Thoughtful Interaction Design

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A Design Perspective on Information Technology

Jonas Löwgren and Erik Stolterman

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There are many ways to describe the uniqueness of design, and many theories explaining what design is really about. Such theories usually focus on a specific aspect of design, such as creativity, teamwork, management, social aspects, aesthetic or ethical aspects, or analytical or visual thinking. Some have even tried to capture the whole design process in a complete model or methodology. In the information technology (IT) field, there are many such theories, all possibly valuable and useful. But they can never be comprehensive or complete in any sense. Anyone who tries to "use" or "follow" these theories or models must understand their inherent limitations.

We believe that the design process is too complex and diverse to fully describe in any universal or general way. At the same time, however, we realize that a designer needs a description, model, or theory that can help her plan, organize, navigate, and evaluate her work. All this leads to the conclusion that in order to be able to "use" explicit theories and models, the designer has to remain critical. The designer needs to be critical toward any description of the design process, and to appropriate aspects of it rather than adopt it completely. This is the *thoughtful design stance* advocated in this book. The designer has to rely on her own reflective and critical mind, based on a thoughtful understanding of how design can serve a purpose.

Our description of the design process will not be in the form of a method, techniques, or distinct phases. We will try to portray the process by focusing on some aspects that are not usually addressed in IT design methodologies. Our purpose is to show how these aspects are to a great extent the basis for a thoughtful understanding of the design process. They form a set of starting points from which theories and methodologies can be evaluated and examined, appropriated, and brought to use.

Our main focus is on the early parts of the design process. This is where the designer gets involved in design work, establishes a preliminary understanding of the situation, navigates through available information, and initiates all necessary relationships with clients, users, decision makers, and so forth. Based on all this, she creates a design proposal.

In the first section of this chapter we present a brief overview of the scope of the design process from initial idea to final specification (see figure 2.1). We then discuss the design process as a *thinking* activity and as a *social* activity. We conclude with some comments on how the process can be organized and managed.

2.1 From Vision to Specification

A design process begins in the moment when a designer is "thrown into," or thinks about, the environment where she is supposed to act, or in the moment when she is assigned to a particular design task. This is usually the moment when the designer is exposed to the background material, a problem statement, a list of requirements, or a task description for the first time. In some cases, it might be the designer who initiates the design process.

We want to emphasize that the design process begins earlier than what is usually realized. In traditional methodologies, particularly within fields such as information systems development and software engineering, the process does not formally start before a plan is in place and there have been several meetings about what is supposed to be done. However, the actual design work has begun much earlier. This is especially true in regards to the *design of the design process,* which may well be the most important design work in a typical project. In the design of the process, which takes place very early in a project, it is decided to what extent the process will focus on early phases, creative and innovative work, new technology, the organization in question, users, the needs of the client, analysis, and specification. These early decisions create the "container" and the conditions for the subsequent process.

Our message is that this kind of design of the design process requires *thoughtful design*. It entails reflecting on the larger picture, the overall role of the design work, the approach to be used, the need for skills and competence, and so on. Dealing with such complexity demands a critical and reflective mind—the mind of a thoughtful designer.

Before focusing on the actual design process, we have to touch upon some fundamental aspects of the process. They are fundamental because they cannot be separated from the process and do not belong to a particular phase or activity. They are present throughout the process. One of these fundamental aspects is the *recurrent leaping between details and the whole,* or between the concrete and the abstract. In many cases, the designer has strong initial ideas about what should be done, or what constitutes an innovative solution, but is also facing a very chaotic situation that requires a practical solution. It is then necessary to move rapidly and repeatedly between the world of ideas and the concrete reality of the design situation. Sometimes, this process can seem cum-

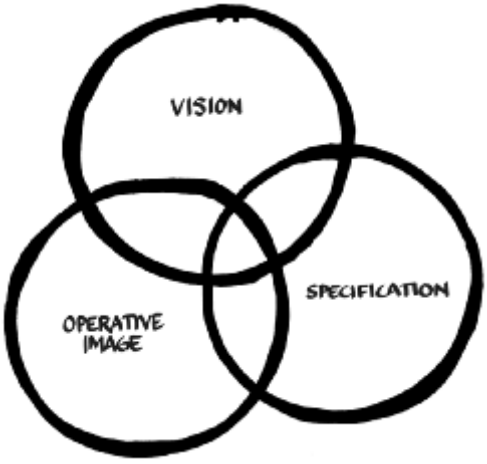

Figure 2.1
The three abstraction levels of the design process influence each other in a fully dynamic dialectical process.

bersome and an obstacle to creating a good design process, but it is in fact a necessary and natural part of design work. Accepting this reality and dealing with it is better than hiding behind a model of design work that appears rational or logical.

Another fundamental aspect is that any design process is characterized by *dilemmas*. A dilemma is not a problem in the logical sense, since it does not have one given solution. In fact, it does not have a solution at all in the most basic sense of the word. Instead, we know that something is a dilemma when we realize that the situation involves choices that all lead to unsatisfactory solutions. The complexity of design and the nature of dilemmas make creativity fundamental. In a dilemma situation, there is no chance that we could simply find a solution within the existing framework of the situation, because there is no solution hidden in the situation. Instead, a dilemma can only be resolved by a creative leap, by transcending the limitations of the present. Since design is inevitably concerned with dilemma situations, creative thinking becomes one of the fundamental aspects of the process. So, both the leaping between details and the whole and the creative transcendence of given boundaries have to be seen as underlying all the other aspects of the process we will discuss in this chapter.

We distinguish among three levels of abstraction in early design work: the vision, the operative image, and the specification. When a designer is confronted with a design situation, a *vision* emerges. If the designer is experienced, an initial vision will probably emerge very early in the process, especially if the situation reminds her of similar

situations from previous design experiences. Even if we view the vision as something emerging, it comes from the mind of the designer. However, we want to point out that a vision is not necessarily a conscious and deliberate decision. On the contrary, it often seems to be an intuitive, immediate, and almost instinctive reaction to the situation at hand.

The way we define a vision is not as a solution or a specification. It should be thought of as a *first organizing principle* that helps the designer to structure the initial attempts to respond to the situation at hand (Nelson and Stolterman 2003).

A vision can take on different forms. It can be a preliminary idea about a basic technical solution or an infrastructure, a thought about an essential function in a new design, or an image of a certain style or form. At this early stage, the vision is only in the mind of the designer and it is usually sketchy and diffuse.

As an example, we can imagine a designer who meets a new client for the first time. The designer is told that she is expected to create a new solution for the company's internal database of all employees. The client tells the designer how things work in the present situation and why they are considering a new system. The basic argument is that they have several systems that do not communicate, which means that when information about an employee is changed, it has to be updated in many different places. Depending on who the designer is, different visions might emerge. To one designer the vision might be a "unified database," to someone else an "improved user interface," and to yet another a "technical infrastructure." These or other visions will follow the designer through the design process and influence her analysis, studies, ideas, thoughts, and proposals.

A problem, and at the same time a strength, of a vision is that it is *elusive* and *contradictory*. In the early stages of design, there will be several visions "fighting" to be realized. The early design process is more or less a chaos of conflicting visions, of details struggling to become part of a whole, of practical circumstances causing "damage" to abstract ideas. A typical example is the vision based on the idea of a specific form and the use of a specific material. As is often the case, it might turn out that the envisioned form cannot be implemented with the envisioned material. So, even if the vision actually guides the design process, it might also be contradictory.

Contradiction is not necessarily a bad property of a vision. In fact, the strength of the vision may lie in its contradictory nature. Within a contradictory vision, different and opposing ideas can be held together and support the designer in her subsequent work. The fact that a vision can simultaneously be diffuse and detailed, abstract and concrete, makes it a conceptual tool that helps the designer in working with complex real situations where many demands and desires struggle to be fulfilled. Ultimately, the vision is the designer's first organizing principle.

During the next stage of the design process, which typically lasts a relatively short time, the designer develops an initial version of the *operative image*. The operative image is a first externalization of the vision. It starts out as a diffuse image and is usually captured in simple sketches, sometimes with the help of metaphors or analogies. As the process continues, the operative image is given more defined shape and becomes a more solid foundation for design work. This development unfolds as a dialectical play between the situation at hand and the operative image, and between the operative image and the vision. Since all three of these things can be quite different in character, structure, and level of detail, the dialectic relationships function as an "engine"—catalyzing or releasing energy that can be transformed into new ideas.

The tensions among the situation, the vision, and the operative image have to be overcome, which "forces" the designer to be creative. An important implication of our conceptualization of the design process so far is that it facilitates or necessitates creativity. This is in contrast with views of design where creativity is seen as the starting point of the process. For designers, our message might be helpful. It says that design is not necessarily a process where a person sits down and waits for the creative spark or insight that will tell her what to do. Instead, it says that a designer has to delve into the situation, and all its dilemmas and complexity, with an open mind. If she is sincere in her approach, she will come up with a vision and can start working on an operative image. When the designer has reached that point, the complexity in the relationships between the situation, the vision, and the operative image will "force" creative work, which then tends to come naturally in response.

The operative image is probably the most important part of the design process. It has the function of bridging the abstract and elusive vision to the concrete and complex situation. Both the vision and the view of the situation will change over time. When new details are added to the operative image, the situation will look different. They will also influence the vision and vice versa. What finally decides how this process will move forward is the designer's ability to refine the operative image.

The operative image is usually stabilized at the time when more visible and "productive" design work begins. In the structured work following the initial phase, the operative image will be put to test. It will be challenged by new conditions, restrictions, demands, and possibilities. The image becomes increasingly detailed and complete.

Many times a designer will feel that the operative image has to be changed into something inferior—that is, the distance from the original vision increases instead of decreases. This usually happens due to changing conditions or the fact that the designer actually decides to alter the vision. As the designer learns more about a situation, new ideas and possibly new visions will arise.

A defining quality of the operative image is that it is operational. This means it will have an explicit form that enables manipulation, simulation, and visualization. Perhaps most important, an operative image enables communication. The operative image will become ever more detailed through all these procedures and is eventually transformed into a specification of the final design.

In the example mentioned earlier where the vision took the form of a "technical infrastructure," the first operative image can be created with simple structural sketches that capture the relation between parts and the whole. Initially, the sketch is crude and can hardly be called a design. Perhaps consisting of simple lines representing an envisioned structure, the sketch can still be used in discussions with other designers and participants. If the designer instead started with an "improved user interface" as the vision, the process would have taken a different path. The operative image could then be realized in sketches of screen layouts and a structure of user functions. It is not possible to say that one way is wrong and the other is right, since that would require a well-defined problem with a solution that could be measured in terms of correctness. In real design situations this is never the case. In this example, both a technical infrastructure and an improved user interface are possible operative images and can only be judged as good or bad in relation to a vision, the particular design situation, and the overall purpose of the design process.

When the operative image is sufficiently detailed, the person formally responsible for the design process makes a decision that it will function as a *specification* of the final design. After this point, another process begins which can be labeled the construction process. During this stage, the task is to produce a concrete and final artifact, based on the specification. Even in this step, many new design issues will appear, since new demands, problems, and opportunities will arise. There is no clear division between design and construction. In the design process, there will always be considerations based on constructional issues, and in the construction process new design situations inevitably come up. In the previous example, the final specification will probably be closely related to the predominant vision. In the case where the vision is based on the idea of a new infrastructure, the final specification might be focused on the envisioned technical platform and how the present system might be moved and adapted to the new infrastructure. In the case of a vision based on an improved user interface, the specification will probably be built around the specific interfaces and focused on how the present system can be adapted to the new form.

At this stage, it is important to state again that we are not talking about a linear process nor an iterative process. Instead it is a *fully dynamic dialectical* process. The vision, the operative image, and the specification influence each other continuously.

The fact that all of this happens at the same time does not in itself prohibit an understanding of the design process. To the contrary, our highly relational and reciprocal description corresponds well with the image of the design process given by many professional information systems designers (Stolterman 1991). Practicing designers usually find it very difficult to separate certain steps or phases of the design process. To them, it is all about a process where you move from a complex and open situation to a more focused and operational one.

It is this web of relationships in constant change and development that we call the *design process*. In different parts of the process, the designer makes choices on how to acknowledge and handle the complexity of the process. To an artist, working in a highly creative process, the dynamics of the process might be the dominant experience. The artist modifies sketches, which lead to new ideas about the artwork, which in turn affects the ideas the artist want to express, which influences subsequent sketches, and so forth.

In other processes, such as in engineering, most participants would agree that complex and dynamic relationships between the vision and the operational image receive full attention in the very early phases of the process, while they are later suppressed in favor of a much more controlled process. In a field such as engineering, the idea is to stabilize the specification as soon as possible, by fighting changes and influences that might challenge it.

The way that a generative task is approached—whether as an engineering problem, an artistic exploration, or an intentional design process—is a choice that has important consequences for how the design process can and will be conducted. Even though we cannot judge one of these three approaches as generically better or worse than the others, we do know that the responsibility lies with the designer. In every design situation, even when taking into account all restrictions and limitations, there are still an unlimited number of possible visions and operative images. A design situation can never be restricted to the extent that there is only one solution, because if that were the case, it is, by definition, not a design situation.

2.2 Design as a Thought Process

So far, we have described design on a more conceptual level, but it is also a process of thought in the mind of the individual designer. When we focus on design as a thought process, we do this from the perspective of thoughtful design. This means that we will not take a prescriptive approach, but rather introduce certain aspects of design thinking that might seem strange and perhaps irrational. The idea that underlies this chapter is

that to be good at design, you have to understand what seems to be the "nature" of design thinking. Of course, there is no "natural" way to do design, but there are recurrent and common characteristics in the design process. The perspective of thoughtful design implies that the first prerequisite for change and development in design thinking is to have a deeper understanding of design as such. Armed with this kind of knowledge, it is possible to start "designing" your own way of design thinking.

2.2.1 The Problem and the Solution

One of the most fundamental things to know about design is that an understanding of the design situation is established in parallel with the first design proposals. At the same time a designer starts to formulate a problem—that is, a specific interpretation of the design situation—a solution is also formulated. Note here that we use the word *problem* to refer to a designer's current understanding of a design situation, and the word *solution* to refer to the designer's idea on how to shape her intervention in the situation. This is in line with common usage of the terms in design, but different from the logical notion of a problem as an exhaustive specification and a solution as an answer that can be either right or wrong.

A common idea in IT fields such as information systems, software engineering, or human-computer interaction is to assume that the timeline demands the problem to be clearly defined before a solution can be devised. However, we have already mentioned that a vision is formed at the very first contact with the design situation. This vision will change, develop, be criticized, and maybe rejected in favor of some other vision, but it is certainly present and is going to affect the thinking and decisions of the designer. The vision even influences what the designer chooses as a foundation for the work and what is deemed important enough to require analysis. In a design situation, there is never enough time to examine and analyze everything with equal care. Decisions and choices have to be made, and the vision influences all of these decisions and choices.

It is also not possible to finalize a description of the design situation without simultaneously working with a solution proposal. There is no way a designer can say that she understands the situation before having struggled with ideas for solutions. Through this work, new insights on the character and nature of the situation are gained. In this sense, the search for design solutions is also a way of revealing the design situation.

Donald Schön has influenced many design thinkers with his ideas on the nature of practical, action-oriented knowledge. In his work, Schön (1987) focuses on professional design fields where there are no right or wrong answers, only actions and consequences. He discusses what knowledge is needed and how it is used and creates an outline for an idealized design process that looks like this:

- It starts in a situation where the actor applies common concepts, strategies, and interpretations of what she sees and formulations of what she is planning to do. The actor does not spend a lot of time and energy in the determination of what strategies and interpretations to use. It could be argued that the knowledge is "tacit" in the sense that the designer will probably not be able to describe it, only to act in accordance with it.
- Then something happens: A well-known action leads to a result that in one way or another surprises the actor.
- The surprise makes the actor reflect on what happened and what caused the unexpected result. The reflection is more or less conscious, but maybe not expressed in words. The actor tries to relate what she sees to similar situations in her previous experience.
- The actor's reflection is a questioning of the familiar assumptions that were the basis for her decisions and actions. In this new situation, she can rethink her strategies for action, create new interpretations, and formulate new agendas for what to do.
- The new ideas are used as a basis for improvised experimentation, where the actor tries new actions to explore the unexpected result, test her understanding, or evaluate new ways of doing things. These experiments can create new surprises.

Schön's description of this chain of events is not strange or difficult to comprehend, and it helps us to understand some important aspects of what it means to approach a design situation. Schön describes this approach as a kind of *conversation* between the designer and the situation. The designer asks questions of the situation—through actions or "design moves" rather than words. She listens to the replies and adapts her further actions accordingly. This can be understood as the designer's way of testing her vision against the situation.

If design is understood, in Schön's terms, as *reflection-in-action* and *reflection-on-action,* it is easier to understand why the problem and the solution have to evolve in parallel. While trying to solve a problem the way we currently understand it, we create situations that will surprise us; that is, we will *learn* something we did not know. These surprises, this learning, form the basis for the questioning and development of new creative solutions. This kind of learning cannot be achieved without working with solutions, since we need them to find out if we are moving in the desired direction. Another argument for this kind of experimentation with solutions and creating surprises is that it reveals the knowledge that we might possess in tacit, or at least hitherto unarticulated, forms. It forces us to find out things, not only about the situations in question, but also about our own knowledge and ourselves.

So design should be seen as a conversation with the situation and as experimentation where we as designers have to be good "listeners" and "readers" of the situation.

The psychologist James Hillman (1996) talks about the *authentic attention* needed to fully grasp the reality around us. The relevance of this concept for our discussion is that a designer needs to understand the situation she is supposed to change with her design. The notion of authentic attention involves a special way of approaching reality with *carefulness* and *concern*. If a designer does not take this approach, important knowledge that can and will affect the success of a proposed design will be lost.

Carefulness and concern help the designer to recognize alternatives and to be prepared for unexpected events and insights. First of all, they show how the designer's own actions are a natural part not only in a learning process, but also in a knowledge creation process. In this sense, *good design work is knowledge creation and production*. Its ways and conditions are different from those of research, but it is a powerful way of producing knowledge.

As designers, we have to be aware that we can, and have to, work with several different visions and operative images in our exploration of a design situation. We have to accept that there are no problems to take for granted and no given solutions to be deduced. We create "problems" and "solutions" at the same time and in parallel, in a process where they coevolve.

For example, assume that an interaction designer is confronted with a situation where the client has a problem: The internal network used in the client's company cannot manage the present demand for communication capacity. Based on such a problem statement, the solution is obviously an increase in the capacity of communication channels. But if the designer questions the problem-as-stated, other solutions may appear. For instance, the designer might investigate the situation underlying the original problem statement and find that changing the design of the information management procedures currently in use can drastically reduce the need for communication capacity. In this new situation, the problem is no longer the capacity of communication channels, but rather the ways in which the company manages information needs and information flows. This new "solution" does not only indicate what could be done, it also helps to create new knowledge about the present situation.

Being a designer who works like this requires *courage*. It takes courage to avoid the simple solutions, to challenge the present situation, to oppose simplistic interpretations of what makes a proper solution. A common reaction is to question why a designer should spend time and money on exploring a design situation when the problem is already obvious. Such a reaction is not based on a proper understanding of design. A thoughtful designer is someone who knows the limitations and opportunities of design and understands how to handle them in a unique design situation. It is someone who understands that design is a thinking process, which means that almost everything of

importance in a design process is a result of thinking rather than preconditions, limitations, or "obvious problems." If necessary, a thoughtful designer takes on the responsibility of educating the client, users, or anyone else involved in the process, in order to better facilitate a thoughtful design process.

2.2.2 The Process and Levels of Abstraction

From a distance, a design process might look like a straight line from the abstract to the concrete—that is, from the vision, via an increasingly detailed operative image, to a complete specification and a final product. But, if we take a closer look at this "straight line," we will find that it shows a completely different structure. The path moves up and down, from abstract ideas about a vague vision to very concrete work on a specific detail. What seemed to be a straight line is only the mean value of the process over time.

The path of the design process over time is illustrated in figure 2.2. The up and down movement can be interpreted as a consequence of reflection-in-action and reflection-on-action. Design moves result in surprises, forcing the designer to reconsider her basic assumptions. A surprise may occur during work on a concrete detail of the project and overthrow decisions already made at a more abstract level.

The path of the process shows that design is not about logical calculation or deduction from a given situation to a given solution. Empirical design studies show that designers' sketches in the early phases of the process are extremely *ad hoc* and appear random to the observer. In these sketches, one can find attempts to visualize fundamental structures or forms. At the same time, there are sketches showing the very specific solution of a detail or the choice of a certain material. For instance, when a designer is thinking about a new digital artifact, her first sketches might be details describing the

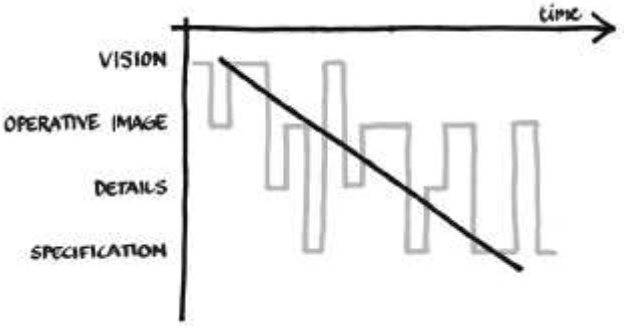

Figure 2.2
The design process as a whole moves from vision to specification, but the path is not straight and linear.

layout of specific screens, simple boxes and lines representing the overall information flow, or a sketch of the actual physical room where the artifact will reside. To an observer, this mix of sketches at different levels might seem irrational, but for the designer, they all connect and influence each other.

The apparently erratic path of the design process might seem unreliable, perhaps even scary to the inexperienced designer. Since the up and down movement and changes in course are not an explicit part of most design methodologies, the inexperienced designer might feel as if they are "wrong." The truth is that change happens in every design process. There is nothing wrong with it; rather, it is a consequence of the concepts we have introduced earlier in this chapter. It is a sign of the way in which a designer approaches a situation, explores possible actions, and expands available knowledge.

2.2.3 Questioning

We have already touched upon the necessity for the designer to ask questions and critically examine assumptions and preconditions. In design work aiming at innovation, this becomes even more important. Asking questions is not only a way to learn more about the preconditions; if done seriously, it is a way of challenging the whole understanding of the existing situation. When a client tells a designer to solve a problem, a fundamental reaction is to ask why.

The "why question" challenges old ideas that have settled over time and opens up new avenues of thought. On many occasions, it may sound a bit silly to ask why, but this can be seen as a sign that the question has actually reached an assumption that is elevated to truth status by tradition. To challenge the truth always sounds a bit silly, but a designer should not be afraid of looking silly sometimes. It might be necessary if you really want to understand the conditions of a design situation. Here is a small example:

Client (C): I need a digital calendar. Can you design one for me? What would it look like?
Designer (D): Why do you need a digital calendar?
C: I can't fit all my meetings in the small calendar I have now, and I still want a calendar that is small enough for my pocket.
D: Why can't you change your work so you don't need to go to all those meetings?
C: Well, it is my job. . . . I just have to.
D: Why do you need to carry your calendar in your pocket?
C: I don't want to go back to my office between every meeting.
D: Wouldn't it be a good idea to organize your work so you could have a short break in your own office between meetings?

This conversation may sound a bit embarrassing to most people. The designer asks seemingly unnecessary questions, but in some cases the answers can uncover unseen and alternative solutions. The role of the designer changes with this approach. Instead of being someone who only reacts to the ideas of a client or user, the designer becomes an actor in a larger social context. This also changes her relationships towards clients, decision makers, users, and other stakeholders. It is not necessarily true that the client or the user knows everything. This approach of questioning becomes a way to challenge the very reason for the design process to take place. When that happens, it opens up many new designs and alternative solutions. The design is no longer a problem-solving activity, but a truly creative and innovative process.

2.2.4 Degrees of Freedom and External Representations

Many designers find it frustrating not to be able to start from scratch. This frustration is caused by a wish for the ideal situation where nothing is given and the creation of the whole and its details is open and unbounded. However, such wishes are based on a romantic ideal that never exists. Moreover, if such a situation could exist, it would actually not be an ideal but more of a designer's nightmare. A common assumption is that it is easier to design with more degrees of freedom. It turns out that facing a design situation where everything is possible requires an enormous effort from a designer. Everything has to be designed; every precondition, goal, restriction, and limitation have to be created and decided. Nothing is given.

An independent artist is probably the one who lives closest to an unbounded creative situation. Many artists have considerable freedom from external requirements about what to do, how to do it, when to do it, and why. At the same time, however, we know that artists usually restrict themselves quite forcefully by choice of material and form of expression. To make the choice to express a feeling by carving a specific form from a rock, without the use of high technology or colors, restricts the artist significantly. Such choices are not made to limit creativity, but rather to cultivate it. When everything is possible and nothing is given, creativity has no friction, nothing to work with, nothing to build on. Creativity is strange in that it finds its way in any kind of situation, no matter how restricted. Metaphorically speaking, the same amount of water flows faster and stronger through a narrow strait than across the open sea.

Designers always work within restrictions and limitations. Examples of such restrictions, typically imposed by external forces, are budget, time limits, and resources available to the design process. One task for the designer is, of course, to seek ways to manage restrictions and maybe sidestep them in creative ways. A good designer is therefore

someone who has the ability to work in a highly restricted situation and still be able to create surprising and satisfactory solutions and designs.

In order to cope with a complex design process, a designer needs to *externalize* the actual design thinking through representations: sketches, drafts, models, and the like. Design research has shown that most designers use some kind of external representations, such as sketches, in their work. These external representations are carriers of the first ideas, of the thoughts that emanate from the vision. They are the first seeds that will form an operative image. Many designers start sketching at the same moment they are introduced to a design situation. The sketching does not necessarily follow any plan or method. In most cases, it is a way to create material to work with.

One explanation for this behavior can be found in the writings of Schön. As we outlined earlier, Schön suggests that there is an ongoing conversation between the designer and the situation. The representations (sketches, drawings, and so on) can be understood as tools for thinking and as mediators in the dialectic relationship between the vision, the operative image, and the situation.

With the external representations, the designer carries out a dialogue about the design situation and solution ideas. The lines on the paper or the shadows in the model give the attentive designer rich information. It is easier to evaluate ideas when they are objectified and externalized. They move out of the vague and abstract realm, start to live their own lives, and have conversations with the designer. As long as ideas reside in the mind, it is difficult to see their limitations and spot their incoherencies. Sketching is a way for designers to bring their thinking out in the world and expose it to inspection, contributions, and criticism by others. At the same time, sketches become tools for the designer to further develop her ideas.

Even though sketching has different characteristics in various fields of design, it is possible to recognize its three basic purposes: (1) to form ideas, (2) to communicate with oneself, and (3) to communicate with others.

Forming Ideas Sketches can be used to stimulate creative thinking, by opening up new possibilities and combinations of ideas. In many cases these openings and combinations can be difficult to see without external representations. Sketching can also be used to structure one's thinking, test the logic of a proposition, outline restrictions, dependencies, and relations, and handle many proposals at the same time. In sketching to form ideas, speed and lightness of hand are often of the essence. Many designers use thumbnail formats in order to keep the sketches fast—and sketchy.

Communicating with Oneself When ideas are externalized, that is, brought into the world, it is possible for a designer to view her own thinking in a new way. She has something to react and respond to, and is relieved of the hard task of being proactive and inventive from scratch. It becomes possible to reflect upon something that exists. The sketch works as a conversation partner by presenting resistance, drawing the designer's attention to previously unseen properties, revealing obstacles and openings, and talking back to the designer.

Communicating with Others Perhaps the most obvious purpose of a sketch is to function as a tool for communication with others. Sketches express our thoughts and a design team can work together by developing something that they can all see and discuss. Even if the sketch is not understood or interpreted by all members of the team in a uniform way, it still serves as a focus for further critique and discussion.

The importance and understanding of sketching in the design process can hardly be exaggerated. Practicing sketching, developing new sketching techniques, and inventing new externalization tools are fundamental in design learning. It is the way designers present ideas, form suggestions, test their proposals, and communicate their visions. It is at the core of the design process.

2.2.5 Exploring Design Possibilities

In discussions of design, the terms *convergence* and *divergence* are often mentioned. These concepts are used to capture two basic approaches in design thinking. Divergence is an approach where the designer expands her thinking to cover broader issues, find more alternatives, and explore more opportunities. It is a process that creates more information and options. Convergence is about focusing on a specific solution or a synthesis of several ideas. Convergence creates a deeper understanding and a more detailed and narrowly focused proposal. Since the final outcome is usually an artifact, a system, or a specification, the design process always ends in a convergence phase with the focus on one specific solution. This, however, does not mean that the whole design process is a continuous convergence from the broad initial situation to the narrow final solution. Rather, a design process is driven by the will to learn as much as possible about different opportunities existing in a particular situation.

Moving forward in a design process usually means that the designer has to explore as many possibilities as time and resources allow. Consequently, the early design work is often primarily a divergent activity, where several ideas are developed instead of focusing on a single one. The aim is to explore the spaces of possible designs and problem formulations.

Divergent thinking—considering several ideas in parallel—has an important practical advantage. In a design process, it is not uncommon for a designer to "fall in love" with a favorite idea and defend it by refuting all criticism from other team members. Sometimes people push their own ideas farther than they deserve to go. The design process can degenerate into a case of personal pride where nobody wants to lose. By working with several ideas in parallel, however, it is possible to avoid this trap. A more desirable situation is where ideas are not closely related to individual participants, but exist in their own right as alternative or complementary proposals. Recognizing the possibility that there might be several equally satisfying solutions in a design process is necessary in thoughtful design. To be thoughtful is to acknowledge your own limitations and to welcome possibilities presented by others. A thoughtful stance is characterized by a will to explore design possibilities, even when an apparently sufficient proposal already exists. Innovative ideas and creative solutions take time, in particular when it comes to finding out how new ideas can be integrated into an existing situation.

2.2.6 Capturing the Design Situation

Every design addresses a specific context. A new design will become a part of an already existing reality. All qualities of a new design have to fit the environment where it will be placed and used. For this to happen, a designer needs to have knowledge and insight about the context where a design will end up. In this sense, a designer is a researcher exploring the reality that constitutes the design situation.

Whenever we try to study the world around us, two aspects become crucial. One aspect is our understanding of what constitutes reality—our ontology—and the other is what we believe is possible to know about reality—our epistemology. These two notions significantly determine how we will approach the study of the existing reality. Our ontology influences what we consider to be important aspects and dimensions of reality and our epistemology determines in what way we believe it is possible to acquire knowledge about reality.

For instance, if we believe that the world consists of layers where the underlying layer determines and explains the one above (e.g., that psychology can explain sociology), we have an ontology that tells us how the world should be approached and studied in order to be understood in a correct way. Questions of possible ontological and epistemological assumptions have been studied in philosophy for centuries. These discussions have influenced how scientific research is carried out today; they have also been influential in determining what are considered good ways of exploring a design situation.

Even though the work of a researcher and a designer are similar in the purpose of trying to understand reality, there are also differences. A researcher who wants to understand the behavior of a group or organization has the ultimate purpose of revealing the fundamental structures and processes determining the behavior. For a researcher, the most important criterion is that the acquired knowledge is true, or at least the best and most credible explanation at a given time. As a consequence, a research result is evaluated in part based on the way the study has been carried out. If research is done according to the scientific method (which does not denote a single method or approach, but rather a majority view on appropriate methods of inquiry for different classes of knowledge interests), then its result is correct.

To a designer, truth is not as crucial. In design, it is necessary to create an image of reality that makes a good foundation for design. What to include in such a foundation is one of the most important questions for a designer to answer. Since a design situation can be approached from any aspect (ethical, functional, aesthetical, structural, material, experiential, and so on), a designer has to make a decision on what needs to be studied most carefully and which dimensions of the situation will have a real impact on the design process. A designer is working within the restrictions made up by the specific task and its limitations, while a researcher has a broader perspective and pays attention to everything that might influence the findings. Crudely stated, a researcher is interested in reality whereas a designer is interested in what reality could become.

These different mindsets create distinctive preconditions for the methods and techniques that can be used to study reality (that is, the design situation). The main point here is that a designer has to be *intentional* and *careful* in her choices of how to approach reality. There are many decisions that have to be made. First of all, she has to decide what dimensions of a design situation to examine. Other issues include how much information is needed, what techniques and methods are suitable, and how much time is available. The overall question is how much the designer needs to know about the present design situation in order to have a good foundation for the design work. In a practical, work-oriented interaction design situation, main questions might concern how much we need to know about existing work practices and procedures, the IT system presently in use, the users' competence and knowledge, the information content being manipulated, existing technology infrastructure, the surrounding organization, the management, and so on. It might be that most of these issues are unimportant, but decisions about them have to be made nevertheless. Most of these decisions are never based on conscious reflection, but we believe that if the designer is aware of the decisions and why they are made, it makes the design process more open and creates room for creative decisions.

2.2.7 The Final Composition

When an understanding of an existing design situation is obtained, and a vision and operative image are developed, then the two elements—the present and the idea of the future—have to be combined into a single design. Designers are often measured by their creativity and innovation, but in this context we want to emphasize the importance of *composition.*

The design process always results in a composition where all aspects, dimensions, ideas, limitations, and opportunities have to be molded into one design. A design is not finished until the outcome of the process is composed into a whole within the context of the existing situation where the design will reside. The purpose of any design is to change existing reality into a reality that we find more desirable. That is why no design can be truly evaluated before it is implemented.

A digital artifact cannot be judged as a good design unless the designer has composed a whole of the artifact and the use context. Of course, it makes a difference whether the artifact is a consumer product or a product for a specific client. In both cases, however, there is a composition that will be judged as the final outcome of the design process.

Composition is a delicate task involving *balance* and *contrast.* The purpose is to compose a whole entity out of existing and not-yet-existing reality. There is a need for balance between new and old, technical and non-technical, and function and form. There is also a need for contrast so that components are distinguishable units, complexity is reduced, and that it is possible to navigate in the new reality. Composition is very different from "pure" creativity, since it might be the case that it is not the perfected part that is most crucial, instead, it is the composition of all parts that matters most. It takes a lot of courage to decide what makes a whole into a composition, what needs to be part of that whole, and what can be removed.

We all know of examples when a designer of a digital artifact finds it hard to understand why the users do not want to use her "perfect" design. The users fail to find the artifact useful since it does not create a meaningful whole together with their existing reality. When this happens, it does not matter how perfect the design is by itself. In the design situation, it will be judged as a part of a whole composition.

Thoughtful design is about this realization of the whole and the vital importance of compositions. Being thoughtful means being humble when it comes to smart solutions and focusing on thoughtful compositions.

2.3 Design as a Social Process

Designers rarely work alone on design projects, and interaction design is no exception. The scope of a design project is usually so complex that one person is not enough. There

is a need for a diverse set of competences, which is typically hard to find in one individual. Consequently, the design process is almost always a *social process*. As a social process, it has to be managed and organized. All people involved need to know what to do, when to do it, and with whom they need to work. Issues of responsibility, accountability, and power invariably emerge. The design process must therefore be seen not only as a process of thinking, but as a management challenge as well.

A simple way of sorting out the stakeholders involved in design projects is to introduce a three-layered structure (see figure 2.3). At the *core,* we will find the professional designer together with the users and clients directly involved in the work. The *periphery* includes the users and clients not actively participating in the actual work, together with all other stakeholders. The *context* is the surrounding environment and society at large that is not directly involved in the design process, but still influences it in indirect and complex ways.

The idea of three circles of involvement is, of course, oversimplified, but it highlights the complexity of managing the design process. It is, for instance, not possible to manage design by focusing only the core circle alone. Successful design requires a recognition of the intricate relationships between the circles, as well as managing the processes within each circle.

First of all, the design process has to accommodate the fundamental aspects we have already discussed, such as the relation between the vision, operative image, and specification. All parties involved in the process—that is, all circles—will influence the development of the final design. There is a need to manage these relationships in a way

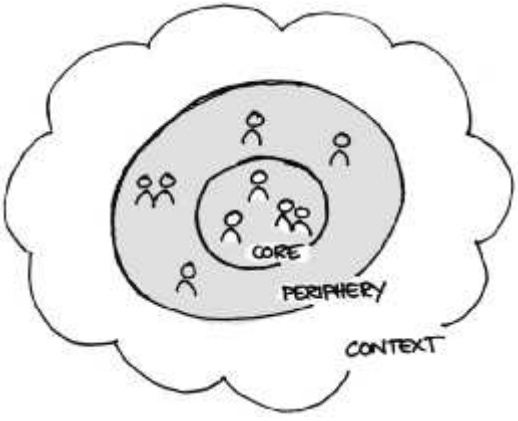

Figure 2.3
The three circles of involvement.

that acknowledges the role of the vision, that honors the integrity of all involved parties, and that leads to a final design in a reasonably predictable way. We will briefly outline how that can be done by discussing how to care for the vision, how to deal with relationships and roles, and how to see the process as a project.

2.3.1 Caring for the Vision

When IT development projects increase in size and complexity, it is common to divide a project into parts or modules based on the structure of the imagined final design. After the initial phases where the vision and first operative images are created, a first attempt is made to divide the system into subsystems or modules. The subsystems are then given to different teams for further development. This approach is powerful and efficient in principle, but it is difficult to employ in a satisfactory way. For instance, subsystems are frequently identified based on technical considerations. A typical example might be one subsystem for data storage, one for data entry and maintenance, and one for search and presentation of database contents. Such a division is unfortunately not likely to coincide with the users' perspective, where it might be necessary to enter data and search in the context of the same task. If the two subsystems are developed by different teams without close coordination, it is likely that the users will find them inconsistent and inconvenient to use.

Managing the design process by dividing the system into smaller parts requires an initial design of the whole system in the way that a user will experience it. All designers working in a project need to have a similar understanding of the vision and the wholeness of the system. It is also important to have a continuous and lively discussion around the operative image, since it will develop and influence the vision during the project. A common experience is that it is difficult for a design team to share and develop a vision and an operative image together. Potts and Catledge (1996) studied a rather large software project for almost a year and describe the creation of a shared vision and its evolution into a final specification as a process of nonmonotonic convergence. This is to say that there were periods of incremental detailing, but between those periods the team was forced to rethink and reformulate its basic vision.

Other studies show that successful design teams use a diverse set of strategies to disseminate and share the fundamental ideas that constitute the basis for a system. One method is to facilitate informal communication across organizational borders. This has been seen as an approach to handle insecurity and change in a design project (Kraut and Streeter 1995). Informal communication can be supported by having design teams share offices and common spaces, by sharing information channels such as email or conference systems, or by using methods that force people to meet across

teams and groups. All of these strategies create opportunities for informal communication that can help the total design project hold together its ideas and development trajectories.

Yet another strategy is to appoint a "super designer." This person, who might be called a systems architect or lead designer, has the ultimate responsibility for taking care of the vision. In some cases, this task is given to a small group of designers. It is not unusual to find a person or group of people taking on this responsibility without formal appointment, based merely on their experience or informal status (Curtis, Krasner, and Iscoe 1988).

Perhaps the most common approach for managing a vision within a project is to write documents of various types, such as project-specific design rules, specifications, and descriptions. Documents have some obvious advantages but also severe limitations. Documents and text have to be interpreted by the readers and it is apparent that even if people work in the same project, it is not easy to reach full agreement on abstract notions such as visions and ideas solely through the use of text. It is also a fact that people, including skilled professionals, are very poor at documenting their work, even though they know how much work it will save in the long run. This probably has to do with the relation between short-term efforts and long-term paybacks and with the division of responsibility between the individual and the organization. To the individual, it creates more overhead work to write documents describing her own ideas and work than the immediate benefits motivate. For the organization, on the other hand, a well-documented process and outcome might be worth more in the long run than the individual realizes at the moment when the documentation has to be done. It appears to be difficult to care for the vision in a design project by means of documents, both as a technique (Poltrock and Grudin 1994) and in terms of motivation. Still, an enormous amount of time and resources are spent in large projects on documentation as a way to care for the process itself—as a management tool—and for the evolving vision.

2.3.2 Relationships and Roles

In a design process, there are many different actors interested in the process and in the outcome of the process. A thoughtful designer has to be clear on her own role and position in the process. To act as a designer, with the responsibility for the outcome of a process, is to be in a delicate position. It is not possible to describe all possible positions a designer might find herself in, but what we can do is to outline a few idealized types. Idealized types are thought experiments or theoretical constructions that have no strict correspondence with existing entities, but serve as grounds for reflection.

The role of a designer, in the design process, is shaped by her relation to the client and the user. In the strictly formal sense, the client represents the reason for the design process. This does not mean that clients actually know what they need or want, nor that they know what the intended users of the digital artifact need or want. The client may not even be an active participant in the process. Another issue is that the client's ideas do not necessarily coincide with the user's ideas. For a designer, this is often manifested in a dilemma with contradicting needs and requirements, which plays out as a very practical issue. Who should the designer listen to? Which of the two parties' requirements and needs are important enough to influence the design work? When should a statement by a client or a user be taken literally, when should it be interpreted as a sign of an underlying message to be explored, and when should it simply be disregarded?

In some interaction design situations, it is hard to identify the primary user. For instance, in a system for a car dealership, is the "true" user the car salesperson or the customer? Should the designer aim for a system that supports the salesperson as much as possible, or is it more important for the system to satisfy customers, even though it may entail more work and perhaps more frustration for the salesperson? This dilemma shows the difficulty in determining roles in the design process.

A thoughtful designer has to understand that accommodating people's roles and their relative importance in a design process is itself a design task. A skilled designer recognizes and knows when and how to involve different partners in the process, such as users, clients, decision makers, and others. This is a complex design task. Even if a designer can identify who should be involved, it is quite common that people decline to participate in the process. The reason can be lack of time, lack of interest, or any other practical or political reason. From the perspective of the designer, the forming of the relationships with people involved in the process can be understood as a form of social intervention. The designer enters the social context of a workplace, an organization, a home, an interest-based community, or a group of friends. In that process, the designer becomes an important player. Throughout the history of design, there have been debates about the possible positions and actions for a designer in terms of social intervention. Dahlbom and Mathiassen (1993) present three roles an interaction designer can take, more or less in the form of idealized types. The roles are based on traditional, but still important, historical and philosophical ideas. The three roles are: computer expert, socio-technical expert, and political agent.

The *computer expert* offers technical expertise and expects clients and users to specify what they want her to produce. The computer expert knows a lot about technology and how to build digital artifacts, while the users know their field and are assumed to be able to judge the qualities of the artifacts in use. Being a computer expert entails a cer-

tain humility, in the sense that she view her expertise as restricted. It is the job and responsibility of others to decide the outcome of the process. The traditional assumption within IT development of a complete and detailed requirement specification, finalized early in the process and used to guide design work and verify the outcome, fits well with the computer expert role in a design process.

Socio-technical experts view their responsibility in different way. To them, it is necessary to include social aspects in the design work to achieve a good system and satisfy users. It is, according to socio-technical experts, not always a technical solution that is needed, since many problems can be caused by social or organizational factors. Therefore, they see it as their task to develop an understanding of underlying problems. Socio-technical experts try to reveal what kind of information is needed, what social roles exist, and what expectations future users have. In socio-technical approaches, it is required that users participate in the process. The socio-technical experts need to cooperate with users to be able to fully understand their situation, needs, and expectations. The experts' attitude is to be engaged and cooperative. They master technical as well as socially oriented methods and know how participative design and cooperation with users can be conducted. This position also incorporates the view that an expert is there to solve problems for a user, and that the context and relationships they work with are based on ideals of consensus and harmony. Participation and cooperation creates a common understanding focused on the best possible solution for all parties involved.

Political experts argue that the most important aspect of design is to take a stand in the ongoing struggle that is the design situation. To them, the crucial question is who the users are. When this is determined, the task is to work to empower the chosen users by helping them to develop their resources, technical tools, and knowledge. To a political expert, any digital artifact is by itself an intervention in a play of powers where the designer cannot be neutral but has to choose sides and work for one group and against some other group.

The political expert cannot determine if a digital artifact is good without asking who it helps. Evaluating a particular artifact can only be done in relation to the interests of an actor or group of actors. It follows that groups with different interests cannot agree on the quality of a digital artifact. Therefore, it makes no sense to search for the most agreeable solution; design work should instead be done in close relation with a chosen group sharing values and interests.

Dahlbom and Mathiassen (1993) discuss some classical examples where designers have chosen to take on one of these roles. Historically, the field of digital artifacts has been dominated by designers who take on the role of computer experts. More recently, research as well as professional practice has evolved in directions such that designers take

on the role of the socio-technical expert. The political role is less common, even though it can be argued that many digital artifacts today, when implemented in a context, catalyze changes in power and social order. The artifact becomes a carrier of politically significant outcomes, even if it was not designed with such intentions.

Our short presentation of the three roles is not meant to be used in any way other than as a reflective tool. We believe that a designer in any design situation faces choices that bear some relation to these three idealized types or to other designer positions on a similar level of abstraction. A thoughtful interaction designer reflects on the position that any specific situation requires, even if it does not result in one of the distinct roles as we have described here.

2.3.3 Design as a Project

Since designing is a complex process, it has to be organized and managed. How this should be done depends on the specifics of the situation. There are, however, some characteristics that hold enough general validity to deserve a brief discussion.

There are several reasons for finding ways to manage the design process. Someone in the organization conducting a design process is usually responsible for its outcome and adherence to given time and resource limitations. For anyone who has that responsibility it is necessary to keep track of people and manage communication, cooperation, documentation, and so on. A designer also has personal reasons to consider organization and management. For instance, there is a desire to put one's skills to the best possible use, have the right resources and the right amount of time, and to be relieved of unnecessary and time-consuming administrative work. The client needs to have knowledge about the process in order to handle implementation planning properly. The client may also want to create decision points along the path of a project. Moreover, other stakeholders in a design project often have their own reasons for some kind of organization and management of the process. For example, managers in departments adjacent to the client's may need to coordinate their own activities with development of the new system.

Interaction design inherits a rich history of methods, models, and methodology from fields such as human-computer interaction, systems development, and software engineering. Most of those tools are intended to support the coordination, organization, and management of what we would call "the design process." We do not introduce them in detail here, since they are well covered in the literature (see, e.g., Fitzgerald, Russo, and Stolterman 2002, for a comprehensive discussion). Instead, we will concentrate on the larger context of the process-as-project.

Following Grudin (1991), projects aiming at developing digital artifacts can be divided into three broad categories, each with its own characteristics. The categories are contract development, product development, and in-house/custom development.

Contract development is formally initiated by a client, who decides to do something about a perceived problem or need and asks development companies to make bids for a solution. The real origins of contract development may, of course, be that a resourceful salesperson from a development company convinces a potential client of the existence of a problem or need. In either case, it is common to set up a competitive situation where interested development companies have to propose solutions, present how they would go about in achieving these solutions, and how much it would cost. The client selects the most favorable bid and contracts are drawn up between client and developer to specify what is to be delivered, at what time, and at what price. Then, it is up to the development company to meet the terms of the contract.

Product development, on the other hand, is initiated by a development company. It may have detected a market demand and decided to develop a product to meet the demand. Another typical scenario starts with an idea for a new product and the related work of creating a market, need, or demand. There is no obvious client; development is oriented towards a broad market that may be more or less precisely defined.

In-house development refers to a situation where developers and intended users belong to the same organization. Typical examples are IT departments of large corporations developing systems for internal use. In-house projects are often less formal, since there are established contacts between the parties involved and sometimes even a shared budget. The cooperation often lasts for long periods of time, taking the form of ongoing enterprise support rather than individual projects with fixed delivery dates. Systems developed in-house are tailored to the intended use contexts within the organization, even though they can sometimes form the basis for products and services addressing the customers of the organization.

The nature of design work is affected by project type. In contract development, the core element is the business relation between client and developer. It is quite common to outline a product in the contract, thereby reducing the design possibilities significantly. Unfortunately, these decisions are not always made from a design perspective. They may be taken loosely and based on financial or internal political reasons rather than on proper design work.

Product development ought to accommodate significant elements of unrestricted design work, but in many companies it turns out that management and marketing departments lay out directions for new products. The designer's skills are not necessarily

used in the development of ideas for new products and services, and interaction design in industrial product development sometimes deteriorates into the design of user interfaces for a given set of functions.

The less formal nature of in-house development often affords a more flexible design process. The possibility to view development as a continuous process is particularly interesting. Chances are good that a designer will be able to learn how her ideas work in a practical context and gain important insights for future work.

It is not difficult to come up with project categories beyond the three outlined by Grudin. For instance, contracting situations can often evolve into less formal structures similar to in-house development, based on long-standing business relationships between a client and a developer. Another example is the deployment of cross-media services where, for example, a development company develops and runs a web site related to a recurrent TV broadcast. The rapid development of our design material (digital technology) and its contexts implies the further emergence of yet other categories. Our point is not to identify the specifics of the different categories, but rather to show that a category—whether intentionally chosen or not—affects the way in which design work can and will be carried out. Most decisions influencing the general nature of the project are taken higher up in the organizations involved. Many designers perceive this as an obstacle to their own understanding of the best ways to work. At the level of a single project, most participants wish they had the power to make more decisions, including strategic ones. This is, however, rarely possible. Design processes are set in larger organizations with their own motives and strategies. There is always a tension between the larger organizational context and the individual project.

This leads to the conclusion that "real" design is about finding ways to design a project within these preconditions and limitations—by accepting them or trying to change them. A design project is itself designed and depends on creative and innovative thinking for its success.

2.4 Designing the Design Process

This chapter has briefly touched on some of the more vital aspects of the design process. It is hopefully clear that the process is of such complexity that it is impossible to capture all of its important characteristics in a book, let alone a chapter. Our aim has been to show the breadth of issues a designer will face in preparing and navigating through a design process.

We find that there is no clever way of defining away the intricacy of design. Any such attempt is in itself a form of design. Since every design process itself has to be de-

signed, someone will shape it, decide what has to be done, and how it should be carried out. Unfortunately, this is the task in a design process that typically receives the least attention. Many books and articles are written about the design process, methods are developed, and project models are invented. Much work is devoted to prescribing how to organize and manage the process. The issue of designing the design process, however, is not as well addressed. It is usually assumed that the solution is to use a predesigned model or method. For purposes of managing the design process, this solution may be adequate. But if we assume that the design process has to be created, invented, and designed, then other aspects appear as crucial.

Thoughtful design has to be based on a realization and understanding of the fundamental aspects of the design process described in this chapter. A thoughtful designer knows that almost nothing is given or true when it comes to what and how to design. It is also obvious that the complexity of the process demands conceptual clarity from the designer. The thoughtful position is to view the whole situation as a design task: to design the design process.

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