

NEW WAYS OF INTEGRATING MATERIAL KNOWLEDGE INTO THE DESIGN PROCESS

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ABSTRACT

Throughout recent years a growing number of new materials have been developed. In the design studio context, this has led to the emergence of physical material libraries making the information much more accessible.

The access to information on new material possibilities has also changed the way designers integrate knowledge about materials into the design process. This means that the traditional design process model, where the selection of materials takes place after the design of form and function – based on technical performance, no longer apply.

Accordingly the approach in this paper is to view information about materials through the perspective of organizational memory and technology brokering.

This paper is built upon two cases from the design studio: designaffairs GmbH. The study reveals how the designers use socio-cultural tendencies to select specific materials before the products form and function are designed. The materials are selected based on the visual and haptic qualities of the materials rather than technical data. One of the cases further illustrates three types of material search strategies, which the designers apply in the early phases of the design process.

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1 INTRODUCTION

Although the approach to a design project may differ widely from designer to designer, the main focus in the traditional design process is on form and function. In design process books i.e. *Design Basics* (Heufler, 2004) or *Product Design and Development* (Ulrich & Eppinger, 2005) materials are noted briefly as part of technical, financial and ecological factors to be considered in product design. But during the process of solving a problem and designing a product, materials are barely mentioned and there are no indications about how to integrate them and their abilities with the form and function of the product. Meanwhile entire material libraries are emerging all over the world, some using their libraries externally solely for guiding manufacturers, designers and production companies in finding and selecting materials, they then create a contact to the manufactures (materia, 2012; materialconnexion, 2012), other libraries are used internally in design companies. Every design firm has their own well-kept methods and experiences about storing and applying the materials to products. However it is clear from practice that knowledge on materials are starting to be used in a different way and in a different part of the process, that it is described in the traditional design process models. We find, that there is a gap between the way the use of material knowledge is described in process models and how it is integrated in the design process in practice. Accordingly this paper aims a reviewing the new links between material library knowledge and the design process. This help the use and integration of new materials, leading to more innovative products.

When talking about materials and material libraries in this article, it is used as a joint word covering the areas of materials, colors, patterns, surface finishing and production technologies, as these are often gathered in the same material library.

In this article we view the large database of information and physical samples that the material library is, as part of the organizational memory as described by Walsh and Ungson (1991) to describe some of the challenges of finding and retrieving the information stored and how this might be done efficiently. To describe the retrieval process and how to bring the materials into the design process, we look at how Hargadon and Sutton (1997) describes technology brokering and link it with Schöns (1983) description of how professionals think when working.

We present two case studies from German based designaffairs GmbH (hereafter designaffairs) to show how they conduct a material workshop for a client company and how they use their material library internally at the Shanghai office in a Color, Material, Finishing and Pattern (CMFP) project. In the second case we detect three types of search approaches in their in-house material library. One that corresponds with Schöns (1983) description of how professionals think when working using experience, one that fits well with the proactive work described by Nielsen et al. (2012) Between the two a more structured search showed how the designers search by different criteria based on sensorial characteristics rather than technical specifications. A search type that we believe could be used in most design projects in the early phases, even before the first brainstorm and concept developments to search the material library for relevant inspirational materials.

1.1 The material library as organizational memory

Walsh and Ungson (1991) suggest that there may not be a specific definition of organizational memory, but that it: “in its most basic sense, organizational memory refers to stored information from an organization’s history that can be brought to bear on present decisions.” (p. 61)

A material library fits well under this description as its basic function is to store material samples and information about these. Although many materials may not have been put to use yet they are still stored within the company and ready to be retrieved and put to use.

Walsh and Ungson (1991) go on to explain that the process the information stored goes through three steps: 1) Acquisition, bringing the information into the organization. 2) Storage, keeping the information within the organization until it is needed. 3) Retrieval, locating and bringing the information back to solve present problems. Walsh and Ungson (1991) and especially Hargadon and Sutton (1997) emphasizes that it is the people of an organization and their network connections that acquires information, as the information is brought in by individuals through problem-solving and decision-making activities. Their information does not become part of the organizational memory until it is shared within the organization so it may be retrieved by others. “Through this process of sharing, the organizational interpretation system in parts transcends the individual level. This is why an organization may preserve knowledge of the past even when key organizational members leave.”

(Walsh and Ungson, 1991: 61). Both Walsh and Ungson (1991) and Hargadon and Sutton (1997) argues that organizational memory may not be stored only in the memory of individuals but also in artifacts. One designer at IDEO describes how he has the prototypes and products from past projects stored in his office, and how each of these objects may remind him of the entire process and the ideas that went into the project. (Hargadon and Sutton, 1997)

When retrieving the information from the organizational memory in a design company to create innovative products the term of technology brokering is used (Hargadon & Sutton, 1997). Here existing technology from one industry is used to solve a problem in another industry. Because this existing technology from one industry may be transformed to solve other problems or to fit a new target user group, it often appears new and creative to others. More simply put innovation is: “Original combinations of existing knowledge” (Hargadon and Sutton, 1997: 716) Often these problem solving technologies are collected from the memory of past projects or spare time interests among the designers and engineers working on the project (Hargadon and Sutton, 1997)

In the process of technology brokering the link between the project at hand, and the industry where the solution may be found is not always obvious. Hargadon and Sutton (1997) mentions how the designers at IDEO for example found the solution for the hinge in a personal computer on the wings of a toy dragon.

As the many samples in a material library may not always be brought in for a specific project, it is possible that nobody but the person managing the material library know about the materials available. At the same time some libraries today hold several thousand samples, which make it unlikely that any person is able to remember each material and all their characteristics. Considering the information given above, consulting a person that has specialized in materials is most likely to be the best way to retrieve the information stored in a material library. But such a person may not always be available to assist the ones searching for information. This makes the storage and especially the retrieval process of special interest, as it becomes essential to the success of a material library.

Hargadon (2002) describes how he found that many organizations hold large databases, where people are expected to enter completed projects and the experiences gained during the process, so others individually were able to access this knowledge in the effort to solve problems in future projects. He goes on to describe how the members of these organizations found this structure ineffective, and how an engineer of Design Continuum had experienced such a database that fell apart in only two weeks. The attempts to codify knowledge can work well with common known problems and searching for the typical solutions for these. “But the very efficiency of database ‘deposit-and-withdrawal mechanisms’ makes them difficult tools for finding non-obvious links between ideas” (Hargadon, 2002: 67) Searching for and trying to selecting only a few materials from thousands of samples can become very time consuming if the library is not well organized, and the retrieval of all the information stored becomes ineffective. At the same time the person searching the library for information must have an idea of what he is searching for, otherwise the search will be ineffective no matter how well organized the library may be.

1.2 Organizational memory vs. Designing

Donald A. Schön (1983) describes how professionals think when working. He describes that when working with an unknown situation or problem, the mind tries to see it as one or more situations that it has encountered in past situations. Hargadon and Sutton (1997), Walsh and Ungson (1991) and Schön (1983) all describes how the use of analogies plays a critical role in the retrieval process, because they allow the designer to link past and current design problems. In a situation where a designer may be facing a complicated problem that he has not faced before, he may try to see the problem or just parts of it as problems he has encountered before. This may also help the designer to get a better overview of the situation, and make it easier to sort out what it is that makes the problem at hand unique from previous problems.

Considering this way of thinking in the early stages of an innovative design process, where the first concepts are sketched and a direction for the project may be chosen, means that the designers will only be using materials and technologies that they have had past experience with, unless the past experience proves insufficient where after they may go look for a solution elsewhere.

Comparing the description about the thoughts of professionals from Schön (1983) with the one of Nielsen et al. (2012), these experiences from past projects can be described as proactive work. Here an example is given of two designers who designs a speaker without doing any research for this particular

project, but draws on their experience from past projects within the same industry. Hargadon and Sutton (1997) does not, in their examples from how the people at IDEO work, distinguish between whether the knowledge retrieved from past projects is brought into the project in the process of a brainstorm when generating ideas, and thereby from proactive work done by the people present, or they would face a problem that they did not know how to solve, and would have to go and actively search for a solution from other people in the firm, or externally.

According to Schön (1983) a designer is not able to make any analogies or these non-obvious links to a specific material unless he has at least some knowledge or understanding of it. Given that the materials and technologies that the designers present at a brainstorming already knows, solves the problems that they are facing to a sufficient degree, the designer is not likely to go look for other materials until later in the process, where materials that may prove to have more suitable features can be added, but maybe it cannot be integrated to the same extend.

2 METHODOLOGY

In the following section we address two of the different internal and external uses of the material library of designaffairs. The different observations, interviews and talks have been conducted during a four month stay at the office in the fall of 2012.

The first case study is a material workshop which was carried out before the stay with designaffairs, and so the study is based on an internal summary of the workshop that was conducted in China in January 2012. The workshop was pointed out by the Head of Material Technologies as the best and most recent example of these material workshops that designaffairs arranges for some of its clients, either as a single task or to kick start a project. Additional information about the workshop have been obtained subsequently through qualitative interviews and casual talks with people both from the designaffairs office in Shanghai and the main office in Munich who arranged and/or attended the workshop.

The second case study took place during the stay at designaffairs' Shanghai office. The case is based upon a Color, Material, Finishing and Pattern (CMFP) project, which designaffairs made for a European company. The European company wanted to change the image of the company and their products on the Chinese market. We had the opportunity to follow the development of product concepts, and had casual talks with the designers working on the project through the process, from the information given in a trend report to fully developed product line concepts. By the end of the project we interviewed some of the designers about the different concepts and design suggestions they had developed. The focus in the questions was on where and how they had found their inspiration for the different concepts and how they used the in-house material lab during the project for inspiration and reference. The answers are combined with observations during the project, from a desk which was physically placed next to the in-house material library, which made it possible to observe the designers visits to the material area during the project.

3 EMPIRICAL CONTEXT

In 2002 Designaffairs started their Color and Material Lab, an exhibition area where designers and clients see and feel the materials; they can arrange environments to compare materials in the process of developing new products. Today the material lab and their 100m² Material Dock in Munich contains over 2000 different materials for the designers and their clients to be inspired by. Currently the Office in Shanghai holds an in-house material library with around 300 samples, but by the end of 2012 they will have a 300m² material library available, putting 1500 samples on display, and with room for workshops and conferences

What separates the material library at designaffairs from many others is that it is part of a large international design company providing hardware, software and service design. Furthermore they also conduct market research and consult in market strategy, giving them the opportunity to combine all these areas within the company. The material library itself is one the few that focuses on product design, and there by materials and processing technologies suited for mass production.

3.1 Material workshop

The workshop presented in this first case study shows the general approach of the material workshops that designaffairs conduct for their clients. The two-day workshop was conducted in 2012 for a Chinese manufacturer of household appliances. The goal was to find alternative materials for the

exterior and interior for a high-end product, creating a new visual and haptic experience of the product for the consumers.

At the workshop designaffairs first presented a thorough analysis of the market position of the product that they were to find new materials for during the workshop. The product was then compared to similar products on the market, with special focus on their use of materials. All these analysis were conducted by using some of the tools developed by designaffairs. After looking at the current market position and the competition an extensive report on market trends was presented. By analyzing global social and cultural trends designaffairs selected a number of tendencies that was relevant to consider according to the market that the client wanted to aim the product at.

To visualize the different tendencies and make sure that everybody present at the workshop would have the same understanding of these, each direction was presented using a range of key words describing each trend in general terms, mood pictures describing the feeling associated with the trend, exemplary products corresponding to the trends and the a range of colors that are most commonly used within these trends. This gave the people a common base of references during the workshop that followed. As an example a trend named “New Sensualism” describes how some people every day is visual and sonically overloaded with information from a variety of media, and therefore seeks products and experiences that stimulate all senses or only the remaining senses. Keywords applied are: Atmosphere, human technology and emotional touch among others. The pictures and products chosen to explain this trend focuses on light and touch, creating a special atmosphere or give the products a special haptic feeling. Some of the mood pictures used can be seen in Figure 1 below.

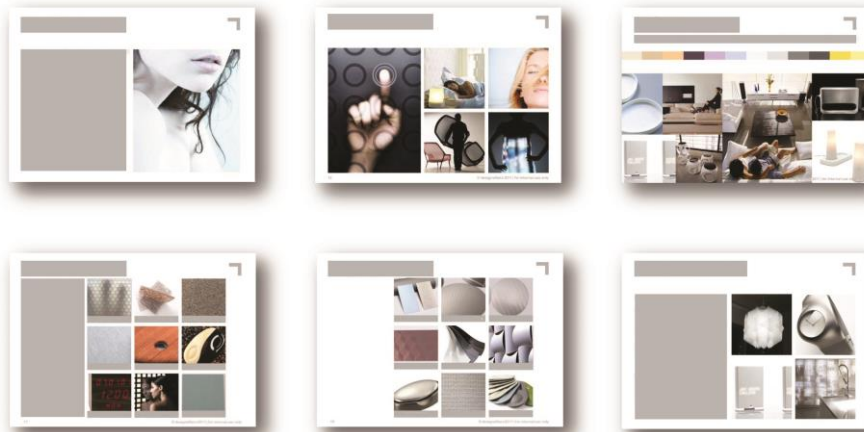


Figure 1. Example of mood pictures

In the preparations for the workshop designaffairs had selected a range of suitable materials for each trend, corresponding to the values of each one. All of which was brought to the workshop at the client company in China. As inspiration for how some of these materials could be used to create the user experiences that was described in the trend report, product examples from other industries were shown, for example to show how the medical industry creates mood light and products with a warm touch.

Throughout the following workshop material samples and mood pictures was put together based on each trend presented. Through discussions in different groups combined of people from different departments of the client company and designers from designaffairs, the material samples where combined into material boards. These boards were to display which materials that would correspond to the trend and how they could be combined, what materials that worked well as large background surfaces and which was more suited for smaller details. The materials where accompanied by mood pictures pointing out the direction that the company wanted for each conceptual direction.

3.2 CMFP project

The aim of the project described in this second case study was to change the image of a client company, which wanted to target a younger group of consumers on the Chinese market. To do this the design research team detected tendencies in the present Chinese market. The design team following adapted the products of the client to the Chinese market by changing only the exterior of the products

using different colors, materials, surface finishing and patterns that corresponded with the target user groups selected and the tendencies that each of these follow.

The trend report was a combination of social trends, CMFP trends on the market and the present and desired future brand image of the client on the Chinese market. The brand image strategy was presented using some of the tools developed by designaffairs called SimuPro and Design Style Observation tool (Designaffairs, 2012) Not much unlike the previous case study, the trends were presented using keywords, colors, mood pictures and product samples. The targeted users were also described in keywords and mood pictures describing their lifestyle and the products they buy. Based on this report each of the user groups were placed within the Design Style Observation tool developed by designaffairs, matching them up with CMFP trends.

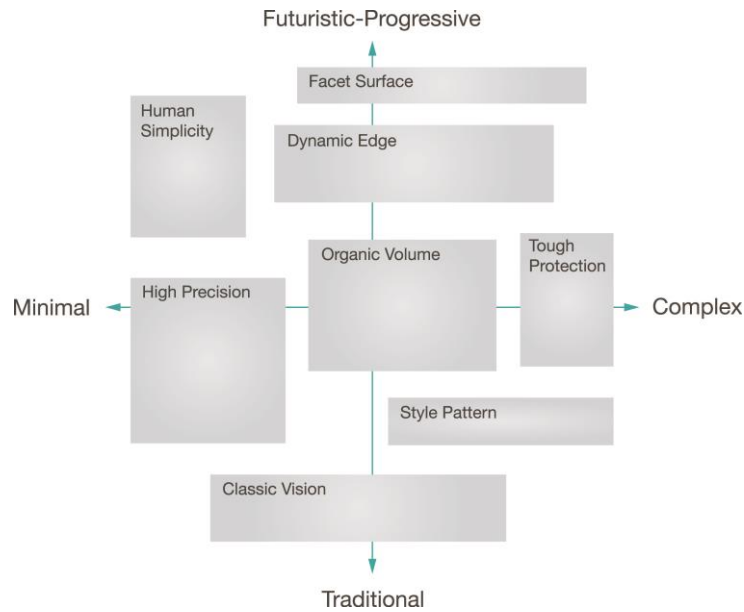


Figure 1. Design Style Observation tool (Own illustration based on the DSO tool developed by designaffairs)

Based on all this information provided by the design research team, the designers would come up with a number of concepts for each of the product lines, matching them with the target groups and their trends.

4 ANALYSIS

If we analyze the two cases from designaffairs, it is clear that the designers use knowledge on materials a different way that it is typically described in design process models. The designers at designaffairs did not select the materials on the basis of technical, financial and ecological factors. Instead they search for and select materials based on the sensorial characteristics of the materials and link them with trends and target users. As it was reviewed the material selection also took place long before the form and function of the product was designed.

Through observations, interviews and talks of the CMFP project, we have further been able to identify three search strategies the designers uses in relation to the material library and its knowledge.

In the beginning of the CMFP project the designers visits to the material area were quite fast, the designers seemed to have a very clear and specific idea of what they were looking for, and as soon as they found it, they went back to their desk. In an interview later about the process one designer mentioned: “Because this is a CMFP project, how you work depends on which of the four [color, material, surface finishing or pattern] you chose to focus on. When working only with colors you think about where or how to use them, so you don’t need to go to the material library.” This corresponds with the first kind of visits to the material library, where they knew exactly what they were looking for, but sometimes needed a sample as visual reference when making renderings.

The other two types of visits could sometimes be difficult to tell apart, but the designers would alternatively stay longer in the material area. Sometimes the search would seem quite structured as they were clearly looking for something specific, but not sure where to find it or what it was. Other

times the search would be more improvised as if they were just taking a walk looking and touching whatever caught their eyes.

Through the interviews the difference between the second and third type of visit became clear. When talking about the process of using the information in the trend report to create the concepts, one of the designers explained a concept he came up with: "I found this picture that I really liked [showing a picture of a dark building facade with warm looking orange light emitting from the entrance] and I wanted the product to have the same feeling. (...) We [the designer and the project manager] wanted to use a special material for this, so we went to the material area to find the right material [that could create this warm feeling]." The atmosphere he found in the picture corresponded well with the values he had found in the trend report about the target user group. When going to the material library they then knew what to look for, as they had the mood picture as a reference to what characteristics the material should correspond to.

When talking more about the use of the material library the designers mention that sometimes inspiration can come from a material itself that they find interesting and then afterwards transform it and apply it to a product in a way that corresponds to the target user group of the product and the trends they follow. We choose to name the three search strategies: 1) Locate and Collect, 2) Structured Sensual Search, 3) Inspirational Walk.

5 CONCLUSION

In this paper, the aim has been to show that in practice knowledge on materials and material libraries are being used in a different way than it is described in the traditional design process models.

Through the observations and information gathered in the two cases we have identified how the designers at designaffairs search for and select materials based, not on their technical data but on the sensorial characteristics of the materials and link them with trends and target users. By doing this, the designers are able to select materials for a product even before any shape has been given to the product. From our practice-based research, we have further been able to identify three search strategies the designers uses in the material library.

The first type of search strategy, Locate and Collect, resembles with the way Schön (1983) describes how professionals use past experience when facing new problems. With the second type: Structured Sensorial Search, the designers at designaffairs are able to structure a visit to the material library although they do not have any information about the technical characteristics of the material they are looking for and can select a material even before any actual form has been given to the concept.

The third type of search strategy: Inspirational Walk, corresponds with the description of Nielsen et al. (2012) about proactive work. It expands the total amount of materials that the designer knows, and opens up too the opportunity of non-obvious connections between a material and future projects where it can be put to use.

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