* Partner Kebe A/S Rapport Arkitektur & Design 2006 Aalborg

[12] Hansen, R. & J. Jacobsen, A. M. T. Tygesen, A. Dancker-Jensen, M. E. Trend *Klipa,* Partner NJA-møbler A/S Rapport Arkitektur & Design 2010 Aalborg

[13] Hisamatsu, Shin'ichi *Zen and the fine Arts* 1971 Kodansha,

[14] Hvass, Jens. *Zen-Æstetik* Proces 14 1999 Copenhagen

[15] Andersne, N. N. & J. Jønsson, U. Ö. Ásgrimsodóttir, M. A. Koppang, M. J. Nielsen *KP1* Rapport Arkitektur & Design 2008 Aalborg