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.

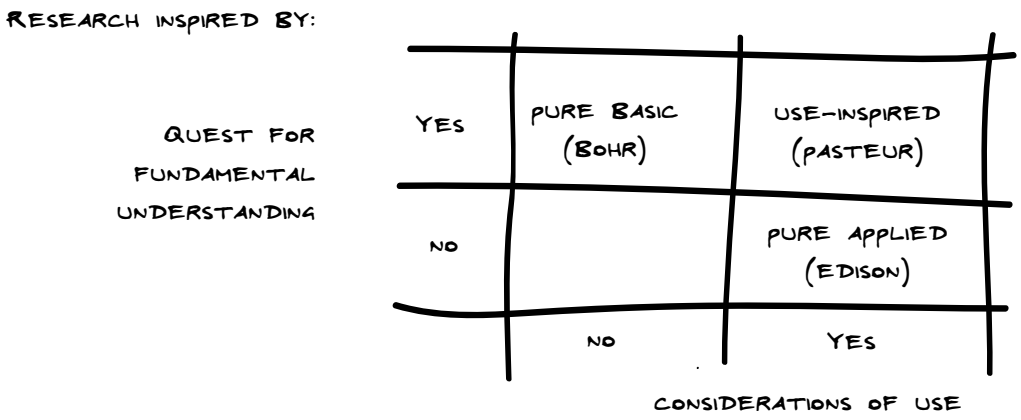
Tools to support designers in getting new insights should therefore not focus on making the best categorizations, nor should they support the most efficient way of structuring. Instead, tools should support expressive ways to get to these organizations, support the richness of visual material, and allow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