

NOTES ON DESIGN – HOW CREATIVE PRACTICE WORKS

The 185 mini-essays in this book provide a deep understanding of what design is. Like *Understanding Design (2006)*^{*}, this book helps designers and students of design to reflect on their practices.

But the book you are holding now goes much further than its precursor. Over the last ten years design has developed far beyond its original disciplinary boundaries, creating great opportunities for designers to work on issues in many disciplines right across society. And designing, these days, is not just for designers – many different fields are learning from design to build their own creative practices.

This book aims to open up key design practices for general use through thoughtful reflections.

These reflections are based on the knowledge and insights that have been gathered in over fifty years of design research, and on my own experiences as a designer, researcher and educator. Each one-page essay deals with a particular aspect of design as a creative practice, and offers some foothold for understanding. All the pieces can be read independently, but they are bundled together in chapters to deal with a topic more thoroughly and completely. The issues raised are made very concrete by linking them directly to experiences

– the essays should ideally be read at the moment you have encountered a specific issue yourself, and are open to contemplation.

There is no shortage of books about design, but they tend to either be stories from practice (always nice to read, but hard to relate to your own work) or top-heavy design theory (with no connection to practice at all). This book tries to strike a balance, to reflect deeply and thoroughly on concrete aspects of design. It is both fundamental and oriented towards practice.

I hope you will find it useful and inspiring.

^{*} See the References section

SCIENCE FICTION

We live in an exciting time of incredible opportunity. Technological advancements that were the stuff of science fiction have now come true, and access to all the people and knowledge in the world is in our pockets. We are continuously connected with everybody and everything. This is exciting, inspiring, and empowering. A special time to be alive.

Yet living now isn't always easy. When we networked ourselves we inadvertently networked our problems and opportunities, too: we have made them more *open, complex, dynamic* and *networked*.

While the rhetoric around progress, innovation and entrepreneurship tells us we should be happily hyperactive beings running around in a constant state of excitement and flow, the reality is more like struggling through mud. The day-to-day experience is confusing and at times overwhelming. When everything is connected, progress actually slows down: there are so many things to take into consideration that it becomes harder than ever to get things done. The overwhelming complexity leads to indecision and stress; there always is room for a quiet nagging doubt that we might have missed something. This is what complexity feels like, when you are in the middle of it. We live in a tangled web.

We will see later in this book that our organisations aren't faring much better. Organisations have huge trouble understanding the complex world we live in, and catching up with the new challenges this brings. Many are holding on to 'best practices' that do not work anymore in a world that is more open, complex, dynamic and networked than ever before.

In the end, the only way forward for them is to adapt by mirroring this environment and to become more open, complex, dynamic and networked themselves*... But how?

To do this they will need to develop new creative practices that actually embrace complexity.

Design can help.

LIVING WITH COMPLEXITY

We need to invent new ways of working to deal with a world that is *complex, open, dynamic* and *networked**.

A *complex* system consists of many elements, with many relationships between them, and also interdependencies between these connections. This creates a system where a small local action can lead to an incredibly complex chain of effects. The properties of such a system are unknowable through exhaustive analysis. Therefore complex systems require a completely different approach from complicated systems – complicated systems also have many elements and relationships, but those are knowable and can be mapped, so the outcomes of an action can be predicted. In contrast, when dealing with true complexity you basically have to kick the system to see how it responds – the response will show which of the relationships and interdependencies are actually important. Structure then emerges.

An *open* challenge is one where the system border is unclear and permeable. Normally when we start out solving a problem we conveniently draw a mental circle: on the inside are the things we need to think about, on the outside those that will be ignored. But in our hyperconnected world there is no such thing as a 'context' anymore.

A *dynamic* problem changes over time, with the addition of new elements and the shifting of connections (e.g., shifting priorities). To deal with such wildly dynamic problem situations you cannot isolate yourself, but must be in constant contact with the developing landscape while you work out what to do.

The *networked* nature of today's problem situations means that you cannot isolate and 'own' the problem anymore, nor can you 'own' the solution – the challenges we face and the solutions we create are networks in themselves.

Often complexity doesn't show itself directly, and we might be tempted to go about our business in the normal way. But conventional thinking will fail, no matter how well conceived and executed. The rise of these open, complex, dynamic and networked problems requires us all to shift our thinking.

In a complex world, the future belongs to the quickest learner.

DESIGN AND CREATIVE PRACTICE

Design has always dealt with open, complex, dynamic and networked problems. That is why people from all walks of life these days find inspiration in design practices and are adopting them in an effort to think differently*. But design is not what you think it is. Let's first get rid of a common misunderstanding around design.

Designers are generally known for their outcomes, for the beauty and cleverness of what they create. Yet when you study top designers, you discover they dedicate most of their time to looking very closely at problems, and creating new approaches ('frames') that will then lead to great solutions. This is where the true innovation comes from, in design.

Often, innovation is defined as 'the introduction of novelty', a possibly superficial hunt for short-term advantage. True innovation is actually not so much about putting shiny new things out into the world, but it is about us seeing, thinking and acting differently*. This different way of seeing and doing is called framing: interpreting the world in a way that leads to new actions.

In the complex world of the 21st century, we need to foster the ability to frame and reframe over and over again. Thus it is worth learning how expert designers employ this crucial skill. How do they manage to create new approaches

to problems, time and time again? This question has been on my mind for about 25 years now. To answer it, I set out to learn from top practitioners, in design and other fields. The pieces in this book reflect those lessons.

But before we jump into the wonderful world of design practices, we need to step back. To really understand *WHY* these lessons from design are so valuable in this day and age, we need to go all the way down to the fundamentals, to the deep logic underlying our reasoning patterns.

Welcome to the logic of action.

ANALYTIC REASONING

The different kinds of reasoning that are at our disposal are described in formal logic, which considers the world to exist of 'elements', such as people and things; connections between these elements, captured in a 'pattern of relationships' that guides the interactions of the elements; and the 'outcome' of a process in which the elements have interacted*. This three-way distinction between 'elements', 'patterns of relationships' and 'outcomes' helps us to analyse the four basic reasoning patterns of human problem solving. We can understand the differences between these ways of reasoning by simply comparing different settings of the knowns and unknowns in the equation, Figure 1 (p.13).

The four basic ways of reasoning we need to compare are *deduction*, *induction*, *normal abduction*, and *design abduction*.

At the start of a process of *deduction*, we know the elements in the situation, and we know how they will interact together. This knowledge allows us to reason toward an outcome. For instance, if we know that there are planets in the sky, and we are aware of the natural laws that govern their movement within the solar system, we can predict where a planet will be at a certain time. The calculations to support this prediction can be very complicated, but in the end, reasoning deductively toward a prediction

is not problematic. With our knowledge of the elements in the situation and the pattern of their relationships (as defined by the laws of gravity), we know enough to safely deduce the outcome. Our forecast can be checked through observation. In terms of our simple equation, the starting position for deductive thinking looks like Figure 2 (p.13).

Matters are more complex in the next reasoning pattern, *induction*, Figure 3 (p.13).

At the start of the reasoning process, we again know the elements in the situation, and – if we take the planets as an example – we know the outcome of their interactions in the sense that we can observe their movement across the night sky. But suppose we do not yet know the laws of gravity, the pattern of relationships that governs these movements. We can't logically deduce such a law from observations. But we can observe the movement of the planets, and think deeply about the underlying patterns that could cause this behaviour. The formulation of laws that explain this behaviour is fundamentally a creative act, where the pattern of relationships is dreamt up and proposed (as a hypotheses). We test them by using the hypothesis to predict future outcomes.

THE LOGIC OF CREATION

Deduction and induction are the two forms of reasoning that we have at our disposal to predict and explain real-world phenomena. But deduction and induction are not enough if we want to *make* something.

If we want to make valuable new things, as in design and the other productive professions, the basic pattern of reasoning is called abduction. In abduction, we set out to create a new 'what' – a new 'element' for the problem situation – so that the interactions in the system lead to a desired outcome, Figure 4 (p.13).

In *normal abduction*, we know the result, the value we want to achieve through the outcome, and also the 'how', the pattern of relationships that will help achieve the value we seek. The missing element is the 'what' (an object, a service, a system), which still needs to be created. In this type of abduction, the degree of innovation will be limited because we don't question the 'how', and therefore exclude the creation of new scenarios. This is the reasoning pattern behind problem-solving: building on a tried and tested pattern of relationships to create a novel solution., Figure 5 (p.13).

In *design abduction*, the starting point is that we only know something about the nature of the outcome, the desired value. So, the challenge is to figure out 'what' new elements to create, while

there is no known or chosen 'how' and 'pattern of relationships' that we can trust to lead to the desired outcome. As these are quite dependent on one another, they should be developed in parallel. This double creative step requires us to devise proposals for both the 'what' and the 'how', and test them in conjunction.

An example can help to clarify the difference between the two types of abduction. Say that the *outcome* we want to achieve is an energy rush when coming to work in the morning. In *normal abduction*, we would also already know the 'how' – say that this is to be achieved through coffee – and we might even have a proposed method of brewing (dripping, squeezing, using steam) so we can start developing a 'what', engineering the machine to make the coffee for us (or developing a service that get us coffeed up). In *design abduction*, on the other hand, we would only know the goal (quick rush of energy before work) but not how to achieve it. The choice of a chemical stimulus (caffeine) as a way to feel energised is the frame, the approach to the problem. But this problem might be reframed by proposing that there are also social ways of being energised (by an inspiring conversation), or by delving deeper and realising that what we really are looking for is not so much the energy rush, but a level of concentration – in which case, meditation would be a way to achieve the clarity of mind that is otherwise achieved by drinking coffee.

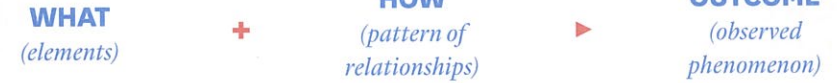


Figure 1: Reasoning



Figure 2: Deduction – solid reasoning from cause to effect



Figure 3: Induction – discovering patterns



Figure 4: Normal abduction – solid problem-solving



Figure 5: Design abduction – two unknowns lead to a process of creative exploration

THE CORE OF CREATIVE PRACTICE: DESIGN ABDUCTION

This logical comparison establishes the designing professions as thinking fundamentally differently from fields that are predominantly based on analysis (deduction, induction) and problem solving (normal abduction).

In questioning the established patterns of relationships in a problem situation, design abduction creates both a new way of looking at the problem situation and a new way of acting within it. We call the act of proposing such a hypothetical pattern of relationships 'framing'. Framing is the key to design abduction, because the only way to approach an open and complex problem situation is to work backwards (from right to left in the equation): starting from the only known in the equation, the desired value, and then adopting or proposing a new frame. Once a credible, promising, or at least interesting frame is proposed, the creative practitioner can shift to normal abduction, envisioning the element that will allow the equation to be completed.

Only complete equations with elements, pattern of relationships and desired outcomes in place can be critically investigated, using the powers of observation and deduction to see if the elements and frame combined actually do create the desired outcome.

When we find ourselves in open, complex, dynamic and networked problem situations, we only have the 'value-to-be-achieved' to go on. We need to experimentally frame and reframe the situation until we find a way into the problem area that captures as much of the complexity as possible, and leads to action that is understood and supported by the stakeholders in the network.

Design abduction is the only way to deal with open, complex, dynamic and networked problems, and it lies at the core of creative practice – not just in design, but for all disciplines.



FRAMING AND REFRAMING

To create progress in a complex world, we need to move away from purely analytical ways of thinking. Even the inventiveness of normal abduction (engineering thinking) is just not going to work. In the face of true complexity, we need to embrace it by dynamically interacting with the whole system through a process of framing and reframing.

This is a playful, designerly process. You cannot attack an open, complex problem head-on, you need to dance around it to find a new way in. In the words of the boxing great Muhammad Ali, you must '*float like a butterfly, sting like a bee*'. This has to become a second nature to us, as creative practitioners.

In creating new frames we develop new ways of *seeing* the world, new ways of *thinking* about it, and new ways of *acting* upon it. But how can frames be created? How do designers manage to do this?

The essays on the coming pages describe many design practices that contribute to this ability to create new frames. They will be brought together in a Frame Creation process on page 180, which shows how designers embrace the complexity of a situation, and then get back to first principles, the deep human values. They use these values to re-anchor their thinking. Starting with these values allows designers

to think about the problem in a different way, propose new frames, playfully suggest new ways forward, test them, and loop back to reframe when the proposed direction doesn't quite work out. This is basically a learning process: in design abduction you are learning your way to a solution.

To enter into this brave new world of design abduction we need to wean ourselves from old thinking habits, which is one of the hardest thing to do*. We identify ourselves deeply with our practices, with how we think about things, and letting go of these patterns requires a good deal of mental space and wisdom. But as my colleague Bert Mulder would say: '*the good news is that we don't have to make a decision about this. We have no choice*'.

HOW TO USE THIS BOOK

We start this book with a deep dive into the practices that design can bring. In Part 1 you will find a close description of design practices, from the inside, as it were. In Part 2 we step back and consider design in the world, to get an understanding of the context in which design practices have developed. Part 3 explains how design is now on the move, and how design practices are expanding beyond the confines of the traditional designing disciplines. The impressive breadth of these newfound applications is then taken as a starting point for drilling down to the core practices that design can bring, showing what other professional fields can learn from design.

The format of one-page essays makes all of this knowledge accessible in the most flexible way. This book is meant for grazing, in all directions. I would recommend reading a couple of pieces at a time, and then reflecting on how these observations link to your own experiences.

The main text is supported by references, marked with a * at the appropriate spot. These stars lead to the References section in the back of the book, which is organised by page number. I have tried to select books and papers that can also be accessed by readers that do not have access to a university library.

In talking about design, the book strives to embrace many issues and problems which are common to all creative disciplines. Inevitably, some of the examples used in the book are taken from my own original discipline of product design – simply because it is always better to write about the things you know. But this book is based on the practices of a very broad array of experienced designers from many fields. The author is just the messenger.

As you read this book, you will find thoughts that range from gentle musings on design to impassioned attacks on various misunderstandings surrounding creative practice. There is well-meant advice, and some warnings about what NOT to do. While these are all very serious, they should not detract from the pure pleasure of creative practice.

Enjoy!



DESIGN AS APPLIED CREATIVITY

It is not easy to explain to people what it is to be a designer. They have trouble picturing what a designer does, and seem to think that you are either a vague arty-type or a hard-nosed technologist. In general your 'softer' audience will tend to assume you are a technofreak, and the technologists will think that you spend your days painting flowers on coffee machines. But what makes design so difficult to explain?

The problem is that design is not one way of thinking, but two: it is a mix of creativity and analytical reasoning. There is something peculiar about the way designers work.

This working method of designers is illustrated by a little experiment that was done by Bryan Lawson*. He was interested in how designers and non-designers would tackle the same problem. So he gave a puzzle (one of those coloured block tests that psychologists like to use) to two groups of students: one group studied mathematics, and the others were designers (architects). And what happened? The mathematicians started by analysing the problem, and once they understood it, they set about solving it. All of them quickly came up with the right answer.

The designers, on the other hand, began by laying out possible solutions and tried to improve upon them. A completely different approach. Apparently, the designers were used to problems that did not lend themselves to analysis. The designers were accustomed to dealing with the complex and chaotic problems of their profession by creating high-scoring solutions, analysing them and evaluating them. Their creativity and analytical skills were focussed on the solution, not on the problem.

This strategy can be recognised in all design professions – in design problems, the generation of possible solutions and their gradual improvement is the only way forward. That is design.

DESIGN AS PROBLEM SOLVING

When people started trying to understand design, they of course began by comparing it to things they were familiar with. So the first model they devised was of design as a problem solving process. Cognitive psychologists had been figuring out the way people solve simple problems like 'what is my next move in a chess game': you pose the problem, search for a good solution by generating (all?) possible next moves, explore the consequences and then choose. This process of pose-search-generate-test can clearly also be recognised in design practice.

The idea that design is problem solving has led to the development of phase models of the design process, in which you first define the problem, analyse it to formulate requirements and then generate solutions. You choose between these solutions with the help of your requirements, and then implement the chosen solution*. This model of design has worked tremendously well, although it has also been criticised. Like any model, it highlights some aspects of design while neglecting others. Yet, it seems that as long as the design goals are explicit, clear and stable, and a set of comparable solutions can be generated, design can be treated very much like problem solving.

If you happen to hit upon such solid ground in (parts of) your design project, you can use the sturdy problem solving model and its many accompanying methods to help you structure your design work. But not all of design is like that.

DESIGN AS LEARNING

Early hopes that by describing design as problem solving we had captured its essence were, in the end, not justified. The problem solving models of design are particularly helpful when you want to control a design process, or to make your design project run more efficiently. But the problem solving model is silent when we want to know more about design than just how to control and structure it.

This relative 'distance' from the way designers experience their work has long been a criticism by designers against the problem solving view of design. One of the early architectural design theorists, Christopher Alexander, is on record* as saying that: '*... <design theorists> have definitely lost the motivation for making better buildings... there is so little in what is called 'design methods' that has anything useful to say about how to design buildings...*' A damning remark, if there ever was one.

So it seems we need more models and metaphors to accurately capture design. A radically different view, which tries to arrive at a much closer description of design as it is experienced by designers, concentrates on the learning that takes place during design projects.

Design can indeed be seen as learning: as a designer, you gradually gather knowledge about the nature of the design problem and the best routes to take towards a design solution. You do this by trying out different ways of looking at the problem, and experimenting with various solution directions. You propose, experiment, and learn from the results, until you arrive at a satisfactory result. For instance, when you are designing, you sketch an idea and then look at it with a critical eye. This fresh look often immediately shows you what must be changed in order to improve the design. So you change it, and then you again look critically at your work, etc. Design can be described as a process of going through many of these 'learning cycles' (propose-experiment-learn, propose-experiment-learn, again and again) until you have created a solution to the design problem.

In this way, you learn your way towards a design solution.

DESIGN AS EVOLUTION

Creativity in the design process is often characterised by the sudden occurrence of a significant event – the so-called 'creative leap'. Sometimes such an event occurs as a sudden insight, but often it is only in retrospect that a designer is able to identify at which point during the design process that key concept began to emerge. Such after-the-fact accounts may not be completely reliable. But we like to believe in this mythical creative leap, anyway.

When you observe designers at work you see a process that is much more gradual, like an evolution. The initial ideas can be seen as the first primitive objects, evolving and becoming more subtly tuned to the design problem over the generations. But design problems are also something like a moving target: they are usually very vague at the beginning of the design project. As the designer acquires more knowledge about the problem and about the possibilities for solving it, the design problem also evolves during the design project.

So creative design is not a matter of first fixing the problem and then performing a 'creative leap' to a solution. Creative design is more a matter of developing and evolving both the formulation of a problem and ideas for a solution, while constantly shuttling between them. The aim of the designer is to generate a matching problem-solution pair*.

Design thus involves a period of exploration in which problem and solution are evolving and are very unstable, until they are (temporarily) fixed by an emergent idea which identifies a problem-solution pairing. The creative event in design is not so much a 'creative leap' from problem to solution as the building of a 'bridge' between the problem and the solution by an idea. A creative event is the moment of insight at which a problem-solution pair comes together. This can be such a triumphant feeling that it overshadows all the slow and laborious evolution that went before it.

DESIGN AS A SOCIAL PROCESS

Nowadays, designers rarely work alone. It has become almost impossible for a single designer to possess all the necessary knowledge and skills to develop a complicated design. You usually have to cooperate with other designers and consult specialists from various fields.

This means that design has become a social process, whether we like it or not. Designers need to interact with groups of people that have different ways of looking at the design problem and the design solution. These people do not only bring their knowledge to the design project, they also bring their own viewpoints, expectations and ambitions. Because they represent widely different aspects of the design, and come from completely different knowledge fields, these groups often have trouble understanding each other. Yet for the design to succeed, it has to perform well within all these different worlds (financial, technical, ergonomical, aesthetical, etc)*. There is no single overriding perspective that encompasses all aspects of the design problem and solution. Because of this, designing becomes a process of negotiating a consensus among all the participants who have differing interests in the design.

People who have been trained as creative designers may not be particularly suited to lead such discussions. They may be much too involved with the developing design idea to act as an independent chair in such a negotiation process. The separate discipline of design project manager has arisen to fill this need for someone who can really make the design team work together. Now that design has become a social process, designers will need to become skilled negotiators.

DESIGN AS RHETORIC

Looking at design as rhetoric means seeing design as an act of persuasion. From this perspective design is not just about the making of an object, but also the creation of an argument.

As we use designed products, systems and services, we act in a pattern that is sparked by the design, and most likely has been foreseen and created by the designer on purpose. In this way, the use of an object is a kind of long-distance discussion between the user and the designer, although the latter is not present at the moment of use. An object of design is a frozen statement in a discussion, that comes to life in its use.

Sometimes this discussion is the main objective of the design project*. The distinguished UK fashion designer Adam Thorpe created a radical garment, a sweater with a hood that is perfectly shaped to ensure that the wearer's face cannot be recognised on a surveillance camera... a rhetorical design, that has started a much-needed discussion on privacy in public spaces. This is an extreme case of design as rhetoric and was made to purely spark a debate. The design was looking for trouble, and was really successful in getting it. The garment was not banned by name; however, in 1998, the Crime and Disorder Act included a clause that gave police powers to request the removal of items of clothing worn to obscure identity. The

designer's response was the Vexed slash neck: a rollneck that hid the face but could easily be removed - and reinstated - when required. The new legislation was printed on the collar of the garment.

But it is good to realise that designing is *always* a rhetorical act, as all of our designs reflect who we are, how we see the world, and what we judge to be 'good'. Designs require thousands of decisions that designer take based on their own judgment of what is desirable. These decisions are made in considerable freedom and thus every design is to an extent a statement about the maker's view of the world, a self-portrait. This makes the design process an act of argumentation in itself - choosing one idea in favor of another, taking one decision rather than another, reflecting the values of the designer.

Designs can capture and reflect these values and the culture of the day in great clarity. Just think about how strongly and lively a nostalgic collection of old designed objects, advertisements, movie posters or postcards evokes memories of everyday life in a bygone era. The very popularity of collections of these humble objects is a rhetorical statement in itself; a telltale sign of how (un)comfortable we are with the modern world that surrounds us.

DESIGN AS A GAME

Design is a game with very few rules. Design problems are extremely complicated, so we must use all our wits and creativity to solve them. The results are what counts, and we will use any means to get us there.

Any design problem is a challenge, which you can master by experimenting with various views of the design problem and the many roads toward a solution. You have to choose your line of attack early on in the project, always on the basis of too little information, so it automatically becomes something of a gamble. Then you try it out, get nowhere and have to use your creativity to take on the problem in a different way. A new gamble, that may pay off – or not. And a new challenge to make it work this time.

Any self-respecting designer (and aren't they all) will also raise the stakes by adding all kinds of personal goals to the design brief. You want to make the design what you think it should be, something special. You challenge yourself by aiming high, by being as ambitious as possible. Because you have inserted your own goals, you become personally attached to the project, desperately wanting to make your ideas work. How far can you get in realising your ideal? In most of the design firms I know, the lights are on until 11 pm every night.

It's a sure sign that someone in there has become attached to his ideas, and can't stop playing the game of design... It is pure fun, exciting and exhilarating. And when a good idea that you have put a lot of energy into is finally adopted, it really feels like winning. Designing is highly addictive.

Problems & Solutions

WICKED PROBLEMS

We all know that design problems are not easy. But what makes them so difficult?

Cognitive scientists, who study human problem solving behaviour, have tried to answer this by comparing design problems with relatively simple problems, like chess. A chess problem is considered to be well-structured: the chessboard is a nicely enclosed world, in which you know the value and the possible moves of all the pieces. And in chess the goal is clear: to checkmate your opponent. Despite this, solving a chess problem is difficult enough.

But compared to the complexity of design problems, chess is child's play. Design problems have been called 'wicked' problems, because none of the structure of a chess problem is present in the case of design*.

To begin with, there is no fixed playing surface in design: we design in the real world, so outside influences can disturb our plans at any time. And considering a design problem from various angles will give you different pictures of what can be done to solve it – there are many perspectives, each having its own version of the truth. To complicate things further, there are always aspects of the problem that will only emerge during the solution process. So a design problem can't even be comprehensively stated before you set out to solve it...

Secondly, the moves you can make as a designer are not predefined. There are no rules in design, except the limits set by the law and your conscience...

And finally, the goals of a design project depend on the interpretation of the people involved, and they typically will shift during the design project. The changeable nature and subjectivity of design problems accompanies you right to the end of the project: there is not even a clear yardstick for success or failure.

THIS IS NOT WHAT YOU THINK IT IS

Designers are known for their great solutions. But when you study what they actually do, it turns out that they spend most of their time being very focussed on the problem. And when you ask them why, they say that this where they can add the greatest value. After all, creating a new approach to a problem leads to a multitude of original ideas.

Unfortunately, this point has been missed by the hugely successful 'Design Thinking' movement as it has developed in business schools over the last fifteen years. The practices which they promote under the flag of Design Thinking are all very solution oriented.

The business school style of Design Thinking centres on three key points: (1) the stimulation of creativity; (2) human centered design; and (3) the importance of early prototyping ('fail fast'). There is nothing wrong with this, and the design practices that are associated with these three principles are undoubtedly useful for people who work in organisations that have become very bureaucratic or technocratic. These principles can help such organisations to re-orient themselves on the human values that ultimately hold the key to their success*.

But this very success has unfortunately contributed to the promotion of less-than-helpful myths about design.

No, design is *NOT* all about having great ideas.

And whatever the design thinking enthusiasts say, this is not how top designers behave. Their designs are based on a very thoughtful process to create new approaches to problems. As Einstein once said, '*a problem can never be solved from the context in which it arose.*' Apart from the obvious circularity of this statement (if the issue could be solved in its original context, it would probably never have registered as a problem), there is some wisdom here. This quote highlights the need for a problem solver to change the context in which the problem was formulated rather than confront it directly.

Also, expert designers *NEVER* brainstorm.

Brainstorming isn't particularly helpful, because randomly generating lots of solutions then leaves you with the onerous task of selecting some for further development – and if your view of the problem hasn't significantly shifted, chances are you will throw out all the more unusual ideas and end up pretty close to where you started. And really, there is no need: when you have a new approach to the problem, every one of the ideas you come up with is bound to be interesting.

FREEDOM

Design can be seen as a reasoning process, running from problem to solution. But there is no unique road that connects the design problem with the design solution – design problems can be solved in many ways. This doesn't make design irrational, though: there is logic in design, but design problems are so ambiguous that logic can be applied in many different ways. Therefore, design problems are often called 'underdetermined'.

One of the problems designers face, is that design problems are not completely fixed, but also not completely free. Most design problems seem to have a triple nature:

They are partly *determined* by 'hard' (unalterable) needs, requirements and intentions. A designer has to reserve time in the early part of the design project to unearth these 'hard facts' by information gathering and analysis, and learn to accept these specifications.

A major part of the design problem is *underdetermined*. The interpretation of the design problem, and the creation and selection of possible solutions can only be decided during the design process on the basis of proposals made by the designer. Thus, these proposals entail both the possible interpretations of the design problem and possible solutions to those problems.

Part of the design problem can be considered *undetermined*, in the sense that the designer is, to a large extent, free to design according to his own taste, style and abilities. It is, of course, not the case that the designer will never have to defend these aspects of the design to others, but the designer is dominant, in the sense that he also provides the criteria on which these aspects of the design are to be judged.

In a design project, it is not always easy to see what kind of design challenge you are dealing with. How 'hard' are the requirements? How much freedom do you have, as a designer, to follow your own preferences?

PROBLEMS AND SOLUTIONS AS SIAMESE TWINS

So design problems are not fixed, but underdetermined, which means that there is room for different interpretations of what the design project should be about. This gives the designer a lot of freedom. However, it is critical that the interpretation of the design problem is relevant to the stakeholders, and that they also agree on the kinds of solutions this particular view of the design problem will lead to. The interpretation of the design problem and the possible solutions it can lead to cannot be separated. They are Siamese twins.

What then, is a 'good' design problem? To ensure a good 'fit' with the stakeholders you first need to find out what their fixed demands are. Around that core problem there is a lot of freedom, where you can choose your interpretation as long as you convince the stakeholders that the way you interpret the problem is going to be fruitful and will lead to a good solution. But you can never be quite sure about that. It helps to generate some ideas early on, as an exploration of what possibly lies ahead, but you never really know beforehand if a certain interpretation of the design problem will lead to satisfying solutions. You will only find out during the design project.

If it turns out that your interpretation of the design problem just generates a lot of dead ends, you have to go back and change your view of the problem. In practice, this is often a struggle. The design problem is the starting point of your thinking, and drastically altering your basic decisions and assumptions halfway through a design project is tough. I once observed a group of designers in which one person was clearly interpreting the design problem quite differently than the others. She saw the project as a redesigning of the current product, the others treated it as a new, conceptual design challenge. They only discovered this discrepancy quite late in the project, when they were discussing their ideas. She was overruled and had to go along in the conceptual thinking mode of the rest of the group. But she couldn't make the switch, and ended up just supporting the design process of the others without really contributing any ideas herself. She had lost her view of the design problem, the very foundation of her thinking.

Problems & Solutions

BUT, IS IT ART?

In design, your goals are partly determined by others, the stakeholders, because the things you create must fulfill some practical purpose in the wider world. In art, this is not the case. An artist determines his or her own goals. They have this freedom because with their creation, artists do not aim for any practical application, but strive to influence the feeling or thinking of an audience.

Art education in the western world is focused on the personal development of the student, so that the budding artists will be able to generate and pursue interesting goals. This goal-generating ability and their personal development, are the key issues that determine the vitality and quality of an artist. However, once an artist decides on a goal to pursue, his or her creative process looks very much like a design process*. They have effectively turned their self-made challenge into a partly determined design problem. And they temporarily turn themselves into designers.

THE STORY

When you design, you are actually creating two things in parallel: the design itself and the story behind it. This story consists of all the choices you have made during your design project and the arguments that you used in making them. It is the justification of the design, which explains why the design is constructed in just the way it is.

Of course in any design project, all attention tends to focus on putting the design together. But constructing the 'story' is a vital and integral part of any design work. It helps you defend the design to others, and – perhaps more importantly – it allows you, as a designer, to keep track of the design's progression. It often happens that some of your early decisions must be adjusted or revoked in the later stages of a design project, either because they keep generating problems or because they are just unworkable. That is all part of normal design practice: you take a decision based on the knowledge you have at that moment. Later, when you have acquired more knowledge, you might live to regret those choices.

The tricky thing is to return to those early choices and revise them without wrecking the whole design. A design can be seen as a tightly knitted web of decisions which are not independent from one another. Chances are that if you change one thing, you must re-adjust a lot of others as well. Keeping track of the story (in notes, annotated sketches, etc) can keep you from getting tangled in your own design.

Problems & Solutions

LOGIC, HISTORY AND SPYING

The story behind the design might help you explain and defend your design to others. But the question still remains: How good is the design solution, really? How do you justify a design solution? This is not so easy.

Explaining the logic behind the design will get you so far, and you can fall back on the design project's history to explain the choices you made. Showing the design alternatives that you considered and explaining the reason for their demise will strengthen the argument in favour of the chosen design considerably. It is worth keeping track of all your design concepts for this reason. In this way, you might convince your paymaster that the design you made is good. But can you also assert that it is the best design, or the best possible solution? Being the best is a relative measure, so to establish a design's relative quality you must compare it to competing designs on the market. You should always be aware of these designs, and if necessary, take them apart and analyse them to the last screw. Big companies have special departments for this competition analysis, which they call 'reverse engineering'. From careful analysis you can not only learn about the rival design, but also about the ideas behind it, the technologies the competition introduced and the organisation of the production process.

But the main thing is to judge the competing product by the same criteria as your own. This 'benchmarking' will give you confidence that your design will get its fair share of the market.

Of course, what you would really like to do is benchmark your new design against the new designs that the competition is developing at the same time as yourself. Industrial espionage aside, this is not possible. You never know for sure how good your design will be.

WHAT DESIGNERS MAKE

Designers make plans. They plan the behaviour of the design and its users and they plan the production of the design.

Designers' plans are expressed in all kinds of different media, depending on the design discipline. Everyone makes presentation drawings and scale drawings, but architects also make scale models, while product designers and mechanical engineers often make prototypes or computer animations. The use of these various media is a clear indication of how difficult it is to convey a design, but it is crucial that this is done well.

These plans, drawings and models are ultimately used as tools to interact with the people who are actually going to make the design. They have to take these plans and develop a way to produce the design. This turns out to be a very difficult step, which often leads to many changes to the final design. Designers, on the whole, do not enjoy this stage. Once they have delivered their plans, they see the design project as finished, and they want to move on to the next one. They do not enjoy being bothered with all kinds of nitty gritty detail problems to get their plans realised. But of course, the quality of the produced design ultimately depends on this step as well. Many delicate details can get lost when the production people find

'an easier way to make this'. So it is in the designer's interest to keep the lines of communication open and to stay involved with the design until, and even after, it is produced.

In large design projects, like the development of a car, the amount of work to be done necessitates a far-reaching division of labour*. This inadvertently means that the design project is completely fractured, and that there are multiple interfaces between design and finished product. The shape designers hand over to the engineers, the engineers to the production engineers in the pilot plant, and the pilot plant ultimately turns over the design and production procedures to the production plants. When the first new model is finally introduced in the Motor Shows, the stars, the shape designers, will be giving interviews to glossy magazines while the engineers are still in 'engineering hell', ironing out final problems and getting the production up to speed.

Kinds of Designing

THE DESIGNING DISCIPLINES

'Design' as such does not exist, not as a single discipline that you can clearly define or point to. This makes general discussions about 'Design' muddled from the start. What do you mean when you say 'Design'? It is even not very helpful to consider the fields of Architecture, Engineering, Graphic Design and Product Design as categories of design practice. The kinds of design work within any of these fields do not have that many traits in common, although they do display a family resemblance.

It is much more useful to choose a variety of criteria to discern different modes of designing, than to draw lines between the design professions as if they were separate species. The lines between the disciplines have always been vague and they are blurring rapidly. For instance, in all the main design disciplines, there are branches that look very much like my own profession of product design: in architecture it is the design of building systems, in mechanical engineering it is the development of small, mass-produced machines and in graphic design, the development of company logo's and house styles.

Thus, it is quite common for designers to defect from their original design discipline and move to an adjacent design field.

CONSTRAINT

Some design problems are much more 'open' than others. They require the designer to play with concepts and ideas through a wide range of possibilities before settling on a firm direction. This takes a great deal of conceptual juggling skills. You propose ideas, look at them critically, and reconsider them. This is done repeatedly, making gradual improvements as you learn more about the problem.

Closed design problems are more like puzzles. You try out solutions, and the feedback you get from evaluating your design is immediate and clear. The assessment might even directly point the way towards a better solution. If a piece of the jigsaw puzzle doesn't fit, you know you'll have to search for something that has a slightly different shape.

Puzzle solving has its own strategies. Start where the problem is the most constrained, where there are the least choices or possibilities for error. For a jigsaw puzzle, that would be the border or the corners. Or you start with pieces that show a clear, unique image. And you always end by filling in the biggest uniformly coloured surface (the sky). However, this does not imply that this is always the fastest way, or that other solution strategies are impossible or wrong. It might also be more enjoyable to solve the puzzle in a random, browsing way.

There clearly are different skills involved in the 'idea juggling' of the open design problem and the 'puzzle solving' of the closed problem. It could possibly involve completely different types of designers. There is creativity and inventiveness involved in both, although designers often don't see it that way. It is a misconception that is kept alive by both parties. The 'creatives', who deal with more open design problems, tend to look down on the 'non-creative' closed problem solvers. And some 'closed problem' designers confirm this by downplaying the creative side of their profession. As the industrial designer Richard Stevens observed: *'A lot of engineering design is intuitive, based on subjective thinking. But an engineer is unhappy doing this. An engineer wants to test - test and measure. He's been brought up this way and he's unhappy if he can't prove something.'*

Kinds of Designing

KNOWLEDGE STRUCTURE

The thinking tools available to designers depend heavily upon the knowledge structure of the disciplines that play a role in the design project. In some technical domains it is possible to reason from problem to solution in a relatively orderly way. We know a lot about the 'laws of nature', and there are some slightly more iffy 'laws of technology' that really help iron out a solution. It is even comparatively easy to translate between several technical domains (like mechanics and hydraulics) because both domains share some of the same variables.

However, this does not apply to, for instance, the fields of aesthetics and form-giving, where the knowledge base is extremely weak. It consists of some psychology, some art theory and some craftsman's knowledge of what can be done with forms, colours and textures. All of these sub-domains are completely unconnected. For every new design they have to be combined by the designer, on the basis of personal preference, taste and style. People who have tried to unite these particular subdomains on a general, non-personal level, have only come up with pseudo-theories. Several Bauhaus teachers have developed theories of form and colour which contain statements like 'squares are inherently blue'*. It is easy to ridicule this, but it was an honest attempt to develop a theory of aesthetics that was every bit as solid as science or technology.

Sometimes you just wish this was possible. In conversations with clients, it is always reasonably straightforward to explain why a technical construction has to be the way it is, but it is almost impossible to convince some people of the suitability of a certain form. You suddenly have to defend your design against the clients' own personal preferences and taste.

THE GOLDEN PROTOTYPE

Designing wisely is all about being frugal with your time. Any design problem is immensely broad, so it is impossible to list and explore all potential solutions. You have to choose and rule out options as early as possible.

Every exploration takes time, and the time commitment becomes bigger and bigger when developing concept ideas in ever more detail. You should strive to be reasonably sure about your design when it comes to the point where a prototype has to be made, because often, making a reasonably realistic prototype is as expensive as the whole design process before it. Design disciplines where prototyping is more expensive tend to build in many intermediate steps, checks and balances into their projects to avoid wasting time and resources.

That makes sense, but not for all design disciplines. If you look at web design, for instance, you would see quite a different pattern. In developing a website or an interactive system for a computer, you work on designs that are easy to replicate, and that will be used by means of the same medium on which they are made. So you have a realistic 'prototype' at almost any moment during the design process. You can do user testing at all times. Designing then changes from a linear process which leads to a prototype, into a process of continuous testing and learning. Design becomes

an evolutionary process' you are able to test many generations of the design before delivery.

Evolutionary development is wonderful: the earlier you can incorporate user knowledge into the design, the better. Unfortunately, in practice it turns out that these evolutionary processes are even harder to manage than 'normal' design projects. How do you decide on the number of generations you will need, for instance? This way of working also has its own pathology, the results of which are all too familiar: the debugging drama. Software designers are often tempted to 'just make something' and then to improve that imperfect concept over many generations. But if you begin the evolutionary process at a level which is too detailed, you end up debugging a structurally bad design, ultimately creating a weak and unstable monster.

Kinds of Designing

TRADITIONS AND RITUALS

One way to get a fresh look at the social aspects of design life would be to actually study designers as if they were a newly-discovered culture, as an ethnographer would hacking his or her way through the jungle, befriending the chief, taking up residence in a hut in the village, and describing in detail everything that is going on around him. Most things he/she might observe would be of a direct practical nature - human beings reacting to circumstances in a way that is quite universal and predictable. But some behaviour would be non-practical, steeped in traditions and rituals that define the local culture.

If you take this way of exploring human behaviour into a design department, you will observe a lot of things that have seldom been described.

You would suddenly notice that a major portion of design work consists of negotiating with colleagues about information, problems and ideas. These negotiations are often not conducted on the basis of objective information. Conclusions may be reached according to the organisational status of one of the parties, or everyday human rules like 'if you give in now on this point then I will give in next time'. You would also see that the people who are formally in charge of a design project are often not the ones who have the most influence. Other people might act as central

'trusted persons' and actually be the major influence on what is decided. The network of social roles that people adopt almost never matches that of the formal organisation.

A particularly telling moment is the arrival of a new staff member into the department. Initiation rites are then in order. Some of the 'old' group members will take time to explain to the newcomer 'how we do things here'. This is a subtle process of indoctrination (autopoiesis), to make sure that none of the sacred rules will be broken or traditional ways of working will be changed. While cultures can shift and change, identity is defined by old habits. The funny thing is that when you confront designers with these 'unwritten rules of the game', they are immediately recognised: 'Of course, that's how it works, but you can't say so' is the response.

It is important for an organisation that needs to change its ways to have access to explicit knowledge of its own culture and the assumptions that are hard-wired in it. Wouldn't it be fascinating to ask different groups of creative professionals to study each other, and inquire deeply into the roots of the habits they observe.

ROLES OF DESIGNERS

An important distinguishing characteristic of a design practice is the specific role the designer plays in the complete process of creation. Some architects or designers are cast in the role of the 'creative', and hand over their design concepts to technical people to iron out their construction. Others have a much more integrated approach, and actually use the technology as a source of creativity.

It's hard to say which approach is better. But these organisational choices (the division of labour within a company) does have a pervading influence on the resulting design*. In 'The Soul of a New Machine', Tracy Kidder describes how the project leader of a development team that is going to design a new computer, looks at the latest model of the competitor. In analysing the design, he describes it as 'bureaucratic' because two parts that could have been integrated were clearly developed separately. And the project leader decides to develop a more efficient, integrated solution by assigning both design problems to a single team.

Every work division creates a point of contact between people or parts of an organisation. And despite all the good ideas of how to manage these interfaces by introducing 'multidisciplinary design teams' or 'concurrent engineering', they remain a huge managerial problem.

Who talks to whom about what, etc. The management sciences have been oscillating between task division and integration – especially after the shock that the Japanese dealt to Western companies with their highly successful products that grew out of more integrated development processes.

Since then we have learned that this is one of those problems that don't have one solution: both integration and task division have their pros and cons. The unsuccessful search for the one best choice has resulted in the constant re-organisation of design functions within companies, from divided to integrated and back again. The answer to this dilemma may not lie in the organisation at all. It may lie in the commitment of the project management to create an open atmosphere where information can flow freely between all those that need to be involved*.

Kinds of Designing

SUCCESS

When is a design project a success? This is a deceptively simple question. In the management sciences, success is traditionally associated with speed ('time-to-market'), efficiency and Return On Investment ('shareholder value'). But some years ago, a couple of management scientists became uneasy about this definition of success*. They decided to ask the people who should know, the managers, which of the development projects in their firms they judge to be successful. In these interviews they found to their surprise that there are actually two disparate kinds of projects that managers call a success, for very different reasons.

Some projects are deemed successful because they provide a great learning experience for the organisation. These are potentially really messy projects, full of friction between the parties involved ('creative abrasion', as it is called in lovely management speak), false starts, trial and error, and considerable overruns in time and cost. From a distance, one would say that this is the kind of projects that any manager would frown at. But the learning experiences were apparently deemed so valuable by the managers that for these projects, their 'normal' criteria of speed, efficiency and financial gain moved into the background. These 'learning projects' are appreciated as successes because they can be the starting point for other, less innovative projects, in which

the lessons learned are 'milked' and translated into hard cash. These 'Cash Cow' projects themselves are judged purely on their speed, efficiency and financial merit.

This is an interesting observation: management scientists have traditionally selected the 'best practices' that they analyse and parade before us as shining examples of successful design on the basis of the amount of money made on a project. In doing so, they have inadvertently focussed on the second kind of project. But these routine projects cannot exist without the other, much more messy 'learning projects' where innovative design should roam freely.

THE RESOLUTION OF CONFLICTS

Many design problems cannot be solved within the context in which they have arisen. And if they actually cannot be solved at all, they have to be resolved. The way designers deal with the paradoxes and conflicts in a design situation is considered to be rather special, and a core quality of good design.

The problem is that the conflicting statements in a design situation tend to trap you in a strange thought-loop that it is really hard to get out of. For instance, the conflict could be that your design should be clearly visible and available to the user at one moment in time but should preferably not be visible a moment later. But physics tells us that matter doesn't just disappear. What can you do? Design something that is comparatively small, and unobtrusive? Paint it in camouflage colours, make it fold down, or inflatable? All of these are compromises, sub-optimal solutions that try to find a position within the conflict that is acceptable.

The resolution of a conflict is something radically different. It calls for a complete redefinition of the problem situation. It challenges us '...to do what designers often do so well, namely, to satisfy potentially conflicting considerations simultaneously'*. To attain the resolution of conflicts in a design problem, the designer has to take the long way around: not attacking the problem head-on but dancing around it, playing with different ways of looking at it. If you manage to step out of the ways of thinking that gave rise to the conflict, and find a fresh and productive perspective to the design situation, then the conflict resolves itself. It just is not there anymore!

MOULDING THE DESIGN SITUATION

Imagine a group of friends getting together on a Saturday night. Let's then first give them the problem to go 'looking for a good movie in town'. And then give them a second problem, to set out and 'have a party'.

The first situation is considered to be 'problem solving', the second situation is considered to be a real design project, because there are three important differences between these two situations. The first difference is that the design situation includes the definition of the pivotal word or a possible expansion of the meaning of that concept (What is 'a party'? What do the different people involved *mean* by 'a party'?). There is no dominant design for what a party should be, so imagination needs to be applied at this very fundamental level. A second difference is that the design situation requires the design and use of (thought) experiments in order to get to a solution ('Shall we go to a club...?'). Thirdly, in design you have to develop tools to reach a solution, such as ways to discuss issues or arrive at decisions ('Let's vote on this, guys...').

The problem solving that involves in the 'movie choice' scenario is very simple by comparison. List the available movies, agree about the criteria ('Not too scary', 'No, I've seen that one already') and choose. Selecting can be hard enough, but it does not require a creative leap and inventiveness that it takes to mould the design situation. Design undoubtedly includes moments of problem solving, but it also contains other, more complex processes*.

COMPROMISE

Any design must satisfy the many needs of everyone involved in its making and use. These needs are often contradictory, so any design project involves weighing the importance of many requirements. We aim for a design that brings the greatest happiness to the greatest number of people. This often leads to making deals and compromises. Nothing wrong with that, unless it becomes an unfortunate habit.

During my own studies, I had a tutor who helped me break that habit. I was doing a design assignment, studiously putting together a list of requirements and coming up with concept designs. Those concepts were reasonable, although I had the feeling that they weren't sparkling or innovative. Just OK. During a conversation with my tutor I expected some encouraging remarks and a pat on the back. To my surprise, the tutor really got angry, and I had to work hard to defend my ideas to him. Somehow my defence didn't work, and he brushed all my arguments aside. What was happening here? First of all, he saw my design concepts for what they were: uninspired compromises. I had tried to make a product that was OK, aesthetically, ergonomically and technically.

My tutor had seen that I had failed to make any fundamental decisions or to produce a strong basic idea in any of these areas. This became clear when I tried to justify my meagre efforts: I

had been excusing a particularly awful form-detail by saying that it was ergonomically good, or technically smart. This is actually the only way you can defend bad compromises: dodge the discussion, and change the subject. The form detail was aesthetically bad and inexcusable.

This way of designing had become a firm habit with me. As a 'smart' student, I had become devilishly adept at this kind of compromise and hide-and-seek discussion. Good marks, too. And I had started to believe that this was what design was all about. Fortunately, my tutor saw right through it. He said that if I kept making compromises, I would have to defend every one of them (impossible, of course). But if I made some clear basic decisions that he could understand, he would accept almost any clear choice I made. After this traumatic event I had to start my project all over again and, of course, the later ideas also contained some compromises, but I could point out where they were, and why they were absolutely necessary. The quality of the design was much better.

Elements of Design

WEB OF DECISIONS

If you are a designer, you will recognise the sinking feeling one gets when an idea that you are working on, improving step by step, turns into an already existing design, or into an idea you had previously rejected. You can easily get into these vicious circles because design decisions tend to be dependent on one another – a decision you take for one part of the design will affect the rest. Following where these consequences lead, you can end up uncomfortably close to where you started.

A design is made up of many of these chains of decisions, which are interconnected. Together these chains make up a very complicated network of interconnected decisions (or, not to put too fine a point on it – a giant knot). Weaving such a network takes a lot of thought, creativity and patience.

As you start a project, you have nothing but loose ends, so you begin by combining all kinds of unconnected ideas into some sort of whole. You're never quite sure whether another starting point wouldn't have given you a better, simpler web of decisions. But you have to go on connecting problems and ideas with one another. This can make designing a restless dance from subject to subject. The evolving design solution has to be cross-checked continually, because a proposal that might solve a problem in one area of the design could aggravate others.

In this process, it is really hard to keep track of what you are doing. Every designer knows the moments of complete disorientation while leafing through his piles of sketches ('What was the reason for this?'). It would be nice if you could alleviate the complexity of a design challenge by splitting up the problem into smaller parts. Unfortunately, you cannot usually do that: design problems have too many internal dependencies. Designers are experts in weaving extremely complicated webs of decisions.

INTEGRATION

One of the strongest impressions you have when you are deeply immersed in a design task, is the feeling of performing a balancing act. All of the various demands of the project's stakeholders (e.g. the producer, the user) have to be reconciled within your design. And the design must be 'good', as seen from different perspectives: it must be technically sound, ergonomical, aesthetically wonderful, and all kinds of business considerations must also be taken into account. Each of these stakeholders come with viewpoints, knowledge and values from their own world. In designing, you are making decisions in which all these different worlds must be combined. The process of combining different worlds is called integration.

Attaining a well-integrated design is all about getting the balance right: after concentrating on one stakeholder or perspective on the design, you must compensate for the inevitable limitations and bias of that approach by making a second step that balances the first. For instance, if a product has been designed while focusing on form, the designer will have to compensate for this bias by investigating whether the design is technically possible, producible, ergonomically sound and economically feasible. Integration-loops like these are made constantly while designing. We have already seen that you need to develop many parts of a design more or less in parallel, and with the need for

integration, this means that you should develop them with all the stakeholders, and every perspective on the design, in mind. Unfortunately, it is impossible to do everything simultaneously, even for a designer. So you sometimes feel like a Chinese juggler with the absolute maximum number of plates spinning on the end of his poles. From time to time you must stop running around and create a renewed overview of your design. It is so easy to get much too involved in one pet solution, stakeholder or aspect of the design, and neglect the others.

However, there is much to be gained by striving for integration: a well-integrated design is simple, elegant and gives the feeling that 'everything has been taken into consideration, and is as it should be'. There is a glimpse of perfection in an integrated design.

COHERENCE

Integration is a hard enough goal to attain in design practice, but the problem is severely aggravated by the need to simultaneously reach coherence in your design. Coherence describes to what extent a design is 'unified', the extent to which it is free from inner contradictions, and can be perceived as a whole. The need for coherence effectively limits the amount of compromise a designer can build into a design: compromising too much will make it 'look like nothing'.

We have seen that the need for compromise and integration leads to an erratic design process of moving restlessly from subject to subject, trying to reach a balance. To attain coherence you need to adopt a clear priority and stick to it. These opposing strategies make the design goals of coherence and integration difficult to reconcile in practice. But both of them are important aims in any design project.

The resolution of a design problem can be reached by negotiating, bargaining, and making compromises. Or by doing quite the opposite: by taking a coherent standpoint and defending it, convincing all stakeholders of the legitimacy of your stand.

YEARNING FOR NOVELTY

Designers set out to innovate, to cover new ground. Nevertheless, in nine out of ten cases a new design is a creative combination of concepts that have existed before. It is already difficult to create anything novel in this sense, let alone making something that is completely new to the world. This inability to create completely novel designs can easily lead to frustration and cynicism. If cynicism reigns, design can become an uninspired cut-and-paste profession. Many of these mediocre designs will be good enough to be dubbed successful, if the market accepts them. Design then easily degenerates into being a cheap trick.

Novelty is an elusive target to aim for. Maybe it should not even be aimed for directly – if it occurs, it is often the result of a personal journey of discovery.

To avoid frustration, it is important not to burden yourself with the target of achieving Novelty in every project. But you should strive to always do things that are new to you, irrespective of the novelty-value they might have for the rest of the world. In doing so, it is quite possible that you will sometimes 'reinvent the wheel'. This may even be necessary – only if you come up with an idea yourself will you really understand it, get a handle on it and realise what you can do with it. The longer and more intense your journey of discovery, the

further you will be able to wander off the beaten track, and the greater the chance that you will eventually achieve Novelty in your designs.

Whether you actually achieve Novelty then ultimately also depends on many things: the design challenges you get, the people you work with – and on something called pure luck.

WHEN ALL ELSE FAILS

Design problems can be acutely paradoxical. The different stakeholders (producers, buyers, users, society) of a design project often have contradictory needs. This can make life very difficult for designers, saddled with the task of creating something which will somehow satisfy all these parties.

And as a designer you do not have the luxury of choosing one side of the paradox over the other – you have to create a solution in such a way that the paradox is resolved. This is actually what stakeholders expect from designers, to be magicians that conjure a simple design that satisfies everyone.

Surprisingly, this is often possible.

But sometimes a paradox is so fundamental that it just cannot be resolved, no matter how hard you try. Returning to the brief, you have to negotiate with the parties involved, explain your predicament and convince them to lower their ambitions a bit. This, of course, is not what they want to hear and it involves a good deal of persuasion. You have to convince them on the basis of an extensive analysis of the possibilities that they really have to lower their aims to arrive at any solution at all. But it remains a tricky situation. In most stories, the messenger isn't the one that lives happily ever after.

WHY DESIGNERS DON'T DOCUMENT THEIR PROJECTS

A design problem is a situation of tension, of unattained aims and unresolved conflict. This tension is the force that initiates and drives design. At the end of a design project this tension is more or less relieved.

Once a design problem is resolved, it disappears from the mind of the designer. This is very much like any form of problem solving. The philosopher Ludwig Wittgenstein has stated that:^{*}... *we are aiming at ... complete clarity. But this simply means that the philosophical problems should COMPLETELY disappear. The real discovery is the one that makes me capable of stopping philosophy when I want to.*

Design, however, does not take place in the pure and abstract world of philosophical thought. The world in which we design is much too complicated, contradictory and changeable to allow for such a complete resolution. There is always room for improvement, and although design projects end, a design itself is not stable – it will have to be changed over time.

These changes are much harder to make when there is no record of why the design was put together in the way that it was. The later 'improvements' might disturb the design, and effectively destroy its coherence. Because

of the difficulty of making changes, there is always pressure on designers (from their employers) to document their work in great detail. Designers tend to resist this – during the project they want to continue designing, and anything remotely like bookkeeping is often against their nature. After the design project, the documentation task becomes very difficult – designs are tangled webs of decisions which are so closely dependent on one another that is impossible to find a logical point to begin the explanation of the how and why. And the resolution of a design problem makes it hard to imagine that certain things were problematic at one time.

Thinking About Design

THINKING ABOUT DESIGN

People who have thought about design have done so in many different ways, motivated by a variety of reasons. To managers, design is important because there is a lot of money involved in design and innovation projects, and so they have developed methods to control design processes. Sociologists have described design historically, as a crucial component in the making of our brave new technological world. Psychologists have tried to model the creativity that plays such an important role in design. All of these standpoints, and many others, touch upon widely different aspects of design^{*}.

Most importantly for this book, designers themselves have become interested in understanding design, to improve their own performance.

But how can you ever gather enough knowledge to thoroughly reflect on an elusive, complex and creative process like design?

The good news is that most of what we would like to know about design exists already, hidden deep inside the brains of designers. Good designers know how to tackle design problems in very successful ways. The bad news is that they are not usually able to explain to others what they do, why they do it, and how. The complicated and creative nature of

design means that most design knowledge is implicit – and is notoriously hard to bring out into the open. Design researchers therefore observe designers at work, interview them, and try to make theoretical models that they hope will capture the essence of designing. This is the scientific way to gather objective knowledge about design in order to pass it on to design students and professionals.

After early hopes to the contrary, design researchers have realised that they can never capture all of design, nor completely understand or model it.

REALISM VERSUS CLARITY

Thinking about design can be somewhat paradoxical. On the one hand it is fascinating to try to understand what happens within a design activity. But on the other hand, when you read what design researchers have to say, it feels like design practice with all the fun left out. Dry, abstract descriptions of a very exciting occupation. This is not easy to avoid, because some amount of abstraction is inevitable: you have to step back and take a detached look if you want to describe something. If you would stick closely to the reality of design practice, and manage to describe design in all its complexity, you would end up being swamped in detail. You would be unable to get any kind of overview at all, let alone develop helpful advice for designers. So any general statement (theory, model or method) about design must sacrifice some realism for the sake of clarity.

Case studies and anecdotes from practice can feel much more 'real' and appealing, and in their richness they can be of great help to designers. In such accounts design is described holistically, nothing is left out: process, people, design problem and the context of the project are all included. This makes a well written case study a pleasure to read, much livelier than any abstract theory on design will ever be. However, the drawback of case studies is that it

is difficult to pinpoint what you should learn from them. People can interpret such 'rich' stories in any way they want, and they can always be interpreted to confirm your preconceptions.

I have approached this dilemma by dividing design into small subjects, and looking at design from many different angles. These facets of design can be described in one page which is meant to be clear, concrete and succinct. All these pieces together then form a general but detailed picture of design, much like an image is built up out of many coloured pixels.

Thinking About Design

THE PLEASURE OF ABSTRACTION

Since the real world is much too chaotic for us humans to understand clearly, we use a trick called abstraction. In considering something in an abstract way, you try to ignore all unnecessary details. Abstracting is a process of putting things between brackets.

Design researchers who have developed models of designing have done so by focussing on the dynamics of design processes, and they 'bracketed' everything else. They completely ignored the properties of the designer, the design problem and the design situation. The various phase models of design are examples of this limited way of thinking. It is claimed that these models are purely process-oriented, and that they could therefore be applied by all designers to all design problems in all design situations. These sweeping claims are part of the pleasure of abstraction.

These abstract models of design take many steps back from a direct design experience to reveal patterns in design processes. They are extremely useful for managers because the patterns enable us to 'objectively' control design projects much better than before. But they are so abstract, so far removed from what designers experience, it is like they are looking at design from the outside. They are never going to help us inside a design project, working

through our problems and solutions. They are about controlling design processes, not about doing design.

THE PROBLEM OF APPLICATION

Can you talk about design in an exclusively process-focussed way and still make sense? You ignore so much that is interesting, and also difficult, about designing. The art of design is all about the intricacies of choosing the best actions to take in a concrete design situation, which very much depends on the specific design problem you are dealing with and your own abilities. The art of design is linked to the designer, the design problem and the design situation, not just to the process of designing.

The big trouble with abstraction is that people tend not to go further. Once they have bypassed the messy details of everyday life by developing a wonderful theory or method that works within the abstracted world they constructed, they leave it at that. They present the method to the world as a new piece of truth, write a book about it and start a lecturing tour.

But this is where the real problems start for practitioners. By abstracting, theorists put many aspects of reality between brackets. When applying such a method in real life, those aspects that they conveniently left out come back to haunt us (us, not them!).

Sadly, design research is no exception to this. Most design methods that have been developed over the years are basically correct in what they say. But they are very hard to apply successfully. What we miss is a manual with instructions for use, linking the method to our own concrete design situations. When should I apply a certain method? When is it not appropriate? How should it be applied? Often it is not even clear what the consequences are of using it.

This is why most design curriculums are built around a lot of design project work. Let students live their own case studies, and have an experienced designer come in to help make sense of them.

Thinking About Design

SCREENWRITING

Theoretically, it should be possible to establish detailed methods for design practice, if only we would be able to combine our knowledge about the design process, the design problem and the designer into a coherent whole.

I never thought this was realistic, though, until I read the *Screenwriter's Workbook*. In this amazing little book* Syd Field presents the rules of practice for writing a (Hollywood) film script. Based on a detailed view of the dramatic structure of a movie, a keen knowledge of the writing process of a scriptwriter, and his feeling for the motivations and troubles of an aspiring writer, he delivers a very detailed description of the writing process. The method that he constructs using this description is unabashedly prescriptive and almost aggressive in its assertiveness: after your initial idea has been developed, you should write a four page summary. 'Not two pages, not ten pages, but four'. And he gives valid reasons for all his golden rules. He knows how many acts and scenes it takes to tell a story, and that the main dramatic development, in the middle of the movie, will take place on page 60 of your manuscript.

Of course, this all sounds like a much too restrictive framework for a writer to work in. You suspect that his method could only lead to very banal, standard movies. But the examples Syd Field gives are very diverse, and include some movies you really liked and experienced as being original. It is not easy to dismiss his method, because apparently he really does know how these movies work.

There is no fundamental reason to assume that something like the *Screenwriter's Workbook* would not be possible for other design fields. But do we want such absolute methods?