For Inspiration Only

ISBN-10: 905155026X
ISBN-13: 9789051550269

For Inspiration Only

Designer Interaction with Informal Collections of Visual Material

Proefschrift

ter verkrijging van de graad van doctor
aan de Technische Universiteit Delft,
op gezag van de Rector Magnificus prof. dr. ir. J.T. Fokkema,
voorzitter van het College voor Promoties,
in het openbaar te verdedigen op vrijdag 11 november 2005 om 10.30 uur

door

Adriaan Ianus KELLER

ingenieur industrieel ontwerpen,
geboren te Sleeuwijk.

Dit proefschrift is goedgekeurd door de promotoren:

Prof. dr. P.J. Stappers

Prof. J.M. Hennessey

Samenstelling promotiecommissie:

Rector Magnificus, voorzitter

Prof. dr. P.J. Stappers, Technische Universiteit Delft, promotor

Prof. J.M. Hennessey, Technische Universiteit Delft, promotor

Prof. dr. J.P.L. Schoormans, Technische Universiteit Delft

Prof. dr. ir. J.B.O.S. Martens, Technische Universiteit Eindhoven

Prof. dr. B. Laurel, Art Center College of Design, USA

Prof. G. Crampton Smith, Interaction Design Institute Ivrea, Italy

Prof. dr. K.P. Lee, Korean Advanced Institute of Science and Technology, Korea

“The best way to predict the future is to invent it” — Alan Kay

Table of Contents

Designers collect *visual material* for *inspiration*. The picture you can paste above shows part of my *personal* collection, which contains images of many kinds, advertisements and other publications on high-tech gadgets, often *from decades ago*.

I find this collection a *source of inspiration* because it provides another *perspective* on the current stream of innovations. I have *reorganized* this collection several times.

Many *friends* and *colleagues* have added to this collection, by giving me *interesting snippets*. The collection has one *basic organization*, but new material sometimes *forces* me to *restructure* it.

Paul Mijksenaar, a well-known Dutch graphic designer of way finding signage, has built up an enormous collection of signage, maps, pictograms and instructional diagrams. The collection has been the direct source for his book *Open Here,* a kaleidoscopic overview of instructional design examples that *"designers and illustrators can employ in creating visual instructions"* (Mijksenaar & Westendorp, 1999).

Marieke Sonneveld, a researcher on tactile aesthetics, is building up a collection of photographs of materials, people, animals, objects and situations that arouse tactile experiences in different ways. She aims to use this collection as a tool for designers to incorporate and communicate tactile aesthetics into their design process.

These three examples show how designers keep and grow their collections of visual material. An interactive version of Marieke's collection as well as my own historical collection can be found on the DVD accompanying this book.

Design companies such as IDEO describe their use of this kind of informal collecting to support lateral thinking (Kelley & Littman, 2001). The role of imagery in the design process has often been mentioned in literature (Athavankar, 1997; Gero & Purcell, 1998). Some studies describing the designer's working methods and workplace, notice the importance of collections of existing visual material as an integral part of the design studio (Eckert & Stacey, 2000; Kolli *et al.*, 1993). Both these studies describe how designers use visual material from their collection to make collages or moodboards. The direction of a design solution or the analysis of the target group, product group or its environment can be conveyed using existing images in composition. Most design schools, including ours, teach students how to make and use collages as a design method (Muller, 2001).

Not only designers, but many other people too collect artefacts and make categories or structures in these collections. Obvious examples are stamp collections or beer bottles, but more informal collections of magazine snippets or comic books also bear similarities to designer collections. Usually there is no clear apparent reason to collect, the collection is interesting only when it contains a certain amount of elements, with its owner trying to structure or make categories from what is available.

The collections are personal and diverse, which makes it hard to communicate and generalize them.

1.1 Marking the field

This thesis focuses on the collections of visual material that are collected by industrial designers. Collections which they use as a source of inspiration in their design process.

1 Visual material: representation, pictorial quality and carrier

So, what constitutes a collection? The 2001 Merriam-Webster Online Collegiate Dictionary cites the following entries under *collection:* [1]

1) a group, aggregate;
2) something collected; especially: an accumulation of objects gathered for study, comparison, or exhibition or as a hobby.

The American Heritage Dictionary of English Language, Fourth Edition adds to this:

3) an *accumulation*; a deposit, 'a collection of dust on the piano'.

These definitions of everyday use point out a number of key aspects: 1) shows that a collection is a *whole* which consists of *multiple elements* which share some characteristics; 2) indicates collections are dynamic objects created *by somebody, over time,* for an explicit or implicit *purpose.* However, 3) suggests that the growth of collections may not always be under *conscious control* of the user; like a garden, collections acquire a life of their own, which in turn allows them to surprise their owner.

[1] To enhance readability, the order of the entries has been changed; also, some less relevant entries, such as 'collection' as the act of forming a group of objects, have been omitted.

The collections used by designers consist mostly of visual material, such as the pictures and advertisements shown in the first example. In this thesis the term visual material is illustrated in figure 1 meaning a combination of something (e.g. electronic gadgets) represented visually with pictorial qualities (e.g. front views in a symmetrical grid) and represented on a physical carrier (e.g. glossy magazine). The combination of image and physical carrier is an important aspect that makes the difference with the commonly used term visual information.

The reason designers collect these materials is that they can use them in the design process for reference and inspiration. This thesis mainly looks at the collection as a source of inspiration. Eckert and Stacey, in their research into knitwear design described sources of inspiration as *"All conscious use of previous designs and objects in a design process"* (Eckert & Stacey, 2000), but this research also takes into account the unconscious use of and the interaction with existing visual material that brings new ideas into the design process.

1.2 Goal and relevance

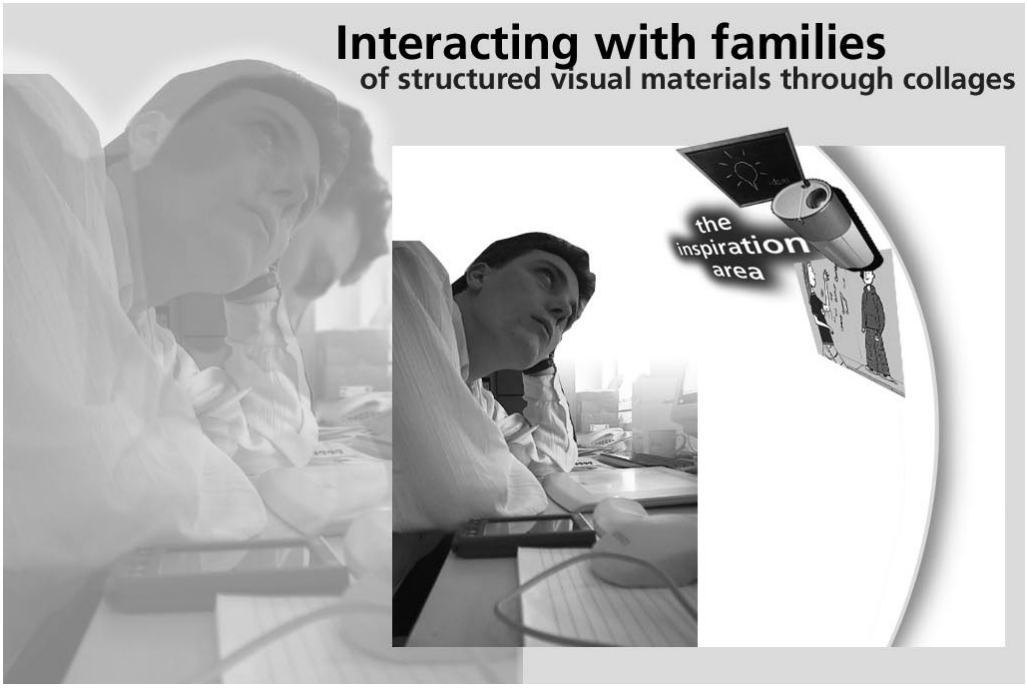
The main research questions in this thesis are: 1) how do designers currently use collections of visual material for inspiration, and 2) how can new media tools help the designer interact with their collections of visual material.

The division in the two research questions serves to on one hand to gain knowledge on how designers currently work and think and on the other hand to use this knowledge to allow us to expand our capabilities.

For science, the relevance is in finding out how designers think and work. By looking at the role of visual material this can take us another step closer to finding out where designers get their new ideas. Both the mechanisms in theory and the results in practice are ingredients for these questions.

By making tools that integrate this knowledge, new ways of using interactive media and computers are demonstrated. Making computers capable of supporting creative and inspirational activities is opposed to crunching numbers and presenting data.

Finally this research addresses designers as users and users as designers. Most tools and solutions that worked for experts have found their ways into the lives of everyday people. The findings presented in this thesis and the tools developed during this research will appeal to designers as well as other users.



2 Collage made on the first day of work, interpreting the research project

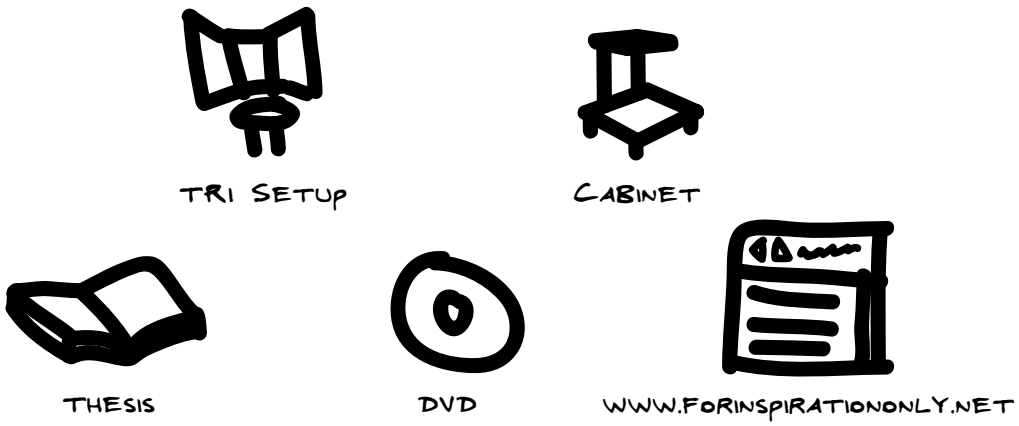
1.3 Background

This research project was started within the Ambition project. The Ambition project was initiated in 1998 to stimulate new research that connects different groups and shows relevance to design. In one of the Ambition themes called conceptualization, this research project had the original title *Interacting with families of structured visual materials through collages* (figure 2). During the course of this project the title changed to the current *Designer interaction with informal collections of visual materials.*

This research belongs in the IDEATE research line, devoted to researching and developing new tools that designers use in the conceptual phase of design (Hennessey, 1990). Since 2001 this research has become a part of the ID-StudioLab, a design research community within the faculty of Industrial Design Engineering.

The design-driven research approach fits my personal background. I am trained as a designer and have experience in the design practice. This background makes me approach the research questions as a designer, constantly trying to find opportunities for solutions from a design perspective.

At the ID-StudioLab, research and design are integrated in the *Research through design* approach, a term coined by Archer in which the design



3 The different prototypes and media used to present the work in this thesis

process is used as a form of research to contribute to a design activity (Archer, 1995). In this project we do both *Research through design* and *Research for design.* The design process is used to integrate theory and practice from different fields into working experiential prototypes, i.e. working artefacts that can be experienced. These same prototypes are used as research means to demonstrate and explore these theories. This is inherently an iterative process, similar to the design process.

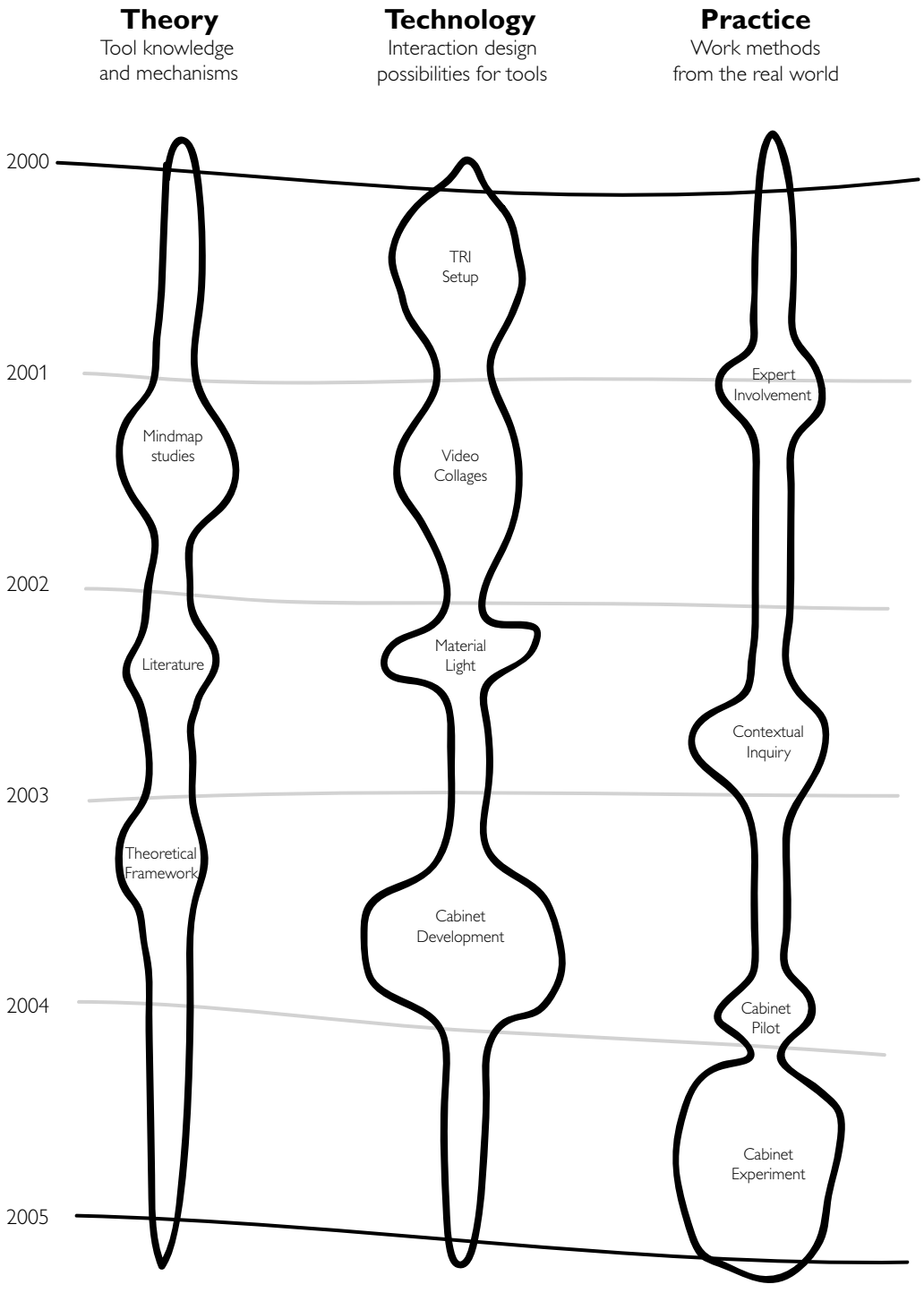
This same iterative process using experiential prototypes can also be found in the relatively new movement of participatory design or co-design (Sanders, 2004), which greatly influenced the research methods used in this study.

1.4 About the work

During this research two main research prototypes have been developed: the TRI Setup and Cabinet. In this thesis these prototypes are described in chapter 3 and chapter 5. The thesis also uses other media to present the work done. The prototypes can be experienced dynamically and interactively on the DVD accompanying this book, which includes video presentations, slideshows and interactive demos. The website at http://www.forinspirationonly.net/ presents more in-depth and up-to-date information on the research and prototypes (figure 3).

Furthermore, the two prototypes themselves are still actively used for research and often they can be experienced at the ID-StudioLab.

The printed thesis is constructed as a grouping of publications from the author divided into different chapters. These chapters can be read separately, which means that the field and background may be repeated in the beginning of chapters. These introductions are always written for different audiences



4 Timeline of the research project

from a different perspective and will therefore still offer new information, even when read in its entirety. The thesis follows a chronological order, but some of the activities were done in parallel or developed over a longer period of time (figure 4).

All the work done in this research involves some common themes. The theories are taken from multiple disciplines, theoretical constructs are verified in the design practice, prototypes are created as a means to demonstrate the effects of both theory and practice and these prototypes are used in expanding our knowledge of theory and practice. Designers and researchers have participated in every phase of the research, not only as users, subjects or experts, but also as cocreators, peers and inspirators.

1.5 Outline of this thesis

The work in this research continuously relies on three pillars: 1) theory, 2) technology, and 3) practice. Chapters 2, 3 and 4 look at these three pillars separately. In chapters 5 and 6 the three pillars are integrated.

In chapter 2 the theoretical framework for this project is constructed and described. The chapter starts with an article describing the method to use participatory design techniques to direct theory formation. The conclusion of this article gives an overview of the theoretical framework itself integrating different fields.

Chapter 3 looks at technology and presents the TRI Setup as a first working prototype. This chapter describes the new ways of looking at body-scaled interaction and expressive use of new media and the lessons learned from that.

In chapter 4 the design practice is visited to find out how designers collect visual material in a contextual inquiry using sensitizing through cultural probes. From this contextual inquiry opportunities for new tools are identified and the considerations for such a tool are defined.

In chapter 5 the development of Cabinet is described and the design is specified. The Cabinet uses the knowledge and experience from the previous three chapters and integrates it into a working prototype.

In chapter 6 the working prototype is put back into the design practice to find out if our findings hold up in practice.

Chapter 7 concludes with a general discussion on what we learned and the impact of these results.

LITERATURE REFERENCES 1

Archer, B. (1995) The nature of Research. *Co-design,* (2), pp.6-13.

Athavankar, U.A. (1997) Mental imagery as a design tool. *Cybernetics and Systems* (28), 25-41.

Eckert, C.M., & Stacey, M.K. (2000) Sources of inspiration: A language of design. *Design Studies, 21* (5), pp.523-538.

Gero, J., & Purcell, T. (1998) Drawings and the design process. *Design Studies, 19* (4), pp.389-430.

Hennessey, J. (1990) *The Designer's Toolkit.* Proceedings of the 22nd International Seminar on Industrial Design and CIDA Congress, Taipei and Tainan, Taiwan, pp.2-16.

Kelley, T., & Littman, J. (2001) *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm.* New York, NY: Currency.

Kolli, R., Pasman, G., & Hennessey, J. (1993) *Some considerations for designing a user environment for creative ideation.* Proceedings of the Interface '93, North Carolina State University, Raleigh, NC, pp.72-77.

Mijksenaar, P.P., & Westendorp, P. (1999) *Open here: The art of instructional design*. London: Thames & Hudson.

Muller, W. (2001) *Order and meaning in design*. Utrecht: Lemma.

Sanders, E. B.-N. (2004) *Design and the empowerment of everyday people.* Presented at a lecture at TU Delft.

This chapter describes how I set up the *theoretical framework* for this research project. *Practitioners* and *researchers* from different parts of the field were involved to provide fresh perspectives on *designer collections of visual material*.

The chapter is based on a paper accepted at the *Journal of Design Research*. It describes the *rationale*, *method* and *results* of involving experts with *mindmapping techniques* for their interaction with collections of visual material. In the last sections it gives an overview of the literature included in that framework.

In this chapter I look at our phenomenon critically from a *research method perspective*. The big shift in thinking that resulted was, that designer interaction with their collections does not benefit from optimized *"image database query systems"*. Instead, designers get *new insights* in the *activity* of *organizing* and *growing* their collections.

This work was done in early February to March 2001 and resulted in a theoretical framework that was used in the remainder of the project.

ABSTRACT

Participatory Design Techniques have been successfully applied to let users inform and guide designers in their design projects; in this chapter we present how these techniques can be used to let designers inform and guide researchers in setting up a theoretical framework. The approach is specifically useful for multidisciplinary fields, such as design research, where many disciplines from anthropology to design methodology intertwine. The goal of this technique is to find insights that are covered across instead of within disciplines, and to narrow the ingredients down to a manageable amount. The participatory design approach has been proven to be successful in design user studies, by adopting research techniques from ethnography and the social sciences. In this study, the approach has been used as a bootstrapping technique to create a theoretical framework for the problem of designer's interaction with visual materials. In this research designers are looked at in their role as users of design tools. Using these participatory design techniques the author constructs a framework tuned to the phenomenon. The framework combines both the richness of everyday experiences with theoretical constructs presented in literature.

This chapter is largely based on: **Keller, A.I., & Stappers, P.J.** (accepted) Codesigning a theoretical framework with reflective practitioners. *Journal of Design Research.*

2.1 Problem

Many disciplines intertwine when researching the tools designers use for early concept generation. Research in such a multi-disciplinary field is built on both theoretical knowledge and practical experience in tool development (Stokes, 1997). This requires collaboration of disciplines such as cognitive science, social sciences, design methodology, media research, human-computer interaction and computer science. In some aspects these disciplines work well together but in other aspects these disciplines stay close to their own paradigm. For example, in the literature on image collections there is surprisingly little overlap in the image management (the technical angle) and image classification (the library angle) research (Cawkell, 1992).

In this multi-disciplinary setting, what is the theoretical knowledge needed to support a research project? Because a grand unified theory does not exist, we need to take ingredients from different disciplines for each research project. Then again we need to make a relevant selection; it is not possible to cover all the disciplines and every aspect available. By looking at a phenomenon from different viewpoints, but on the level of everyday experiences, a framework can be constructed that facilitates further research and development. In this respect, multidisciplinary application-minded research bears many resemblances to design projects, rather than to formal scientific studies conducted within an established paradigm.

To achieve such a framework one must escape the bias of a particular field; there is a need to stay removed from the different domains before setting up the theoretical framework. Given the fact that every researcher is always in some way hindered by bias from his or her discipline, a method is needed to avoid premature commitment to frameworks or concepts. This problem of fixation is well known in design (Oxman, 1999; Pasman, 2003).

2.2 Possible methods

Several methods exist for establishing a scientific framework for a research problem (Babbie, 2003). A literature search gives you access to the insights found by your predecessors. Often interviews, observation techniques, experiments and statistical analysis are used to expand and deepen on existing insights. Most of these techniques require you to start out with a theoretical framework and build on that. A contrasting approach is practiced in Grounded Theory, where theory is developed inductively from a corpus of data, by studying transcripts and labeling variables and their interrelationships using different types of coding (Glaser & Strauss, 1967). This approach, in which theory emerges from real-world observations, is also applied to literature search in Grounded Theory. In later publications on Grounded Theory (Glaser, 1978) researchers are advised to read widely

1

2

3

4

5

Examples of different ways in which designers keep their collections of visual material.
Part of an inventory by the author.

1 Box of cards
2 Computer
3 Stack of magazines
4 Photo wallets
5 Cabinet with organized (left) and unorganized (right) drawer

while avoiding the literature most closely related to the research topic before gathering and analysing data. This makes Grounded Theory useful, but difficult to combine with existing theories and literature.

In our approach we use the emergent aspects of working directly with real-world observations, values and opinions as a bootstrapping technique to integrate existing theories into a theoretical framework.

2.3 Approach

To find the categories, keywords and constructs that form the basis of our theoretical framework, we use knowledge elicitation techniques with people that are familiar with our research problem, either through professional or academic experience. These techniques come from the field of participatory design (Sanders, 2002). Participatory design is a relatively young movement that aims to make the end user an active participant in the design process. To achieve this goal, the participatory design techniques use a broad range of methods from anthropological research. Particularly in Generative Tools, these methods are combined with methods and techniques from design (Stappers & Sanders, 2003).

Generative Tools help participants to open up about the phenomenon being researched. By making expressive artifacts such as collages, flowcharts and even models and by presenting and talking about these artifacts, the user shares insights, often not mentioned in interviews, which are rich in content and context. At all times the user is encouraged to take initiative and is seen as the expert in the domain of his or her personal experiences.

Participatory design has been successfully used in several design projects to give a direction for further design process (Laurel, 2003). In this article we propose to use these tools in design research to give directions to theory development.

2.4 Designer collections of visual material

The research project presented in this paper concerns the way designers keep and use their collections of visual material, such as advertisements, magazines and pictures. Some examples of different ways in which these collections can manifest themselves in the designer's environment are shown in figures 1 to 5. Our main research questions are 1) how designers currently use their collections of visual material, and 2) how new media techniques can help the designer in the use of such collections.

Earlier research on the designer workplace (Kolli *et al.*, 1993) have shown that designers surround themselves with rich visual material and use existing images and photos in moodboards and collages for presentation to their clients. Eckert and Stacey found that designers, in their case knitwear

designers, use these collections of visual material as a *"source for inspiration"* in the design process (Eckert & Stacey, 2000). At successful design companies homegrown collections of materials are appreciated, such as the IDEO Techbox, a cabinet filled with technical oddities, to serve as a tool for serendipity and to support lateral thinking (Kelley & Littman, 2001). In computer science, different visualization techniques have been explored to support this kind of serendipity with personal photo collections (Kang & Shneiderman, 2000).

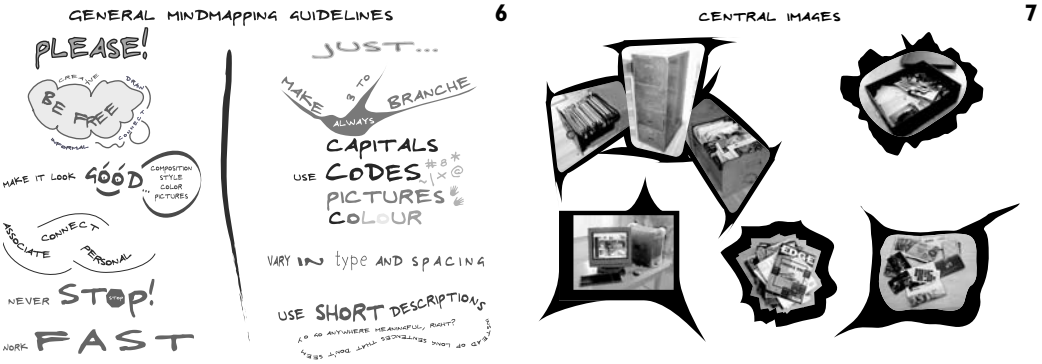
For further research and tool development it was decided that the present case of informal collections of visual material requires a theoretical framework that integrates different fields and approaches. By first taking a helicopter view before narrowing down on relevant theory, we can attempt to be unbiased by our disciplinary blind spots. We identified our own bias as being researchers on user-centred design in an engineering school, which tends to force us to technology-based, solution-oriented approaches. We believe that given the right method and participants we can compensate for this bias.

2.4.1 Method

To get our keywords, constructs and experiences surrounding these collections of visual material we needed to get different people together who both had knowledge of theory and practice on the matter. Furthermore we needed a generative tool that would let them open up about the phenomenon in an associative yet structured manner. We decided to use Mind Mapping for this. Mind Mapping is a technique that combines free association with structuring through composition and categorization (Buzan & Buzan, 1994). A Mind Map is a method for associating, structuring and visualizing in which one starts out with a strong central image or theme, branching out with associations from that. All the statements in a Mind Map are linked to other statements, and color, visuals and drawings are included in these Mind Maps.

The advantage of Mind Mapping over other Generative Tools is that the results are relatively easy to yse, and that it results in more structured stories over pure associations (Stappers & Sanders, 2003).

We used the images shown in figures 1 to 5 as a means to prime our participants to the phenomenon. The real-world examples of collections of visual material we chose to let them associate on, keeping a focus on the phenomenon, rather than bringing in pre-existing theories.



6 Instructions given to the participants on how to make a Mind Map (adapted from Buzan & Buzan, 1994)

7 Central images that were reprinted on cardboard plates showing different ways in which collections of visual material can appear in the designer's workplace

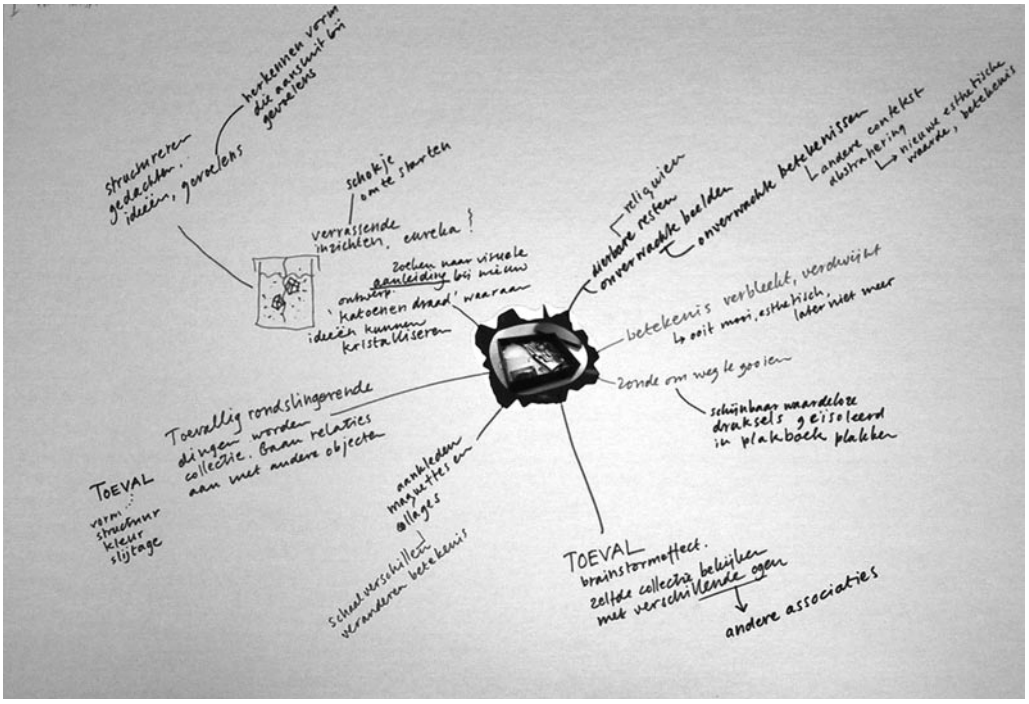
2.4.2 Procedure

Four designers/artists participated in this study. All were reflective practitioners (in the sense of Schön, 1983); they had explicitly worked in practice, research and teaching about design. The participants consisted of three men and one woman, one was a professor with a background in design (initials JH), the second one was a designer and teacher who had started her PhD research (initials MS), the third one a teacher and researcher with a background in graphic design (initials FM) and the fourth one an artist with a background in teaching art and drawing (initials TK). Each was invited for an afternoon session in their own workplace. In the instruction they were asked to think of their interaction with their collections of visual material. They were given instructions on how to make a Mind Map (figure 6) and five central images showing different manifestations of collections (figure 7).

Each participant was asked to select three out of the five cardboard plates and make three Mind Maps, containing the important aspects relating to their interaction with the collection, radiating out from the chosen central image. After this Mind Mapping session, which did not exceed 45 minutes, the participants were asked to present their Mind Maps and explain their train of thoughts (figure 9). Because both this research method and the Mind Map technique were new to all our participants, we finished the sessions with a short evaluation on how the participants experienced the method and technique.

8

9



10

8 Participant FM drawing a Mind Map

9 Participant FM presenting the result

10 Mind Map by FM (in Dutch). It contains expressive words such as "Eureka!…" and a drawing of the collection as a saturated bath with crystal formation

The Mind Maps that came out of these sessions were analysed by the authors. All the individual Mind Maps were combined into one big Mind Map containing all the aspects mentioned, but reorganized into recurring themes and recurring branches. The combined Mind Map was written out and put together in an outline by the author. The outline in turn was translated, grouped and linked by both the authors.

2.4.3 Results

The sessions lasted approximately 90 to 120 minutes, and making the Mind Map took considerably less time than presenting and explaining them. All of the participants made three different Mind Maps as instructed. Though it was not part of the instructions, we could see a distinct pattern in the order of the three Mind Maps: the first one discussed the phenomenon in general, the second one zoomed in on one aspect from the first Mind Map. Finally the third one was used to cool down; the participants used it to make their final loose remarks or to play around with the Mind Mapping technique itself. Although the Mind Mapping technique was completely new to all of the participants, they all worked fluently and reported it as being *"enjoyable"* or *"interesting"*. The participants all used metaphoric drawings to symbolize their collection or the role of their collections.

The keywords and phrases used by the participants contained extensive lists of aspects pertaining visual material in their design work. Also they used stories and descriptions of experiences to explain their interaction with collections of visual material. Finally, many of the second Mind Maps contained dreams or aspirations on their ideal collection, both in content and in interaction (figure 10). All of them used strong metaphors in their Mind Maps, for example, browsing the collection was described as *"a walk in the woods"*, and the collection as a source for inspiration was described as *"a saturated salt solution"*.

Apart from the observations from the Mind Maps noted above and in table 1, the explanations by the participants provided rich metaphors and narratives related to designer collections. Two of the participants compared the evolution of the collection to plant life, specifically woods and branches. The participant MS, who had just started her research, had two very interesting analogies:

> *"I see the way I grow my collection as to nursing a small branch. It needs strong roots, which you can't see and you can't really do anything about it, but what emerges above needs to be trimmed, nurtured and fed."*

> *"Looking at ... or visiting my collection is like taking a walk in the woods. You usually take the same path and you see the same things, which is nice, but the really interesting things are what has changed since you took the walk and the little detours you find and explore yourself."*

The artist TK used the same nature and travel analogies, but in different and shorter terms. He talked about *"sedimentation, humus"* and *"a journey of exploration through known areas"*.

Table I. Topics touched

Main topics	*General aspects*	*Conclusions on the topic*
Description of collection	*Media types:* photo, drawings, magazine, newspaper clippings, whole 3D product, part of 3D product, sample material. *Attributes:* composition, detail, meaning, form, structure, emotion, multiple sizes, multiple formats, multiple places. *Modality:* 0D (text as visual material), 2D, 3D, Video, Virtual objects (thoughts and memories). *Storage:* computer, wall, shelf, filing cabinet, shoe box. *Ownership:* personal, shared, a typical designer collection.	They all spoke of a highly diverse collection, both content, material and storage. The reasons for keeping things are not always in the pictures themselves. All of the participants spoke of collections that are in some way typical to a designer (being loosely structured, chaotic).
Use of collection	*Process:* adding, maintaining, organizing (structuring, branching, sorting), selecting, fitting into categories, cross referencing, loosing things, temporary placeholders, growing, throwing away. *Method:* testing ideas (benchmarking or fitting), presenting, evaluating. *Creativity:* combining, surprising, discovering, living with information, triggering associations, constructing/forming categories, interpreting. *Other uses:* 'just looking', playing with it, daydreaming. *When:* short spare time, when in bad mood, with a prepared mind, in the back of your mind.	None of the participants spoke of labelling, but a lot about organizing and reorganizing. Creativity and collection gave a lot of different results. All of these keywords had to do with some way of categorization, but in different terminology. None of the participant used the same words. Collections are not used at planned moments and often the participants refer to non-use (remember/available).
Value of collection	*Stability:* new aesthetic values emerge or disappear, forgetting, unburdening, estrangement. *Insights:* new relationships, differentiating scales, looking with other eyes. *Personal:* apparently worthless, open to interpretation, not understood by others. *Symbolism:* monument, representation, relic, a dream.	A collection itself is not stable, neither is the way the designer values it. New relationships and insights is what makes having a collection worth the effort. A "finished" collection is both something to aim for as it is useless.
Goal of collection	*Remembering:* documenting, archiving, mental imaging, memory. *Sharing:* communicating (experiences or feelings), with oneself, with clients, colleagues, extreme objects/pictures. *Urge:* a nice activity, nice thing to won, making beautiful things, a pity to throw things away.	The obvious reason for keeping things in a collection is to find them back again, but that is not the main goal mentioned. The urge of collecting and the fear of throwing things away is mentioned as a more important reason.

The graphic designer FM used a strong metaphor when explaining the drawing on his Mind Map in figure 10. The drawing represents his collection as being a *"saturated salt-water bath"*. The way to get new ideas from your collection is described as:

> *"If you need a new insight you stick your problem into the collection like this little metal stick and you give the bath a tiny shock. Crystals will form on the metal stick. It is a tiny shock of insight."*

The description of the collection also contained an interesting paradox. A perfectly organized finished collection was what most participants were aiming for or dreaming of (*"where everything is part of the dream",* TK). The image of the organized filing cabinet (left part of figure 5 and 7) was seen as a good example of that. On the other hand, that same neatly organized filing cabinet by the same participants was seen as an example of a bad thing. It was a *"dead monument",* containing negative things like *"bureaucracy"* or *"x-files"* (TK); it was not a *"typically designer"* (JH) collection.

2.4.4 Constructing theoretical framework

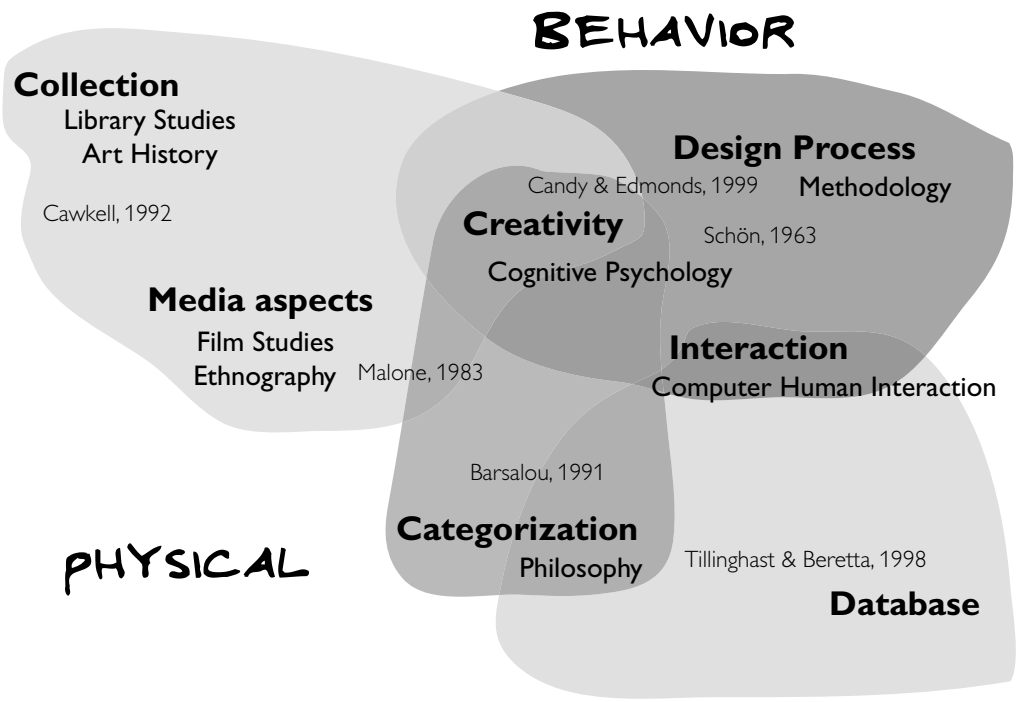
The keywords and conclusions of the Mind Maps shown in table 1 were used as the basis for a further literature search. The richer metaphors and narratives from the presentations were not used directly in formulating the questions for our literature search, but played an important role to put its finding in context.

The general aspects from table 1 were used to widen the literature search and the conclusions on the topic were used as filters to narrow down on the literature.

The main goal of this exercise was to escape the bias of our own discipline, therefore we first looked at the results that differed from what we expected. Contrary to our expectations none of the participants mentioned textual or verbal labeling in their Mind Maps or presentations; searching with queries and alphabetical sorting were not mentioned at all. All our literature found so far was pointing at an approach of keywords and labels for organization. Apparently this approach does not fit with the experience of interacting with personal collections of visual material by designers. This discrepancy is supported by two other conclusions from the results: 1) the goal of the collection was not to find back images, but for remembering, sharing and for the urge of collecting and 2) a *"finished"* (or non-personal) collection was controversially spoken of in negative terms, not fitted for designers. The existing literature on image management tools did not support this kind of approach to collections.

The description of the collection as mentioned in table 1 primarily pointed at media aspects: modality of elements in the collection, where and how it was stored, the attributes beyond what was on the pictures themselves and ownership. These are typically aspects that media studies have critically looked at. The issues of form and storage for organization have been explored in ethnographic studies on, for example, how people organize their desks (Malone, 1983).

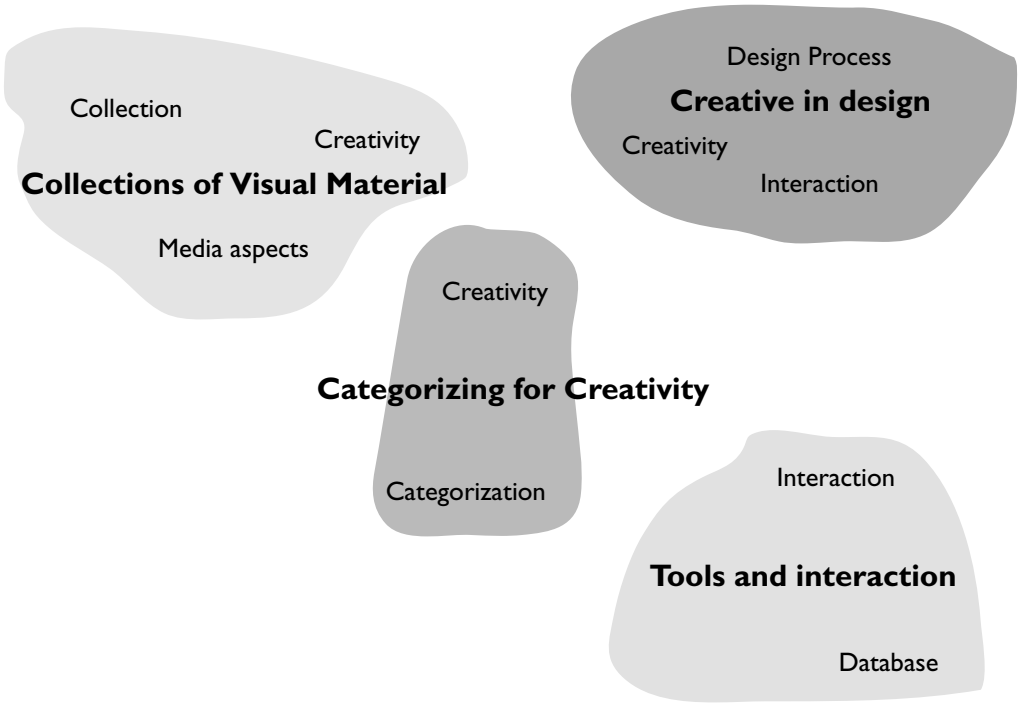
The participants described their use of the collection related to creativity, design process and interaction. The participants characterized their use of the



11 An overview of the literature field that was constructed from table 1 and the literature search. Disciplines are shown as clouds with key themes and references among them; we can see overlap and lack thereof in the different disciplines

collection as not being part of a formal procedure or structural design process. The use of technology and interfaces to support this kind of peripheral activities (see table 1: living with information, short spare time, in the back of your mind) has been explored as a new path for interaction design (Norman, 1998; Weiser & Brown, 1996).

The way in which the participants mentioned creativity and their collection had to do with trying to match different concepts together (see table 1: combining, discovering, triggering associations). This description of creativity comes close to what Schön describes as a *"displacement of concepts"* (Schön, 1963) in which new ideas come from trying to fit concepts onto each other through the use of metaphors. The process described by Schön bears resemblances to the metaphor of the *"saturated salt bath"* by participant FM. Another important and related aspect on creativity had to do with the categorization itself (see table 1: forming categories, fitting into categories, interpreting). New insights can come from making new categories, based on the material available at hand (Barsalou, 1991).



12 Exploded view of the theoretical framework presented in figure 11

The literature mentioned above showed overlap in some areas, especially in the different approaches towards creativity and categorization. For further research, such a complex set of intertwined literature references needed to be transferred into a usable visualization or organization. To do this we developed a cartographic overview of different themes, disciplines and exemplary literature shown in figure 11. The figure provides an helicopter view of the theoretical framework and was used in the remainder of this research as a reminder or placeholder for new literature or insights. The central themes are Creativity and Categorization. Around these themes we find important other themes such as Media Aspects, Design process and Interaction. Our starting point, the collections themselves and computer tools and databases to support them are now only peripheral aspects.

2.5 Theoretical considerations

After this study presented in the previous sections, we did a broad literature review. The general aspects mentioned in table 1 were used as the primary search criteria for a literature search in our library. The theoretical framework illustrated in figure 11 was used as a means to structure these results.

The framework covers many disciplines, therefore it is impossible to do a complete literature review on all these fields. From our design perspective we decided to stay broad and integrate different fields to serve our problem.

We didn't stop our literature review after this initial search. In the years after this initial literature review, we used our theoretical framework to structure and organize other literature that bore relevance to this project.

Our framework became a tool for organizing and collecting other literature and theories.

The remaining of this chapter will give an overview of the theories found in the literature that relate to designers collecting visual material. To do this, the different areas of the theoretical framework have been untangled into four distinct areas, presented in figure 12.

The four areas in figure 12 will be presented in the remainder of this section, starting from the perspective of the Design Process with aspects of design methodology and interaction design and its relation to creativity. After this creativity itself will be further examined and especially in relationship to categorization literature. The next field covered is the theory on collections themselves and specifically the role of media aspects in it. The overview ends with a brief look at tools and specifically computer interaction.

2.5.1 Collections for creativity

Being creative means giving rise to new outcomes, which is seen by peers as new and relevant (Csikszentmihalyi, 1996). This immediately suggests that creativity can't be seen separate from the context and social setting. Neither the context nor the person have complete control over process, which is why creativity is sometimes seen as an activity by a person and in other cases as something that happens to a person.

In design, creativity relies on visual thinking (McKim, 1980). The importance of images and even other senses are also deemed important outside the realm of design: *"The words or the language ... do not seem to play any role in my mechanism of thought. The physical entities which seem to serve as elements of thought are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined ... the above mentioned elements are, in my case, of visual and some muscular type."* (Einstein, 1979).

Candy and Edmonds take into account that new solutions come *"from working with physical artefacts and tools"* taking away the notion of the *"disembodied mind"* (Candy & Edmonds, 1999). The artefacts and tools designers use, such as sketching, are very visual and create an internal visual dialogue (Tversky, 1999).

Such a dialogue can also be created using collages as a means to structure and create typologies on different levels (Muller, 2001). The representation

of these typologies themselves has already been shown to have a beneficial effect on creative design (Pasman *et al.*, 1999). The activity of making these organizations offers even more potential for creative thinking (Pasman, 2003).

2.5.2 Collections and categorizing for creativity

Designers create collages to organize visual material and find new insights in the order that comes from that. The collages however are explicitly ambiguous and expressive, meaning that the categorizations are vague and ill-defined. In the classical view categories are arbitrary, having defining or critical attributes and intension (set of attributes) determine the extension of a category. The categories described here come from the natural view in which categories have an internal structure, centred around prototypes or stereotypes and instances of the categories exist in the periphery (Gardner, 1987). This natural view is what collages specifically support, even going so far to support making categorizations that would be seen as childlike mistakes in the developmental psychology of Piaget (Daehler & Bukatko, 1985).

Barsalou provides some clear example of how categorization in itself can be seen as a creative activity (Barsalou, 1991). In goal-derived categories the example is given of the category *"things to pack for a holiday"*. Though this is a simple description of a new category many aspects influence the outcome of this category (this is why so many mistakes are made in packing for a holiday). Imagine yourself packing for a holiday, you will probably first think some obvious thing such as clothes (a category) and by opening up your closet you will encounter elements and judge them for their appropriateness. Then, by laying them out on floor, table or bed you get an overview, which in turn sparks new ideas of things to pack. This example can go on and on, but bears many resemblances to the collage making task, manipulating existing knowledge to allow for new concepts and creating ad hoc categories that have stability in a moment but can become irrelevant when goals change.

The design methodologist Schön provides an interesting perspective on creative thinking in the Displacement of Concepts (Schön, 1963). By mapping one concept onto another, a new situation is created. Creative thinking involves trying to fit these different concepts on their attributes and associations. It is the friction and instability in these association clusters that brings new insights. This requires allowing for mistakes, which is a well-known requirement for creative behaviour (though mistakes do not guarantee creative outcomes).

In other words, metaphors can work, if you use them creatively or following Pablo Picasso's famous quote *"Bad artists copy, good artists steal, great artists transform"*.

2.5.3 Collections of visual material

Eckert and Stacey describe how designers of knitwear actively search for inspiration by looking for, organizing and discussing shapes, patterns, motifs and colour combinations in other designs (Eckert & Stacey, 2000). A nice example of a very physical collection of materials collected for inspiration is the *Tech Box* by the successful design agency IDEO (Kelley & Littman, 2001). The Tech Box is a rolling cart containing many different innovative technological solutions, collected for inspiration. The Tech Box started out as a personal collection by an employee, but is now a formal part of the company's working method. The risk of shared collections is that only the extreme examples survive, leaving out the common objects, that might also allow for insights.

The media aspects of collections have, specifically, impact in finding back objects. Designers personalize their work environments such as walls and tables with all kinds of objects (Kolli *et al.*, 1993). These organizations also apply to clerical office workers (Lansdale, 1991; Malone, 1983), but with designers the elements are more diverse in appearance and nature.

Most research into image collections don't take into account these physical aspects. Cawkell cleverly notes the difference in literature in the term *"image"* (dry, technical) and *"picture"* (warmer, artistic) in which images are automatically assumed to be digital (Cawkell, 1992).

2.5.4 Tools and interaction

The influence of tools and interaction with our tools is often underestimated in practice. In the words of Marshall Mcluhan *"We shape our tools, and then our tools shape us."* (McLuhan, 1964).

Most computer tools don't support the conceptual phase of design because they expect the user to know what they want in advance (Stappers & Hennessey, 1999). Moreover computer tools currently don't support the expressive gestures and bodily interaction that is such an important aspect of creativity (Hummels, 2000). The ambiguity in sketches is an important tool for designers to bring out their ideas fluently and expressively (Gross & Do, 1996).

In our work, the main implications for and experiences with *sketchy* design tools are divided in aesthetics, interaction and usability (Keller *et al.*, 2000; Stappers *et al.*, 2000). The *aesthetics* of the rough concept sketch are a guiding principle in these tools. Where many computer tools offer an array of possibilities with their own aesthetics, tools for the conceptual phase should offer no other aesthetics other then the user's. The aspect of *interaction* refers to being sensitive to the input of the user with their richness of gestures in strokes and timing. For example, most computer interfaces do not take into account the mouse movement without selections, the location of selection within an object or the length of a selection. These interactions have meaning

and can be used as clues by computer tools. With *usability* we imply both a very focused functionality within tools, yet a high degree of freedom in how this functionality can be used. Accepting the fact that interfaces simply get in the way of our intentions, it is possible to hand over a limited set of functionalities to the user and allow for improvisation by the user beyond the original limits. An example of a tool that incorporates all three aspects of aesthetics, interaction and usability, allowing for an exploration of these aspects is given in the next chapter on the TRI Setup.

2.6 Discussion of the method

The method used in our case gave us a tremendous amount of material in a relatively short time. These materials consisted both of structured, concise aspects, written down in keywords on the Mind Maps, and on rich metaphors and experiences presented by the participants. By allowing our participants to choose their starting points and themes the initiative was continuously placed with the participants. Making more than one Mind Map made our participants go both broad into general issues pertaining the phenomenon, and deeper into specific aspects they chose themselves. In hindsight a third Mind Map might not have been necessary, but in their evaluation all but one of the participants (MS) said they did appreciate this. Our participants said they did enjoy the sessions themselves and found the Mind Mapping technique a powerful way of getting their ideas out of their system. One participant (TK) even referred to the session as a *"pressure cooker"* for his thoughts.

We initially selected Mind Mapping as our generative tool because we expected to get complete, comprehensive lists of aspects and specific references to literature. Neither of these results happened as expected; our participants did incorporate their own research problem in their presentation, but no specific references or projects were mentioned.

A structured interview would probably have resulted in more specific literature references compared to the result on the Mind Maps, but our method encouraged our participants to phrase their theoretical knowledge into the language of everyday experiences. The result of the mindmapping study could not be directly used to select or point at existing literature, but it did work as a bootstrapping technique to find the relevant aspects, themes and keywords.

The big advantage of Mind Maps over other generative tools was the relative ease in which we could structure and condense our results. The participants have provided both a set of keywords and a structure, which could efficiently be organized and compared to the presentations. In all, our sessions took only 8 hours with 36 hours of preparation. Structuring

and analysis took us 72 hours, and translating the outcomes to a theoretical framework and finding the relevant literature took us 80 hours. In total, we have been working for less than five weeks to get a framework that allowed us to continue our research on a solid basis. A traditional goal-directed literature search might have resulted in a more in-depth overview of literature in one or more disciplines, but we would not have been able to get both the breadth and the overlapping disciplines integrated in our literature field and it would have taken much more time.

2.7 Conclusion

We used participatory design techniques as a means to widen our scope on literature, yet to narrow down our research to a manageable framework. Using this method we were able to gain some insight on the phenomenon of how designers interact with their collection of visual material without getting caught in the bias of one discipline. Also, it changed our preconcepts: where we first looked into existing solutions for image management we now took in account that these tools might not be aimed at the goals of designers.

We have stayed close to the disciplines of design and human computer interaction, as this is our own discipline. Yet, without this study we wouldn't have been able to critically look at what defines a collection of visual material for designers and what aspects of use we should look at. This study took us from a focus on technical solutions for a possibly non-existent problem to a set of fundamental viewpoints on creativity in categorization and media aspects.

LITERATURE REFERENCES 2

Babbie, E.R. (2003) *The practice of social research* (10th ed.), Belmont, CA: Wadsworth.

Barsalou, L.W. (1991) Deriving categories to achieve goals. In: G.H. Bower (Ed.), *The psychology of learning and motivation: Advance in research and theory* (27) San Diego, CA: Academic, pp.1-64.

Buzan, T., & Buzan, B. (1994) *The mind map book: How to use radiant thinking to maximize your brain's untapped potential*. London: BBC Books.

Candy, L., & Edmonds, E. (1999) *Introducing creativity to cognition.* Proceedings of the Third conference on Creativity & cognition, Loughborough, UK, pp.3-6.

Cawkell, A.E. (1992) Selected aspects of image processing and management: Review and future prospects. *Journal of information science, 18* (3), pp.179-192.

Csikszentmihalyi, M. (1996) *Creativity: Flow and the psychology of discovery and invention.* New York, NY: HarperCollins.

Daehler, M.W., & Bukatko, D. (1985) Relational concepts and reasoning. In: *Cognitive development.* New York, NY: Knopf, pp.257-282.

Eckert, C.M., & Stacey, M.K. (2000) Sources of inspiration: A language of design. *Design Studies, 21* (5), pp.523-538.

Einstein, A. (1979) *Ideas and opinions*. New York, NY: Dell.

Gardner, H. (1987) A world categorized. In *Mind's new science.* New York, NY: Basic pp.340-359.

Glaser, B.G. (1978) *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press.

Glaser, B.G., & Strauss, A.L. (1967) *Discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Gross, M.D., & Do, E.Y.-L. (1996) *Ambiguous intentions: A paper-like interface for creative design.* Proceedings of UIST 96, Seattle, WA, pp.183-192.

Hummels, C. (2000) *Gestural design tools: Prototypes, experiments and scenarios.* Doctoral dissertation, Delft: TU Delft.

Kang, H., & Shneiderman, B. (2000) *Visualization methods for personal photo collections: Browsing and searching in the photofinder.* Proceedings of the IEEE International Conference on Multimedia and Expo, New York, NY, pp.1539-1542.

Keller, A.I., Stappers, P.J., & Hoeben, A. (2000) Listen to the noise: 'sketchy' design tools for ideation. *Exchange Online Journal, 1* (1).

Kelley, T., & Littman, J. (2001) *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm.* New York, NY: Currency.

Kolli, R., Pasman, G., & Hennessey, J. (1993) *Some considerations for designing a user environment for creative ideation.* Proceedings of the Interface '93, North Carolina State University, Raleigh, NC, pp.72-77.

Lansdale, M.W. (1991) Remembering about documents: Memory for appearance, format and location. *Ergonomics, 34* (8), pp.1161-1178.

Laurel, B. (Ed.) (2003) *Design research: Methods and perspectives*. Cambridge, MA: MIT Press.

Malone, T.W. (1983) How do people organize their desks? Implications for the design of office information systems. *ACM Transactions on Office Information Systems, 1*(1), pp.99-112.

McKim, R.H. (1980) *Thinking visually: A strategy manual for problem solving*. Belmont, CA: Wadsworth.

McLuhan, M. (1964) *Understanding media: The extensions of man.* Cambridge, MA: MIT Press.

Muller, W. (2001) *Order and meaning in design*. Utrecht: Lemma.

Norman, D.A. (1998) *The invisible computer*. Cambridge, MA: MIT Press.

Oxman, R.M. (1999) The reflective eye: Visual reasoning in design. In: A. Koutamanis, H. Timmermans & I. Vermeulen (Eds.), *Visual databases in architecture*. Aldershot: Avebury, pp.1-14.

Pasman, G. (2003) *Designing with precedents.* Doctoral dissertation, Delft: TU Delft.

Pasman, G., Muller, W., & Hennessey, J. (1999) *Random versus typological organization in precedents in a design task.* Proceedings of the 4th International Design Thinking Research Symposium on Design Representation, Boston, MA: MIT, pp.125-138.

Sanders, E.B.-N. (2002) From user-centered to participatory design approaches. In: J. Frascara (Ed.), *Design and the social sciences*. London: Taylor & Francis, pp.1-8.

Schön, D. (1963) *Displacement of concepts*. London: Tavistock.

Schön, D. (1983) *The reflective practitioner: How professionals think in action.* New York, NY: Basic Books.

Stappers, P.J., & Hennessey, J. (1999) Towards electronic napkins and beermats: Computer support for visual ideation skills. In: R. Paton & I. Neilson (Eds.), *Visual representations and interpretations.* Berlin: Springer, pp.220-225.

Stappers, P.J., Keller, A.I., & Hoeben, A. (2000) Aesthetics, interaction, and usability in 'sketchy' design tools. *Exchange Online Journal, 1* (1).

Stappers, P.J., & Sanders, E.B.-N. (2003) Generative tools for context mapping: Tuning the tools. In: D. McDonagh, P.P.M. Hekkert, J. van Erp & D. Gyi (Eds.), *Design and emotion, the experience of everyday things.* London: Taylor & Francis, pp.77-81.

Stokes, D.E. (1997) *Pasteur's quadrant: Basic science and technological innovatiion*. Washington, DC: Brookings Institutions.

Tversky, B. (1999) *What does drawing reveal about thinking?* Conference proceedings of Visual and spational reasoning in design, Sydney, Australia, pp.93-101.

Weiser, M., & Brown, J.S. (1996) The coming age of calm technology. In: P.J. Denning & R.M. Metcalfe (Eds.), *Beyond calculation: The next fifty years of computing* (Vol. 1) New York, NY: Copernicus Books, pp.75-86.

How can *technology* support *creative activities*? This chapter presents our experiences in this field with the *TRI Setup*. We explore how *new media* can support designers in the *conceptual phase of design*. Many elements of the TRI Setup (or TRI) were included in the design of Cabinet presented later in this thesis.

The first part is based on a paper published in *CyberPsychology & Behavior*. It *describes* TRI as a whole and elaborates on the earliest applications of TRI with *Video Collages*.

Because TRI served us so well and still *influences* our work, the article is complemented with a *summary of experiences* with TRI over the last years, from several publications.

We take the perspective of *tool developers* with experience in *Virtual Reality*, *perceptual psychology* and *design practice*. In the first two sections we once again look at how designers *surround themselves* with *visual material* from the perspective of *tools* and *technology*. With TRI we have gained *valuable insights* in *expressive body-scaled interaction*, *sketchy use* of *new media* and the *use of light* as *design matter*.

This work was *initiated* by Pieter Jan Stappers in the 1998 *TWAIO course* and was developed in late 1999 in *collaboration* with *SARA*. At the moment of this writing, TRI is *still actively used* in the ID-StudioLab.

ABSTRACT

Product designers use imagery for inspiration in their creative design process (Athavankar, 1997). To support creativity designers apply many tools and techniques, often relying on their ability to be inspired by found and previously made visual material and to experience the atmosphere of the user environment. Computer tools and developments in Virtual Reality (VR) offer perspectives to support this kind of imagery and presence in the design process. But currently these possibilities come at too high a technological overhead and price to be usable in the design practice.

This chapter proposes an expressive and technically light-weight approach using the possibilities of VR and computer tools, by creating a sketchy environment, using a technique we call "Video Collages". Instead of relying on highly realistic or even "hyperreal" graphics, these video collages use lessons learned from theatre and cinema to get a sense of atmosphere across. Product designers can use these video collages to re-experience their observations in the environment in which a product is to be used, and to communicate this atmosphere to their colleagues and clients. For user-centred design, video collages can also provide an environmental context for concept testing with prospective user groups.

This chapter is largely based on: **Keller, A.I. & Stappers, P.J.** (2001) Using video collages in the design process to experience presence and atmosphere. *CyberPsychology & Behavior, Special issue on Presence, 4* (2), pp.215-223.

3.1 Introduction

To capture their imagination, designers currently use a variety of methods, such as sketches, collages and mock-up models (Kolli *et al.*, 1993). These methods allow the designer to create, organize and communicate rich visual media. As the interaction and complexity of products increase, designers also need more narrative tools to capture, organize and communicate the way products are used. For this, designers have started to use methods used in theatre and cinema, such as role-playing, scenarios and storyboards, in their design process (Verplank *et al.*, 1993).

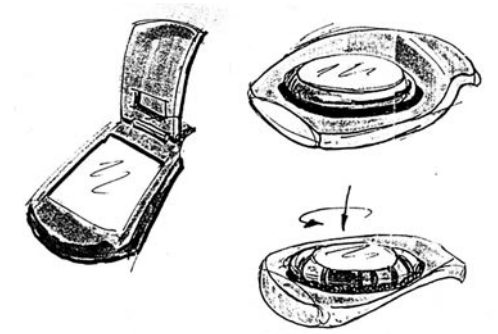
We believe that new tools and developments in VR offer possibilities to support and even extend the methods that designers use right now, if they offer good interaction, usability and aesthetics (Stappers & Hennessey, 1999). But current VR systems, though very impressive technologically and perceptually, do not sufficiently support the fluency and interactivity needed to inspire designers in their creative process. In particular, the technical overhead of creating applications, setting up the system and calibrating the system for the user (Krueger, 1995), keep these VR systems from being a suitable alternative to the traditional tools for inspiration (Stappers *et al.*, 1999). This situation is definitely improving, but still far from acceptable for conceptual design tools.

In our research we explore the possibilities of new inspirational tools by offering a possible solution and using it in a given design process. This chapter reports experience in constructing video collages to elicit the feeling of presence in a product's use context. *Presence* is a person's ability to experience a certain location or context. From the perspective of designers seeking presence, aspects of *atmosphere* are more important than any realistic or geographic location. This is similar to the use of the term *presence* in cinema or theatre (Naimark, 1997).

The discussion here focuses on the concepts and early observations. We look at the role of video collages as an inspirational tool in the design process, but also at how the act of making these video collages can help the designer explore the design issues related to the user environment.

3.2 Inspiration & context

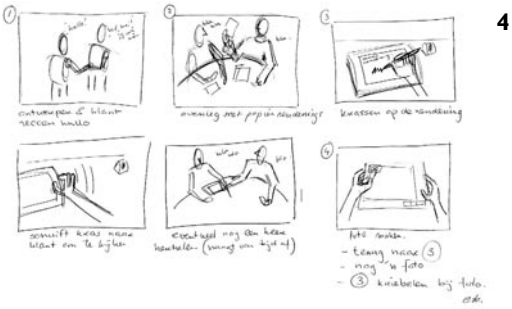
Imagine you are a designer being asked to design a new interactive device for consumers to be used in the kitchen. How would you take this description as a starting point for a meaningful product design? Aside from the technical issues, the designer needs to address the interaction, usability and aesthetics of the concept. A creative solution for this requires the designer to find inspiration for this assignment. This is the main focus of our research on tools and methods in the conceptual phase of design.



1

2

3



4

5

1 Traditional ideation tools: sketch exploring different details

2 Traditional ideation tools: collage conveying atmosphere of leisure time

3 Traditional ideation tools: exploring handling in a foam mock-up

4 Theatre derived tools: storyboard for a sketching device

5 Theatre derived tools: designers role-playing a situation

The term User-Centred Design or UCD implies an emphasis on the human user – his perceptual, motor, and cognitive skills. A user-centred approach usually relies heavily on user participation and extensive user testing, to develop a product that best fits the user's need (Norman, 1988).

The conceptual phase of design (or ideation phase) is the initial phase where designers discuss and explore their ideas, using many different methods to visualize them (McKim, 1980). Observations of the designer's workspace show that some of these visualizations are pasted on the walls and periphery of the workspace to serve as a source of inspiration in the creative process (Kolli et al., 1993).

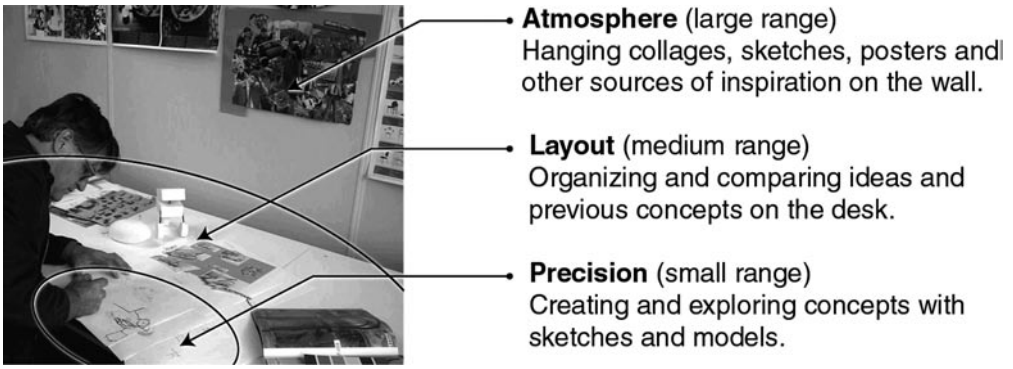
The traditional tools designers use for inspiration are shown in figures 1 to 3: sketches, collages and rough mock-up models. These tools and techniques are the most widely used by designers as they support imagery, associative thinking and imagination skills, without high technical overhead and with readily available materials such as pen, glue, clay, foam or paper.

Sketches are useful to create, explore and communicate shape and appearance of a design and are the most widely used tools for idea creation (Verstijnen, 1997). Collages are an intellectual and aesthetic exercise made out of found material to express an idea or feeling (Lynch, 1961). The collage offers the ability to deal with design precedents and precedent knowledge and to transfer abstract ideas and concepts into a visual language or atmosphere, hardly expressible in words (Tufte, 1997). Rough mock-ups, quickly made out of foam, clay or cardboard are often used in the conceptual phase to physically experience the scale, feeling and handling of a design.

In the past decade designers have started to borrow tools and methods from the field of theatre and cinema, such as role-playing, scenarios and storyboards, exemplified in figures 4 and 5, to explore and communicate dynamic and interactive aspects of their concepts. For example, role-playing and scenarios are ways for the designers to freely explore the whole context of a product and the role it can have in the life of a user (Burns *et al.*, 1994; Djajadiningrat *et al.*, 2000). Designers use storyboards to look more in detail at the dynamic use of a design and the possible user interactions.

The tools and methods for inspiration mentioned above are not relying on realistic fidelity (Naimark, 1997; Stappers et al., 1999). Fluency, exploration and aesthetics are the more important aspects.

New tools and techniques for computer interaction and visualization can provide a more efficient and flexible way to create a sense of presence in the user environment. The technological advances allow us to create images with such a high level of detail and quality of shading, rendering and reflections that the quality is often referred to as *hyperreal*. However, these advanced VR systems lack the flexibility and ease of use that the designers appreciate



6 Three ranges in the designer's work environment

in their pictures, sketches and collages (Stappers & Hennessey, 1999). For example, a new concept sketch can be made in a matter of minutes, where a VR simulation can take months of programming.

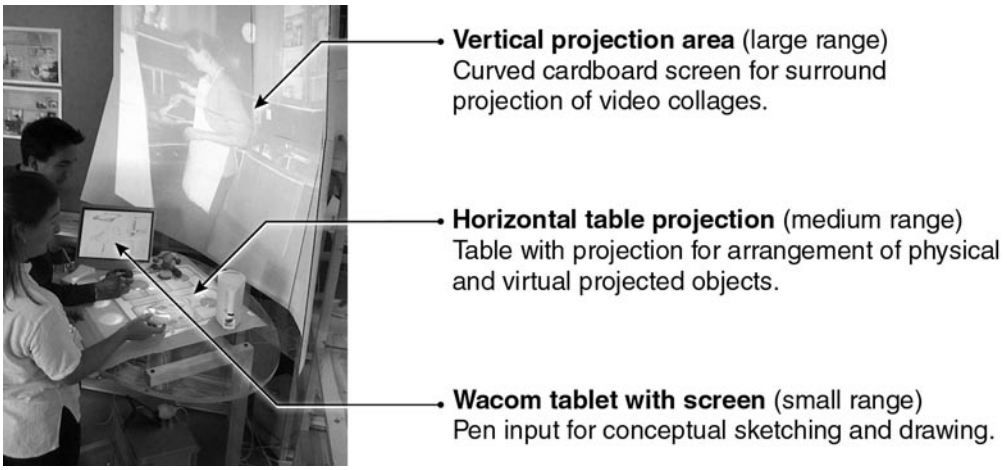
In general the advantages of the traditional tools such as sketches, paper collages and models can be found in the aspects of interaction, usability and aesthetics, i.e. they allow for fluent, direct and shared interaction. Their usability allows for improvisation and the materials used are readily available and they allow for expressive and suggestive aesthetics focusing the attention of the viewer.

Current VR tools fall short in these aspects, but when they are improved on, they can also offer advantages in simulated use and handling, easy change of environments and the application of rich media such as sound and animation.

Although the possibilities of such new tools are promising and have shown useful achievements, the latter usually come at a price that conflicts with the demands of our simple traditional tools. The key advantage that VR-related tools offer us in the conceptual phase of design is the ability to create an immersive sense of presence. We will show that this can also be achieved with less technical overhead.

3.3 Three Ranges of Interaction setup

With the experimental TRI Setup, *Three Ranges of Interaction,* we have tried to create a medium and an environment that allows the new possibilities offered in VR, while keeping as many of the advantages of traditional tools as possible. The TRI Setup is a body scaled interactive medium supporting the designer, exploring design concepts. The term *Three Ranges of Interaction* refers to three scales in which we interact with our environment: large, medium and small for respectively atmosphere, layout and precision.



7 Three scales applied in the TRI Setup

These ranges can be best illustrated by the way product designers interact with their work environment as exemplified in figure 6. For atmosphere, designers hang pictures, collages and sketches of the environment of use on the walls around them. For layout, sketches and models are laid out on desks to compare and organize possible solutions and use them in discussions and presentations. Finally, for precision the designer uses paper, pens and models to create detailed sketches.

TRI supports all the three ranges with an interactive setup that provides atmosphere (large range), virtual and physical organization and presentation (medium range) and computer supported sketching (small range). The combination of the three ranges allows for an atmosphere fit to the assignment where designers can collaboratively discuss, arrange and visualize ideas.

These three psychologically meaningful ranges are physically implemented in the TRI Setup, shown in figure 7. By physically dividing the three ranges in the setup, content can be developed separately for the three ranges. This simplifies the development of content, as the developer only has to tune and tweak one kind of interaction at the time, without influencing the other ranges at the same time. Argumentation of the design of the TRI Setup has been published online at DCNet (Keller *et al.*, 2000b). For the present discussion, it is important to note that the TRI Setup attempts to make a *sketchy* form of VR, sacrificing technical fidelity for conceptual usability. Like a pencil-sketch, TRI applications aim to give a quick, rough idea rather than a fully tuned, pretty picture.

Designers can use the TRI Setup for inspiration by generating presence in an immersive environment. With the traditional tools this is achieved by

8 Two stills from the kitchen environment video collage as presented on the vertical projection area

surrounding the walls of the desk with sketches, collages and storyboards. In contrast the large scale of the TRI Setup can serve as a rich and immersive environment, to experience the location or context of the design and its use. To create these rich environments we are exploring the use of video collages presented on the large range of the setup: a curved vertical projection area.

3.4 Video collages

Video collages are expressive combinations of image sequences, video, animations, music and sound to communicate an atmosphere, context or visual language. The goal of using these collages in the design process is to evoke a sense of presence in an inspiring environment related to the product to be designed. The video collages made on the TRI Setup have the same sketchy aesthetics as those in paper-and-pencil sketches, cardboard mock-ups and collages, allowing the designer to *fill in the gaps* and create his or her own interpretation of the atmosphere, which promotes active participation.

The goal of these collages is therefore not to aim for suspension of disbelief in a passive sense, but to use the *visceral eye* as described by Boorstin to help the designer who is actively wanting to participate in the simulated environment (Boorstin, 1995). In his book Boorstin explains that unframed images like IMAX and 3D images like the CAVE stand in the way of this visceral eye because they do not force the viewer to the center of interest. Instead of relying on picture-pretty images, Boorstin emphasizes the possibilities of narrative, pace, montage, sound and movement to create a compelling atmosphere. This is similar to how designers prefer to use sketches over photographs to focus the viewer's attention on the important aspects of a product design.

The video collages are made using simple 2D authoring tools such as Macromedia Director or through video editing techniques. This low-tech approach makes it easy for the designer to focus on the content and quality of the experience, without having to communicate these ideas to a programmer or developer.

As an example of a video collage and its use, think back to the example of the designer being asked to create a product to be used in a kitchen. A good way to start the design process is to observe a kitchen environment and to capture it in a video collage. For this example we created a video collage that conveys the atmosphere of cooking a meal in a kitchen environment. The video collage uses photographs of a woman in a kitchen environment (figure 8).

As shown in figure 8, the collage does not show a true representation of the actions in a kitchen but has the aesthetics resembling those in conventional sketches and collages. The composition of the kitchen background is created from different pictures placed together to match the visual field on the TRI Setup. This creates a somewhat distorted view on reality similar to the photographic collages of Hockney (Evans & Hockney, 2004). The composition allows the designer to fill in the gaps of reality and enrich the images with her own experiences (McCloud, 1994).

The different actions in the kitchen (such as cutting, baking, washing) are displayed as sequences of still photo inserts and recorded sound. The selection of the photo inserts highlights the actions, cutting out many irrelevant parts of reality such as the legs or head of the woman in the kitchen. In this way the kitchen stays completely clean and unchanged at all times with only a relevant change in the area of the woman's actions. This method of animation provides a clear focus of attention on the actions of the woman in the kitchen.

The use of stop motion allows the author of the video collage to balance the timing of the different actions in the kitchen. Sounds that accompany the actions serve as a continuous and ubiquitous reminder of the context even when the attention is not focused on the projection.

The sketchy aesthetics of the video collage encourages the same participation by the designers as conventional sketches and collages do. The use of stop motion exaggerates the actions of the user, so that it forces the viewer to the center of interest (Wurman, 1989). These forms of incompleteness, as compared to plain video, promote the designer's participation in the environment, i.e. sense of presence.

A regular video would be seen as a form of *entertainment* while it embodies some aspects of *environment,* it fails to provide a specific focus. Collages of still images, however, can contain close-ups of activities and actions of specific tools. Also, the collage sounds can be edited to promote design activities – not

9

10

9 Experimental setup with design students sketching an MP3 player with a video collage as design input

10 Same experimental setup with a traditional collage as design input

just ambient sound as heard in a plain video. For the designer, a Video Collage of selected images and sounds is much more informational and focused toward the design problem at hand.

3.4.1 Viewing video collages for inspiration

We conducted a study to compare the effect of being exposed traditional collages and video collages in the design process. The goal of this study was to find out which part of the different types of collages the designers pick up in their design activity. The hypothesis was that designers pick up more form and color related aspects from the traditional collages and more contextual, interactive and usage aspects from the video collages.

Two groups of five design students were asked to sketch a concept for an MP3 player. One group used a video collage showing the use environment, possible users and form details as inspiration (figure 9). The other group relied on a traditional collage providing similar information (figure 10). Both collages were presented on the TRI Setup. After a short written instruction they were given 30 minutes to sketch out their concept design. After they completed their concept sketches they were interviewed as to the use of the collage, the experience of the environment and the elements of the collage that influenced their designs.

Though we used a small group, we found that all our subjects readily accepted the video collage as a useful way to communicate context and atmosphere. The group exposed to video collages focused more on usability and context of use in the design, whereas the group exposed to traditional collages focused more on detailed aspects of shape, colour and form.

We present here only the observation rather than a formal description of

the experiment, which was limited in scope. For instance, in this study the experimenting researchers, not the participating design students, created the collages. In the conceptual phase of design the act of making collages, sketches, models etc. is at least as important (if not more) than the end result itself. Therefore we are actively studying the creation process itself as well.

3.4.2 Creating video collages for inspiration

To experience the possibilities that the TRI Setup has to offer in creating an atmosphere, several video collages of different user contexts have been made by 12 design students. In this aesthetic exercise they focused on the cinematic aspects of the video collage, influencing the atmospheric experience: narrative, framing, timing, transitions, sound, perspective and lighting. Moreover the students explored the usefulness of creating video collages in the conceptual phase of the design process.

All the video collages were made in a relatively short time – varying from 4 to 12 hours – and required setting out a design goal, choosing an environment, observing the aspects of atmosphere, capturing these observations in sound and images and combining them in a video collage.

The 12 different video collages offer many different experiences: from being on a busy marketplace to a quiet beach, to sitting in the chair at the dentist's. The feedback given by the students on their video showed, that they found it important to set the goals on conveying an atmosphere opposed to just creating a pretty image or good sound. The students who took the longest time tweaking aspects of sound quality or image quality in itself were the least satisfied of their results, whereas the students that took more time trying out the complete experience and overall narrative achieved the most useful and aesthetically expressive results.

3.4.3 Using video collages for concept testing

The conceptual phase of design relies heavily on iterations, trying out different concepts and verifying them with the end users. Therefore almost all guidelines on user-centred design stress the importance to test ideas with users in the earliest possible phase (Nielsen, 1994). The problem with most of these informal tests is that it's hard to test a concept in the right atmospheric contexts.

With video collages on the TRI Setup it is possible to quickly and easily convey a sense of atmosphere as a backdrop for user testing. When the TRI Setup is used for this purpose. the video collage on the large range is for conveying the atmosphere and context of product use. In this way, we have used video collages on the TRI Setup in a series of interface design evaluations.

11

12

11 Screen-based setup for testing handheld navigation interface

12 Alternative test setup using the TRI Setup

In one experiment an interface for a portable navigation aid running on a handheld computer was tested. The application is intended to be used while walking through a city. The interface design was simulated on a normal PC with a touchscreen, which made it impossible to test the concept in the field. The original solution was to provide a sense of context in another part of the same touchscreen (figure 11). As an alternative, we proposed using a video collage of the user environment projected, with the touchscreen tilted in a position that resembles the way a user holds a handheld computer (figure 12).

During the usability test our subjects were asked to navigate through the city by using arrow keys on the touchscreen with the navigation interface for reference. As the users navigated through the city the experimenter changed the backdrops according to the appropriate location. This could have been programmed, but for a short study, a Wizard of Oz technique, in which a human makes these decisions is often more efficient (Gould, 1988). After completing a task the users were asked to recollect some details of the projected environment. This way the experimenters could measure the amount of attention the user needs for operating the handheld computer (Wolf & Keyson, 2000).

Though the usability of video collages for usability testing itself was not the goal of this experiment, we were able to verify that our users readily accepted the projection as an environment. Even without an explanation of the background or purpose of the large screen projection, the users easily accepted the video collage as a means to illustrate the environment of the user context.

3.5 Conclusion

Computer tools can provide a sense of presence that is useful for the conceptual design process. To allow the designers to suspend their disbelief these tools will focus on easy ways to create a sense of the environment in an abstraction such as a video collage. These collages offer possibilities for abstraction and expression that designers have learned to appreciate in their pen and paper based ideation tools (sketches and collages). The TRI Setup provides the tools to create sketchy representations of a user environment in video collages. Although we have not completed rigorous experiments yet, we feel confident in the following observations.

The possibilities of dynamics, interactivity and the use of digitized sounds makes these virtual environments more engaging and flexible than the current conventional methods such as making conventional collages or filling the walls with sketches and photographs. Moreover these video collages form an important aspect of the conceptual design process as an aesthetic exercise. By using sketchy aesthetics, saving time on details, the designer can explore, visualize and communicate the user environment as an atmosphere.

Lessons learned from cinema and theatre can be used to lure the attention of the viewer to important aspects of the environment. This is similar to the way the sketchiness in drawings is used to emphasize important aspects of the product design. This approach assumes that if the viewers are prepared to fill in the gaps, they can immerse themselves in an environment by their own imagination and don't have to rely on the highly realistic, expensive and difficult to make three-dimensional graphic representations.

Designers can use these video collages for inspiration and verification. Inspiration can be promoted by creating a sense of presence in the environment in which the product will be used; verification is possible when testing conceptual designs on users in a simulation of the user environment.

3.6 Experiences with TRI 2000-2005

The previous sections were written in 2000, at the beginning of our explorations with the TRI Setup (or TRI). In the years after it, we integrated TRI in our working methods. Especially the large and medium range of the TRI Setup were further developed and explored by both researchers and students. These explorations were a persistent creative background activity in the ID-StudioLab.

The remainder of this chapter summarizes these experiences, taking material from different publications related to the TRI Setup (Keller *et al.*, 2000a, 2000b; Saakes, 2005; Stappers *et al.*, 2000; Umemoro *et al.*, 2003). We will first cover the principles that guided the design and then talk about the different applications of TRI divided into the different ranges.

3.6.1 Design Principles

The TRI Setup was designed with three main principles: *approachability*, *low threshold* and *body-scaled* interaction. To make it easy to approach the TRI Setup we placed the setup in the centre of our working environment, the ID-StudioLab, opposed to most advanced VR systems that are high-tech machines hidden in darkened rooms. By using bright video projectors we are able to work on the TRI Setup in normal lighting conditions. The *low threshold* was achieved by using 2D interaction instead of cumbersome 6DoF VR technology. Instead of all these advanced technologies, we use commercially available presentation software. Finally the TRI Setup supports *body-scaled interaction* divided in three ranges, each range tuned with its own display, content, input devices and software.

The TRI Setup was developed as a platform on which designers can create their own applications and solutions given these design principles. Therefore, to compare the TRI Setup with other augmented reality systems (Aliakseyeu, 2003) or input devices (Gribnau, 1999) based on features or abilities would not do it justice. Instead of offering technological abilities, the TRI Setup forces designers to think differently about how computer tools can be used in the design process.

3.6.2 Using TRI

In the last five years we have seen many applications appear on TRI. These applications started on the large range, such as the video collages and the others that will be discussed below. In the years after this we have seen a growth of applications of the medium range, specifically to support sketching and using the projection of textures on physical models. The small range interaction stays outside of the scope of this research project and will not be covered in this chapter.

In this section we will briefly discuss the applications of the TRI Setup of the large and medium range.

USING THE LARGE RANGE

The large range has developed itself into a shared library of images and music that is used by all members of the ID-StudioLab. Using a screensaver that randomly and smoothly displays the images stored on its directories we have been able to keep colleagues visual aware of each others project without formalizing this communication.

The large range is also used as an informal presentation display. Over the years many small presentations of student projects and visitors were shown on the large display of the TRI Setup. The curved screen often surprised presenters and audiences, forcing the presenters to rethink their mode of

13

14

13 Screenshot of a shared collage of images on Iris on desktop
14 Same collage displayed on the large range of the TRI Setup

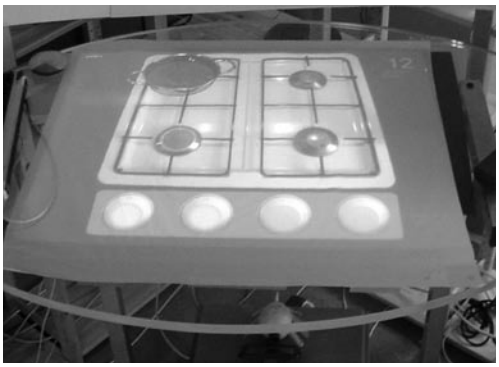
presentations. With its readily available large display, work can be presented without requiring a separate conference room with all its presentation etiquette associated with it (Tufte, 2003).

The ambient aspect of the large screen has been further explored in a research project to support visual communication in a closed community (Peeters & Stappers, 2005). For this project a software prototype was built called Iris. The Iris application[1] allows ID-StudioLab members to informally share images from their personal computers using screenshots in a shared collage (figure 13). The collages of the combined results of these messages are continuously presented on the large range of the TRI Setup (figure 14).

USING THE MEDIUM RANGE

The initial purpose of the medium range was for testing and organizing on a tabletop display. The first applications for TRI consisted of testing interfaces. In one explorative experiment we used TRI to test different arrangements of cooker knobs and compared the table projection with shadow detection (figure 15) to a setup with regular mouse input on a CRT computer screen. Though the shadow input was not optimized, we got positive feedback on the projection itself. Almost all users confronted with the projected image liked the realism of the projected image, especially when a Video Collage was shown of a kitchen environment. One user even told us this was the first computer interaction he could do *"without having to put his glasses on"*. This can be seen as a testimonial to the naturalness of the interface and gives hope for this and other augmented or tangible interfaces to break away from the stifling mouse-and-keyboard manifestation of computer interaction.

[1]On http://studiolab.io.tudelft.nl/peeters/iris/ more information on IRIS is available



15

16

15 Medium range interaction used to test different arrangements of cooker knobs

16 Medium range used to explore different textures on a physical model. The table is transparent, so only the objects on the table are illuminated, not the table itself.

In the course of interacting with the medium range we found the overhead projection on the medium range to be a powerful tool for creative explorations. By projecting textures, interfaces and other images on foam models and physical products we can explore and enhance these models (figure 16). The distortion of the image on the shape can be used as a feature for explorations, finding new expressions by moving the shapes around. With this we can use light as a design material with interesting potential. In ongoing research, this so-called *"material light"* is being used to explore textures on foam models to define the material properties of such products (Saakes, 2005). In the course of its availability, many students have used the medium range to project their interactive interfaces on their physical models. This was used both for exploring different kinds of interactions and for presenting their work on video. With these augmented models they could use their hands and fingers to interact with the interface without requiring advanced video editing and 3D software.

In our later explorations of the medium range we used a camera on top of the TRI Setup looking onto the table to capture people's hands together with what was on the table. This was used in our sketching research to see if we could incorporate the hands and fingers more easily and expressively into design sketches. In a pilot experiment we asked design students to interact with a foam model using their hands on the table of the TRI Setup. This interaction was captured using the camera and projected on the same size and place on the table. Using A3 marker paper, students were asked to draw the hand and the model that were projected on the table and fill in the detailed design of the foam model (such as buttons, displays and materials).

We expected our participants to be helped by this projection to be able to better draw the hands and interaction. Contrary to our expectations, the projection didn't help improve the quality of the drawings, because our participants only drew outlines of the projected hands and didn't deconstruct the hands into their separate segments. Though this was first seen as a failure of the experiment, the experimental setup showed promise in incorporating the hands in the design process itself (Saakes & Keller, 2005).

Many of these findings on material light and projecting captured image in place were used in the development of Cabinet, which will be described in chapter 5.

Acknowledgements

The TRI setup was created in collaboration with the Academic Computing Services Amsterdam (SARA), who have shared their knowledge and experiences in the field of presence in their CAVE systems. Especially Jorrit Adriaanse of the Academic Computing Services Amsterdam has been a driving force in making the TRI Setup a reality. The TRI Setup is an integral part of the interior of the ID-StudioLab, a collaborative research workspace at the Delft faculty of Industrial Design Engineering.

Moreover the authors have benefited greatly from the ideas and discussions on the TRI Setup with the members of the ID-StudioLab.

LITERATURE REFERENCES 3

Aliakseyeu, D. (2003) *A computer support tool for the early stages of architectural design.* Doctoral dissertation, Eindhoven: TU/e.

Athavankar, U.A. (1997) Mental imagery as a design tool. *Cybernetics and Systems* (28), pp.25-41.

Boorstin, J. (1995) *Making movies work. Thinking like a filmmaker.* Los Angeles, CA: Silman-James.

Burns, C., Dishman, E., Verplank, W., & Lassiter, B. (1994) *Actors, hairdos & videotape – informance design.* Proceedings of the Conference on Human Factors in Computing Systems, CHI '94, Amsterdam, pp.119-120.

Djajadiningrat, J.P., Gaver, W.W., & Frens, J.W. (2000) *Interaction relabelling and extreme characters: Methods for exploring aesthetic interactions.* Proceedings of DIS 2000, New York City, NY, pp.66-71.

Evans, G., & Hockney, D. (2004) *Hockney's pictures: The definitive retrospective.* New York, NY: Bulfinch.

Gould, J.D. (1988) How to design usable systems. In: R.M. Baecker, J. Grudin, W. Buxton & S. Greenberg (Eds.), *Readings in human-computer interaction: Toward the year 2000.* San Francisco, CA: Morgan Kaufmann, pp.93-121.

Gribnau, M.W. (1999) *Two-handed interaction in computer supported 3D conceptual modelling.* Doctoral dissertation, Delft: TU Delft.

Keller, A.I., Stappers, P.J., & Hoeben, A. (2000a) *Listen to the noise: 'sketchy' design tools for ideation.* Exchange Online Journal, *1* (1).

Keller, A.I., Stappers, P.J., & Hoeben, A. (2000b) *TRI: Inspiration support for a design studio environment,* International Journal of Design Computing. Sydney: University of Sydney.

Kolli, R., Pasman, G., & Hennessey, J. (1993) *Some considerations for designing a user environment for creative ideation.* Proceedings of the Interface '93, North Carolina State University, Raleigh, NC, pp.72-77.

Krueger, M. (1995) *When, why and whether to experience virtual reality.* Proceedings of Virtual Reality World '95, Munich, pp.477-478.

Lynch, J. (1961) *How to make collages.* Northampton, UK: Viking Press.

McCloud, S. (1994) *Understanding Comics: the Invisible Art.* New York, NY: Kitchen Sink.

McKim, R.H. (1980) *Experiences in visual thinking.* Monterey, CA: Brooks/Cole.

Naimark, M. (1997) *What's wrong with this picture? Presence and abstraction in the age of cyberspace.* Proceedings of Consciousness Reframed, Newport, Wales.

Nielsen, J. (1994) *Usability engineering.* Los Angeles, CA: Morgan Kaufmann.

Norman, D.A. (1988) *Psychology of everyday things.* New York, NY: Basic.

Peeters, A.W.J., & Stappers, P.J. (2005) *Iris: Supporting workplace awareness by triggering informal interactions with visual material.* Proceedings of DPPI 2005, Eindhoven (accepted)

Saakes, D.P. (2005) *Material light: Exploring expressive materials.* Proceedings of 3AD Third International Conference on Appliance Design 2005, Bristol, UK.

Saakes, D.P., & Keller, A.I. (2005) *Beam me down, Scotty. To the virtual and back!* Proceedings of DPPI 2005, Eindhoven (accepted).

Stappers, P.J., Gaver, W.W., & Overbeeke, K. (1999) Beyond the limits of real-time realism: Moving from stimulation correspondence to information correspondence. In: L.J. Hettinger & M.W. Haas (Eds.), *Virtual and adaptive environments: Applications, implications and human performance issues.* Mahwah, NJ: Lawrence, pp.91-110.

Stappers, P.J., & Hennessey, J. (1999) Towards electronic napkins and beermats: Computer support for visual ideation skills. In: R. Paton & I. Neilson (Eds.), *Visual representations and interpretations.* Berlin: Springer, pp.220-225.

Stappers, P.J., Keller, A.I., & Hoeben, A. (2000) *Aesthetics, interaction, and usability in 'sketchy' design tools.* Exchange Online Journal, *1* (1).

Tufte, E. (1997) *Visual explanations: Images and Quantities, Evidence and Narrative.* Cheshire, CT: Graphics Press.

Tufte, E. (2003) *The cognitive style of PowerPoint.* Cheshire, CT: Graphics Press.

Umemoro, H., Keller, A.I., & Stappers, P.J. (2003) *More light on your table: Table-sized sketchy VR in support of fluid collaboration.* Proceedings of the 6th Asian Design International Conference, Tsukuba.

Verplank, W., Fulton, J., & Moggridge, W. (1993) *Observation and invention: The use of scenarios in interaction design.* Proceedings of CHI '93 Conference on Human Factors in Computing Systems.

Verstijnen, I.M. (1997) *Sketches of discovery.* Doctoral dissertation, Delft: TU Delft.

Wolf, E., & Keyson, D.V. (2000) *Lokaal mobiel navigatiesysteem.* (Dutch language) Unpublished Masters Thesis, Delft: TU Delft.

Wurman, R.S. (1989) *Information anxiety.* New York, NY: Doubleday.

Now we get into the *designer's practice* where the *real collections* of visual materials *are kept*. A *contextual inquiry* was conducted on the designer's *work environments* and the *role of collections* of visual material in the *design activities*.

This chapter is submitted to *Codesign*. It *describes* how the contextual inquiry *was conducted* and how it led to the *six considerations* for a *collecting tool* for designers. The inquiry follows up on *a similar study* done ten years earlier by the co-author Gert Pasman.

We use *methods* from *social sciences*, looking at the designer's collections from an *ethnographic perspective*. In the introduction the area of research is explained once more, this time with an emphasis on *observations* and *ethnographic research*.

At the end we define the *key elements* of our phenomenon and *link back* to the previous two chapters. In combining *theory* (chapter 2) with practice we learn that we should focus on *collecting* as an *ongoing activity* and in combining *technology* (chapter 3) with practice we see opportunities in *bridging* the *physical-digital divide* in the designer's collections.

This work was done in the summer of 2002 and resulted in the considerations used in the *Cabinet prototype*.

ABSTRACT

This chapter reports on a contextual inquiry performed at six design agencies looking at the role of visual material in their design work. The inquiry used a cultural probe to sensitize the participants to the subject of visual material, collecting and collages. The visit to the studios consisted of a tour of the workplace and a structured field interview.

In the design studios all the designers were surrounded by different kinds of physical visual material on different carriers, storage methods and locations. These materials were collected structured on medium, time or theme and often shared with colleagues. All the designers also kept digital images on their computers, structured by project and phase. These images were used in their collages and in communication to the client. The digital and physical collections were hardly ever used in combination.

The results of this inquiry were used to set up a set of six considerations for a tool to support designers in collecting visual material. These considerations focus on the merger of the two collections in both interaction and value.

This chapter is based on: **Keller, A.I., Pasman, G, & Stappers, P.J.** (submitted) Collections designers keep: Collecting visual material for inspiration and reference. *CoDesign: International Journal of CoCreation in Design and the Arts.*

4.1. Introduction

Kolli, Pasman, & Hennessey (Kolli *et al.*, 1993; Pasman, 2003) studied the designer's practice in order to identify the requirements computer tools should fulfil to support designers successfully in the conceptual phase of the design process. Using the method of Contextual Inquiry, a synthesis of ethnographic studies, field research, and participatory design techniques, they interviewed designers at their workplace on several topics, such as the different methods, techniques and tools they used, how and where they were getting their inspiration for new design concepts, what role the computer played in their working habits and how they organized their work environments.

Kolli et al. summarized the results of their study into a set of seven considerations for designing computer tools to support conceptualizing. Such tools should: 1) support the rapid and rough capturing of ideas; 2) afford a personalized environment; 3) use rich information sources; 4) enable a high level of communicability; 5) support individualistic styles; 6) afford a smooth shifting of activities; and 7) support motor skills. These considerations were later further explored and worked out in the development of a series of tools for supporting sketching (Hoeben & Stappers, 2001), visual database queries (Stappers & Pasman, 1999), and 3D conceptual modelling (Gribnau, 1999).

One overall conclusion from the Kolli study was the importance of visual material and visual ways of working in the conceptualizing process. All interviewed designers reported the collecting of visual reference material in the form of photographs, glossy magazines, product catalogues, videos, slides et cetera to be a major activity. Especially references to existing products, in the form of images, models or commercial samples, were actively sought for. These were then subsequently processed into collages, moodboards or presentations. Other researchers have also pointed at the prominent role of existing visual material in design thinking. For example, Eckert & Stacey (2000) reported that skilled designers use their strong visual memories to recall complex visuospatial chunks of their collection of *"sources of inspiration"* to mentally redesign their design. And in most design schools, students are taught how to use visual material in the design process (e.g., making collages; Muller, 2001).

The decade after the Kolli study has seen a rapid and radical change in both tool use and the role of industrial design itself. The graphically powerful computer has taken a central place in design. The adoption and growth of the World-wide-web led to an explosion of visual information and communication. Furthermore the role of industrial design itself has evolved (Kelley & Littman, 2001). Where product design previously was regarded as having to do with form and colour, it has now become an integral part of the

innovation process, including user studies and idea and concept generation.

These factors will also have affected the ways designers collect, organize and process visual material.

4.2 Contextual inquiry

To find out these changes a follow-up of the 1993 study was conducted with the following objectives. Firstly, it takes a fresh look at current design practice, to gauge whether the findings of the 1993 study are still valid. Secondly, it narrows the focus on the use of visual materials, towards gaining knowledge on how designers collect, organize and process visual materials in their design process and what new media tools can do to support these interactions. Topics covered in this study therefore include the designer workplace, the design process, the use of collages, the visual material used for collages, the way this material is collected and stored, and the role it plays in the generation of new ideas. Finally, it was expected that through a better understanding of the role of visual materials in the workplace the findings of this study can be translated into a set of design criteria for new media tools, supporting the interaction with collections of visual material.

4.2.1 Participants

The participants were recruited from five independent design agencies, which were selected in co-operation with the Dutch designers association BNO to reflect the differences in the field. The agencies varied in size (from a one-man consultancy to agencies with over 60 employees) as well as in product markets (consumer, medical, professional or packaging). One agency specifically focused on new media design, but was part of an association of other creative agencies. Two of the agencies had been involved in the 1993 study, but none of the present participants had been involved in that study. Partners of the five design agencies then selected one designer from their staff who had been involved in one or more design projects in which collage making or making visual presentation using existing material had played an important role. All of the selected five participants had over two years of practicing experience but varied in educational background (university or academy), age and sex (figures 1 to 6).

4.2.2 Method

In line with the 1993 study, contextual inquiry was taken as the basic method for the present study. It consists of a joint *inspection* of the workplace, followed by a structured field interview (Beyer & Holtzblatt, 1997). This method works well to bring out aspects that the participants can talk about easily, addressing both the current practice and reasons behind it.


1

MV


2

JB


3

RH

4

LS


5

PR


6

MS

1 **Marcel Vroom** (MV), MVAVD (1 employee). *Graduated from TU Delft, over 20 years of design experience in product design, research and consultancy*

2 **Jan Willem Bouwknecht** (JB), NPK (60 employees). *Graduated from TU Delft, 4 years of design experience in product design, engineering and conceptualization*

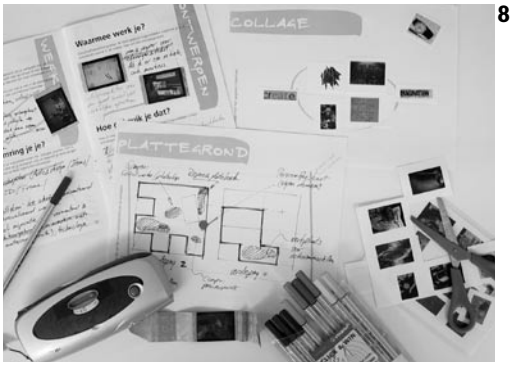
3 **Rogier Hendriks** (RH), Onesize (2 employees). *Graduated from artEZ, 2 years of design experience in motion and graphic design*

4 **Lisa Smith** (LS), WAAC's (8 employees). *Graduated from ACCD, 7 years of design experience in product design, packaging and consumer research*

5 **Peter Roeland** (PR), Flex (24 employees). *Graduated from TU Delft, 3 years of design experience in product design and packaging*

6 **Marieke Sonneveld** (MS), Nomos (1 employee). *Participant for pilot*

7



8

7 The cultural probe as it was distributed to the participants

8 Overview of a cultural probe filled in by one of the participants

In addition to this method, the workplace was preceded with new techniques for knowledge elicitation developed in the participatory design community, namely cultural probes (Mattelmäki & Battarbee, 2002) and generative tools (Sanders, 2002a). These techniques deepen the levels of information accessed by sensitizing the participants by using diaries, expressive techniques and playful assignments. As Sanders argues, they enable participants to talk about their dreams and wishes for the future, not just their observations and irritations from the present and the past. This last aspect, getting at participants' dreams, is especially relevant because we want our findings to drive future tool development.

Moreover, we expected the sensitizing techniques were needed, because in a previous study described in chapter 2 it was found that collecting visual material itself is a continuous side activity to designers. Collecting was not considered to be a formal, structured and documented way of working; rather it appeared to be an informal part of design culture. Such informal activities involve levels of tacit knowledge that are not easily brought out in a conventional interview technique (Polanyi, 1974; Sanders, 2002a), hence the need for these new sensitizing techniques.

4.2.3 Procedure

SENSITIZING

One week before the interview, each participant received a cultural probe: a small package containing a booklet with evocative assignments, stimulating visual material for collage making, a set of colored pens, scissors and a Polaroid instant camera (figures 7 and 8). The assignments, 14 in total, were

open-ended, covering different themes in the design process, starting out with specific questions on their workplace and the tools they use, and then gradually moving towards collections of visual material and sources of inspiration. A sample assignments was *"take a picture of your workplace, paste it on this page and give some comments"*. Also, they were asked to draw out a *"plan of your work environment"*, and *"mark the place where you keep your visual material on the plan you drew using this red dot"*. In the final assignment participants were asked to make a collage representing their work process when designing.[1] The materials, pens, and form of the assignments (e.g., half-finished diagrams, photographs chosen to elicit associations), were playful and intentionally rough and sketchy, in order to provoke the participants to take the initiative, bring in their own perspective and express freely (the reasons for this are argued in Sanders, 2002b). The cultural probe therefore served three purposes: 1) it gave us rich user data in the context of the workplace over time, 2) it forced the participants to think about their use of tools and visual material and, related to that, 3) it sensitized the participants on the topic of visual material in relationship to their design process (Sleeswijk Visser et al., 2005). Thus awareness was created which was then subsequently 'harvested' during the interview.

INTERVIEW

The sessions started with a 20-minute tour of the workplace, followed by the actual interview, which took place at the participants' workplace and lasted about 90 minutes. The participants were asked to briefly describe a recent design case, and were encouraged to refer to this case whenever appropriate. Topics covered during the interview partly resembled those from the 1993 study, such as the designer's workplace, their design process, the tools they used and their sources of inspiration.[2] However, this time the questions were directed more towards the role of visual material in these areas. Next to these, new and more specific topics were addressed, such as the participant's use of visual material in general, the making of their collages, and their collections of visual material, both physical and digital.

The interview also contained a small assignment. At some point, after a participant had referred to a specific image from his digital or physical collection, the researcher asked him to show this image. This required an impromptu search for that image in the collection. The search itself was observed, eliciting questions from the researcher and unsolicited comments from the participant. This assignment was conducted for both a physical and a digital image. If the participant had not spontaneously mentioned an image,

[1] On http://www.forinspirationonly.net/appendix/ a PDF of the booklet can be downloaded

[2] On http://www.forinspirationonly.net/appendix/ a PDF of the questionnaires for the interview can be downloaded

the research would ask if the participant could think of one, which was then used instead.

Audio was recorded during the interview and photographs were taken of the workplace and the material shown during the tour and the interview. Following Collier & Collier's (1986) recommendation, pointing the camera was also used as a means to elicit comments from the participants.

4.3 Analysis

After gathering the data, meaning had to be assigned to it through interpretation. The data used for analysis consisted of the transcripts of the interviews, supplemented with photographs and notes made by the interviewer. Because the probes were only used to prime and sensitize the participants for the actual interviews, their data was not included in the analysis.

In a number of interpretation sessions, the interviewer walked through the interviews together with the researcher, who had also conducted the 1993 study. Goal of these sessions was to build a shared understanding. For each of the identified areas of interest, all observations, statements, notes and photographs were jointly interpreted and then subsequently processed into more general findings. These findings were then discussed between the two researchers as well as with other researchers and designers, resulting finally in a set of six design considerations, which can serve as guidelines for developing a tool to support the use of visual material in the design process.

4.4 Results

All participants were very open in explaining and showing their workplace, the tools they used and the visual material they collected for their design process.

4.4.1 Using the cultural probe

All participant had studied the probe and done most of the assignments, though only two had completed all of them. Adding the new sensitizing tools of workbooks and probes appeared to have been a good addition to the proven method of contextual inquiry. Participants talked not only about their past experience, the current situation and its problems – by also probing their dreams and aspirations, they could frame their observations into desires for the future more readily.

9 Observations of collections in different ranges in the workplace

4.4.2 Observations from the guided tour

In the two large agencies (RH, JB) due to security reasons the guided tour was limited to the areas that the participants considered their daily practice. In the case of the other participants, even at the smaller home offices (MV, MS), the tour covered several stories, rooms and functional areas.

VISUALS IN THE WORKPLACE

All workplaces contained a diversity of ways of storing visual materials of different modalities: cupboards filled with visual materials; stacks on floors; posters, notes and artefacts on the walls; reading tables filled with magazines (both stacked and layed out). Each of the participants at one point in the

tour apologized for messiness, sedimentation or chaos. When making these remarks, they either pointed at stuff that colleagues had left there, at the results of a group meeting, or at artifacts on the wall *("we need to update these walls"*, PR). LS explained that she did not use the walls because in her previous workplace she had had the experience of these walls becoming too static and turning into *"visual wallpaper, which is only a disturbing noise"*.

All participants talked at length about the artifacts in their own cupboards and on their desks during the tour of the workplace. They all worked on multiple, large-size desks, on which a computer and sketching tools such as pen and paper were layed out, with the exception of the new media designer (RH), who had a single desk which was dominated by a computer with almost no free surface. All participants also displayed a sense of pride about the work that they were currently working on. PR, who worked in a so-called *"flexible workplace"*, talked fondly about his personal closet as being the real showcase of what he was working on, communicating both to himself and to his colleagues.

Figure 9 gives an overview of how each participant stored their visual materials. The table is organized into four places of storage and presentation: 1) walls and cupboards, 2) floor, 3) the tabletop, and 4) the computer. All participants used all these places, yet in different ways. Some walls and cupboards are full, some are empty and one participant used a magnet wall (JB). Similarly, the use of tables and floor space varies, as does the collection of computer software and the way the computer is 'embedded' on the table.

4.4.3 Interview

All the designers freely talked about the tools and techniques they used in their design process. The results will cover tool usage, role of collages, their collections of visual material and their sources of inspiration.

TOOL USAGE

Although all participants had spoken with pride about their workplace during the guided tour, they initially talked down the importance of tools, stating that they could work *"with anything available"*. Yet, when asked to describe their pens and how they use them, they more than once showed special bonds with their tools and the techniques they used to optimize their tool usage (e.g., PR mentioned wearing down his fineliner in order to get a drawing style with more personality; MV showed a pencil and pen that he used for all his drawings and annotations over the past 10 years). Although such physical tools are used with care and devotion, they seem to have receded however into the background of the designer's awareness.

10 Unused tools: a scanner with books and magazines on top of it

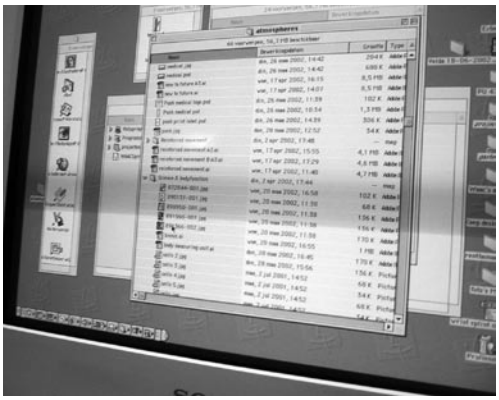
11 Unused tools: a digitizer tablet in vertical position between computer and monitor

The computer, on the other hand, was very prominent in their minds. All participants stressed its importance as a tool for working out and visualizing their ideas. Presentations to clients were always guided by a computer presentation, often in PowerPoint. At five of the agencies these presentations were accompanied with printouts, models and posters. In these cases the PowerPoint presentations would serve as a guide to structure these different elements.

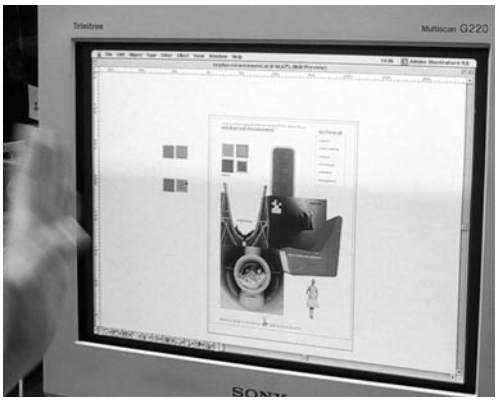
Besides their own desktop computer, the participants also used other computers, such as laptops or shared computers, which were set up for specific tasks like scanning or engineering. In two cases this shared computer was also the main computer of one of their colleagues, meaning that they had to disturb him to make a scan or print. Neither the scanners nor the pen tablets (input devices) were intensively used. In two instances we even found the scanner rendered useless by a pile of books and magazines covering it (figure 10), while the two pen tablets we encountered were either shoved under the keyboard or stored vertically (figure 11).

COLLAGE

When asked *"when and why do you make collages?"* all designers stated that they only made collages for clients wanting them or projects needing them, such as *"for presentation to the client"*, or *"as 'visual contract' with the client on the direction of the project"* (LS). Only RH indicated he used collages for his own overview and for finding direction. This surprised us, as we had expected collages to be an important instrument in the image creation process as it is taught in design schools (Muller, 2001). Although all participants used collages to convey a sense of atmosphere or to set the mood for a product, they remarked little on the collages' formal aspects, such as composition or structure.



12



13

12 Digital imagery used for collages in a list of named files

13 Digital collage in the making with unused imagery and colour swatches outside the page

Collages could be anything, from singular images to complex arrangements of many images and words, while many of the collages that participants showed also contained keywords, as a title or as smaller elements.

LS demonstrated a typical way in which collages would be made with the computer. She would first start out by discussing and selecting several directions she wanted to explore. For each direction she then created a separate folder, which she labeled with a short description of that direction. After this, she would visit a stock photo website and search it using keywords related to the several directions. Selected images would be saved in the relevant folders without renaming them. After the search she would add materials from other web sources, or by scanning in images from magazines. Subsequently a selection was made of the images within each folder (figure 12), which were then given more descriptive names. Finally the selected images were imported and organized in a collage using Adobe Illustrator (figure 13). The images that were not used remained with their old names in the folder.

This example demonstrates that verbal rather than visual interactions guide the image formation phase.

Most of the interactions related to storing and organizing images on the computer are simply concerned with file management and have nothing to do with either image creation or collage making at all.

COLLECTIONS

During the tour, all participants had pointed at several collections of visual materials in their office (as shown in figure 9). Demarcations of collections were explained by referring to places (stacks with themes), media (slides in one cupboard, magazines on bookshelves) or ownership (personal versus shared collections).

As motivation for collecting, participants indicated several uses of the collected material: 1) as reference (catalogues, colour and material samples); 2) to archive their own work (product photography, drawing archives); 3) as elements to use in collages; and 4) to get inspired for new ideas, which was emphatically split in new ideas concerning *form* (illustration styles, angles, sketch or rendering styles) and new ideas concerning *content* (people, situations or use of colour).

Surprisingly the participants explicitly stated not to use images of existing other products. The reasons for this were that it was considered to be *"not very creatively stimulating"* (LS), *"unethical to steal"* (PR) or that *"most of these other products are already in my head"* (MV).

COLLECTIONS / PHYSICAL COLLECTION

As mentioned earlier, the physical collections were mostly structured by themes or by media and storage type. The participants had great difficulty giving names to the themes, but could talk very fluently about the kind of images in them. For example, RH owned a collection of old typography, which was acquired through taking pictures of typography in public spaces, while MV owned different collections of articles and material on *"home automation"*.

Further findings strengthened the idea that collecting as a background *activity* was more important than the actual collection as an *object of reference.* Although participants were sometimes rather vague on the reasons for collecting *("I want to use it for something, sometime")*, and used very loosely structured means of storing (stacks, folders), they reported to take great care in growing the collection. Selecting and adding material was done with quite a lot of attention: MS in our pilot test said she cut out all the material she selected on black cardboard to *"make it more special"*. MV would add the date and some keywords on the back or on the side of all the materials, while PR had a process of first hanging things in his personal cupboard and gradually moving it into a stack in his collection. Furthermore, only a few images from the extensive physical collections would end up in the collages or become an explicit part of the design process. MV described the physical collection as *"just being a part of the working environment"*.

14 Yellow notes in books and magazines to mark images for use in collages

15 Stock photography book with images marked with yellow notes and project codes

For organizing their physical collections, we found the designers at Flex and WAAC's using yellow sticky notes to bookmark pages in magazines (figures 14 and 15). At WAAC's LS even joked about taking out a colleague's yellow notes or labels as a way to communicate their disapproval of the colleagues choices. *"Colleagues would probably never notice this, but I enjoyed doing it anyway."*

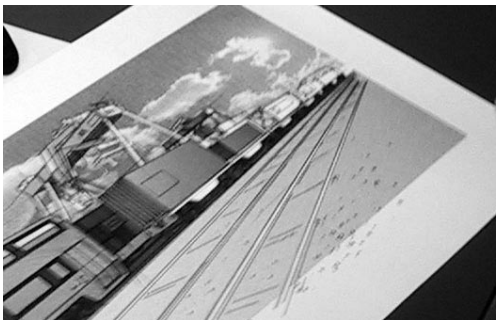
COLLECTIONS / DIGITAL COLLECTION (ON THE COMPUTER)

A second collection of images, totally separate from the physical one, was found to reside on the participants' computers. They all had structured their digital collection in a uniform and verbal way, based on projects, clients and phases. The images all had names, some of them indicating the source of the material, such as a number from a stock photography website or a client's naming structure, or a description of what was being depicted. The digital collection was used for explicit goals such as making a collage or to create a background for a rendering (see the discussion of LS' collage making above).

All the participants talked about websites and stock photo collections to find images for their collages, but these online resources were not organized on their computers. They talked about them *"as places to go"* rather than their own collections.

COLLECTIONS / THE DIGITAL-PHYSICAL DIVIDE

The two collections of physical visual material and digital imagery did hardly overlap. The only ways designers said to connect the digital with the physical world was by either printing out a digital document or use



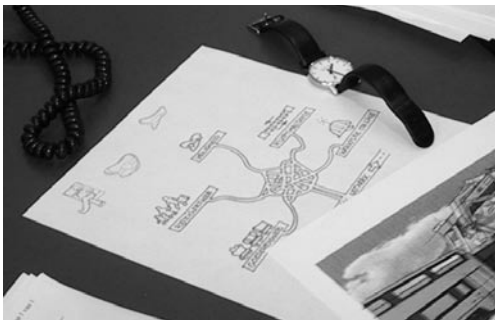
16 Misprints used to share projects with their colleagues

17 A printed photo used as a background to draw upon

the flatbed scanner to digitize an image from a magazine or book. Both the observational evidence (figure 10) and their own stories indicated, however, that this connection was neither fluent, nor practiced frequently. Scanning was described as an awkward but necessary task. Therefore designers would first make a selection of those images really needed in a collage, which were then all scanned in one batch.

Not many printouts from the digital collection were kept in the work environment, the few ones hanging on the walls almost seeming to need an excuse. At NPK there were some printouts hung on the side of a cupboard (figure 16). When asked about them, JB said: *"Actually these are misprints because we changed some stuff, but because these colour prints are so expensive, we just hung them up on the wall to show to our colleagues what we are doing"*. At WAAC's a colleague of LS showed sketches, for which a print of a digital image was used as a background to draw upon (figure 17).

An interesting illustration of divide between the physical and the digital collection emerged in the last assignment of the probe, in which the participants were asked to make a collage of their design process based on material given to them and, optionally, another collage with their own material. While four out of six participant made the first collage, only one participant (LS) made the optional collage using the Polaroid camera that was given as part of the probe. The reasons to not complete this last assignment being (apart from time restraints) that they didn't have the materials available at hand or had no inspiration to collect them. Two of the participants (MV and RH) actually said that all their visual material was *"inside the computer"* and therefore *"hard to get out"*.



18 Source of inspiration: illustration from the collection

19 Image rhyme: drawing with similar illustration style

INSPIRATION

Participants found it difficult to talk about how they used visual materials in their design process, indicating they used them *"to set the mood"* or *"to do something with it at a certain stage"*. When asked for specific sources of inspiration, little was said. LS showed an illustration in a book (figure 18), whose style inspired another illustration in progress (figure 19).

When the question was rephrased in *"ways in which you got your inspiration"*, almost all participants referred to the act of physically changing environments, e.g., by taking a stroll outside (MV), going to a shopping area (LS) or visiting an exhibition (PR), all activities directed towards breaking the rhythm, looking outside or stumbling upon unexpected things.

Three of the designers also referred to their collection of visual material for getting new ideas. But this role was not emphasized. PR: *"I collect the material for my own inspiration, yet I don't look at it that often. I just know it exists. If I like something, I want to remember it, therefore I collect it,"* This difference between "sources" and "ways" was striking: whereas designers attach great value to being inspired, they regard this as a specific activity, but rather as a background process, not related to specific objects answering explicit or implicit questions.

4.4.4 Get-an-image assignment

The image search assignment showed a clear difference between the physical and digital images. Searching an image from the physical collection was usually a smooth, low-load activity, which was conducted in parallel with other activities, such as talking and thinking about the criteria of the assignment. All participants walked to cupboards, bookshelves, archive boxes or stacks on desks in their studio to take out a snippet, a book or magazine,

20 Design books on a shelf above the printer
21 Design magazines with an archive in the lunch area
22 Magazines on display near printer, hallway and staircase

sometimes picking up another book on the way (figures 20 to 22). This held true even for those who had prepared a set of images on their desk. Two participants changed their minds during the search, and went to look for another, better, example. Most importantly, all participants continued the conversation during their search. They exhibited a strong sense of where they were within the collection, making the interviewer an active participant in browsing the collection.

This sense of place and enjoyment when visiting the collection did not appear for the digital image. Finding it on their computer or on their network turned out to be a completely different activity. PR, who worked at a flexible office, had no computer at hand, and therefore redirected his search to printouts he had prepared in advance. All the other participants found material in their computer. During this process they were very focused on the single result, making no remarks on what they found *"along the way"*. They needed all their attention for the computer, sitting with their back turned to the interviewer. All participants but one located an image on their computers

by going through the directory structure. They would open one or several image files by double-clicking the file icon, or by using the *open file* menu in their graphics application. The first image was usually *"not the right one"*, after which they would simply close or click through the different images until they got to *"the right one"*. This was often accompanied by a sequence of opening and closing windows.

One participant (JB) launched a heavy PowerPoint presentation and quickly clicked through the slides on the way to the image he sought. The contents of other slides in the sequences were not discussed but referred to just as *"not the one I am looking for"*. The PowerPoint presentation eventually caused his computer to crash, and could not be restarted for the remainder of the interview. All participants clearly experienced searching for the right image on their computer as a task instead of the pleasurable activity they were subjected to in the search for physical material.

4.5 General discussion

The results from the contextual inquiry offered a rich source of anecdotes, routines and observations on the use of visual materials by designers.

CONSIDERATIONS FOR A COLLECTING TOOL

In line with the 1993 study the results of the present study were translated into six considerations. These considerations were used as guidelines for developing a tool to support the use of visual material in the design process. In the remainder of this section, we will present each of these considerations.

1) **Active collecting.** From the interviews we learned that, although designers could not clearly point out the reasons for collecting certain pieces of visual material, the act of collecting itself seemed to help them to set a mental image that could be recalled later. Collections of visual material can be found near the lunch desk or the printer to allow for reading them in between tasks or at moments of spare time. New tools should aim to support *collecting* as an ongoing activity, rather than *the collection* as an object. A tool should allow for flexible adding of visual material and be readily available for use.
2) **Merger of physical and digital collections.** In the tour, the interview as well as the get-an-image assignment, we observed designers having two completely different types of collections, a physical and a digital one, with hardly any connections between them. The physical collection was the one that surrounded their workplace and was kept as an ongoing activity, whereas the digital collection contained the images used in collages organized by project and timeframe.

Better tools for merging these worlds can make the physical collection more useful in the communication to clients and make the digital collection more expressive, communicable, and inspirational.

3) **Serendipity.** Chance encounters were mentioned as an important source of inspiration, but occurred mainly in the physical world. The digital environment, with its collection kept hidden inside the computer, does not seem to lend itself to casual browsing, thereby lowering the chances of unexpected findings. New tools should therefore offer the same odds on serendipitous encounters of digital images as in the physical environment. This finding is related to the previous one in that not just should the collections merge, also the way of interacting with them should, retaining the best of both worlds.
4) **Visual interaction.** The physical collection of visual material was navigated purely on designers' visual and spatial memory, whereas their interaction with the digital collection relied almost exclusively on verbal keywords. The computer has put too much of a focus on the verbal aspects (figure 13) to support collage making, which is described as creating *"a visual experience, hardly expressible in words and rarely based on words"* (Tufte, 1997). New media tools should still allow the use of verbal keywords, but this verbal interface should not be an unavoidable barrier between imagery and collages.
5) **Inspiration by breaking the rhythm.** Designers talked about getting inspired by breaking away from their desks. This has other benefits as well, with designers talking positively about breaking their work rhythm during presentations, workshops or brainstorm sessions where the designers were usually standing up and using expressive gestures in drawing and presenting (Hummels, 2000). Although it is very hard to get a grip on the notion of *inspiration* in a tool or technique, involving the body and changing the rhythm are clearly positive factors on stimulating creativity and inspiration.
6) **Social value of visual material.** In our observations we found that the physical collection of visual material was used to share knowledge with colleagues. The cupboards and walls were used as small exhibitions of ongoing work (figure 9) often using misprints to communicate process. By marking pages with sticky notes designers could communicate interesting images to colleagues (figure 16). These subtle social aspects are not well supported in the computers. Which were personal and closed for colleagues.
   New tools should allow for the same kind of subtle and ongoing communication with the digital collection as well as the physical collection of visual material.

COMPARISON TO THE 1993 STUDY

Much of our findings were in line with the Kolli et al. (1993) study on the creative work environment. Designers still use quick means such as sketching to capture ideas, gather a variety of information sources, personalize their work environments, and explore expressive styles for communication. The main differences with the 1993 situation lie in the ubiquitous use of computers, the rise of the Internet as an informative and inspirational medium, the emergence of the separate worlds of digital and physical materials.

Most of the focus of work now lies in the digital world, although the use of physical media is downplayed by most of the designers. Partly this is because a lot of time is spent at the computer, partly because most visible end products are made and kept on that computer. However, it also seems that designers don't "see" their use of physical media just because it is so fluent and unobtrusive that it can occur as a background or on-the-side activity such as doodling or rough sketching.

Switching between tasks on the computer has become quick and frequent, without the ritual of gathering and arranging all the physical stuff. Over the past decade, computers have provided many extra features, becoming more powerful at displaying expressive graphics, but have not become sensitive to the richer, more expressive use of the possibilities of the user's body. Richer input devices, such as pen tablets, are present in most design studios, but are used relatively little.

The leading visual culture that designers explore for inspiration has shifted from MTV's video style, mentioned by all designers in the 1993 study, to the visual styles used in websites. Also, the Internet has become the dominant source of visual information and inspiration.

Both digital and physical materials are intensively used, but they appear to live in two separate worlds, the former being created and used for formal documentation and presentations to clients, while the latter is mainly used for exploration and idea generation. Although there are connections between these two worlds, such as scanning hand-drawn sketches into the computer or sketching over printouts of images, the actual use of these connections are rare.

4.6 Conclusion

In this chapter a contextual inquiry has been described involving designers from different fields and backgrounds, focussing on the way in which designers gather, keep, and use visual material. In comparison with a previous study held in 1993, we found that visual material still plays an important role both for information and for inspiration. However, currently, designers

keep two separate collections of visual material: one highly structured set of digital images on the PC and another loose collection of physical artifacts and clippings living on the desks and walls of design studios. Both these collections are important, but only the former contains the material that reaches the client, whereas only the latter is used socially and serendipitously (for inspiration) in the design studio.

These findings have implications on the development of a design tool that uses the power and advantages of the graphical computers and presentation techniques, yet integrates the social use of visual material in design studios and the serendipity that is important for inspiration. Most importantly this study changed our initial view on collections of visual material from object to activity. Before this we looked at the collections as a repository of objects to answer specific design questions. After the study we identified the value of collecting as an ongoing process to keep the designers sensitive to their social, cultural and technological environment in relationship to their design problems.

The study resulted in a set of six guidelines for a visual collecting tool specifically aimed at supporting these aspects. Development of this tool is described in the next chapter. Many of these guidelines can also be used in the development of other *image management systems* or *tools for ideation.*

Acknowledgements

We would like to thank all the design agencies and specifically our participants who have taken the time to give us an insight in their working process.

LITERATURE REFERENCES 4

Beyer, H., & Holtzblatt, K. (1997) *Contextual design: A customer-centered approach to systems designs.* San Francisco, CA: Morgan Kaufmann.

Collier, J.J., & Collier, M. (1986) *Visual anthropology: Photography as a research method.* Albuquerque, NM: University of New Mexico Press.

Eckert, C.M., & Stacey, M.K. (2000) Sources of inspiration: A language of design. *Design Studies, 21* (5), pp.523-538.

Gribnau, M.W. (1999) *Two-handed Interaction in computer supported 3D conceptual modelling.* Doctoral dissertation, Delft: TU Delft.

Hoeben, A., & Stappers, P.J. (2001) *Ideas: Concepts for a designers' sketching-tool.* Proceedings of CHI 2001 Conference on Human Factors in Computing Systems, Seattle, WA, pp.199-200.

Kelley, T., & Littman, J. (2001) *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm.* New York, NY: Currency.

Kolli, R., Pasman, G., & Hennessey, J. (1993) *Some considerations for designing a user environment for creative ideation.* Proceedings of the Interface '93, North Carolina State University, Raleigh, NC, pp.72-77.

Mattelmäki, T., & Battarbee, K. (2002) *Empathy probes.* Proceedings of the Participatory Design Conference 2002, Malmö, pp.266-271.

Muller, W. (2001) *Order and meaning in design*. Utrecht: Lemma.

Pasman, G. (2003) *Designing with precedents.* Doctoral dissertation, Delft: TU Delft.

Polanyi, M. (1974) *Personal knowledge: Towards a post-critical philosophy*. Chicago, IL: University of Chicago Press.

Sanders, E.B.-N. (2002a) From user-centered to participatory design approaches. In: J. Frascara (Ed.), *Design and the social sciences.* London: Taylor & Francis, pp.1-8.

Sanders, E.B.-N. (2002b) Generative tools for codesigning. In: L.J. Ball, A. Woodcock & S.A.R. Scrivener (Eds.), *Collaborative design: Proceedings of CoDesigning 2000*. London: Springer.

Sleeswijk Visser, F., Stappers, P.J., Lugt, R. van der & Sanders, E.B.-N. (2005) *Contextmapping: Experiences from practice.* CoDesign: International Journal of CoCreation in Design and Arts, 1 *(2)*, London: Taylor & Francis.

Stappers, P.J., & Pasman, G. (1999) *Exploring a database through interactive visualised similarity scaling.* Proceedings of CHI '99 Human Factors in Computer Systems, Pittsburgh, PA, pp.184-185.

Taking our *knowledge* and *experience* from the previous chapters, the next step is to bring *theory*, *technology* and *practice* together in a *working prototype* called *Cabinet*.

Section 5.3 describes the design and *development process* of Cabinet. Section 5.4 and 5.5 contains the *specifications* and *evaluation* of Cabinet. These sections *justify* this research project to be *valued* as a *doctoral design* opposed to a doctoral thesis.

Cabinet addresses the two main *research questions* of this research: 1) Cabinet can be used to *gain insights* on *how* designers *use* collections of visual material in their design process, and 2) Cabinet *demonstrates how* new media tools can *support* this.

Now we can finally take the *perspective* of the *designer* and *builder* of *product* and *interaction*. The first two sections of this chapter *recapitulate* our *main findings* in the previous chapters from a *design perspective*. The findings are used to *demarcate* a playing field in which we design and develop our tool.

This work was done in the summer of 2003 and resulted in the *working prototype* of Cabinet and *many demonstrations* of it. In these demonstrations Cabinet *sparked discussions*, bearing relevance to all *three ingredients* mentioned above (*theory*, *technology* and *practice*).

ABSTRACT

This chapter presents the development of Cabinet, a tool for designers to collect and organize visual material. The development builds upon insights from our previous research in both theory and practice. Our previous experiences in making prototypes that support creative activities provided us with opportunities to apply technology and design into our tools.

Cabinet was developed in a user centred tool design process, with our users being designers themselves. The tool design process used many different methods and techniques such as translating design criteria to personas, developing storyboards and paper prototypes. The tool design process also produced many different working prototypes, which we have put through actual use scenarios.

Our final working prototype called Cabinet is a tool that is useful, stable and pleasurable enough to be exposed to the real world. By placing Cabinet into the designer's workplace we can verify the validity of Cabinet as a tool as well as gain knowledge on how designers use their collections of visual material in their design process.

The main developers of Cabinet, Aadjan van der Helm and Aldo Hoeben have contributed to many parts of this chapter.

5.1 Goal

Cabinet was developed as a tool to support designers in collecting visual material in the conceptual phase of the design process. In general, tools for this phase should empower their users to express themselves, something which computer tools often lack (Stappers & Hennessey, 2000). In solutions of computer-aided sketching, expressive and fluid ways of interacting with computers have started to emerge in research prototypes (Aliakseyeu, 2003; Gross & Do, 2000; Stappers *et al.*, 2000).

Another technique used in the early phases of design is to make collages. A collage (French for pasting) combines images to create a provoking experience, hardly expressible in words and rarely based on words (Tufte, 1997). In design these collages are used for the designers own image formation and are used to communicate the direction of a design project (Muller, 2001). Clearly the tools for making these collages should allow for expressivity, ambiguity and fluency. Yet, for making collages and moodboards, we found that designers directly resort to advanced image manipulation tools on their computers. The image manipulation tools used (most noticeably Adobe Photoshop) are powerful for the goal of making moodboards to present to clients, but the visual analysis and organization is not intrinsically supported.

Existing tool research into supporting visual material in design focuses on finding images in computer systems rather than adding and growing collections. In these research projects advances are made in using vague or visual queries (Nakakoji *et al.*, 1999; Restrepo, 2004) in existing, structured image databases. When research and software development doesn't rely on existing image databases, it usually focuses on *adding for retrieval* rather than the activity of *building a collection*, organizing and browsing it as a pleasurable task (Keller *et al.*, 2004b).

With Cabinet we aim to develop a tool to support the designer in collecting visual material over time, enabling the designer to gain new insights and find inspiration in such a collection and the interaction with it.

5.2 Design approach

In our *research through design* approach we try to integrate the theoretical constructs (described in chapter 2) and the field observations (described in chapter 4) into experiential tools. In making these tools, we use our experiences with technology. These experiences come from making and using prototypes, such as the TRI Setup (described in chapter 3) and others described in this chapter

Because we are making a tool for designers and we in turn are designers ourselves, we have to make a clear distinction in terms. Our users will be

referred to as *product designers* with a *product design process,* whereas the work presented in this chapter is part of a *tool design process.*

This distinction also clarifies that we, the *tool designers,* are not designing a tool for ourselves. In design in general and human computer interaction design in specific, designing for yourself is commonly seen as a bad approach. On the other hand, it is important to empathize with and take the perspective of the end-user (Laurel, 2003). We have seen that involvement and empathy is important in design, as long as you are able to keep distance and fresh perspectives, based on solid user data (Keller *et al.*, 2004a).

5.3 Tool Design Process

The tool design process for Cabinet was highly iterative, involving user studies, prototyping, testing, evaluating and creating new prototypes (Sanders, 2004). In this chapter the tool design process is structured by the kinds of activities. This section starts out with how we involved our end-user, the product designer, in our tool design process. After that we will expand on some of our own previous experiments and prototypes that have influenced the development of Cabinet. We will end the section in a chronological report of the different prototypes that led up to the final prototype called Cabinet.

5.3.1 User involvement

The first step in involving our users was to visit them in a contextual inquiry. The main results of this contextual inquiry are described in the previous chapter and resulted in six considerations for a collecting tool. During the tool design process we used more data from the contextual inquiry and made them applicable by creating personas, scenarios, and storyboards, which will be described more detailed in the remainder of this section.

DESIGN CRITERIA FOR CABINET

In the contextual inquiry into collection use in design practice, described in the previous chapter, we found that designers take care in building and maintaining collections of visual material but hardly approach these collections with a specific question in mind. They rather visit their collections for reference and inspiration. Another important aspect found in the design practice was the huge effect of current graphically powerful computers in the design process, specifically in making collages and moodboards. All designers in our contextual inquiry made their collages directly on their computers, but none of them had specific tools for organizing and managing their source material.

The findings from the previous chapter are translated in six considerations for a collecting tool in table 1.

Table 1. Design criteria for Cabinet, with the findings on which they were based

	Findings	*Design criterium:* A tool that supports collecting should ...
1	**Active collecting**	... allow for building a collection without a predefined structure and make it easy to add material.
2	**Merger of physical and digital collection**	... merge the physical and digital collection in both interaction and value.
3	**Visual interaction**	... not force designers to verbalize their visual thinking process.
4	**Serendipitous encounters**	... allow for serendipitous encounters with digital material.
5	**Inspiration by breaking rhythm and involving the body**	... lure designers away from their desks and involve their body in visual thinking.
6	**Social aspects of visual material**	... allow designers to calmly communicate the contents of their collection to colleagues.

Apart from these six criteria, the Cabinet prototype had to function as a research tool as well. This meant that it needed to stay within the theoretical framework set out in chapter 2 and needed to provide answers to our research questions on how designers interact with collections of visual material and what new tools can do to support this. To provide these answers we needed a prototype that makes the implicit behaviour of collecting explicit, either by invoking reflection on its users or by logging the users actions.

Finally Cabinet was developed to be able to withstand real world conditions, i.e. in design practice. This means Cabinet had to be technically robust, extremely easy to use, self explanatory, focused in functionality, with a compact but complete feature set, tuned to the context of use. This also involved some practical considerations: we should be able to transport our prototype and the technology used should be available and affordable.

These considerations set the boundaries to develop and design within. However, we also needed tools to empathize with the user and make them a contributing part of the tool design process.

PERSONA

One way to translate user data into tool design parameters is the use of *Personas.* A Persona, as defined by Cooper, is a fictional archetypal user based on user research (Cooper, 1999). The technique combines the creative use of characters and playacting (Djajadiningrat *et al.*, 2000; Verplank *et al.*, 1993) without loosing sight of the actual users.

Cooper advises to define this character as real as possible and communicate this to all the members of the tool design team. By referring to

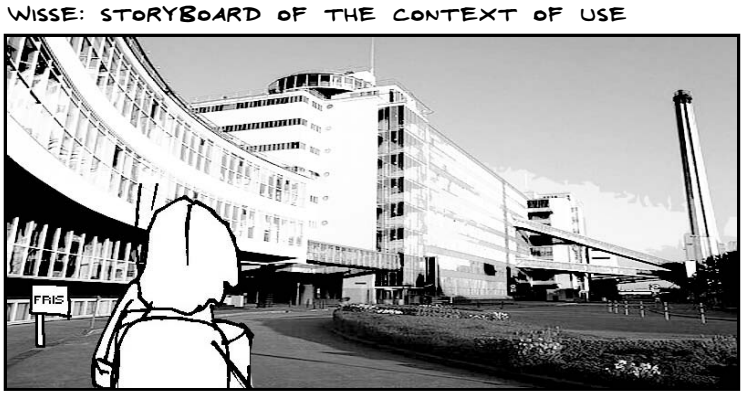
1 A photo collage of the main character Wisse, what he looks like, what he does, where he works, who his colleagues are

the character all through the tool design process, this avoids trying to cater to every possible user (usually resulting in feature-rich but unusable products).

In our case the six designers visited in the contextual inquiry formed the basis of our Persona called Wisse. Figures 1 and 2 show an image of the character and context with a part of his week in a contextual scenario partly described below.

> *"Wisse is a 26-year-old male designer with three years of work experience. He works at Fris Design, a studio with 3 partners and 10 employees. He is currently working on three different projects a medical project, a packaging for candy and a conceptual scenario for subway interiors.*
> *He has received our prototype and plans to use it for the candy packaging client ...*[1]

[1] On http://studiolab.io.tudelft.nl/cabinet/wisse/ the complete scenario continues



2 A part of the storyboard for Wisse, illustrating the contextual scenario

The scenario continues to report a complete week and contains client contact, collaborative use and many other situations for which Cabinet may or may not be suitable.

In each step of the tool design process we evaluated our decisions by asking ourselves whether this would be relevant to Wisse and the story we had made for him and his colleagues. Early on, we also set up a reference collection of 80 images related to the fictitious company and the different clients and projects Wisse was working on. This reference collection was used to deliver suitable content in the development of Cabinet.

PAPER PROTOTYPING

To explore natural interactions and to think about how to make the digital collection more physical we used a technique known as paper prototyping (Snyder, 2003). The 80 images from the reference collection were printed on cardboard and made into 2 by 3 inch cards. These cards could easily be manipulated on a flat surface, to try out natural behaviour in organizing.

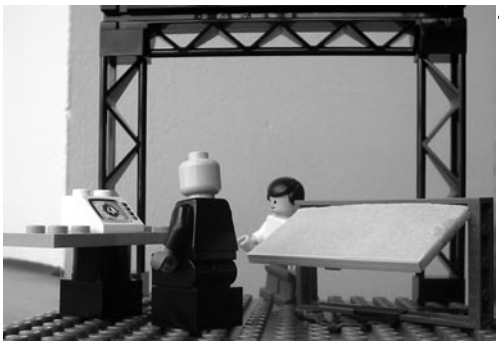
Working with these cards showed that images could be organized relatively easy by making meaningful compositions on a table. Furthermore, the use of stacks or piles (Mander *et al.*, 1992) offered a good way to represent groups.

With these insights we performed a small grouping and composition experiment. We asked 12 design students to create a composition using 40 cards on a table. After completing that task they were asked to identify groups in the composition by drawing a line around them. Half of the participants were asked to select a representative for each of the groups, while the other half would get a randomly selected representative. After taking away all the images but the representatives, all participants were able to fit the right images in the right categories. There was no significant difference between the participants that could select the representative themselves and the random representative. Though this experiment didn't help in the decision of how to select a representative, it did offer confidence that designers would be able to remember the contents of a group represented by a stack using composition as the organizing principle.

PLAY-ACTING

By physically acting out different situations that were described in the contextual scenario of Wisse, we could explore the situations and interactions, using the printed cards of the reference collection of Wisse as our incarnation of the tool to be designed. Many new ideas emerged on details and interactions while acting out these new ideas, such as the way stacks would be created or how they would get *out of the way.* One important decision made in these play-acting sessions was to use a horizontal table display for both scanning and organizing (figure 3).

To explore different set-ups in the context of design studios we built different *sets* using Lego. This made us decide our tool should be more like a drawing board, opposed to a wall projection (figure 4). In later play-acting sessions we used photographs from situations and sketched prototype designs over these situations (figure 5). With these rough sketches, we were able to define the size, scale and transparency of the physical prototype in its context.



3 Play-acting: three colleagues are acting out the contextual scenario of Wisse, using the paper prototype

4 Lego storyboard: a situation from the scenario recreated using Lego, with Wisse at his desk and a colleague passing by

5 Play-acting with sketching: using a photo print as a background to draw on

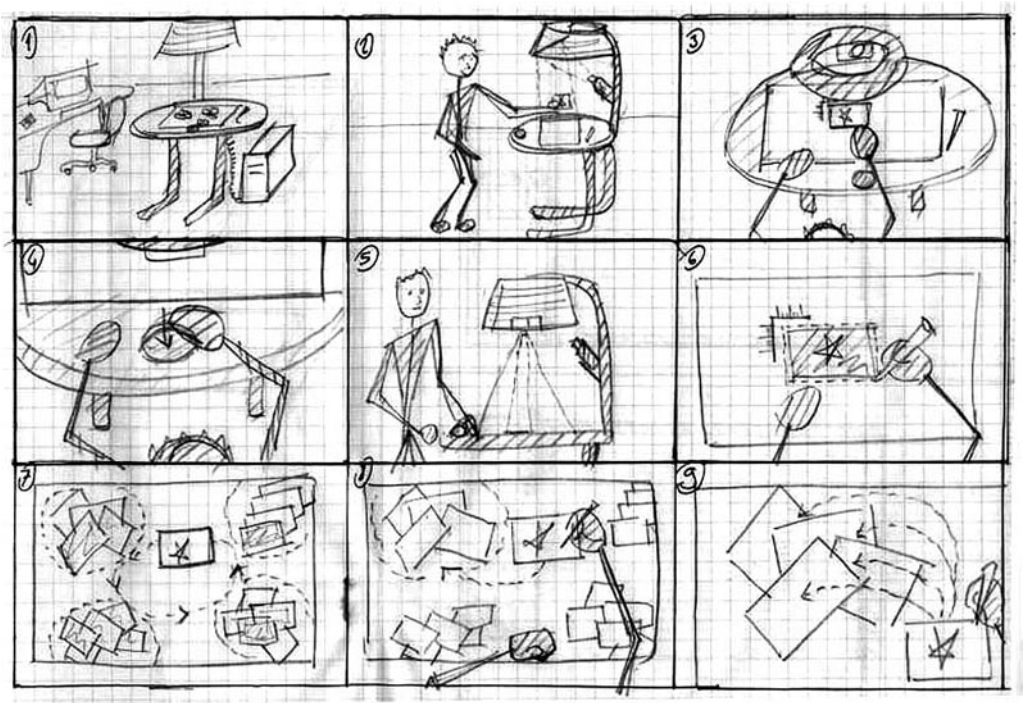
ACTION STORYBOARD

The overall scenario of Wisse, the paper prototyping and our play-acting sessions gave the team members a shared image on the direction of our solutions. To visualize the solutions in more detailed actions, a rough storyboard was generated of the interactions with the hardware and the software.

Figure 6 shows the interaction of transferring a physical photo into the digital collection organized in stacks.

5.3.2 Involvement of technology

In this chapter, we describe the tool design process from a user-centred perspective. Apart from this user perspective our previous experiences with technology also had a big influence on the tool design process. Therefore we now take a small step sideways and present our previous explorations in

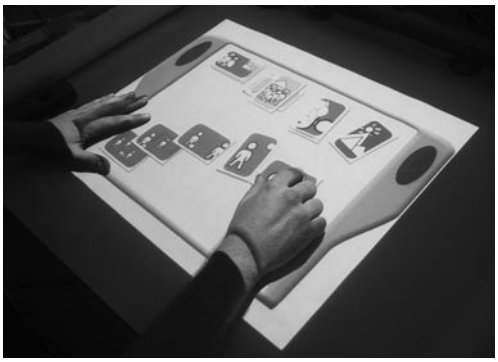


6 Storyboard of the actions the user goes through with Cabinet to scan a photo (1-6) and place it within the collection (7-9)

technology. Before entering into the actual prototype development we first present other hardware and software prototypes we developed before, and their influence on Cabinet.

TRI

A first exploration into how new media can be given sketchy interfaces was our work on the TRI Setup, explained in-depth in chapter 2. In the years before developing Cabinet we have been using the large-scale display of the TRI Setup as a library of images, which we shared with our colleagues in a smooth screensaver. The medium-scale display was used for organizing experiments and table interactions. The last years we used the projection in combination with an overhead camera to scan in hands, models and sketches and project them on the same scale and on the same place. The almost magical effect of this transformation – from the physical to the digital realm – was directly used in Cabinet and served as inspiration for a combination of digital camera and projection on a table.



7 MyPhotos: a design prototype for interacting with personal photo collections

8 ThinkTUB: an interactive prototype for a shared collage making tool

MDS-INTERACTIVE

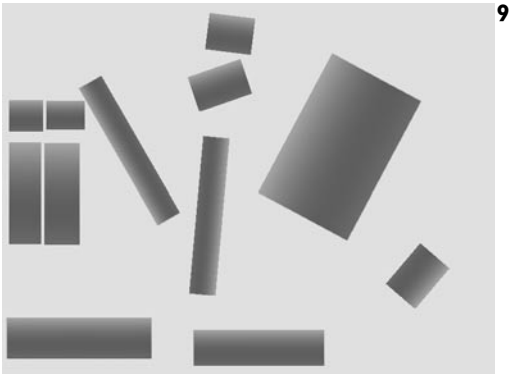
This whole research project was initiated as an opportunity for further research on the patented MDS-Interactive visual searching method (Stappers & Pasman, 1999). With MDS-Interactive users can visually explore databases by interactive visualized similarity scaling. Using a real-time Multi-Dimensional Scaling algorithm, queries can be made by selecting between samples in a composition, resulting in a new composition with optimized distances. The interactive visualization, in which the whole set looks for new stability, provides a fluent and dynamic effect.

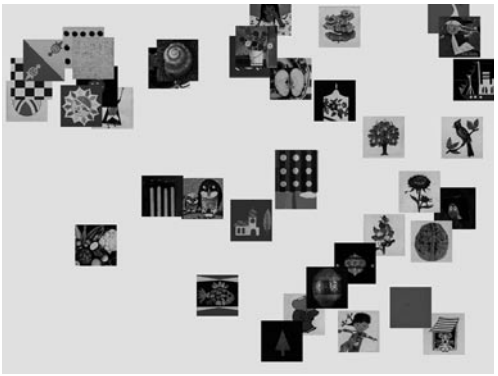
ProductWorld, a software tool developed using the MDS-interactive techniques, supports designers to get new insights from the activity of structuring visual materials (Pasman, 2003). ProductWorld offers a visual mode of interacting with a collection of images (in this case existing products in a product catalogue).

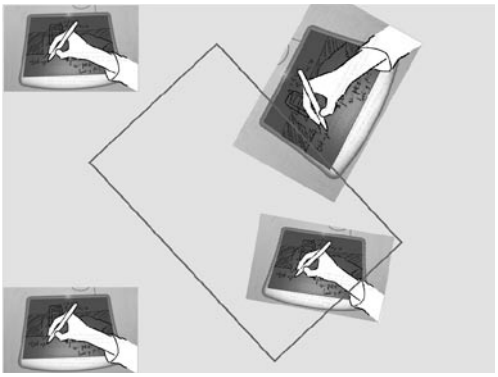
The techniques from the output of MDS-interactive and the input of ProductWorld showed great potential in supporting designers in actively collecting and structuring visual material. Cabinet uses these techniques to integrate the theoretical framework and makes it explicit in the prototype and interaction.

COLLECTION PROTOTYPE DEMONSTRATION

In a series of small design studies, students developed demonstrations of tools to support personal collections and design tools with an emphasis on inspiration. In MyPhotos (Vroegindeweij, 2003), a tabletop interaction is proposed for organizing personal photo collections. The emphasis in this design was direct manipulation of images, in a way that resembled ordering


9


11


10


12

9 An interface exploration for rotating images, using a simulated center of gravity
10 An interface prototype that allowed to both rotate and scale in one gesture
11 A gestural method of selecting and grouping thumbnail images in a sweeping gesture
12 A purely visual interface to select images for a collage, in this screen 6 images are selected and have become semi-transparent

physical photos on a kitchen table, rather than dragging thumbnails across a computer screen (figure 7).

These concepts were explored further in ThinkTUB, a tool for designers, which combined collecting images with collage making.[2] ThinkTUB used a physical interaction style with thumbnails on a wall-sized projection. Using the metaphor of gravity, users could rotate and drag the thumbnails using hand gestures. This prototype also allowed for the designers to take a picture of a physical object and add it to the collection immediately (figure 8).

[2] On http://studiolab.io.tudelft.nl/act02/project5.html ThinkTUB is presented

INTERFACE EXPLORATIONS

Using Macromedia Director we built many small experiential prototypes in which several interaction styles and solutions were explored. Some examples are illustrated in figures 9 to 12, though still pictures can hardly illustrate these explorations.

The different interface explorations were used as sketches and demonstrations for interfaces. With these different examples and some imagination we were convinced that we could make an interface that acted natural while not requiring verbal input to interact with a collection of images. In these explorations composition, orientation and minimal interfaces were the key aspects to be explored.

A separate stream of interface explorations was geared towards implementations of the MDS-interactive algorithms in growing and interacting with collections. The MDS-interactive algorithm was first tested as an input mechanism, but later in the tool design process we found it had the most potential as an output mechanism, in representing the collection in other ways to the user.

RESULTS FROM TECHNOLOGICAL EXPLORATIONS

From all these explorations the following aspects were used in the further tool design process.

1) Tangible interaction with digital images: direct manipulation and rotation;
2) Expressive possibilities of dynamic and interactive spatial visualization: MDS-interactive and other fluid visualizations;
3) Effects and possibilities of using the different ranges of body actions: lessons learned from the TRI Setup;
4) Shared use of interfaces: collaboration on the same interface.

5.3.3 Cabinet prototype development

The remainder of this description of the tool design process presents the different prototypes and the lessons learned from those. By making many different working prototypes, and putting them through actual use scenarios, we could make big decisions in a relatively short time. Early on we accepted to design and build our prototypes quickly, making it easier to throw them away if things did not suffice. In software development, Brooks describes throwing away prototypes as an efficient process (Brooks, 1975), we applied these same rules to physical prototype development.

In each of these prototypes we always based our decisions on whether our solution was good enough for Wisse, instead of being led by what was technologically possible. With knowledge of what is technically possible,

13 Collage for the possible direction of the tool. From lef to right: the current situation for collecting, the technical components used for a collecting tool, and three directions of overall appearance of the prototype – professional, playful or flexible

it is always tempting to opt for the highest resolutions or fastest computers. Instead of aiming for the best technology available, we decided on stable and proven technological solutions, allowing us to take big steps on the user side.

TOOL COLLAGE

The tool design process for a tool that supports making collages should include at least some collages. We made many intermediate collages of situations, characters and such, but for the development of prototypes we made a collage shown in figure 13. It depicts what we are trying to replace or improve in the current situation at design practices with cupboards, what technical components we use to achieve an improvement, and different directions for the overall appearance of such a tool.

FIRST TECHNICAL PROTOTYPE

To bridge the gap between the physical and digital world we needed a smooth way of digitizing visual material. Meanwhile consumer digital cameras had become powerful tools for capturing static images. At the ID-StudioLab it was common practice to archive our student's big-sized collages by laying them on the floor and taking a snapshot with a digital camera from above.

With this routine in mind, we took a repro camera (figure 14), used in reprographic studios to capture pages and other 2D graphics, to transform it into a smooth and efficient grabbing mechanism.

14

15

16

14 The first technical prototype using a standard repro camera

15 The first technical prototype with projection on the medium range of the TRI Setup

16 Image taken with the prototype using a webcam

In our first technical prototype we wanted to see what possibilities such a repro camera combined with a digital camera could deliver. The repro camera was connected to custom software on the medium range of the TRI Setup (figure 15) and different cameras and lighting conditions were tried to explore image quality, speed and interaction.

Our initial attempts, using USB web cams to capture images, offered direct feedback, but the image quality of the stills were not good enough to be used by designers (figure 16). The digital cameras tested offered better image quality, but without the direct feedback, and some of them required external lighting or the use of flash. Especially glossy material would suffer from these external light sources so we finally opted for an indirect light source in combination with a digital camera that offered optimal conditions.

FIRST TECHNICAL PROTOTYPE / INTERNAL TESTING

To find out if the workflow and quality worked for other people as well, we created a feature-focused application that allowed users to take a picture of a composition made on the table. After taking the picture the image was projected on the medium-range surface of the TRI Setup and by using a combined rotation and crop utility a selection of the picture could be made. This selection was automatically uploaded to our research lab website and could be placed on people's personal web pages on the ID-StudioLab website.[3] We invited our colleagues to try out this tool and many of them were eager to try out such a simple way of adding images to their web pages.

FIRST TECHNICAL PROTOTYPE / RESULTS

In the internal test we found that we didn't need the amount of control delivered by the repro camera stand with its levers and measurement grid. Most of all the colleagues reported problems with finding what area was captured and especially the orientation of the compositions captured. Transferring the image to the medium-scale of the TRI Setup was too much of a mental transformation for its users. For further development we looked for ways to strengthen the relationship between the capture mechanism and display and interaction.

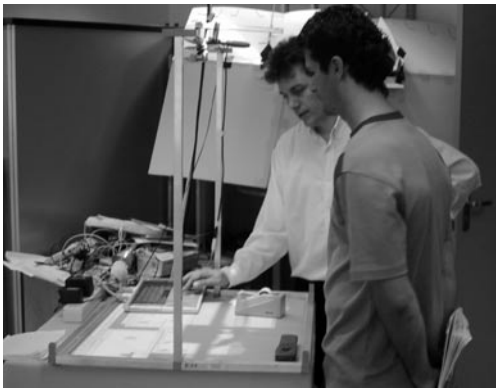
IGS

The first working prototype of a collecting tool was called the Image Generation Station (IGS in short). With IGS we built a prototype that could do all the things described in our scenarios and storyboards. IGS took the experience in capturing physical material by using a digital camera. With IGS the projection of the result was done over the original in the same size and location.

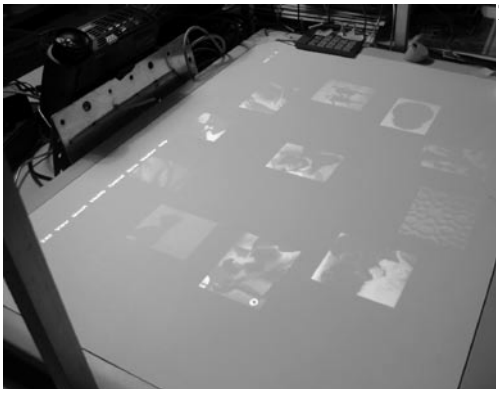
To make the prototype more compact, we used mirrors to project the collection on a table from a digital projector. In these tests we found a solution in which we could use a mirror that could rotate 45 degrees providing both a wall projection (figure 17) and a table projection (figure 18) in one solution. Though this feature seemed rather tempting, we finally ended up not using this solution because it would make the mechanisms unnecessary complex and would result in two interaction modes. Moreover, we expected tabletop interaction would elicit collaborative behaviour more easily than a wall projection (Scott *et al.*, 2003). Though wall projections (if you can find any clear walls in a design studio) would enhance serendipitous encounters, it would also elicit situations with one presenter and other people passively watching.

[3] On http://studiolab.io.tudelft.nl/cabinet/webscan are some examples of the results


17


19


18


20

17 Testing a wall projection using a mirror
18 Rotating the mirror 45 degrees for table projection
19 IGS Construction made of alumunium
20 Close-up image of projected interface and input devices

IGS / IMAGE GENERATION STATION

The IGS could handle both physical material and digital images. Using a USB flash drive, digital images could be added to the collection. The collection was projected on a digitizer board, on which users could directly interact using a special digital pen. The collection was organized using composition and stacks. The compositions with their separate originals could be exported to the USB flash drive to be used on the designer's personal computers.

The IGS is constructed from aluminium square tubes (figure 19), with all the cables and technical components connected to the aluminium construction. A mirror on top of the frame reflects the image produced by a digital projector (figure 20). The image is projected on an A2 Wacom digitizer tablet. The interaction takes place using a digital pen with 4 buttons. A digital camera is connected to the top of the aluminium frame facing downwards to the centre of the table. On the side of the frame a 500-Watt halogen light

is attached to provide a light source on the surface. A numeric keypad and a special USB button provide further input. A laptop computer controls all the components.

IGS / INTERACTING WITH IGS

IGS enables the designer to capture physical material, to add and export digital images and to organize by making compositions and groups. A physical object can be captured by laying it on the table and clicking the special USB button. The halogen light source illuminates the table for 20 seconds and the camera takes a picture from above. After the light is turned off, the image is projected over the original. The selection can be cropped by dragging a rectangle directly on the image on the table and the selection is accepted by clicking the special USB button. The new image automatically appears as a thumbnail, rotating in the centre of the composition, waiting for the user to give them a place.

Digital images can also be added by copying them to a USB flash drive. If the USB flash drive is connected to a cable and the zero-key on the external numeric keypad is pressed, the images are transferred to the collection and represented as thumbnails, rotating in the centre of the composition.

The user can directly interact with the thumbnails using the digital pen. Touching and dragging a thumbnail in the centre moves the thumbnail, touching and dragging an image on the side rotates the thumbnail.

To make a group or stack of thumbnails, the user holds a button on the side of the digital pen and selects each of the thumbnails in that group. By clicking twice on one of these thumbnails they become a group represented by that image. The interface makes no visible distinction between thumbnails representing an image or a stack. To take an image out of a stack the user can click the thumbnails with the backside of the pen. The thumbnail would start to rotate in the middle of the screen, similar to new images in the collection. These rotating thumbnails follow the user around while navigating the collection.

The user navigates into stacks by double clicking the representative of that group. The other thumbnails disappear and the images in the group appear. By clicking on the enter-key on the numeric keyboard, the user returns to the *top-level* of the collection.

IGS / PILOT TEST

To find out if the prototype also works for designers we performed a long-term pilot test in the office of a designer and research colleague Marieke Sonneveld (figures 21 and 22). She used the IGS for three weeks to digitize and structure

21

22

21 IGS in the pilot test at the office of Marieke Sonneveld

22 Physical and digital piles at the desk during the pilot test

her collection of pictures related to tactile aesthetics in product design. During the pilot she kept notes and provided a lot of feedback on both the IGS prototype and how it affected her thinking and working with visual material.

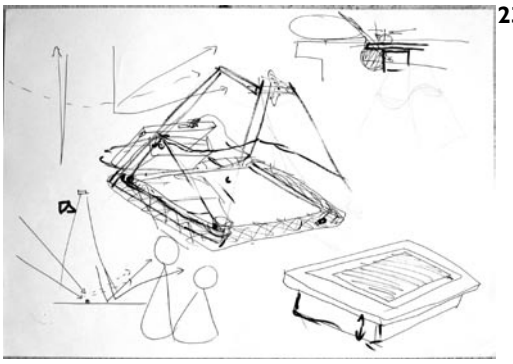
IGS / CONCLUSIONS

Clearly the prototype was not a finished product, but it technically performed all the things it intended to do. During the pilot Marieke Sonneveld built a collection of 333 images.[4] She wasn't able to finish organizing all the images but she was happy with the first overall result.

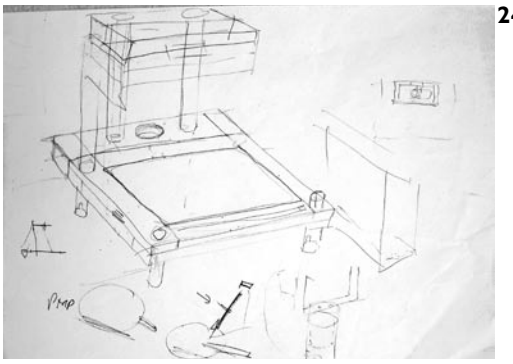
In her evaluation, Marieke reported having problems with the image quality and the overwhelming effect of the external light source on her desk. Furthermore the complex interactions with the numeric keypad, the buttons on the side and the back of the pen proved to be too complex and ambiguous.

Critical evaluation made us decide the IGS prototype was not yet suitable for the design practice. In all aspects, software, hardware, interface and

[4] On the DVD accompanying this book, an interactive working demo of this collection can be tried out



23



24

23 Sketches for the hardware design of Cabinet, three people collaborated on this sketch

24 Final solution by Onno van Nierop resulting in a table-like design using wood and tubes

features of the IGS prototype came close to all the considerations, yet improvement was needed on all aspects.

Therefore we decided to do extensive tweaking, that came close to completely rewriting the software and rebuilding the hardware. For our next prototype, the following changes were identified.

1) A higher resolution, more light sensitive digital camera;
2) No external light source;
3) No cables or technical components visible on the prototype;
4) Only one button on the whole prototype;
5) Pen input device would only afford clicking and dragging (no extra buttons used on the side or double-clicking);
6) Fluent dragging of thumbnails;
7) Improve creating and navigating stacks.

BUILDING CABINET

Knowing we were so close yet so far away, the whole team started redoing their own parts in such a way that the elegance and smoothness would be integrated in a whole concept. It took less then two months to do a drastic rewrite of the software and rebuild of the physical prototype.

Because the feature set was taken directly from the IGS prototype and the software was already there, it was possible to distribute tasks. We used a web logging system that was available on our ID-StudioLab website to communicate results to each other and this worked effectively over this short period of time.

25 Building the table construction of Cabinet

26 Finished construction of Cabinet, with tools in the background

Ideas on the hardware design were first sketched out in sessions with different people from the ID-StudioLab, discussing overall looks, room for components, light reflection, ergonomics and user interaction (figure 23). The final hardware design incorporated many ideas and solutions from different sketches in one solution (figure 24).

The exact measurements were specified according to the sketches and the technical components. The hardware for Cabinet was built in a period of three weeks (figure 25), partly in the workshop of the TU Delft faculty, and partly at home (figure 26).

During the development of this final prototype a new name was decided upon: *Cabinet.*

The name refers to its definition, a cupboard for storing and displaying articles, and to the *cabinets of curiosities* that the well-to-do of the 16th and 17th centuries used to keep collections of strange and foreign objects in.

27

28

29

27 Cabinet: scanning in a physical packaging design

28 Cabinet: moving and rotating a thumbnail

29 Cabinet: selecting images for a group

5.4 Cabinet specifications

Cabinet (figure 27) is a tool for product designers to build up and organize their collections of visual material in their work environment. To achieve this Cabinet offers the following features.[5]

1) **Dragging.** With the pointer, the user can directly manipulate projected thumbnails in both orientation and position (figure 28), allowing the creation of meaningful compositions.
2) **Enlarging.** By touching a thumbnail, it is enlarged to a full-screen image.
3) **Grouping.** By drawing a (red) line around a number of thumbnails of images and stacks, they can be selected for grouping (figure 29). The selected thumbnails will start pulsating and the user can assign the representing image by clicking on its thumbnail. The thumbnails will then move together into a stack.
4) **Navigating.** By clicking on a stack, the group will open up pushing all the other stacks and thumbnails to the sides of the table. Within these stacks all the features are available that were available before. The user can close a stack by clicking the right or left sides of the screens where the other stacks have moved while opening up the stack.
5) **Organizing.** Stacks and thumbnails can be moved into and out of stacks, by respectively moving and holding them above a stack or moving and holding them to the right or left side of the composition. The selected thumbnail will disappear from the current composition, and when moving out of the stack the thumbnails will appear spinning in the centre of their new location in the collection.
6) **Adding physical material.** Any image, object or composition put on the table surface of Cabinet can be added to the collection by pushing the (only available) button on the side of the table. The camera gets activated and an image is taken from above. The digital image is projected over the physical original providing a smooth transformation from physical to digital. The image can be cropped by dragging a rectangle using the special pointer. The selected image is then added to the collection spinning in the centre of the last active composition.
7) **Adding digital material.** When a special USB flash stick is inserted into Cabinet's USB slot, all the JPG images that are stored in its *to Cabinet* folder are automatically added to the collection, with a thumbnail of that image spinning in the centre of the last active composition.

[5] On the DVD accompanying this book these features are demonstrated in a movie and can be explored interactively in a working demo

8) **Taking out digital material.** When the USB flash disk is inserted, it also automatically exports the current active composition, together with all the original images, and transfers it as a HTML file with clickable image map into the *from Cabinet* folder.
9) **Searching images.** When Cabinet is not touched for 90 seconds, it automatically starts displaying three random thumbnails from the collection based on the MDS-interactive algorithm. The relative distances between the thumbnails are based on the sum of the distances between the thumbnails in the compositions in different stacks. Images can be queried by selecting anywhere between or outside of the composition. The image that fits best the selected location will be displayed in the composition. The thumbnails are continuously looking for a new stability with dynamic, fluid aesthetics.
10) **Show images.** When Cabinet is not touched for another 5 minutes, it will automatically start displaying thumbnails in a circular grid. All the images will keep an even distance and every 20 seconds the next image in the database will be displayed, resulting in a circular grid.

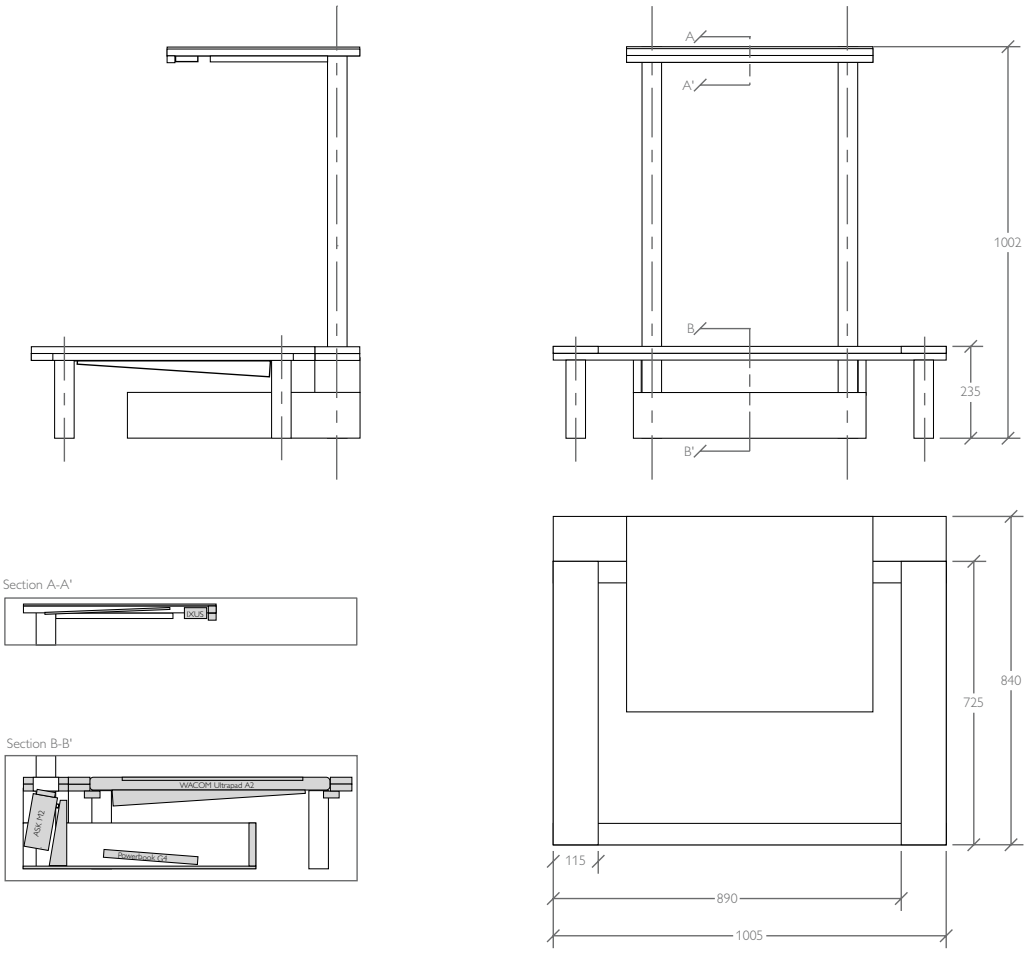
Overall, Cabinet uses the notion of thumbnails to represent images, stacks to represent groups and composition to represent organization. The features explained above are demonstrated on the DVD accompanying this book.

5.4.1 Physical specification

Cabinet is a device that can be placed on an office desk. It is built up from three structural components: 1) the table surface on which the user interacts directly, 2) the technical box below the table containing all the components, cables and the projector, and 3) the overhead construction holding the camera and the mirror that reflects the projected image on the table. For transportation and maintenance Cabinet can be separated in these three structural components.

The footprint of Cabinet is 1050 mm wide by 840 mm deep; the table surface is elevated 240 mm from the desk to allow use while standing. The overall height of Cabinet with overhead construction is 1050 mm (figure 30).

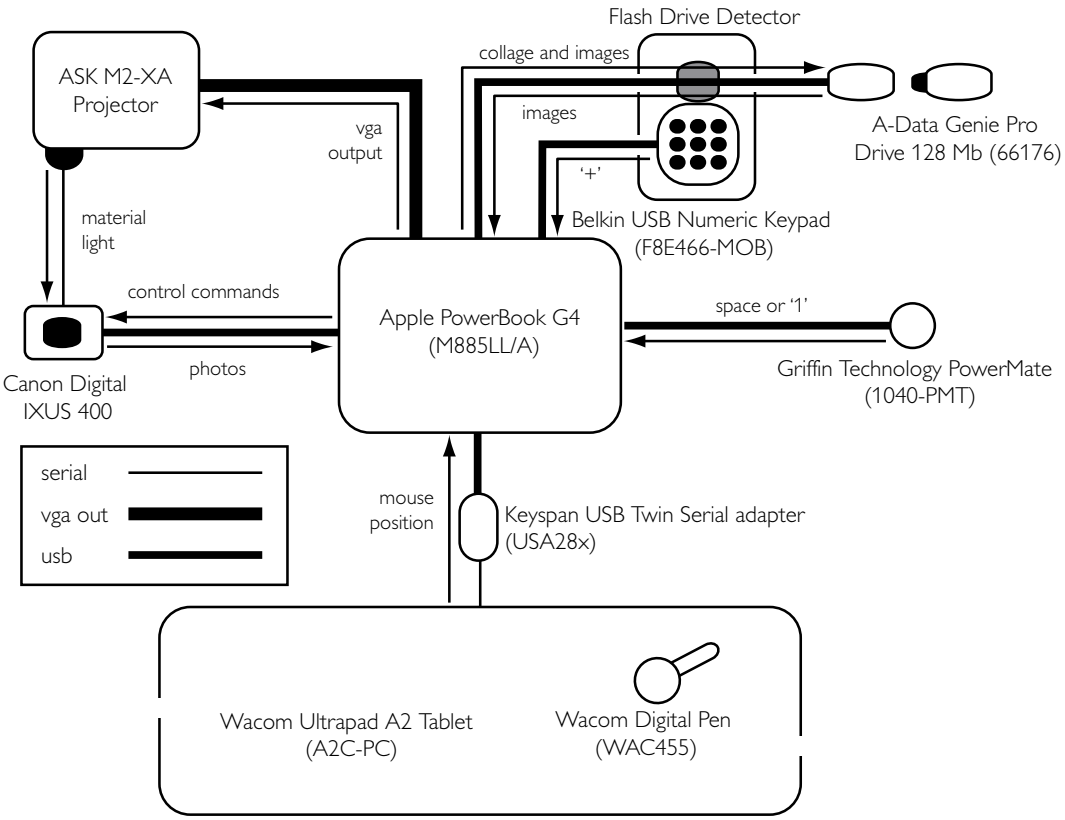
The wooden parts of Cabinet are made of 18 mm thick multiplex, the same material used for construction in the building of our department. The visible construction parts are made of a double thickness of this multiplex, providing a solid, rugged yet natural look and feel. Both the table surface and the overhead construction are elevated with an aluminium tube construction with a radius of 50 mm. The table surface has 4 legs to resemble a table design. The overhead construction is supported by two tubes, allowing an open construction on the front side.



30 Technical drawing of Cabinet with two cross-sections

The wooden parts in the construction have a transparent acrylic finish. The aluminium tubes are blasted with glass pearls to give them a matte appearance.

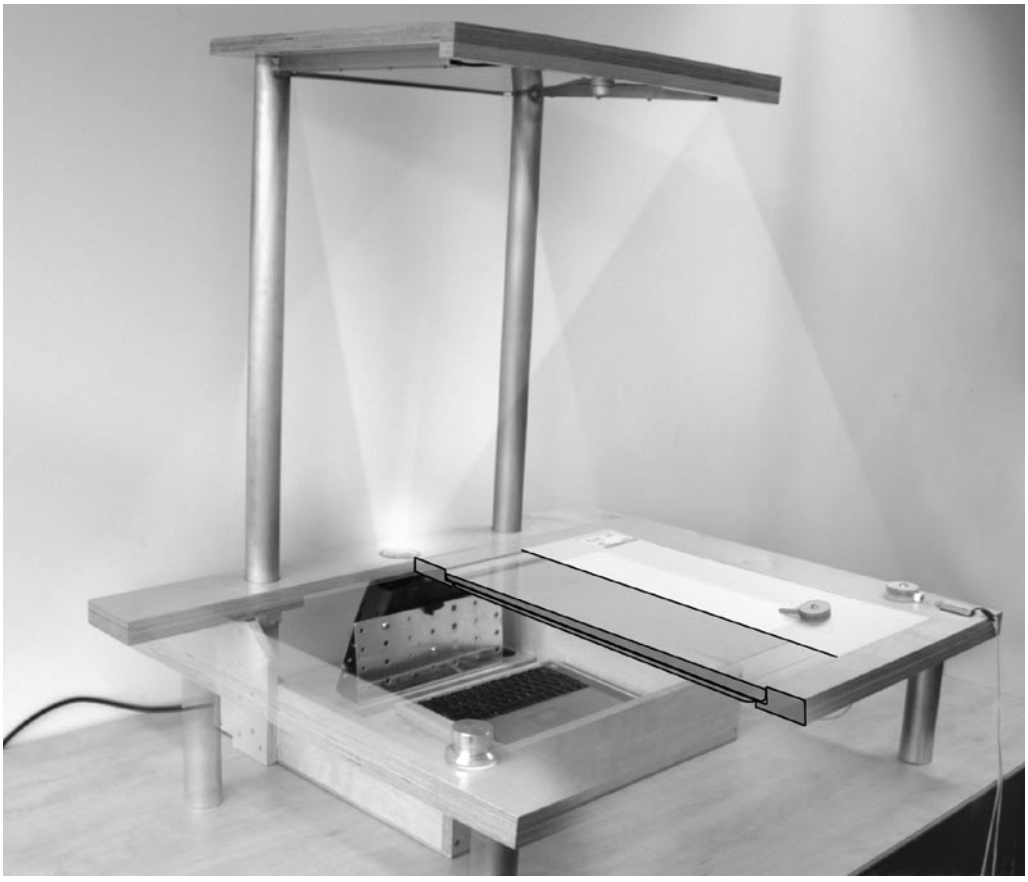
The table surface is covered with an acrylic board that has the Cabinet logo, ID-StudioLab logo and contact information on a business card printed on it. Also the interface outlines are printed on the surface: the active surface is kept white (for maximum contrast), while the outside area is a light blue. The active right and left side of the table are printed with a white to yellow to light blue gradient. The design of the print supports a smooth transition between the physical and the projected interface.



31 Schematics of technical components, cables and information flows in Cabinet

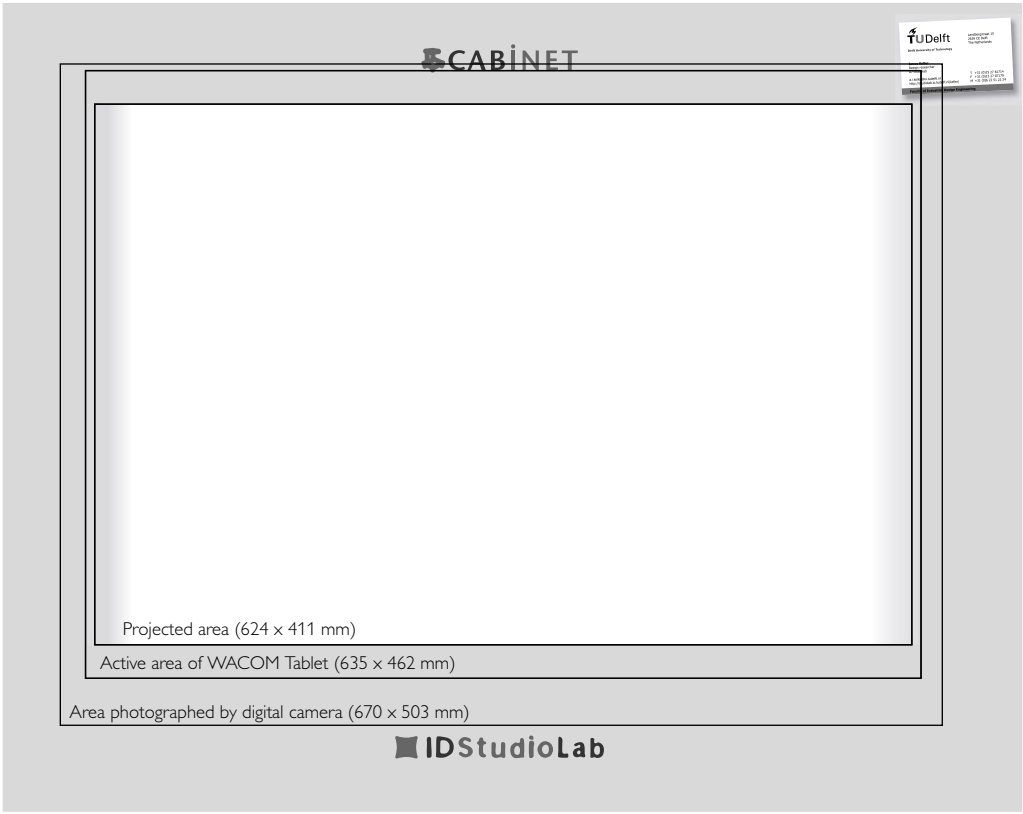
5.4.2 Technical components

Cabinet relies for the most part on proven technological components. The components are visualized schematically in figure 31 and in a cutaway diagram in figure 32. Cabinet is controlled by a compact portable computer which connects all the components and runs the software for the collection. The computer display is sent to a digital video projector. A digital camera is used for capturing the originals on the table. The Flash Drive Detector senses if a USB Flash drive is connected, to allow for digital images to be imported and exported to the collection. The user interacts with all these components through one button and a digitizer tablet with digital pen.



32 Cutaway diagram of Cabinet with the technical components. On the left of the table the big button is visible; on the right lies the pen input device, connector and flash drive. The first cutout layer reveals the digitizer tablet below the printed acrylic board. Below the table the technical box is visible containing the digital projector and the computer. The diagram also displays how the light is projected via the mirror on the table. On the overhead construction the lens of the digital camera is also visible

All but one of the technical components and cables used in Cabinet are standard commercial solutions and standard cables without adaptations. The only custom-made component is the Flash Drive Detector. It consists of a circuit board – developed by Rob Luxen – that measures the power throughput in the USB cable and sends a signal to the '+' key in a USB numeric keypad logic board. This key-press is sent to the software notifying the system that a USB drive is connected.

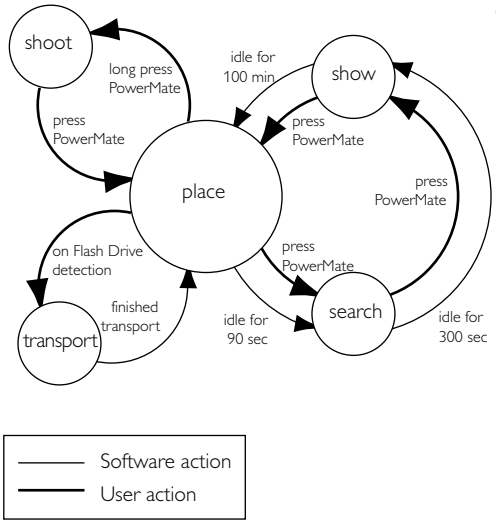


33 Interface surface with active and used areas

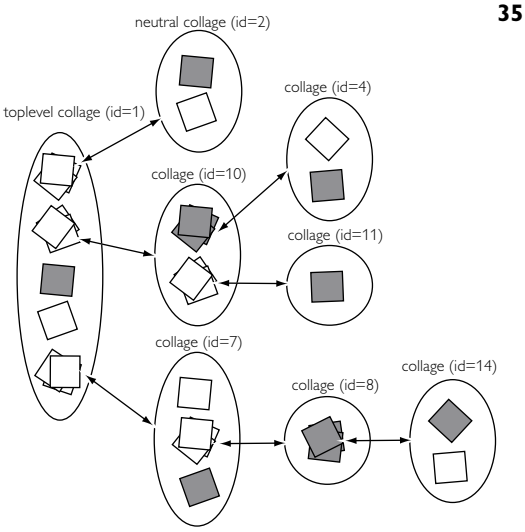
5.4.3 Interaction surface

All the user's interactions with Cabinet and the collection take place on the table surface (figure 33). The digital video projector projects the interface at a size of 624 x 411 mm. The active area of the digitizer tablet (i.e. sensitive to pen input) is slightly larger at 635 x 462 mm. The camera mounted above captures an area that is larger than both at 670 x 503 mm.

The interaction surface can be calibrated in three steps to fine-tune the alignment of the projected image, the camera and the digitizer tablet. First step in the procedure is to align the corners of the projected image to four printed markers (cornered lines) on the display surface. Alignment is done manually, adjusting the mirror and the digital projector to visual accuracy. Second step is to adjust the tablet's active area to match the image, which is performed in software by tuning the driver. Third step is to adjust the image grabbed by the camera to match the displayed image. To do this, an image of the display surface with contents is made and projected back on the surface.



34



35

34 State diagram of Cabinet software

35 Diagram of the data structure of the collection in Cabinet with examples of different collages. Collages are sequentially given an id when they are created. Collages can consist of only one (id = 11) or more images (id = 2, id = 4, id = 14). Collages can contain only stacks (id = 10) or only one stack (id = 8). Finally, collages can contain a combination of images and stacks (id = 1, id = 7)

Using a temporarily attached keyboard, the image can be panned and scaled using the cursor keys. Again, the calibration is done visually.

In practice only steps 1 and 3 are needed after Cabinet has been transported. Most of the times calibration only provides fine-tuning (to approximately 1 mm), while uncalibrated, the accuracy is quite acceptable of working (approximately 3 mm). In the experiments reported in the next chapter, calibration was performed only once for each visit. It was not part of the user experience.

5.4.4 Software

All the software for Cabinet is written in Macromedia Director. The software controls the digital camera using third party extensions (Xtras). In a similar way the software communicates with the Flash Drive and other input devices.

The software on Cabinet has five different states (figure 34) in which different features of Cabinet are supported. These states are not communicated as such in the interface and most users will not even notice them. The central state is the *place* state in which the user can organize thumbnails, navigate the collection and make stacks. From this state the

software can switch to the *shoot* state in which the camera is controlled and images of physical material can be added to the collection. The *transport* mode starts automatically when a flash drive is connected and enables importing and exporting images to and from the collection. The other two states, *search* and *show*, start automatically after respectively 90 and 300 seconds idle time, and show the images in the collection in different visualizations based on the MDS algorithms.

The user interacts with the collection through interaction with stacks and images. The organization of the collection is organized in a tree-like structure (illustrated in figure 35) of collages (compositions), stacks (groups) and images (thumbnails). All the images, collages and stacks have a unique serial number. And all the collages have an image or stack in them that represents the group (the grey images in figure 35). This image or stack is displayed at the top of that stack, with the other images layered below them.

The collages are connected with bidirectional links, allowing the user to navigate up and down the tree structure, while maintaining the flexibility to reorganize the collages and tree structure. The first two collages in the collection stand aside; the first collage (id =1) is the top-level collage from which the tree structure starts. The second collage (id =2) is the neutral collage, which allows the user to get erroneously imported images out of the way. The images in the neutral collage are still in the collection, but will never be presented in the *show* or *search* state. Most users interpret this neutral collage as the *"trash can"* from the desktop metaphor. Because the capacity or performance is not an issue, we chose not to support deleting images, instead images can be ignored by putting them in the neutral collage.

5.4.5 Performance

As shown previously in figure 33, the active display area of Cabinet is 624 by 411 mm, with a display resolution of 42 dpi. On this size and distance, the projector provides a brightness of 1002 nits (cd/m2), which in theory should provide a sunlight-readable display. In this calculation the mirror used in the projection and the reflective properties of the projection surface are not taken into account and the display is not used to read text, but only to judge colour and visual expressions. In practice, the thumbnails and interface can be properly viewed in a normally lit office environment (400 lux).

The camera captures the active display area at 2076 by 1378 pixels. The resolution of images captured by Cabinet is 86 dpi (pixels/inch), more than double the size of the display resolution. When the scan is projected over the original, it is slightly displaced over the original, up to 2 mm on a flat image and more on thicker originals, caused by the slight displacement of

Table 2. Design criteria for Cabinet with the findings on which they were based

Activity	*Conditions and measurements*	*Duration*
Take picture	From pushing the button to shooting the picture	6.8 s
Display image	From shooting the picture to displaying it over the original	14.5 s
Add to collection	From cropping an A4-sized image to appearance on Cabinet	3.2 s
Add digital image	From inserting the flash drive (with 300Kb image) to appearance on Cabinet	9.1 s
Export image	From inserting the flash drive to taking it out (with 2 images copied, 700 kB)	15.0 s
Enlarge image	From clicking the thumbnail to displaying the original image (of 240 Kb)	1.6 s
Open stack	From clicking a stack to displaying the opened stack	2.3 s
Close stack	From clicking the sides to displaying the upper collage	1.6 s
Change state	From *search* state to *place* state	1,3 s

the camera and projector. Most viewers perceive this displacement not as an error but as a shadow effect.

The performance of Cabinet is best demonstrated in its speed and responsiveness. Cabinet is always on, readily available for use. A physical object or image can be scanned in and added to the collection in less than half a minute. Adding a digital image to the collection takes under 10 seconds. For more details and other performance data, see table 2. During most of these activities the user can see the activities, such as opening or closing stacks or enlarging an image, happening on the screen.

The speed and performance of Cabinet is enhanced by the smoothness and low attention needed for these activities. A physical object can be added while passing by, and the animations make the interaction seem natural.

5.5 Evaluation

Cabinet has been evaluated on different aspects and in different ways. First we look if Cabinet fits the design considerations we formulated in table 1.

Secondly we look at the things we might have wanted to change, add or develop further. This could be an endless list, but we are aware of the dangers in adding more features than needed, therefore we give a short overview of opportunities for further development or improvement.

Apart from our own evaluation, we also base our observations on its use by colleagues and on the reactions of peers and visitors during many demonstrations. Finally we will look forward to the evaluation of both the prototype and its impact on our research questions at design companies, described in the next chapter.

5.5.1 Design criteria

As we stated in the beginning of this chapter in table 1, a tool that supports collecting should:

1) *Cabinet should allow for building a collection without a predefined structure and make it easy to add material.* Cabinet does this by offering groups and compositions based on *what is present on the table*. The user has to give the images a place, but these are not based on predefinition. Adding both physical and digital images is easy and smooth activities with a low cognitive load, especially because Cabinet is meant to be readily available: always on and present in the design environment.
2) *Cabinet should merge the physical and digital collection in both interaction and value.* Cabinet does this by making the interaction with digital images more physical, and by stimulating the user to add physical material to the collection. The value of digital material for inspiration rises, whereas the value of physical material for use in collages rises as well.
3) *Cabinet should not force designers to verbalize their visual thinking process.* Cabinet uses no words at all in any part of the interface. Words, when scanned in, also become visual material in the collection.
4) *Cabinet should allow for serendipitous encounters with digital materials.* Cabinet continuously displays visual material from the collection in different ways. These displays allow for interaction but can also be just noticed while passing by. Serendipitous encounters do require Cabinet to be placed in a strategic position in the work environment, e.g. near the door, printer or bookshelves.
5) *Cabinet should lure designers away from their desks and involve their body in visual thinking.* The mere size and scale of Cabinet forces the designer to stand up and walk to Cabinet. Cabinet's interaction involves rough gestures using the whole arm, opposed to precise interaction requiring concentrated eye-hand coordination.
6) *Cabinet should allow designers to calmly communicate the contents of their collection to colleagues.* The table size and scale of Cabinet are automatically associated with collaborative work. It is easy and inviting for a colleague to stand next to the designer and look over his shoulder. Furthermore, the serendipitous encounters described in design criterium 4 also allow colleagues to stumble on the images.

We also set out practical criteria in the beginning of this chapter, such as transportable, self-explanatory and stable. Cabinet turns out to be a practical and stable tool; transportation is easy, e.g. we have been able to take apart and set up Cabinet in less than 30 minutes.

5.5.2 Good enough to be criticized

Cabinet was built as a one-off prototype that was good enough to be set out in the field and to be evaluated by designers as described in the next chapter. On the one hand it has a complete set of features, which makes it look and feel like a working and stable product. On the other hand, it is not so polished, that it would stifle critical evaluation or raise the expectations of a *real* product. From our research towards sketching and *sketchy* tools (Stappers et al., 2000) and in the experiences with paper prototyping (Snyder, 2003) it was found that a completely polished sketch or visualization can get in the way of valuable criticism.

Having said that, there certainly are features and implementations that could be improved upon or added if time and technology would permit it.

1) **Pen input device.** Though we chose a proven method for pen input, the digitizer tablet, we found that the operating system still can be erratic in tracking the cursor and clicks. The pen input device allows for sudden clicks from one end of the screen to the other, making thumbnails appear to stick to the pen. In practice we found that – after a short training – our users could avoid these situations and didn't find it problematic.
2) **Picture taking performance.** Though adding physical material with Cabinet is efficient as compared to a flatbed scanner, it is not instantaneous. The camera has to be activated, it has to do some adjustments and the picture has to be transferred from the camera to the computer. In all, this takes about 30 seconds, but some users tend to take away their source material too quickly. Besides optimizing the speed and performance in technology, a better feedback mechanism could also solve this problem.
3) **Centred spinning of new image.** To support active collecting, we decided to never automatically place new images, but force the user to give these images a place in the collection. This was fine, but our implementation of a *spinning* thumbnail in the *centre* of the screen attracts too much attention and makes users compose their collages with an empty centre. A more subtle and location-independent solution might have been a better choice.
4) **Spring-loaded stacks.** Currently the user can drop a thumbnail on a stack and it will disappear from the current collage. Taking cues from the Mac OS (Apple Computer, 2005), the idea of spring-loaded stacks, which would open when the drag action hovers over a stack, may be a useful added feature.

5) **MDS-Interactive search.** The way to search or explore the collection using the MDS-Interactive algorithm looks and feels good, but doesn't provide a useful search mechanism, yet. It is both not random enough and not specific enough, because the algorithm requires a weighing method based on knowledge of the collection. On the other hand, the automatic display of images works quite well for exploration by simply glancing at it when passing by.
6) **Wall-projection.** The option of rotating the mirror (explored in figure 17 and 18) to project both on the table and on the wall, could enhance the social use of visual material in a studio environment, especially when combined with the MDS-Interactive displays.

Apart from these points we came up with numerous ideas, features and solutions, which we wisely kept outside the scope of this project or put off for later. Given our criticism, we believe we have built a working prototype that in the words of Alan Kay is *"good enough to be criticized"* (Laurel, 1990).

5.5.3 Living with the prototype

As described in the design process, we involved our colleagues in the ID-StudioLab actively in the development of all the prototypes. We have lived actively with Cabinet for three months before setting it out in practice.

During this period twelve colleagues actively used Cabinet. Nine colleagues approached Cabinet by their own initiative. We have never presented or promoted the use of Cabinet actively, but word-of-mouth referral made many colleagues come over to see if it met their needs. All of the colleagues were positive on their use of Cabinet, though many of them had suggestions for improvements, alternative uses or added capabilities.

From living with Cabinet we found the value of the USB flash drive for social use of digital imagery. Colleagues enjoyed taking away a physical carrier to transport their digital images from their computer and back. Colleagues perceived borrowing the USB flash drive itself as a social act (Miller, 2004). We originally opted for this solution over using a networked solution, to avoid problems of network security at different design studios, but this was an unexpected positive side effect.

Our own use of Cabinet has continued for over a year now and the prototype supports our own collections of visual material. Many of the figures in this thesis are made and collected using Cabinet.

37

38

36

39

36 Usability guru Donald Norman trying out Cabinet

37 Demonstrating Cabinet to the Dean of Industrial Design at TU/e

38 Presenting Cabinet to interaction designers of SigCHI.nl

39 Demonstrating Cabinet to other researchers from Luleå University of Technology

5.5.4 Demonstrating Cabinet

Both during and after the development we demonstrated Cabinet to many visitors of the ID-StudioLab (figures 36 to 39). These visitors represent a mix of valuable peers in research, design and commercial practice. During these

presentations we found that Cabinet was a good carrier of discussions on the subject of designers collecting visual material.

The discussions would sometimes focus on the relevance of such a tool in practice, and on commercial viabilities, or they would focus on the theory on being inspired by visual material. On most of these occasions the discussions would focus on tools in general and the impact of such a tool in other fields or other applications.[6]

5.5.5 Cabinet in practice

After all these demonstrations, feedback from colleagues, first-hand experience by using Cabinet over a longer period, we are confident of the value of its design. Yet a product can only be valued if it has been used in a realistic setting by real users. Therefore in the next chapter, Cabinet is set out in design studios, to get a better insight on the tool itself and to find out more on how designers actually use their collections of visual material in their design process.

5.6 Conclusion

The goal of Cabinet was to develop a tool suitable for use in real practice and for a realistic task. Developing such a tool makes it tempting to add features that may appeal to designers, but have no relevance to phenomena you are researching. Our previous research in both theory and practice allowed us to focus on the phenomena, without loosing its relevance to designers.

To keep this focus we used techniques that allowed us to keep the end user in mind and keep ourselves as users out of the tool design process. We are designers ourselves, yet we are not the designers for which this tool is meant.

We developed Cabinet as a means for technology to support our findings from theory and practice. By developing working prototypes quickly, we could try out and experience the results and decide how to further develop them. We built each of these prototypes with the intent to develop them into the final prototype, yet we kept an open mind and easily threw out any solution that didn't work. For each new prototype we took out the aspects that didn't work and kept the things that were good.

Considering all the techniques used in the tool design process, ranging from sketching, storyboarding to play acting and paper prototyping, the most important technique is demonstrating a tool with a working prototype. Bringing something real to the table is the best way to convince yourself and others of its value.

[6] On http://studiolab.io.tudelft.nl/cabinet/quotes/ all the visitors with their remarks on Cabinet are accumulated

LITERATURE REFERENCES 5

Aliakseyeu, D. (2003) *A computer support tool for the early stages of architectural design.* Doctoral Dissertation, Eindhoven: TU/e.

Apple Computer. (2005) *Apple human interface guidelines*. Cupertino, CA: Apple Computer.

Brooks, F.P. (1975) *The Mythical Man-Month: Essays on Software Engineering.* Reading, MA: Addison-Wesley.

Cooper, A. (1999) *The inmates are running the asylum*. Indianapolis, IN: SAMS.

Djajadiningrat, J.P., Gaver, W.W., & Frens, J.W. (2000) *Interaction relabelling and extreme characters: Methods for exploring aesthetic interactions.* Proceedings of DIS 2000, New York City, NY, pp.66-71.

Gross, M.D., & Do, E.Y.-L. (2000) Drawing on the back of an envelope: A framework for interacting with application programs by freehand drawing. *Computers and Graphics Journal, 24* (5), pp.835-849.

Keller, A.I., Hoog, W. van der, & Stappers, P.J. (2004a) Gust of me: Reconnecting mother and son. *IEEE Pervasive Computing, 3* (1), pp.22-28.

Keller, A.I., Stappers, P.J., & Vroegindeweij, S. (2004b) *Supporting informal collections of digital images: Organizing browsing and sharing.* Proceedings of the conference on Dutch directions in HCI, Amsterdam, p.17.

Laurel, B. (Ed.) (1990) *The Art of Human-Computer Interface Design*. Menlo Park, CA: Addison-Wesley.

Laurel, B. (Ed.) (2003) *Design research: Methods and perspectives*. Cambridge, MA: MIT Press.

Mander, R., Salomon, G., & Wong, Y.Y. (1992) *A "pile" metaphor for supporting casual organization of information.* Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Monterey, CA, pp.627-634.

Miller, K. (2004) Anti-social networking. *Plug In Magazine,* pp.15-16.

Muller, W. (2001) *Order and meaning in design*. Utrecht: Lemma.

Nakakoji, K., Yamamoto, Y., & Ohira, M. (1999) *A framework that supports collective creativity in design using visual images.* Proceedings of the Third conference on Creativity & cognition, Loughborough, UK, pp.166-173.

Pasman, G. (2003) *Designing with precedents.* Doctoral dissertation, Delft: TU Delft.

Restrepo, J. (2004) *Information processing in design.* Doctoral dissertation, Delft: TU Delft.

Sanders, E.B.-N. (2004) *Design and the empowerment of everyday people.* Presented at a lecture at TU Delft.

Scott, S.D., Grant, K.D., & Mandryk, R.L. (2003) *System Guidelines for Co-located, Collaborative Work on a Tabletop Display.* Proceedings of ECSCW 2003, pp.159-178.

Snyder, C. (2003) *Paper prototyping.* San Francisco, CA: Morgan Kaufmann.

Stappers, P.J., & Hennessey, J. (2000) *Beyond the electronic beermat: Digital devices for discussing design drawings.* Adjunct proceedings of Codesigning 2000, Coventry: Coventry University, pp.143.

Stappers, P.J., Keller, A.I., & Hoeben, A. (2000) Aesthetics, interaction, and usability in 'sketchy' design tools. *Exchange Online Journal, 1* (1).

Stappers, P.J., & Pasman, G. (1999) *Exploring a database through interactive visualised similarity scaling.* Proceedings of CHI '99 Human Factors in Computer Systems, Pittsburgh, PA, pp.184-185.

Tufte, E. (1997) *Visual explanations: Images and Quantities, Evidence and Narrative.* Cheshire, CT: Graphics Press.

Verplank, W., Fulton, J., & Moggridge, W. (1993) *Observation and invention: The use of scenarios in interaction design.* Proceedings of CHI '93 Conference on Human Factors in Computing Systems.

Vroegindeweij, S. (2003) *My pictures: Informal image collections.* Internal report No. HPL-2002-72, Bristol, UK: HP Laboratories.

This chapter *exposes* Cabinet to the *roughness* of the *real world*. By *setting out* the Cabinet for *a month* at *three design firms,* our main research questions are *addressed* in *practice*: how do designers interact with their collections of visual material, and how can new media tools support this?

This chapter is submitted to Design Studies. It explains the *methods*, *procedure* and *results* of a six month *experiment*. In this experiment our previous *expectations* were *validated* and other *effects* of Cabinet *observed*, resulting in *interesting* and sometimes *surprising* results.

We look from a *participatory design perspective* using our *prototype* to retake our results from practice and theory. From a *usability perspective* we critically *test* and *evaluate* the prototype in practice.

The first two sections *re-introduce* many of the subjects covered in the previous chapters. All of these serve as *ingredients*, *expectations* and *focus points* for the experiment.

This work was done in the first half of 2004 and resulted in coming *full circle* in this thesis.

ABSTRACT

This chapter presents an experiment conducted with a working prototype in the design practice. The working prototype, called Cabinet, supports designers in collecting visual material that they can use as a source of inspiration in their design process. Cabinet was set out at three different design agencies over a period of four weeks. From these agencies, one designer was asked to use it at their own initiative for their own current design practice. The goal of this experiment was to both evaluate the prototype and to find out what effect a new tool can have on the designers' collecting behaviour.

Though all three participating designers used Cabinet very differently, the prototype was able to withstand the test of three months in the field. The overall evaluation of Cabinet was positive with some valuable suggestions to the prototype's behaviour and functionality. The intervention led to changes in the designers' attitude towards their collecting behaviour, especially the role of physical and digital material in their work process. One surprising effect of Cabinet was that all the designers used it to both collect their source material and their design solutions in one collection.

This chapter is largely based on: **Keller, A.I., Sleeswijk Visser, F., Lugt, R. van der, & Stappers, P.J.** (submitted) Collecting with Cabinet: Or how designers collect visual material, researched through an experiential prototype. *Design Studies.*

6.1 Introduction

Designers intensively use a variety of visual material (McKim, 1980). In the last decade the computer has become an important and powerful tool for designers, streamlining many aspects of their work. Still, computer tools have been found to have shortcomings in supporting creative tasks (Goel, 1995; Kolli *et al.*, 1993). A provoking quote by Pablo Picasso – *"Computers are useless, they only give you answers"* – sums up the biggest problem in computers in creative use.

This same problem of computers in creative use can be found in how designers use existing material for inspiration and reference. In chapter 4 we saw that designers currently keep and maintain two separate collections of visual material: a physical collection of magazines, photos and objects and a set of digital images on their computers, CD-ROMs and the Internet. These two collections don't come together in the design process.

Cabinet is a collecting tool that bridges the divide between the digital and physical world. Cabinet does this on the one hand by easy scanning of physical material and on the other hand by offering a very tangible, visual interaction with digital images.

In this chapter a working prototype of Cabinet is set out in practice in three longitudinal trials. In this study we want to evaluate Cabinet as a tool in practice. By evaluating Cabinet we also evaluate what we found before in theory and practice. Cabinet combines our findings from theory in chapter 2 and practice in chapter 4 into a working prototype.

6.2 Background

First we briefly sum up the most important aspects from theory and practice in this research. In the remainder of this section they serve as the expectations for the experiment. In the last section we present the Cabinet prototype, which is used as our apparatus in the experiment.

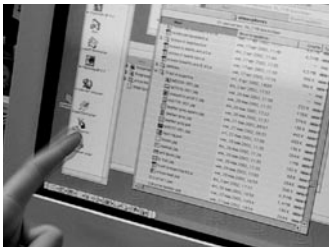
6.2.1 Collecting for creativity

Creative processes make intensive use of *juggling with existing elements*. For example, try to create, as a creative exercise, a group of things to take on a trip. The result of this exercise is a goal-derived category (Barsalou, 1991). It consists of things taken from closets and possibly from a list, but it also contains things that may not be there and have to be bought or even invented. New ideas often derive from these kind of goal-derived categories.

Pasman further elaborated on organizing collections of visual material by designers as a creative activity (Pasman, 2003). In his research he found that organizing visual material resulted in making new designs that went beyond existing categories.

Finding 1. Collecting is an **ongoing activity**. The cuttings in this collection are gathered over time and collections are browsed rather than approached with a query for a factual question.

Finding 2. Designers **keep two collections** of visual materials, which never meet: a digital and a physical. The separation is exemplified by the stacks of magazines laying on the scanner but never scanned in.



Finding 3. Computer tools do not support **visual interaction**. The files in this screenshot are images gathered for collages. The display only shows the filenames and tiny thumbnails.

Finding 4. Designers organize their workplace to promote **serendipitous encounters** with earlier work. The yellow sticky notes are kept in the magazine even when they are not used afterwards.

Finding 5. Most new ideas come from **breaking the rhythm**. In computer tools, time is an underestimated design parameter and most work revolves around looking at the computer display.

Finding 6. Designers use visual material **socially** to support awareness and knowledge exchange with their colleagues. Images on computer displays do not allow for this fluent sharing.

1 The six findings form the contextual inquiry illustrated by observations from that study

Schön proposes a metaphorical thought of explaining where new ideas come from, by mapping one concept onto another, as a source of design creativity (Schön, 1963). New ideas come from extending and setting symbolic replacements where the metaphors don't fit.

The mechanisms described above rely mostly on cognitive skills, whereas designers find their creativity not only in their minds but also in the physical interaction with their tools (Candy & Edmonds, 1999; Hummels, 2000).

In the combined theory we see a strong case for collecting and organizing visual material as a creative activity for designers.

6.2.2 Collections in practice

In a contextual inquiry at five design agencies we found that designers keep and organize visual material in their workplace as a means to stimulate their creativity. The main theme of our findings relates back to the designer

2 Adding visual material to the collection with Cabinet

3 Organizing your collection with Cabinet

keeping two collections, a physical and a digital collection, each with different goals, uses and values. Figure 1 sums up the six findings that came out of this study explained more in-depth in chapter 4.

6.2.3 Cabinet

To integrate knowledge from theory and practice, a tool was developed to support the collecting activity. The six findings from figure 1 served as design criteria. In chapter 5 the prototype and its development are described in detail; a popular presentation can also be found in Delft Outlook (Van Kasteren, 2004).

Cabinet is a table-sized workbench on which a computer generated digital collection is projected. Cabinet addresses the merger of the two collections by allowing the user to add both physical and digital images to the collection. Cabinet can capture physical visual material on the table by taking a picture and leaving a digital copy projected on the surface over the original (figure 2). Cabinet addresses the physical interaction of organizing and categorizing by allowing the user to directly interact with the images in large gestures (figure 3).

Cabinet is intended to be always on, readily available for use, and providing a continuous presence of the collection of visual material in the working environment. It supports the latter by continuously and dynamically presenting images from the collection when not actively used.

Cabinet combines the advantages of working with physical collections with the advantages of new media tools, by addressing the six findings from figure 1.

1) *Active collecting* is supported by Cabinet's readily availability and the possibility to add material without prompting for structure;
2) *Merger of the physical/digital collections* is supported by smooth scanning and physical interaction;
3) *Visual interaction* is supported by taking out all verbal clues in the interface;
4) *Serendipitous encounters* are supported by the continuous and dynamic display of different images from the collection;
5) *Breaking the rhythm* for inspiration is supported by the physical scale of Cabinet, which lures the designers away from their desks;
6) The *social use* of visual material is supported by continuously presenting images in the workplace and inviting collaborative use in table-sized interaction.

During its development we used the Cabinet ourselves and extensively demonstrated it to peers from the field of research and design. The positive reactions gave us confidence in Cabinet.

6.3 Experiment

To further generalize and extend our knowledge on Cabinet and collecting behaviour we set up a long-term experiment in the design practice, embedding the prototype in the actual work practice.

6.3.1 Research objectives

The goal of the experiment was twofold. On the one hand a further evaluation of Cabinet as a tool for collecting based on our previous findings from theory and practice. On the other hand the experiment aims to explore the effects of such a tool on the designer's collecting behaviour.

These effects are explored by finding out: 1) if the collections of physical and digital material actually merge, 2) to what kind of (new) uses this leads, and 3) whether this is felt by the designers as an improvement.

Cabinet was expected to make the implicit activity of collecting more explicit. In our contextual inquiry described in chapter 4, the results of the ongoing activity of collecting were found, but not the actual process that resulted in these collections. Both the actual use of Cabinet and the designers' perception of that use could make this activity more explicit.

On the other hand, Cabinet was expected to bridge the physical and digital

divide by resulting in a collection in which the user would collect and talk about digital and physical images with the same value and use.

6.3.2 Experimental design

The experiment employs a prototype, set out over four weeks at three design firms, where it is used in real design tasks. In the structure of the experimental design, the independent variable is the presence of Cabinet in the experimental group, as opposed to a control group which did not receive the prototype.

Research in such practical settings does not benefit from purely this experimental approach, therefore we approach the results of this study as a case study research (Yin, 1984). This means that the experiment has a largely open structure, looking at the effects of Cabinet in the work practice.

6.3.3 Participants

Participants in the experiment are three designers from three well-known design companies in the Netherlands. The designers were selected by their management on the basis of their experience with finding and using imagery in the design process.

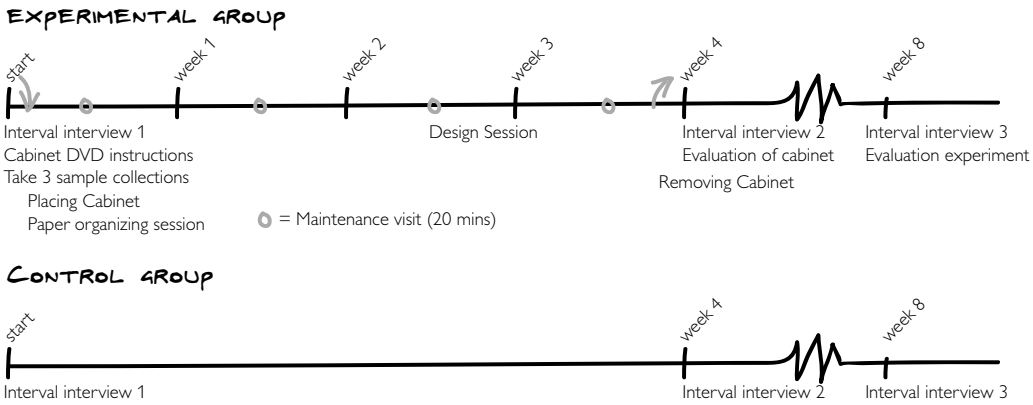
First run was from March 8 until April 2, 2004 at WAAC's, a design agency in Rotterdam with seven employees, working on product, packaging and interior design. The second run was from April 13 until May 7 at Fabrique, a design agency in Delft with over fifty employees, working on graphic, industrial and new media design. The third and final run was from May 25 until June 22 at Smool, a design agency with three employees working on concept, product and furniture design.

The control group consisted of three designers with similar backgrounds and employment. They were interviewed on their collecting behaviour parallel to the experimental group to avoid bias from external influences.

6.3.4 Procedure

Figure 4 shows the procedure that the participants went through. The participants did not see or try Cabinet before it was placed in their workplace. In a short session, they were introduced to Cabinet, and had it uninterrupted in their workplace for a four-week period. They were free to use it at any time.

At the beginning and end of this period, and four weeks afterward, they were given an *interval interview*. This interview contained specific questions on their collecting behaviour; its size, growth, usage and tools. This *interval interview* was also performed with the control group over the same period. These interviews provided a baseline measurement against which to offset the effect of Cabinet as an experiment, both over time and over the two groups.



4 Timeline of the experimental procedure over a period of 8 weeks with an experimental and control group

Participants in the experimental group also had one interactive *design session* midway through the period, in which they were given a design task. After the Cabinet was removed, a separate researcher interviewed the participants in an evaluation interview.[1] The separate research was needed to avoid positive bias towards the researcher, who is also the developer of Cabinet and had facilitated the experiment for the last month (Nielsen, 1994).

INSTRUCTIONS

The participants in the experiment received an instructional DVD with a 7-minute movie that explained all the functionalities and features of Cabinet. They were asked to view this instruction at home or in the office before the Cabinet prototype would be placed in the studio. The DVD instruction was their first impression of Cabinet.[2]

PLACEMENT IN THE WORKPLACE

Cabinet was strategically positioned in locations in the design studios where social interaction or interaction with visual material could possibly take place (figure 4). The participants were first given a visual organizing task on paper to sensitize them to organizing visual material in general. After this, Cabinet was turned on and the participants could try out some of its features and ask questions if things were unclear. Detailed instructions were provided on the cover of a comment log book they were invited to fill in. In the instruction

[1] On http://www.forinspirationonly.net/appendix/ is a PDF of the complete outline of both interval and evaluation interview

[2] On the DVD accompanying this book the original and dubbed version of the instruction can be found

5 Cabinet placed at WAAC's, next to a workplace near to the entrance
6 Cabinet placed at Fabrique, on a separate table near the entrance and the water cooler
7 Cabinet placed at Smool, on the magazine table next to the printer

we asked the designer to turn the projector on in the morning and off in the evening, keeping the Cabinet active and available all through the working day.

MAINTENANCE VISITS

Each Wednesday (circles in timeline on figure 4) the researcher would come by for a short maintenance visit, to backup the log files and collections and clean and restart Cabinet. The maintenance visit also served as a chance for the participants to ask questions or report problems to the researcher and as a reminder on the experiment's progress.

DESIGN SESSION

In the third week, the participant was asked to present one of their active projects in which they had used Cabinet. Participants explained a design project they were working on using Cabinet. The participants were asked to perform some tasks on Cabinet to elicit use; for example they were asked to show on Cabinet in which direction the project was heading and to summarize the project with three images. This session was recorded with a camera pointed at the hands and the projection surface.

Table 1. Expectations of phenomena expressing the 6 criteria and the ways in which data are gathered

Criteria	*Expectations*	*do*	*make*	*say*
1) Active collecting	More use/value of physical images	CL		II, EI
	Short bursts in intervals during the day	CL		EI
	Physical collection will grow			II,EI
	Collecting will be more aware			II,EI
2) Merger of physical/digital collections	Physical and digital images used on equal footing	CL		II,EI
	The collection will be less rigidly structured	CL		EI
	The line between physical/digital collection will blur	CL		II,EI
3) Visual interaction	Participants can fluently interact with purely visual interface		DS	EI
	Story emerges from pictures and composition		DS	EI
	Composition is used for meaning-giving, classification, finding back	CL	DS	EI
4) Serendipitous encounters	Participants will stumble more often on images	CL		II,EI
	Screensavers and always on will be appreciated	CL		EI
	Serendipitous encounters in search session	CL	DS	
5) Breaking the rhythm	Breaking the rhythm for inspiration	CL		EI
	Creativity in motor skills		DS	EI
	Ad hoc categories, fitting in		DS	EI
6) Social use	Table will invite joint use		DS	EI
	Colleagues will know about Cabinet and its contents			EI
	Interaction with two people is fluent		DS	EI
CL = Log file, II = interval interview, EI = evaluative interview, DS = design session				

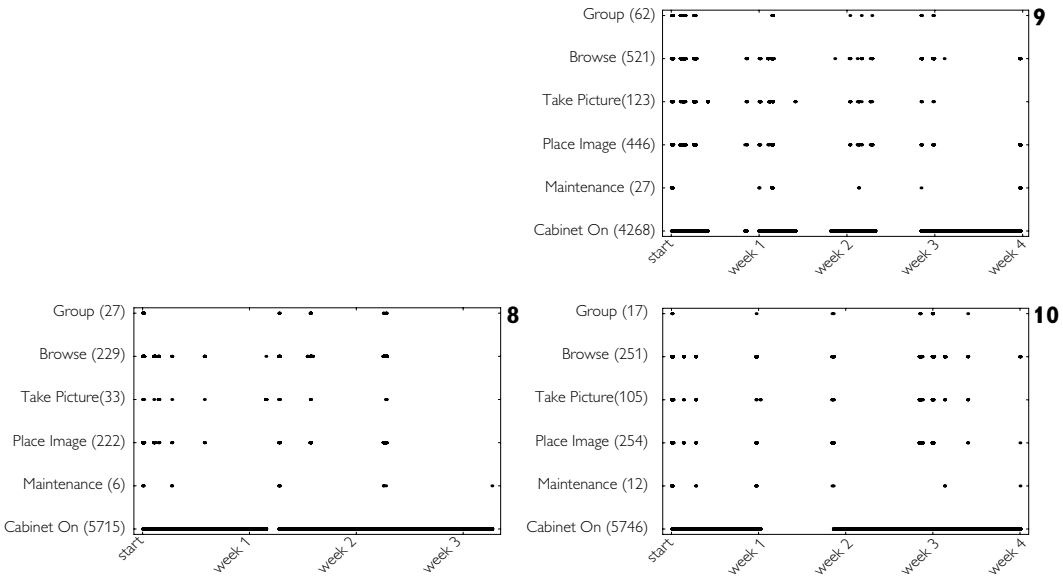
EVALUATION INTERVIEW

After four weeks the Cabinet was picked up and taken away. A few days after this, an independent researcher interviewed the participant to evaluate Cabinet and reflect on their attitude towards visual material in the design process after using Cabinet.

In the evaluation the participants were asked to describe what Cabinet is, how they used it, what their collection on Cabinet looked like, and how it influenced their collecting and design behaviour. This kind of reflection on a product can result in a very rich and valuable evaluation on design concepts (Gaver *et al.*, 2004). During the interview the participants were also asked to invite a colleague in the studio for some questions. The colleagues were asked to describe Cabinet as a product and to describe an image in the collection.

6.3.5 Expectations

Table 1 lists the different expectations grouped by the criteria by which Cabinet was developed as described in chapter 5. Table 1 also lists three categories of data gathering, and their appropriate form for each expectation. For observable behaviour *(do)*, the prototype keeps a *log file* of all user actions, and the primary researcher has notes and photographs of the workplace. Two types of interviews *(say)* are used to record participants' opinions; short factual questions in the *interval interview*, and an elaborate *evaluation interview* at the



8 WAAC's log file visualization: Cabinet was active *(Cabinet On)* almost all the time with 5 *Maintenance* visit. The log files further show four active uses outside the maintenance visits.

9 Fabrique log file visualization: Cabinet was inactive *(Cabinet On)* often with 6 *Maintenance* visit. When working, it was used intensively *(group, browse, take picture* and *place)*.

10 Smool log file visualization: Cabinet was inactive *(Cabinet On)* for one week with 6 *Maintenance* visit. In the 4 active uses outside the maintenance the log shows many activities of *Take picture.*

end with the participants working with the prototype. Finally we had the observed task in a *design session*, in which reflection and action concur *(make)*.

6.4 Results and discussion

6.4.1 Results

The whole procedure resulted in several sources of data, which have been analysed and matched according to our expectations. The Cabinet prototype had produced log files over the four weeks of all activity that influenced the collection. These were visualized (figures 8 to 10) and tested for patterns. The three collections the participants had created over the experimental period were also part of our dataset.

The richest source was the transcript of the evaluation interviews combined with observation notes. The evaluation interview resulted in 20 pages of transcripts from the three sessions, from which excerpts were cut out and independently grouped by three researchers into 18 themes related

Table 2. Results of interval interviews

How many images are in your collection?

physical	t1	t2	t3
p1	63	300	200
p2	9250	50	250325
p3	1000	3000	1900
c1	35000	500	350
c2	4100	1000	875
c3	900	1000	2000

digital	*t1*	*t2*	*t3*
p1	*225*	*250*	*500*
p2	*20000*	*2000*	*503250*
p3	*1175*	*1540*	*1300*
c1	*500*	*2000*	*100*
c2	*3000*	*2000*	*4950*
c3	*1500*	*960*	*1800*

For what do you use your collection?

physical	t1	t2	t3
p1	1	5	4
p2	1	3	2
p3	2	2	2
c1	1	1	2
c2	2	2	2
c3	4	2	3

digital	*t1*	*t2*	*t3*
p1	*5*	*4*	*6*
p2	*1*	*3*	*5*
p3	*3*	*5*	*1*
c1	*1*	*0*	*2*
c2	*1*	*1*	*2*
c3	*1*	*3*	*4*

The results of 2 out of 12 questions we compared for differences in experimental group (p1,2,3) and control group (c1,2,3). On the two tables on the right the answer to the question "How many (physical and digital) images are in your collection of visual material?" asked at three different 4-week intervals. The patterns within the two groups – and even within participants – are incomparable.

to our expectations (see table 1) in a post-it session. An independent facilitator moderated this session and led the discussions on the differences between the researchers. The analysis resulted in 112 separate quotes categorized over the six main themes of the expectations. These quotes were evenly distributed over each theme, with at least 12 quotes to each theme.

Our interval interviews containing questions about the participants' use of their collections were quantified and analysed for differences in the experimental group and control group. Though we didn't expect these interval interviews with six participants to give us exact and solid data, we did believe that setting out a baseline at the start, and a control group over the period, would give us some insights in the effects of Cabinet relative to our control group. The resulting data gave us such a variety in answers over time and within groups (table 2) that we will not present these results in-depth in this article.

The question in the first table in this interview, for example, was to make an estimate of the size of their collection in amount of images, both physical and digital. We asked all our participants to base their estimate on the same strategy, where they would first make a rough estimate, after which a small sample was taken, and finally to make a calculation of the amount of places where images were stored times the amount of images in each of these places.

The variation between participants and within participants over times shows that the definition of collection and images is not stable for participants even over time. This could be due to the fact that participants don't look at their collection as a whole but as an activity, and that these collections are not objects with fixed value. Though this may be a reason, the results from these interviews were not used for validating our expectations in table 1.

Finally we had video observation material on interaction with Cabinet in *design sessions* (DS in table 1). The researcher and co-author analysed the videos independently looking at the expectations in table 1.

6.4.2 General observations

Technically the Cabinet prototype was able to withstand the long-term exposure in practice. The Cabinet was technically functional 94% of the time and the three participants encountered in total only five technical breakdowns while using Cabinet. These breakdowns did not result in total abandonment of their commitment to use Cabinet.

All participants actively used the Cabinet over the whole experimental period (figures 8 to 10). All participants worked readily with the size and style of the prototype. This is remarkable because Cabinet's interaction style, with its large interaction area, minimal interface and tangible computing, are typical for research models, but very unlike the tools currently used in practice.

In their evaluation the designers reported in total 19 suggestions, featuring requests or bugs, but these reflected mostly on details in interaction or appearance and did not affect the overall concept of a collecting tool or the interaction style as a whole.

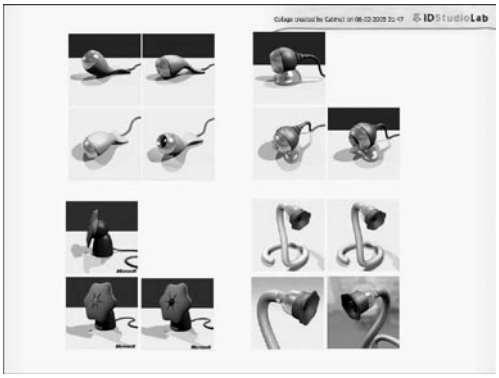
In their descriptions of Cabinet all the participants talked about the contents of Cabinet – *"it is a kind of collection of images"*, *"a photo thing"*, *"like working with photos"*. Next to that they would describe its goals – *"storing visual information ... and organizing"*, *"an organizing thing"*, *"an ACDSee folder"*, *"an image management tool"*. Two of the participants also mentioned the collaborative aspects of Cabinet – *"a meeting tool"* and *"a brainstorm tool"*. Finally none of the participants described the technical components of Cabinet, but they did describe what you could do with it as a whole – *"a desktop to scan images"*, *"scanning in 3D objects"*.

In their use of Cabinet one exciting new pattern emerged that was beyond our expectations. All three participants spontaneously used Cabinet not only to put in existing visual material from their collections, but also to add their digital or physical sketches of design solutions. These images were not just added for archiving or presentations, but also for their creative processes. With two of the participants, the solutions were also mapped next, or even in the compositions of source material for comparison or analysis. This unexpected result presents an exciting opportunity for enhanced use of visual material in the design process.

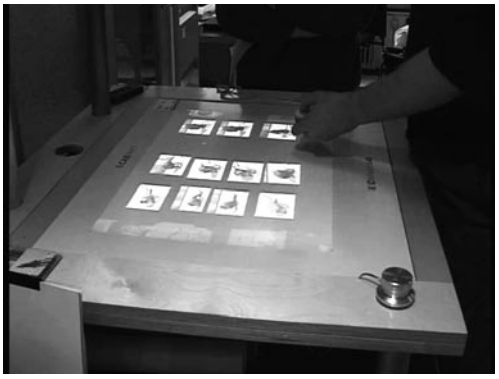
6.4.3 Observations at the three agencies

The three participants had three distinctive ways of using Cabinet. This had a reflection on their use patterns, their collections and their evaluations. The differences and description of the cases themselves are presented first, followed by an analysis of the results based on the different criteria and expectations.

11



12



13

11 An impression of the studio of WAAC's

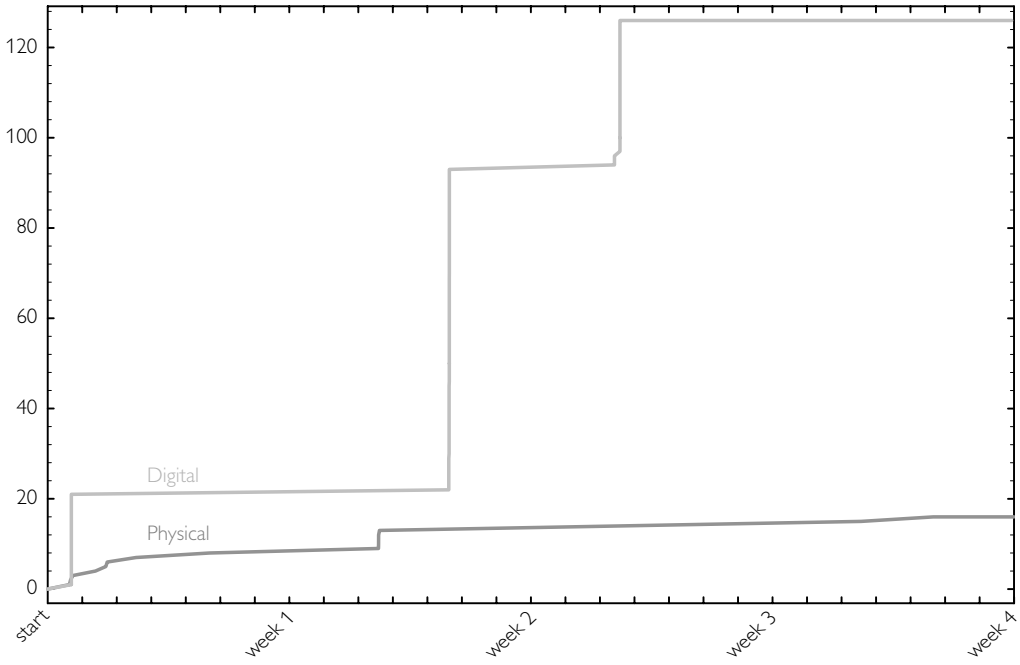
12 Cabinet export of a composition of web cam renderings at WAAC's

13 Still from the *design session* in which Roy presents the process of making these renderings

WAAC's

The first participant, Roy Gilsing, is an industrial designer at WAAC's (figure 11). He used Cabinet to organize handmade sketches of web cam designs and translate them into computer renderings (figure 12). These renderings were to be used on the company web site.

Roy was very fluent with the interaction and used Cabinet a couple of times for presentation to visitors and colleagues. In his compositions he made a distinction between sketches and renderings. The renderings were organized very neatly in straight, organized grids (figure 13). These kinds of static compositions are not explicitly supported in the expressive interaction of Cabinet, allowing images to be easily rotated and moved.

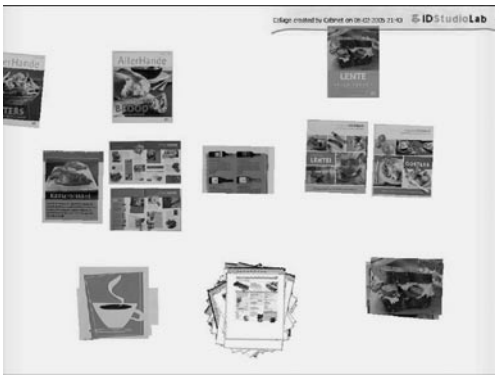


14 Timeline of physical and digital images added at WAAC's over time

Over the experimental period Roy added mostly digital material to Cabinet (figure 14). He added 18 physical images, evenly distributed over four weeks. The 123 digital images were added in three bursts of activity Roy started out enthusiastically and open, but the problems with making straight, aligned compositions strongly influenced his opinion regarding Cabinet. He didn't trust many of the features of Cabinet without trying or comparing them with his current tools and techniques.

In the evaluation interview, Roy described Cabinet as an *"image management application"*. In all his suggestions for Cabinet he emphasized the possibilities of presenting images to clients, and shared use of Cabinet in brainstorms.

15



16

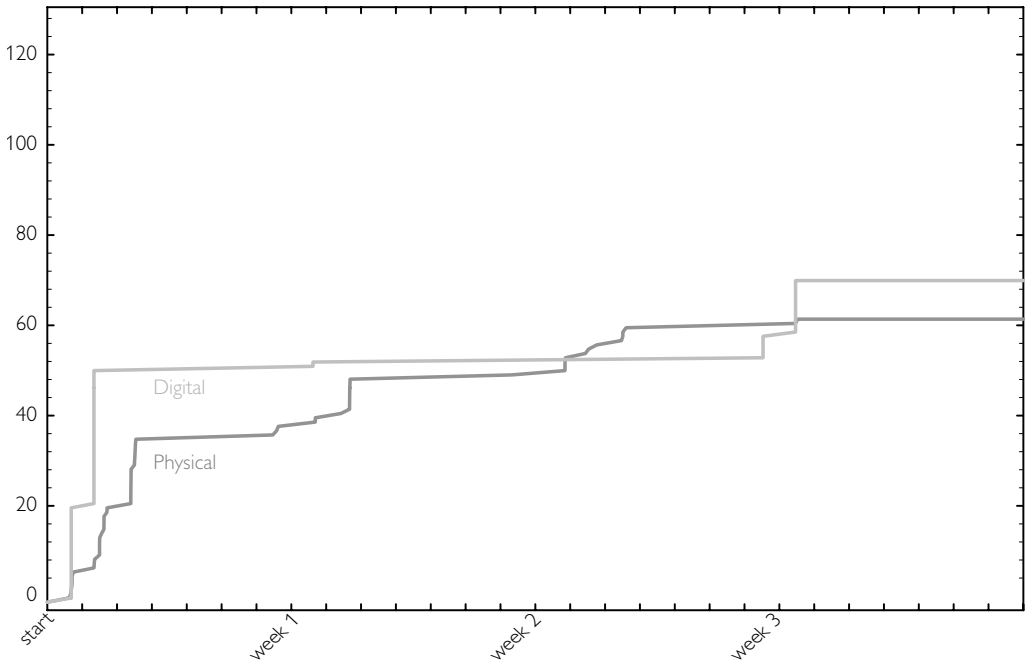
17

15 Panoramic impression of the studio at Fabrique
16 Cabinet export of Renate's analysis of a magazine
17 Still from the *design session* in which Renate points at elements she can use for her designs

FABRIQUE

Renate Frotscher, a multimedia designer at Fabrique (figure 15), was the most intensive user of Cabinet over the whole experimental period. In two projects she used Cabinet to analyse graphic designs. The project she presented during the *design session* dealt with the translation of the style of a company magazine onto their web site. She scanned in different spreads of the magazines, and analysed them regarding layout, use of photography and illustrations (figure 16).

In the beginning, she invited her colleagues to use Cabinet, but found them messing up her collection. After these disturbances she only used Cabinet for herself, not for presenting to clients, colleagues or managers.

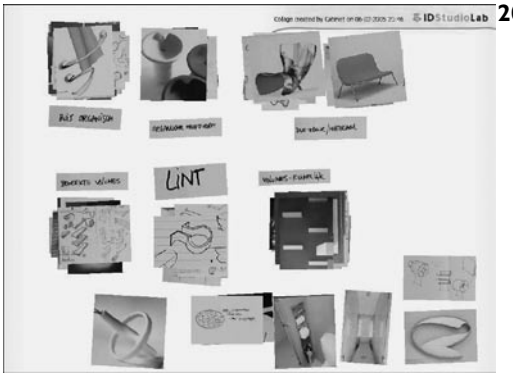


18 Timeline of physical and digital images added at Fabrique over time

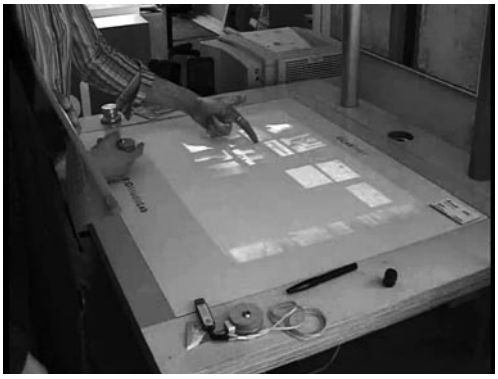
Renate added both physical and digital material in equal proportions, and in the same tempo. She added 66 physical and 75 digital images. She used Cabinet many times, in irregular intervals over shorter and longer periods. At the end, she was very enthusiastic about Cabinet and its value.

In the evaluation interview Renate described the Cabinet as *"an ACDSee folder"* (a photo management application). In her further remarks on Cabinet she stressed the importance of overview and using Cabinet for analysing images.

19



20



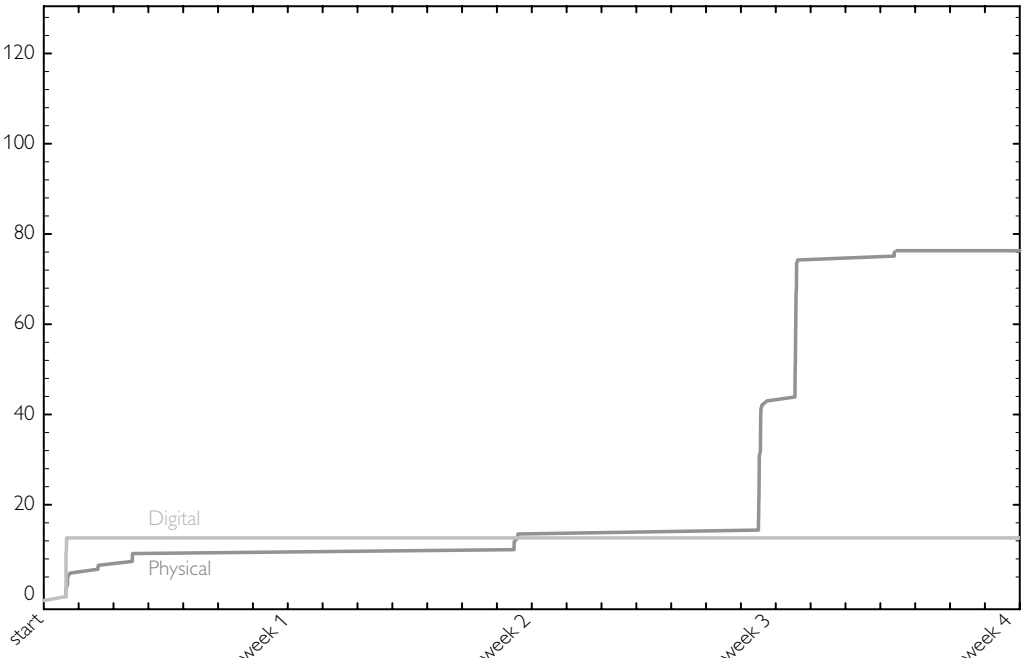
21

19 Impression of the studio at Smool
20 Cabinet export of Renée's combined use of magazine images, sketches and word labels
21 Still from the *design session* in which Renée points at source material next to her sketches

SMOOL

Renée Schuffelers, industrial designer at Smool (figure 19), used Cabinet to organize her own sketches in relation with source material or reference designs from magazines. By cutting out her sketches, and composing and organizing them with collage material she looked for new patterns and directions in her own solutions (figure 20).

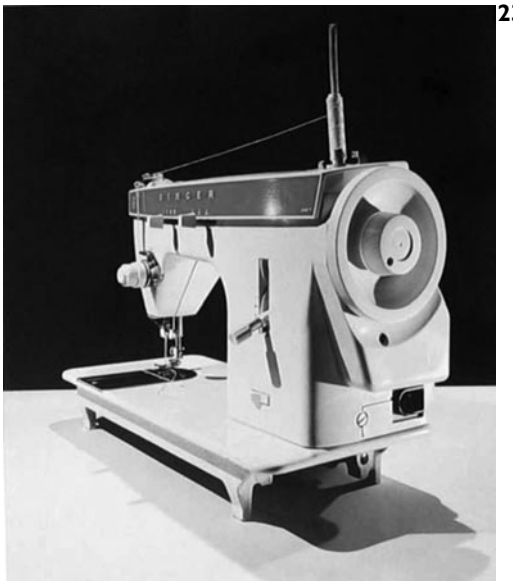
After making the organization, she labelled each pile by scanning in handwritten notes with Cabinet and placing them below the piles. Renée presented the result of this exercise to both the researcher and to her colleagues in a collaborative design session.



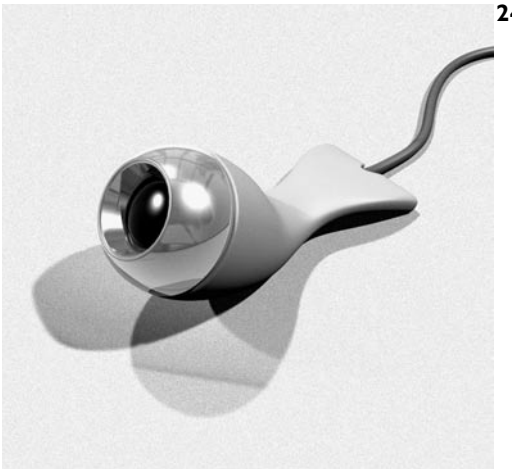
22 Timeline of physical and digital images added over time at SMOOL

Renée used Cabinet merely for adding physical images (89 physical images against 16 digital images). Almost all the physical images were added in two lengthy sessions at the end of the experiment (figure 22). She did not use, and could not appreciate, adding digital material to Cabinet. At first she was quite hesitant to start using Cabinet, which was extended by Cabinet breaking down on first contact. In the final weeks of the experiment she started using Cabinet more intensively.

In the evaluation interview Renée described Cabinet as an organizational tool, with the power to mix sketches and reference material. She also described it as a tool to discuss designs. In her final remarks, she was very positive about the possibilities of scanning in 3D objects.



23



24

23 Reference material found in Roy's Cabinet collection

24 A rendering from the collection of Roy Gilsing

6.4.4 Discussion by findings

ACTIVE COLLECTING

From the log files we saw that our participants used Cabinet 3 to 4 times a week with small short bursts. They all had 2 to 3 longer sessions in the four-week period. Their own estimations in the evaluation interview were close to this as well. The participants did not really say that the role of their collections or visual material changed after using Cabinet. Roy did refer to the role of visual material though – *"I now realize that I am working with visual material daily ... but I knew that in some way already".*

The unconsciousness of collecting is illustrated by Renate when she talked about images that she didn't *put into* the Cabinet, but images *ending up* in there as part of her design solutions.

Though Cabinet aimed to make the implicit aspects of collecting explicit, the collecting behaviour was still mostly an unconscious stream. For example, Roy was asked to tell if he used other visual material for inspiration in the design process. He could give no examples, saying that the project was not really creative, just an engineering or computer task. When the researcher pointed at a specific image in his collection on Cabinet of a sewing machine

(figure 23) Roy explained – *"O, that ... I kept it because I like the lighting effect in this photo resulting in double shadows. It is very dramatic. I used it in my renderings of the web cams as well ..."* (figure 24).

MERGER OF THE TWO WORLDS

All the collections on Cabinet contained images from both the physical world and digital sources, where Roy's collection had an emphasis on digital images and Renate's collection was mostly physical. With Renate, the merger was most balanced and in her evaluation Renate talked about one project in which she *"was able to use the complete span of Cabinet"*. In another project she described a similar merger – *"I designed a leaflet, printed it out, made photos of the leaflet [with Cabinet] in different stages of folding, and used those pictures in the CD-ROM"*.

The merger became more apparent in the evaluation interviews when confusion occurred over the real and physical world. Two of the participants said they missed a *"waste basket"* which should be *"bigger"* (Renée) or should be *"like a physical waste basket"* (Renate).

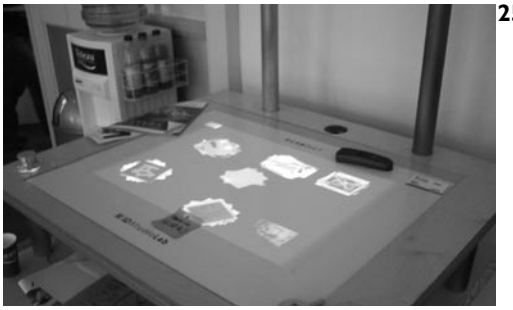
Roy made a distinction between computer material and handmade sketches in his compositions in Cabinet. He also did this without a real conscious choice: *"A computer rendering is more exact, so maybe that's why I might have preferred them neatly organized ... These sketches are, well more messy, so I found it OK to put them like this"*.

One anecdote at Fabrique illustrates the merger of physical and digital. On the company intranet Renate had invited her colleagues to come by and try out Cabinet. After one week her colleagues had messed up her collection so much that she couldn't use it anymore. She solved this problem by making a special stack in her collection that her colleagues could use (figures 25 and 26). She physically labeled this stack with a pink sticky note bearing the text *"start here"*. In the digital collection she repeated her instruction with a sticky note she had captured with Cabinet reading *"that means here!"* (figure 27). The physical and digital sticky were stuck on top of each other creating a seamless integration of physical and digital sticky notes.

The integration between digital and physical images had gone further than just seeing both types of images in one tool. For all the participants the line had blurred in their perception of and interaction with their collections.

VISUAL INTERACTION

Cabinet offers a completely visual interaction, with no verbal clues or labels in the interface. None of the participants during or after the experiment reported real problems with the lack of verbal input and complete visual interaction. Two of the participants appreciated having an overview and not being required to enter labels all the time. When asked for suggestions,



25

26

27

25 Cabinet at Fabrique with a physical pink sticky note

26 In close-up we can read "start here" on the physical sticky note

27 Digital sticky note with "that means here!"

two of the participants did mention adding verbal input as an added feature, but it was never regarded as a requirement.

The fact that the designers had strong visual memory was supported by all of their ability to draw out their collections from memory, a week after the Cabinet was taken away.

In the design sessions the participants interacted with Cabinet fluently, allowing them to talk about the images in their collection without being distracted by verbal clues. Making mistakes, such as enlarging the wrong image or opening the wrong stack, did not break the flow of the conversation. During the design sessions two of the participants improvised and explained their design process with the material visible on Cabinet. Roy had used Cabinet to prepare a presentation of his design process. When asked for his future direction of the project, Roy had to make a change to his composition to make his point. He immediately afterwards restored his composition to make the composition more logical and supportive of his presentation.

Though the purely visual interaction was regarded as positive, it was also most criticized in its details in interaction. In the evaluation, the designers talked about missing the ability to scale or align images and the annoyance

of new images added to the collection rotating in the centre, ruining the composition of their images.

SERENDIPITOUS ENCOUNTERS

All the participants described serendipitous activities, which were seen as positive though useless. For example, when asked whether she would miss her collection on Cabinet, Renate played down the importance of the images in Cabinet by saying that *"These pictures in Cabinet are still in project folders and my personal collection are things I am surrounded with, things I want to have available at hand in case I want to use them, or that I occasionally run into. So they are in the back of my head and I don't really need them."*

The fact that Cabinet showed images randomly while not used was described by two of the participants as *"pleasurable, aesthetically pleasing"* (Roy) and *"a fun way to bring out new thoughts"* (Renée).

INSPIRATION BY BREAKING THE WORKFLOW AND USING MOTOR SKILLS

The log files show many short uses by Renate. In the evaluation interview Renate reported using Cabinet *"when my anti-RSI software would force me to stop"* so that she could *"mess around with images ... making larger gestures"*.

We did observe the motor skills in the design sessions where the designers would use both hands and larger gestures, even without actually pointing at the images with the pen. Two participants pointed at empty spaces in the composition to point at new idea directions.

None of the participants attributed a specific new idea coming from using Cabinet. Only one participant (Renée) mentioned using Cabinet for getting new ideas: *"The most interesting areas were switching between the different groups"*.

SOCIAL INTERACTION

The colleagues that were brought in during the evaluation interview (see section 6.3.4) provided surprising results. Considering that Cabinet had been showing images during the last 4 weeks in that design office we expected all colleagues to recollect at least one image they would have seen while passing by. To our surprise none of the participants were able to recall one image; they all mentioned something, but they were all wrong. Then again, these colleagues were able to describe Cabinet's functionality and purpose.

The participants often described Cabinet as a collaborative tool, such as *"a brainstorming tool"*, *"a table to present images to colleagues"*. Though all the participants mentioned collaborative use as a positive feature, only Renée actually reported using it to share her work with colleagues. The *design session* with the researcher was not seen by the participant as a collaborative session.

The fragility of social interaction is also illustrated in the anecdote described in figures 25 to 27, where Renate had to tell her colleagues not to mess up her collection. After putting up the sticky note on Cabinet no colleague ever dared to touch her Cabinet anymore.

6.4.5 Evaluation of the prototype

The participants provided 19 suggestions and features that could to their insights improve the interaction with Cabinet. These varied from improvements in efficiency, *"allowing two crops to be made from one scan",* to changes in physical appearance, *"making it a more elegant device"*. The most valuable suggestions were directed at the interaction with the collection itself, allowing for *"temporary compositions", "clearing the centre from incoming new images",* and *"being able to label groups"*.

6.5 General Discussion

The prototype was set out in practice as both an evaluation of the prototype and an intervention to gain knowledge on designers' behaviour.

The overall result of the evaluation is that the prototype was able to attract the designers into using a new tool and adapting it to their use. We had categorized our findings into six categories, for which our expectations were set up. Three out of these six findings were really supported by what was found in practice. The biggest success was the merger of physical and digital visual material that took place with all participants. Furthermore, all participants were fluent and positive about the purely visual interaction with Cabinet. The social interaction with visual material could not be validated in practice and for inspiration we found that Cabinet did break the rhythm and involved the body in the interaction, but this gave no relation to getting new ideas or insights.

One unexpected and remarkable merger came out of this experiment. All our participants used Cabinet to organize existing visual material together with their own design solutions. In our experimental setup and prototype this effect was not taken into account at all. The possibility of adding sketches and renderings was foreseen, but not the notion of using composition and grouping in Cabinet to compare and organized design solutions directly with source material. An unexpected, but very interesting result.

6.5.1 Discussion of the method

The method of having a prototype in such an open setting as a form of evaluation did work in giving confidence in the appropriateness of Cabinet. Probably harder evidence of specific usability issues with Cabinet could be found in a laboratory setting, but these tests could never give us the confidence in Cabinet as a whole.

The experiment stayed very close to practice, with a realistic task and a working tool with real users. The prototype was expected to elicit different kinds of use, work methods and attitudes towards collecting. Though Cabinet had an effect in the collecting behaviour, the open-ended structure of the experiment led to many different uses and interpretations by the participants. A predescribed procedure might have given us more answers on the designer's behaviour, but this would come at a cost of evaluating the prototype's inherent value and its effects on new uses.

By staying so close to practice, the validity of these results are ensured, this comes at a cost of reliability of our measurements. In the method we measured in several different ways, of which many did not yield reliable measurement. The experiment did however provide results with richness of meaning.

An unfortunate and typical example is the fact that our interval interviews with both the participants and a control group provided incomparable results and patterns. The evaluation interviews and the design sessions provided interesting results that were relevant to the different criteria and expectations.

6.5.2 Conclusions

This experiment has been a no-compromise reality check for both tools and theory in practice. By setting out Cabinet, a working prototype of a tool, in real world practice over a longer-time period we have gained much confidence of its function. At the end of the experimental period two out of three designers valued the prototype as a positive addition to their working methods, and even wanted to have Cabinet back after four weeks to use it on further design projects. During the experimental period Cabinet's use was instigated by the designers own initiative and the participants were not guided by experimental procedures. Given the work pressure in design studios and the stability of the working prototype, these are promising results.

In the evaluation the Cabinet prototype worked convincingly in bridging the gap between the physical and digital divide. All the participants readily accepted the size and scale of the interaction on a tabletop. The lack of verbal feedback in the purely visual interface was not seen as a problem. Many

of Cabinet's virtues were not explicitly mentioned during the evaluation interviews, because they did not cause friction in the designers' interaction. Sometimes the lack of complaints can be seen as a compliment for the design.

6.5.3 Directions for further research

This experiment makes a strong case for doing research through prototypes in practice. Cabinet has a lot of potential to be used for different experiments in practice.

One approach could be to take a similar case study approach, but to embed the prototype over a longer period in the designer's workplace. This will make it easier for designers to really make Cabinet part of their working method. To get reliable and valid results this would not necessarily require more participants. Possibly an experiment with just one designer or one design agency could be enough. In such an approach, the log files can provide reliable data on the change of the behaviour and patterns of uses over time.

Another approach could be to take some more control over the conditions in practice by moderating the use of Cabinet. In moderated workshops or weekly sessions a design process could be observed in relatively controlled conditions. This approach is especially interesting to explore the effects on other areas than mere collecting. The interesting behaviour that emerged during our experiment, in which all three participant used Cabinet to combine both existing visual material for image generation with their design solutions, is an interesting area for further exploration.

Acknowledgements

The researchers would like to thank the designers, their managers and colleagues for participating in our experiment. We would also like to thank the designers in our control group for their time.

LITERATURE REFERENCES 6

Barsalou, L.W. (1991) Deriving categories to achieve goals. In: G.H. Bower (Ed.), *The psychology of learning and motivation: Advance in research and theory* (27). San Diego, CA: Academic Press, pp.1-64.

Candy, L., & Edmonds, E. (1999) *Introducing creativity to cognition.* Proceedings of the Third conference on Creativity & cognition, Loughborough, UK, pp.3-6.

Gaver, W.W., Boucher, A., Pennington, S., Walker, B., Bowers, J., Gellerson, H., et al. (2004) *The drift table: Designing for ludic engagement.* Proceeding of CHI 2004 extended abstract on Human factors and computing systems, Vienna, pp.885-900.

Goel, V. (1995) *Sketches of thought.* Cambridge, MA: MIT Press.

Hummels, C. (2000) *Gestural design tools: Prototypes, experiments and scenarios.* Doctoral dissertation, Delft: TU Delft.

Kasteren, J. van (2004) Cabinet of curiosities fuels creativity. *Delft Outlook, 21,* pp.7-10.

Kolli, R., Pasman, G., & Hennessey, J. (1993) *Some considerations for designing a user environment for creative ideation.* Proceedings of the Interface '93, North Carolina State University, Raleigh, NC, pp.72-77.

McKim, R.H. (1980) *Experiences in visual thinking.* Monterey, CA: Brooks/Cole.

Nielsen, J. (1994) *Usability engineering*. Los Angeles, CA: Morgan Kaufmann.

Pasman, G. (2003) *Designing with precedents.* Doctoral dissertation, Delft: TU Delft.

Schön, D. (1963) *Displacement of concepts*. London: Tavistock.

Yin, R.K. (1984) *Case study research: Design and methods*. Newbury Park, CA: Sage.

In this final chapter I will *look back* at the *results* of this research project. I will draw *general conclusions* on what *knowledge* has been gained. Knowledge on how designers *interact* with informal collections of visual material, and what new tools can do to *support* it. I will also take a *forward look* to see how *future research* can contribute to this field.

I will then take some time to reflect on the *research through design* approach and the role of *making prototypes* in this research.

This chapter is written from my *personal perspective,* balancing *research*, *design* and the many *other roles* I have played in this project.

Though it was written in early 2005, it will cover the work done in the *whole research project* over the past *six years*.

At the end of this thesis I will take a personal look back at the results achieved in this research project. The body of work presented in this thesis and in the design has fulfilled the aims of the research well and beyond. We gained knowledge on how designers interact with collections of visual material in the design process. More extensively, we have shown how new media tools can successfully support this interaction.

This last achievement appeals to me as a designer, because making relevant and functional products is what I am trained to do; it also is what I believe I do best. All through the research project this passion for making things has helped me in getting colleagues to take the journey with me. It helped me to gain knowledge, communicate my results – and to give me a clear goal.

Cabinet, the final prototype made in this project, epitomizes the success of this project. Its design uses the knowledge gained from theory and the observations from practice. Cabinet builds on the experiences we had in making tools and using new media. It has been used as a research tool but it also serves to demonstrate a solution for collecting visual material. With Cabinet I have been able to show the relevance of and the results from this research to all kinds of people, varying from creative designers to the Dutch prime minister and from specialized researchers to my own children. The demonstration and experience of Cabinet made all of them understand at varying levels what my research was about.

In this conclusion I will start by looking back on the results of the research, drawing general conclusions on how designers use informal collections of visual material in their design process and how new media can support this. After this, I will look at the approach and relevance of these results. This part will have a special section devoted to the role of making prototypes. This will bring me to the possibilities to extend this research. I will finish with a personal look at the achievements in this project.

7.1 Collecting for inspiration

Everyone is in their own way sensitive to the world around them. Biologists and hunters see and hear animals where most of us wouldn't notice their presence. Researchers see patterns where most of us just see the obvious relationship. Designers, specifically industrial designers, see a world mediated by products. To find opportunities for product development they look at people's interactions, technological solutions and the needs of their clients.

In this research I looked at how existing visual material can serve as a source of inspiration for these designers. I started out with theory, while looking at technology and grounding all these ingredients in practice.

For theory, I found no ready-made framework to apply to the field.

Therefore I had to integrate different elements from different disciplines related to our question. The main conclusion from this is that categorizing and structuring helps designers get new insights. The goal of this categorization is not getting the best fit, but to visually think about relationships between concepts. The friction and displacement in the categories allows the designer to find solutions and new patterns.

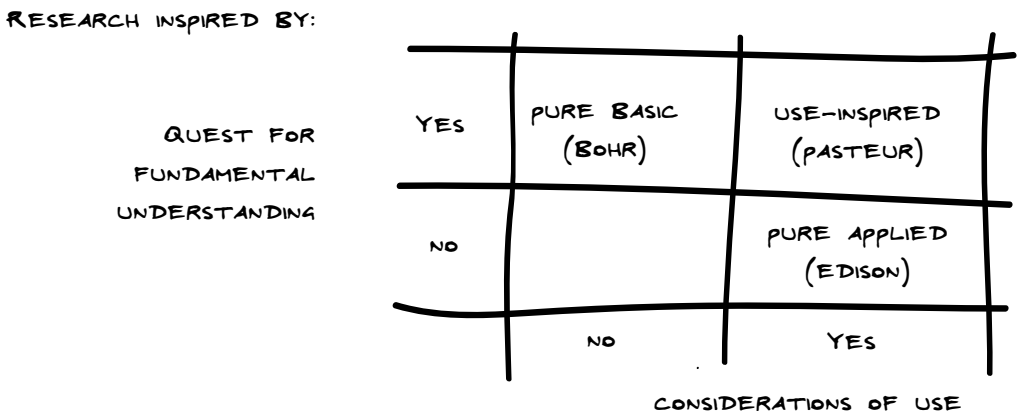
Tools to support designers in getting new insights should therefore not focus on making the best categorizations, nor should they support the most efficient way of structuring. Instead, tools should support expressive ways to get to these organizations, support the richness of visual material, and allow for restructuring, force-fitting and visual thinking.

By developing and experiencing tools I explored these aspects first on the TRI Setup, which supported expressive ways of interaction by involving the whole body. The physical world could be enhanced with the richness of new media by projecting light on different surfaces and objects. Finally the TRI Setup became a part of our work environment, allowing us to collect and share visual material in a social setting.

In practice, designers were found to keep collections of visual material, yet they hardly think about the objects that are in those collections. The collections are not part of a structured procedure or method in the design process. Designers actively collect material that intrigues them or material that they think has potential for future use. It also revealed the huge influence of the computer into the image generation process. The computer has created a gap; a gap between on the one hand the digital images that can be used and transformed in computers to convey a message and on the other hand physical visual material with which the designers surround themselves. The physical collection has the most potential in being a source for inspiration, allowing for expressive interactions, visual thinking and restructuring. The digital collection can be used more easily as a tool in the design process for making collages and moodboards.

Cabinet was developed to combine the two collections – allowing for new media to support collecting visual material. It demonstrates the power of using computer tools to organize and structure visual material, and it supports the activity of collecting both digital and physical visual material. In the design practice I could demonstrate that designers can actually use such a tool and readily accept its interaction. Furthermore it revealed that the design solutions themselves could also become a part of that collection of visual material, extending the field even further.

My personal use of Cabinet has made me more sensitive to the world around me when regarding visual material. On encountering an interesting piece of visual material I always think about the ability to capture it using



1 Pasteur's quadrant: comparing different types of research (and researchers) based on what motivates them (adapted from Stokes, 1997)

Cabinet. In this way I have been able to collect visual material as an ongoing activity. Two of the participants reported similar experiences of being more sensitive to their interaction with visual material.

7.2 Research through design

This research was rooted in the IDEATE research line, focusing on new ways of supporting designers in creative use of computers. My predecessors gradually paved the way for me to use my chosen methods. Researching the two-handed interaction, Gribnau used prototypes for experiments in laboratory conditions with given tasks (Gribnau, 1999). Pasman took this a step further to practice in experiments with tasks relevant to design (Pasman, 2003). All the research in this thesis was rooted in the real design practice with real design tasks. The validity and relevance for the field of design are therefore clear.

IDEATE later became part of the ID-StudioLab, a design research community, doing *research through design*. The definition of this is still open to discussion, but in the ID-StudioLab, relevance to design, working prototypes and using techniques from design are common themes. One of the ways the ID-StudioLab is shaping this definition is by creating a work environment in which designers, students and multidisciplinary researchers work together in a studio environment. The approach of making prototypes in this studio environment has influenced the effect and the results. The impromptu remarks of colleagues on my work and the ideas shared by others in the studio have given me a focus and commitment to this result. Other than relevance to design, our research approach aims to be relevant to science as well. Because of the practical appliance of this research, it may quickly lead to seeing

Cabinet as a result of product development, instead of a scientific endeavour. This is the main reason to let this work be valued as a doctoral design opposed to a doctoral thesis. To see if this project adds to a body of knowledge, we have to first look at three ways in which ways we can gain knowledge.

1) **Description.** This works especially well for new phenomena for which no theory is available. Watching the stars, travelling to countries or using advanced microscopes allows us to explore for description. In the words of Start Trek – *"To boldly go where no one has gone before".*
2) **Demonstration.** Sometimes one example can prove a commonly accepted notion. Demonstration is a good method for rejecting theories, but can also be used to bring us further in our descriptions. *"It can be done!"*
3) **Validation.** If theory is available and can be applied to a phenomenon, experiments and deduction can be used to validate these results.

In my research I have used a combination of these three methods, describing the collecting behaviour, demonstrating possibilities of new tools and validating them in practice. Yet, the focus of this research was not to simply describe what is happening, or to validate things I intuitively knew. In this research I wanted to draw from the future opposed to extrapolating from the past. Therefore most of the knowledge was built on demonstration.

Sanders describes this forward-looking research as *"research for inspiration"*, which *"values relevance, generativity and evocativeness",* and is *"built through experimentation ambiguity and surprise"* (Sanders, 2004). She presents this next to *"research for information"*, which *"values reliability, validity and rigor"* and *"builds upon investigation, analysis and planning"*. Both *"inspiration"* and *"information"* are equally important and cannot exist without each other. Though the title of this suggests *"inspiration only"*, it contains a lot of elements from *"research for information"*. But, I won't mind if inspiration is the only thing you take from it.

This same apparent opposition of inspiration and information can also be found in the notion of basic research opposed to applied research. I don't see that opposition so strongly, and as Stokes argued in his *"Pasteur's Quadrant"* (Stokes, 1997), interesting research can be done that tries to achieve fundamental understanding, without loosing sight of considerations of use. The way Pasteur achieved his scientific breakthroughs relied on both and is therefore called Use-inspired (figure 1). The research presented here is clearly use-inspired, with a quest for fundamental understanding combined with clear considerations of use.

7.3 Research through prototypes

One of the consequences of being in the *use-inspired* research is that the research becomes applicable. I have done this by making prototypes that can be experienced and used by designers. In the course of this research, I found that making prototypes has far bigger consequences. Let me first explain what I mean by prototypes in this context. Prototypes are the things that designers can bring to the table in the design process, for example, sketches, models, mock-ups, software or combinations of these.

As I said before, making these kind of things is what I believe I do best as a designer. It is also the criterion by which I measure my own achievements. The driving force for this research has been the path from *idea* to *realisation* to *user.*

By making prototypes I can integrate different aspects from theory and practice. By setting out and demonstrating prototypes I can get feedback from experts. Prototypes make it possible to communicate complex results through demonstration. Other designers and researchers can easily pick up lessons from these demonstrations and apply them in their own work. In this way the impact of a prototype can be as big or even bigger than a scientific publication. As an example of how prototypes can influence each other and have an impact on further research, I have made a collage of how different prototypes can influence each other (figure 2). A working prototype is a vortex which pulls in knowledge and experience, but which also spins off knowledge and experience for other prototypes to use. The vortex is still spinning, and I expect many more prototypes to be pulled in and spun off.[1]

The danger of communicating through prototypes is that reality can get in the way of theory. On the one hand people can misinterpret a researchers prototype on the wrong merits and make their own conclusions. On the other hand researchers can get distracted from the field they are researching and develop a tool just for the sake of development.

Both these pitfalls can best be avoided by a clear commitment to the phenomenon. Researchers need to serve the field and the field needs to serve them. With Cabinet this commitment was reached by making a prototype that was built on previous knowledge and experience on how designers collect visual material and support this collecting behaviour. By purely focusing on this relatively narrow aspect of collecting I made a tool that is complete for its purpose and doesn't distract from the research field.

The hidden success in making a tool is that good support stays unnoticed. Good instruments in the right hands for the right purpose get into such a symbiosis of action and result that it is hard to tell who or what is in control. In our field test I found that Cabinet supports collecting but didn't make the

[1] On http://www.forinspirationonly.net/prototypes/ an expanded description of these projects can be found

2 Collage of different prototypes and their relations as influencers and followers. The TRI Setup was influenced by Virtual Reality research and the work of the MIT Media Lab's Tangible media group. In turn, TRI influenced many other developments, one of which is Cabinet. Cabinet influenced other prototypes. It probably will continue to do so in the future.

collecting behaviour explicit. The purely visual interaction seemed to help designers get new insights, but it wasn't attributed to this interaction. The bodily interaction was seen as a welcome change of rhythm, but it was not automatically seen as more expressive or inspiring.

Most of all, a working prototype, such as Cabinet, makes the research relevant. The relevance of Cabinet for science and design has been mentioned before. Cabinet also helps in communicating the role of tools, design and visual interaction to other disciplines than design. Cabinet appeals to people other than designers, who understand its role to design and see opportunities in applying Cabinet's functionalities in fields other than design.

7.4 Onwards

Now that the project is finished many opportunities are available for further research: Should this research be expanded by further developing Cabinet? Should Cabinet be used in its current state to get more fundamental understanding of how designers use visual material in their design process? Should further research look at the other applications for Cabinet?

All these directions are relevant and interesting, but let's first look at where this research came from. This research project was initiated to further explore the possibilities of the MDS-interactive software. The visual search mechanism offered tremendous possibilities outside of the realm for which it was initially developed – and it still does. One of these applications was to use MDS-interactive as a tool to interact with the collections designers keep for inspiration. MDS-interactive has been incorporated in Cabinet, not so much as a search mechanism, but rather as an inspirational interface to structure and interact with the collection. I think there are still tremendous opportunities for MDS-interactive in Cabinet, but this would definitely require more development and tweaking.

The other direction for further research is to set out Cabinet in the design practice for a longer period of time to further evaluate and validate the outcomes of the previous research. Specifically the use that emerged during the Cabinet experiment in which designers would combine existing visual material with their solutions could be very interesting to explore. The social aspects of visual material also could come out better over a longer experimental period.

The last direction to explore is to find out how Cabinet can be used in areas other than those for which it was built. There is always a big risk in adapting ideas for other uses than for which it was initially meant. Yet, the Cabinet is a result from such an endeavour, and thus I believe new applications can be made given they are developed with an open mind and a focus on the intended users.

I can see my colleagues picking up the pieces of research that are open for exploration and the overlap in our fields continuing. Daniel Saakes is working on how designers can select and define the material expression of products. For this he is exploring the design practice in a contextual inquiry, using the experiences with material light to create tools for designers. Froukje Sleeswijk Visser is working further on the tools and techniques I have used to involve our users in the tool design process. I expect interesting prototypes to come from these and many more research endeavours.

7.5 Finally…

Because this thesis is called *For Inspiration Only,* let me share my moment of inspiration. There definitely was a *Eureka!* moment. Classically this moment in a PhD would lay in finding a *scientific breakthrough* while analysing results. I had this moment, or even *revelation,* of *"I found it"* when we transformed the first crude IGS prototype into the final smooth Cabinet. All the people that worked closely with me on that project were repeating their work, but this time for posterity. As the pieces came together and transformed into what Gelernter might call an *elegant machine* (Gelernter, 1999), that's when I started to realize that we might be on to something special. We might even have made something close to Tabor's *daydream engine* (Tabor, 2002). I would like to end this thesis with his statement.

> *"I haven't seen my daydream engine yet. But I glimpse something like it in these early paintings by Matta. They enable me to list four attributes of a simulated 'space for half-formed thoughts':*

1) *Its metaphor is spatial, but its spatial character is not limited by the constraints of real space and physics*

2) *It contains flowing patterns that reflect incoming data about the world. But we don't just see these patterns: we sense them as sounds and vibrations; we feel them as wind in hair, taste on tongue, tension in muscles*

3) *Informational patterns are manifested in varying densities of this smoky space; and*

4) *We can sharpen the outlines of things, make them harder and clearer. But we'd only do so when we feel our ideas are ready to coalesce*

> *Vagueness is sometimes a virtue, and clarity is sometimes a vice."*

LITERATURE REFERENCES 7

Gelernter, D. (1999) *Machine beauty: Elegance and the heart of technology.* New York, NY: Basic.

Gribnau, M.W. (1999) *Two-handed interaction in computer supported 3D conceptual modelling.* Doctoral dissertation, Delft: TU Delft.

Kolli, R., Pasman, G., & Hennessey, J. (1993) *Some considerations for designing a user environment for creative ideation.* Proceedings of the Interface '93, North Carolina State University, Raleigh, NC, pp.72-77.

Pasman, G. (2003) *Designing with precedents.* Doctoral dissertation, Delft: TU Delft.

Sanders, E.B.-N. (2004) Design and the empowerment of everyday people. Lecture at TU Delft.

Stokes, D.E. (1997) *Pasteur's quadrant: Basic science and technological innovation*. Washington, DC: Brookings Institution.

Tabor, P. (2002) A space for half-formed thoughts, *Doors of Perception 7: Flow*. Amsterdam.

SUMMARY

Man is a collector. All people surround themselves with assorted artefacts. Things that appeal to them, trigger their memories, or intrigue them. Designers collect visual materials as a *source of inspiration*. They use these materials in the design process when making *collages* or *moodboards* that early on communicate the direction of a design project.

This thesis and the designs described in it explore how designers use such visual material in the conceptual phase of design, and how new media can support this.

The research follows a *research through design* approach, explained in chapter 1. Research methods form the basis of design solutions, which receive a concrete existence in the form of prototypes. In turn, these prototypes become the instruments in experiments. Both design and experimentation generate knowledge.

The thesis explores the phenomenon of designer's collections from three perspectives: *theory, technology* and *practice*. At the start (chapter 2) a theoretical framework is developed integrating expert knowledge and literature that could be expanded and attended to, throughout the research. Two working prototypes have been developed – the *TRI Setup* and *Cabinet* (chapters 3 and 5) – exploring the possibilities of new media and interaction technology, from the perspective of the designer as user. Two field studies have been performed (chapters 4 and 6) at designers' workplaces to find out how designers collect visual material and what new tools can do to support this.

The theoretical framework described in chapter 2 introduces notions from different disciplines. It covers literature on creativity, categorization, media aspects and interaction. Literature describes *categorizing* as a *creative act*. Especially when the categories are not clear, or when *friction* occurs by mapping different concepts onto each other. Such friction often is the source of new insights. Furthermore, creativity is not described as a purely mental act, but also as something dependent on bodily expression.

With collages, designers can create fuzzy categories and force fit concepts onto each other. This, combined with the designer's ability to spatially organize visual material, makes collages a powerful tool for creative exploration.

Following the *research through design* approach, the possibilities of new media in supporting creative activities were explored through working prototypes. The TRI Setup, described in chapter 3, offers a body-scaled interaction in a low-threshold, approachable *sketchy VR Setup*. Designers can use the TRI Setup

to experience, discuss and test their design concepts, using projected light, together with physical models and sketches, as design material. The TRI Setup is based on insights from perceptual psychology, that people interact and experience differently on different ranges, which in interaction design is hardly explored.

Current needs and practices regarding collections of visual material were studied in a *contextual inquiry*. This practice study, described in chapter 4, was conducted at five design agencies. The contextual inquiry used methods from *participatory design* to get more insights than more passive interview techniques would provide, into the often subliminal activity of collecting visual material. Using a *cultural probe*, a package sent out a week in advance, containing a booklet, an instant camera and visual material, designers were asked to expressively record their daily interactions with visual material during the week.

Designers were found to keep *two collections;* a physical collection of magazine snippets, photos and material samples, and a digital collection of images on hard discs, CD-ROMs and on the Internet. The *physical* visual material was *collected for inspiration,* whereas the *digital* images were often the result of a *goal-directed search* for materials used in presentations and collages. These two collections showed hardly any overlap in value and use, and were never used side by side. This inquiry led to *six considerations* for a tool to support collecting by designers.

1) **Active collecting.** Building a collection without a predefined structure and a low threshold to add material.
2) **Merger of physical and digital collections.** Both in interaction and in the value of the collections for the user.
3) **Visual interaction.** No need for verbalizing during the visual thinking process.
4) **Serendipitous encounters.** Stumble upon discoveries both in physical and digital material, without especially looking for them.
5) **Inspiration by breaking the working rhythm.** Involving the body and breaking away from the desk.
6) **Social aspects of visual material.** Sharing material and inviting colleagues to use the collection.

The work up to here laid out a framework of theory, technology, and practical experience. These insights were united in a working prototype named *Cabinet*. Cabinet helps designers to collect, organize and use visual material in their daily work. Cabinet, just as the cabinet of curiosities or *Wunderkammer* that

were kept by the well-to-do of the 16th and17th centuries, gives the collecting activity a flexible place to store and organize collections. Cabinet does this by addressing the six considerations. It *merges* the physical and digital collections, supports *expressive interaction* by involving the whole body, and allows for *shared* and *collaborative* use.

Cabinet consists of a table-sized interaction area, with an overhead projection and capturing system. Any kind of visual material that is placed on the tabletop area can be captured using a digital camera. The digital image is then projected over the original, resulting in an almost magical transfer from the physical to the digital realm. The collection itself is projected on the table as compositions of thumbnail images and stacks. With a special pointing device, designers can directly manipulate composition and groups in large, expressive gestures with a purely visual interface.

Cabinet was developed as an instrument in the *research through design* approach. It demonstrates how technology can support designers collecting visual material. To validate the design solutions it embodies, and to further explore its effect, Cabinet was sent out of the lab into a crucial practice test at design studios – where few other design prototypes had gone before. In the experiment, described in chapter 6, Cabinet is placed at three design agencies over a four-week period. The designers used Cabinet at their own initiative for their own design projects, without guiding experimental protocols or fictitious assignments.

The functionality and interaction style of Cabinet were readily accepted. Cabinet helped bridging the digital-physical divide in designer's collections.

Cabinet had one unexpected effect that occurred with all designers; they combined their source material, normally used for collages and moodboards, with their design solutions. Where currently solutions were compared by comparing them to their collages, they now became *part* of the collages.

Finally, in chapter 7, I reflect on this PhD project as a whole. What did we learn about inspiration? And how do the designerly ways of research fit into the picture of *doing science?* Central in the conclusions is the role of the research prototype. Traditionally, a prototype is deployed to evaluate a proposal after it has been completed. In this project, two other functions of a prototype are more important: 1) its ability to demonstrate (rather than experimentally prove) a principle, and 2) a means to develop discussions and appeal to experience. Prototypes can be used to generate knowledge, also through the many design steps it embodies.

A prototype is a *vortex,* which both pulls in knowledge and experience, and spinning off new ideas for other solutions and research opportunities.

Samenvatting

Mensen zijn verzamelaars. Zij omringen zich met allerlei dingen die hen aanspreken, intrigeren of aan iets herinneren. Ontwerpers verzamelen visueel materiaal als *bron van inspiratie*. Deze materialen worden in het ontwerpproces gebruikt om *collages* of *moodboards* mee te maken, waarmee in een vroege fase de richting van een ontwerpopdracht kan worden gecommuniceerd.

Dit proefschrift en de daarin beschreven proefontwerpen onderzoeken hoe ontwerpers visueel materiaal gebruiken in de conceptuele fase van het ontwerpen, en hoe nieuwe media dit gebruik kunnen ondersteunen.

Het onderzoek heeft een *research through design* (onderzoek door ontwerpen) benadering, beschreven in hoofdstuk 1. Onderzoeksmethoden vormen de basis voor ontwerpoplossingen, die worden geconcretiseerd in de vorm van werkende prototypes. Deze prototypes dienen op hun beurt weer als instrumenten voor experimenten. Daarbij genereren zowel het ontwerp als het experiment relevante kennis.

Dit proefschrift bekijkt het fenomeen *ontwerpersverzamelingen* vanuit drie perspectieven: *theorie, technologie* en *praktijk*. In het begin (hoofdstuk 2) is een theoretisch veld geschetst, waarin kennis van experts en literatuur worden samengebracht, dat gedurende het gehele onderzoek in ogenschouw is genomen en is uitgebreid. Twee werkende prototypes zijn gebouwd – de *TRI Setup* en *Cabinet* (hoofdstukken 3 en 5) – waarin de mogelijkheden van nieuwe media en interactie-technieken zijn onderzocht, vanuit het perspectief van de ontwerper als gebruiker. Twee veldstudies zijn uitgevoerd op de werkvloer van de ontwerpers (hoofdstukken 4 en 6), om te zien hoe ontwerpers visueel materiaal verzamelen, en om uit te vinden hoe nieuwe hulpmiddelen dit kunnen ondersteunen.

Het theoretisch kader, omschreven in hoofdstuk 2, introduceert begrippen uit verschillende disciplines. Dit omvat literatuur over creativiteit, categorizatie, media-aspecten en interactie. De literatuur omschrijft het *categorizeren* als *creatieve handeling,* in het bijzonder wanneer er *wrijving* ontstaat bij het laten passen van één begrip op een ander. Deze wrijving veroorzaakt nieuwe inzichten. Daarnaast wijst de literatuur op lichamelijke aspecten als zijnde onmisbaar voor het creatieve denken.

Met collages kunnen ontwerpers vage categorieën maken, concepten op elkaar wringen. Dit levert, met de vaardigheid van de ontwerper om ruimtelijk visueel materiaal te ordenen, een krachtig hulpmiddel voor creatieve ontdekkingen.

Geheel volgens de *research through design* benadering zijn de mogelijkheden van nieuwe media om creatieve taken te ondersteunen geëxploreerd door middel van werkende prototypes. De *TRI Setup* – een Engelse afkorting voor een opstelling met drie schalen van interactie, tevens een woordspeling op probeersel – is omschreven in hoofdstuk 3. TRI biedt de ontwerper een handelingsruimte op de menselijke maat in een laagdrempelige, benaderbare *schetsmatige VR opstelling.* Ontwerpers kunnen er ideeën mee ervaren, bespreken en proberen, door zowel geprojecteerd licht als fysieke modellen en schetsen tesamen te gebruiken als ontwerpgereedschappen. TRI is gebaseerd op een inzicht uit de perceptuele psychologie: mensen denken en gedragen zich heel anders in verschillende ruimtelijke schalen. Een inzicht dat in het ontwerpen van interactieve producten nauwelijks wordt gebruikt.

In een *contextual inquiry* – een onderzoek bij ontwerpers in de praktijk – zijn de gedragingen en behoeftes van beeldverzamelingen in kaart gebracht. Deze praktijkstudie, beschreven in hoofdstuk 4, werd gehouden bij vijf ontwerpbureau's. Het onderzoek maakte gebruik van technieken van *participatory design* – ontwerpen waarbij de gebruiker als ontwerper wordt betrokken – om zo meer inzichten te krijgen in de vaak onbewuste activiteit van het verzamelen van beeldmateriaal. Hierbij werd gebruik gemaakt van een *cultural probe* of culturele sonde: een vooruitgestuurd pakketje met daarin een opdrachtboekje, een polaroid camera, plaatjes en stiften. Met deze sonde werd de ontwerpers gevraagd om in de week vóór het bezoek op expressieve wijze hun omgang met visueel materiaal vast te leggen.

Het onderzoek toonde aan dat ontwerpers *twee collecties* hebben; een *fysieke collectie* van knipsels, foto's en materiaalvoorbeelden, en een *digitale collectie* van beelden op harde schijf, CD-rom en Internet. De fysieke collectie werd *verzameld* voor inspiratie, terwijl de digitale plaatjes vaak het resultaat waren van *doelbewuste zoektochten* voor bruikbaare beelden. Deze twee collecties hadden voor de ontwerpers nauwelijks overlap in waarde of gebruik.

Het onderzoek resulteerde in *zes overwegingen* voor een verzamelhulpmiddel voor ontwerpers.

1) **Verzamelen als activiteit.** Het kunnen opbouwen van een collectie uit het materiaal dat zich aandient, zonder tevoren bepaalde structuren of drempels om materiaal toe te voegen.
2) **Samenbrengen van fysieke en digitale collecties.** Het gelijkwaardig maken van de twee collecties, zowel in omgang als nut.
3) **Visuele interactie.** Het omgaan met beeld zonder te worden gedwongen beeld of categorie te verwoorden.

4) **Serendipiteit.** Het kunnen tegenkomen van bijzondere ontdekkingen in zowel digitaal als fysiek beeld zonder gericht te zoeken.
5) **Inspiratie uit het verbreken van het werkritme.** Het krijgen van nieuwe ideeën door even los te komen van het bureau.
6) **Sociale kant van beeldmateriaal.** Het delen van materiaal en collectie.

Het werk tot zover legt het fundament van theorie, technologie en praktijkervaring, waarmee een ontwerp gemaakt kon worden dat deze inzichten verenigt. Het werkende prototype, *Cabinet,* helpt ontwerpers om beeldmateriaal te verzamelen, te ordenen en te gebruiken in hun dagelijkse werk. Het Cabinet geeft ontwerpers een flexibele plek om hun collectie te bewaren en te ordenen. Cabinet doet dit door invulling te geven aan de zes overwegingen hierboven. Het brengt de fysieke en digitale collecties samen, ondersteunt expressieve interactie door het lichaam erbij te betrekken, en staat samenwerking en gedeeld gebruik toe.

Cabinet bestaat uit een werkvlak ter grootte van een werktafel, met in een overhang zowel een projectie- als een opname-mechanisme. Alle soorten beeldmateriaal die op het werkvlak worden gelegd kunnen door middel van een digitale camera worden gefotografeerd. Het digitale beeld wordt vervolgens geprojecteerd over het neergelegde, originele object. Dit levert een bijna magische transitie op van het fysieke naar het digitale. De collectie zelf wordt op de tafel geprojecteerd als composities van duimgrote plaatjes en stapels. Met een speciaal aanwijsstokje kunnen ontwerpers de composities direct manipuleren – uitleggen, groeperen en vergroten – in grote, expressieve gebaren, in een puur visuele interface.

Cabinet is ontwikkeld als een instrument in de *research through design* benadering. Het laat zien hoe technologie het verzamelen van beeldmateriaal door ontwerpers kan ondersteunen. Om de ontwerpoplossingen die het Cabinet behelst te valideren, en om het effect ervan te onderzoeken, werd het prototype uit het laboratorium gehaald en in de ontwerpstudio's geplaatst voor een cruciale praktijktest. Een plek, waar weinig andere prototypes eerder zijn geweest. In dit experiment, beschreven in hoofdstuk 6, is Cabinet bij drie ontwerpbureau's geplaatst voor een periode van vier weken.

De ontwerpers gebruikten Cabinet op eigen initiatief en voor eigen ontwerpprojecten, zonder leidende experimentele procedures of fictieve ontwerpopdrachten. In de ontwerppraktijk zijn de functionaliteit en de interactiewijze van Cabinet moeiteloos opgepakt en ondersteunde Cabinet het samenbrengen van de digitale en fysieke wereld.

Cabinet heeft één onverwachts bijeffect bij alle ontwerpers gehad; zij combineerden hun bronmateriaal, normaal gebruikt voor collages, met hun ontwerpoplossingen. Waar normaal gesproken de oplossingen eerst werden vergeleken met de beeldvorming in de collages, werden ze nu *onderdeel* van de collages.

Aan het slot, in hoofdstuk 7, kijk ik terug op het promotieproject als geheel. Wat leerden we over inspiratie? En hoe past deze manier van *onderzoek-door-ontwerpen* in het beeld van *wetenschap bedrijven?* Centraal in de conclusies staat de rol van onderzoeksprototypes. Traditioneel werden prototypes pas ingezet aan het einde van een onderzoek om een finaal voorstel te evalueren.

In dit project zijn twee andere functies van prototypes belangrijker: 1) de mogelijkheid om een werkingsprincipe te laten zien (in plaats van experimenteel te bewijzen), en 2) een middel om de discussie aan te jagen, en ervaringen aan te spreken. Een prototype kan worden gebruikt om kennis te genereren, mede door de vele ontwerpstappen die het belichaamt.

Een prototype is als een *wervelwind,* die zowel kennis en inzicht aantrekt, als nieuwe ideeën voor oplossingen en onderzoeksrichtingen afwerpt.

Yes, I really mean YOU! The fact that you are reading this thesis fills me with great pride. But this work wouldn't have been possible without the help of so many people. Some have guided me along the whole way, whereas others just gave me tiny pushes into other directions. On the next pages I will sum up those who have been crucial on this trip.

Think

Of course Pieter Jan Stappers has rightly been the biggest influence for this research. He took a chance with me, and kept pushing the envelope further and further. Along the way we have both been greatly rewarded for the efforts, but he has always been the one to take on the biggest risks. *PJ, thanks for taking me on this wonderful uphill journey and for setting me free at the peak.*

It is Jim Hennessey who started me on this journey. He was the one to initiate the project and find me as the suitable candidate as I walked by through the hallway. He convinced Pieter Jan to take a chance with me and kept monitoring us from afar. *Jim, thanks for having such a keen designer's eye.*

I would also like to thank the other members of my committee. Their comments on the manuscript and the discussions at the end of this project have been very valuable and even serendipitous. Furthermore, I look forward to the grand finale – *surrounded by the people I have admired so long.*

Design

To stay connected to reality I was able to do all my experiments, interviews and evaluations in the design practice. Fortunately, I was endowed with a passionate and willing subject for all my pilot experiments: Marieke Sonneveld. Having her test out all my interview techniques, prototypes and observations gave me the confidence to face reality in the design practice.

Luckily, the designers and design agencies were also open and willing to share, and let me interfere in their daily work. *Marieke Sonneveld, Frans van Mourik, Theo Kemp, Marcel Vroom (MVAVD), Jan Willem Bouwknecht (NPK), Rogier Hendriks (Onesize), Lisa Smith* and *Roy Gilsing (WAAC's), Peter Roeland (Flex), Renate Frotscher (Fabrique), Renée Schuffelers (Smool)* and *Joanna Boothman (NPK) – thanks for keeping me rooted in reality.*

Build

All the influences and suggestions would never have come into reality without the help of Aldo Hoeben. Both creative and focused on building, Aldo helped me realize and design many different working prototypes. *Aldo, thanks for being both supportive and critical – and for blushing when you read this.*

On Cabinet I could luckily also rely on the continuous efforts of Aadjan van der Helm, who did most of the work unseen by many, work indispensible for a good stable prototype. Luckily, the ID-StudioLab is a safe haven for people with a passion for designing and building prototypes. *Aldo, Aadjan, Daniel, Rob, Kerem, Caroline, Marco, Rudolf, Aernout, Onno, Stoffel, Olger, Joep, Philip, Bart* and *many others – thanks for keeping the tinkering alive.*

Work

The ID-StudioLab is more than just building, it is a *research community,* a group passionate about design and research within our faculty. I have been fortunate to be part of it from the beginning. I hope to fade away slowly at the ID-StudioLab and wish to thank all of the people that helped build up the lab over time. *Karin, Fai, Stephan, Petrik, Michelle, Lucia, Elyon* and *all you others that don't expect to be in this list – this includes YOU.*

Teach

It has been an honour to work with students and teachers at the TU Delft faculty of Industrial Design. Coming back to the place that taught me design, working with the students and their energy, and being able to work with the teachers I admired has been most rewarding. A special mention goes out to the maMasboys. *Dennis, Wouter, Pieter* and *Maarten – thank you for making me feel good about teaching.*

Demo

I would never have made it so far without *the demo.* Demonstrating my work has given me *joy, confidence* and most of all *valuable feedback.* In the early phases, demonstrations of half-baked prototypes helped me find a good direction. In the later phases, more polished presentations helped me consolidate my message. Most of all, the energy stimulated me to continue my work. I would like to thank all of my audience, big or small, experienced or inexperienced, awake or tired, who took the time and effort to listen to my story and even pop in a question or remark here and there. *OK, just one name – Rich Gold, your positive energy will be sorely missed.*

Connect

Outside this research, my whole life has been filled with creative connections. My paranimphs, Huib van Opstal and Irene van Peer, are great examples of how all the themes in my life come together. As my personal hero Steve Jobs said: "You can't connect the dots looking forward". *Huib, Irene, thank you for connecting the dots looking backwards.*

Love

My parents, Jaap and Erica Keller, have stimulated me every step of the way, providing me with so many creative connections. *Jaap, Erica, thanks for bringing out the best in me.*

My sister, Grietje Keller, became a *true* sister in research in marvelous discussions on my subject, becoming equals in parenthood and studying – and helping me make the right movies. *Grietje, now it's your turn.*

That brings me to the love of my life, Anneke Keller. I should have thanked her in every paragraph and it still wouldn't be enough. She makes me think, design, build, work, teach, demo, connect and love. *Anneke, thank you for always being there when I needed you.*

Finally

Finally, I dedicate this thesis to my daughter Kris. Her imminent arrival was the reason to start this endeavor. Kris, together with our son Boris, are the best children a father could wish for. They allowed and even stimulated me to continue this research. They also provided a fresh and balanced perspective on the project. Best of all, they both already know how to handle Cabinet and have had hands-on experience with TRI. *Kris, thanks for coming into my life. Boris, the next big thing will be dedicated to you.*

On http://www.forinspirationonly.net/thanks/ more thank you's can be found

Ianus Keller presenting Cabinet to the Dutch prime minister Balkenende at a meeting of the Dutch Innovation Platform, July 7, 2004 (photo Nout Steenkamp)

Curriculum Vitae

In 1995 Ianus Keller (born August 2, 1970) receives his masters Industrial Design Engineering at the Delft University of Technology, where he also works at the student union's VSSD Computer Shop, selling and supporting Macintosh computers. In 1994 he participates in the Apple Interface Design Project where he is invited to present the team's results at the Apple Advanced Technology Group at Cupertino, California, USA.

In 1995-1999 he works for the Dutch design company Landmark Design & Technology, in Rotterdam, and at an internet consultancy Virtual Affairs, in Amsterdam.

In November 1999 he starts his PhD project at the TU Delft, resulting in the construction of two major prototypes: the TRI Setup and Cabinet.

During his PhD project he acts as a teacher and adviser in different design related classes. In 2003 he coordinates an interface design project similar to his project from a decade before, for the Microsoft Research Design Expo, Seattle, Washington, USA.

At the faculty of Industrial Design Engineering, his Cabinet is a showcase for research. It is regularly shown in presentations, including to the Dutch Innovation Platform. In 2005 Cabinet wins the international design competition at the Third International Conference on Appliance Design in Bristol, UK.

As an independent designer and consultant he participates in juries and brainstorm sessions. He is an invited speaker at cultural and academic institutes.

In 1998 Ianus marries Anneke. They live with their daughter Kris (1999) and son Boris (2001) in the 800 years old town of Dordrecht, running a non-profit modern art gallery on the side.

Publications from this Research

FIRST AUTHOR PUBLICATIONS

Keller, A.I. (2005) *For Inspiration Only, Designer Interaction with Informal Collections of Visual Material.* Doctoral dissertation, Delft: TU Delft.

Keller, A. I., Hoeben, A., & van der Helm, A. (2005) *Cabinet: Merging designers' digital and physical collections of visual materials.* Proceedings of 3AD Third International Conference on Appliance Design 2005, Bristol, UK, pp.106-110. To appear in Personal and Ubiquitous Computing.

Keller, A.I., & Stappers, P.J. (2005) *Serendipitous encounters and pleasure browsing.* Proceedings of CAID & CD2005, Delft, pp.774-780.

Keller, A.I., Hoog, W. van der, & Stappers, P.J. (2004) Gust of me: Reconnecting mother and son. *IEEE Pervasive Computing, 3* (1), pp.22-28.

Keller, A.I., Stappers, P.J., & Vroegindeweij, S. (2004) *Supporting informal collections of digital images: Organizing browsing and sharing.* Proceedings of the conference on Dutch directions in HCI, Amsterdam, p.17.

Keller, A.I. & Stappers, P.J. (2001) Using video collages in the design process to experience presence and atmosphere. *CyberPsychology & Behavior, Special issue on Presence, 4* (2), pp.215-223.

Keller, A.I., Stappers, P.J., & Hoeben, A. (2000) *TRI: Inspiration support for a design studio environment.* International Journal of Design Computing, Sydney: University of Sydney.

Keller, A.I., Stappers, P.J., & Hoeben, A. (2000) Listen to the noise: 'sketchy' design tools for ideation. *Exchange Online Journal, 1* (1).

Keller, A.I., & Stappers, P.J. (2000) *Presence for design: Using video collages for atmosphere.* Proceedings of Presence 2000, Delft.

Keller, A.I., & Stappers, P.J. (2000) *MDS-i for 1-to-1 E-commerce: A position paper.* Proceedings of CHI 2000, The Hague.

ACCEPTED OR SUBMITTED PUBLICATIONS

Saakes, D.P., & Keller, A.I. (2005) *Beam me down, Scotty. To the virtual and back!* Proceedings of DPPI 2005, Eindhoven (accepted).

Stappers, P.J., & Keller, A.I. (2005) *Creating people for products.* Proceedings of DPPI 2005, Eindhoven (accepted).

Keller, A.I., & Stappers, P.J. (accepted with minor revisions) Codesigning a theoretical framework with reflective practitioners. *Journal of Design Research.*

Keller, A.I., Pasman, G, & Stappers, P.J. (submitted) Collections designers keep: Collecting visual material for inspiration and reference. *CoDesign: International Journal of CoCreation in Design and the Arts.*

Keller, A.I., Sleeswijk Visser, F., van der Lugt, R., & Stappers, P.J. (submitted) Collecting with Cabinet: Or how designers collect visual material, researched through an experiential prototype. *Design Studies.*

CO-AUTHOR PUBLICATIONS

Hoog, W. van der, Keller, A. I., & Stappers, P. J. (2004) *Gustbowl: Technology supporting affective communication through routine ritual interactions.* Proceedings of CHI 2004, Vienna, pp.775-776.

Hoog, W. van der, Stappers, P.J., & Keller, A.I. (2004) *Connecting mothers and sons: A design using routine affective rituals.* Interactions, 11 (5), pp.68-69.

Umemoro, H., Keller, A.I., & Stappers, P.J. (2003) *More light on your table: Table-sized sketchy VR in support of fluid collaboration.* Proceedings of the 6th Asian Design International Conference, Tsukuba.

Stappers, P.J., Sleeswijk Visser, F., & Keller, A.I. (2003) *Mapping the experiential context of product use: Generative techniques beyond questions and observations.* Proceedings of the 6th Asian Design International Conference, Tsukuba.

Stappers, P.J., Keller, A.I., & Hoeben, A. (2000) Aesthetics, interaction, and usability in 'sketchy' design tools. *Exchange Online Journal, 1* (1).

Index of Names

This thesis does not provide a subject index, but a fully searchable PDF can be found on the DVD accompanying this book and on http://www.forinspirationonly.net/

Colophon

Text, Image & Design
Ianus Keller, Dordrecht

Text & Design Advice
Huibrecht van Opstal, Amsterdam

Camera & Video Direction
Grietje Keller, Amsterdam

DVD Production
Jacco Otten, Delft

Additional Illustrations
Aadjan van der Helm, Delft
Aldo Hoeben, Schiedam

Photography
Aldo Hoeben, Schiedam
Philip Broos, Delft
Michelle Kuipers, Delft
Daniel Saakes, Delft

Accompanying This Book
DVD-video with DVD-rom contents
Full-colour stickers
Propositions sheet

Companion Web Site
www.forinspirationonly.net

Printing & Binding
Druk. Tan Heck, Delft

October 2005