

Knowing in Situated Design Action

This chapter develops an understanding of the characteristics of knowing involved in situated design action (briefly ‘design knowing’). An overall aim of the chapter is to go beyond what Nigel Cross (2006) calls designerly ways of knowing by claiming why design knowing actually *must* be different from those of natural sciences and humanities. The study of situated design knowing enables a discovery into some fundamental characteristics of the aspects that drive designers’ action. The exposition of these aspects is supported by relevant literature in design philosophy, sociology, organizational sciences, knowledge management, and cognitive, social and experimental psychology.

OUTLINING DESIGN KNOWING

A renowned design research veteran, Professor Nigel Cross, claims that “there are designerly ways of knowing, distinct from the more usually-recognized scientific and scholarly ways of knowing” (Cross, 2006, 5). Why does he claim so?

Cross (2006) has observed in a number of studies that a salient feature that distinguishes designerly way of knowing is how designers relate to ‘problems’. Professional designers employ a solution-focused strategy, whereas, the problem solving in research operates through a problem-focused strategy. Experiments have shown that the difference in approach is learned during the education. The solution-focused strategies of designers are supported with additional characteristics of design thinking: productive or appositional reasoning. (Cross, 2006, 18-20) Productive, or abductive reasoning as it is also called, is not only featured in designers’ thinking – in fact it can be interpreted as a way of conceptualizing processes of discovery more generally (Paavola, 2006).

Cross’s (2006) studies of designers’ strategies to approach design problems highlight the character

of design knowing, however, leaving somewhat implicit why designers need to adopt such strategies. The rest of this chapter is dedicated to explicating the interactive characteristics of *knowing in situated design action* and to showing that designers indeed *must* adopt solution-driven strategies in their work.

NEW REALMS OF DESIGN KNOWING

The emergence of new technologies, and immense expansion in the complexity of designed products, systems and services, are seriously hampering designers’ capability to understand what they are designing. Various connections of designs to different technical and social environments have grown more diverse and more difficult to manage (Kuutti et al., 2007). Moreover, the object of design increasingly disappears from direct observation (such as the electronic information services); it is dynamic, technically mediated, and social. New technologies also facilitate new kinds of activities that have never existed before. Think, for example, the impact that products such as mobile phone, Facebook, or GPS navigator have brought about. The new situation calls for new approaches to be utilised in designing.

Two broad and overlapping approaches have emerged to alleviate the situation: co-design (e.g. Sanders, 2005) and product concept design (Keinonen and Takala, 2006). Product concept design refers to design activities that are not immediately directed towards specifying products for production, but serve broader strategic purposes in organisations (see Keinonen and Takala, 2006). Co-design refers to design activities with an emphasis on the social character of the activity. It builds on the established traditions of participatory design (see e.g. Schuler and Namioka, 1991), computer-supported collaborative work (CSCW, see e.g. Crabtree, 2003) and empathic design (Koskinen,

Battarbee and Mattelmäki, 2003). In the era of traditional artist-designer the practice could be based on the subjective knowledge and personal intuition, but in the design of complex and highly technical products designers face new types of problems that cannot be solved simply on the basis of one's personal experience and intuitive practices. Co-design is based on the assumption that the collaboration of various stakeholders from a variety of disciplines fosters the exploration of a greater diversity of relevant ideas, and that the presence of various people also fosters the contestation of these ideas with the stakeholders' relevant knowledge.

These new developments in designing make it easier to argue for why designing must proceed in a solution-driven fashion. It is ever more evident that the possibilities for alternative ways to frame, conceptualise, structure and approach design challenges are basically unlimited. The social aspect complicates the issue even more, since different people have different skills and personal biases in the ways how they interpret situations, and design problems. Moreover, when understood from a constructivist perspective, any statement made about a problem (e.g. that here the problem is the lack of recycling of trash) is constitutive to its possible solutions. The marriage of 'wicked' problems to their solutions was first articulated by Horst Rittel and Melvin Webber in 1976 (in Cross, 1984), and has later been displayed in design protocol studies. For example, Dorst and Cross (2001) observed that in a design process the object of designing proceeds in a co-evolution of problem-solution.

CHARACTERISTICS OF DESIGN KNOWING

The following listing outlines the characteristics of design knowing, which are covered in this chapter:

Design knowing is *directed to relevance* rather than truth.

Design knowing is driven *by value*.

Design knowing is grounded in expectation.

Design knowing is guided by orientation.

Design knowing is embodied.

Design knowing is both social and material.

Design knowing is continuously produced in situation.

Design knowing is divergent.

Design knowing is context-shaped.

Design knowing is context-renewing.

Design knowing, as defined in this chapter, is different from *design knowledge*, which is presented as texts, diagrams, or other representations in media, such as books. Design knowing comprises the interactive properties of knowing in designing, and puts focus on situations in action. The kind of design knowledge that, for example design theory texts represent, can play a role in design knowing, when placed into and having effect in a situation.

DIRECTED TO RELEVANCE RATHER THAN TRUTH

When a new design becomes created and eventually placed into a human practice the practice will change. This is easy to understand when considering designs, such as digital cameras, phones, and ATMs, how they have dramatically changed our practices. When designers shape a radically new product they can employ numerous means, such as mock-up construction, prototyping, scenario-building and experimenting, to develop awareness of the overall change that their design will bring about. Designers can then make adjustments, or even completely replace the initial ideas that they are working on. The awareness of the potential consequences of the product, thereafter, also changes the product itself.

User study is the method for designers to gain a first-hand understanding of a potential context of use. Every fact that designers discover during a user study can be regarded as a small truth. For example, during a study of a sports culture called 'Freeride skiing' a design team finds that all the studied skiers carry an avalanche beeper with them. What is the meaning of this truth for design? The design team finds thousands similar kinds of small truths: how the skiers dress, what kinds of skiing shoes they use, what kinds of cars they drive, where they live, etc. All these facts are as true for the design team. The relevance of these findings for the design task at hand, however, varies greatly. It is the relative importance of these truths what matters for design rather than the truth-value of individual findings.

A relevant finding in a user study has a meaning for the product that is being designed. It is something without which the product may not be designed, or when known, which cannot be ignored

in order to create a good product.

The issue of relevance is little discussed in contemporary design literature. Schön (1983), amongst the few, have developed the idea of relevance. He, nevertheless, focuses on developing a theory on reflection-in-action, whereby, the treatment of the dilemma of relevance in designing remains thin in his theory.

DRIVEN BY VALUE

Wenger (1998, 4) stated that “knowledge is a matter of competence with respect to valued enterprises”. And, design is a valued enterprise: designers intend to conceive and realise something that is appreciated, desired, needed, endorsed, used, or simply valued. Hence, both design and knowing are inherently value-laden concepts.

A description of the nature of value, which may provide for a proper level of concreteness to discuss the phenomena is one created by Georg Henrik von Wright. His conceptual study called “The varieties of goodness” (von Wright, 1963) aspired to discover some structure in the use of the term good. Von Wright identified six categories: utilitarian, instrumental, hedonic, medical, technical goodness and the good of man. Five of the categories are easily associated to the various traditions or emphases in design. These are outlined in Table 1.

Product concept design aspires to discover *new* kind of products, which enable people to achieve new kinds of goals. In contrast to it, usability engineering (e.g. Nielsen, 1993) or usability-oriented designing, promoted the efficient, effective and satisfactory achievement of the goals rather than achieving new goals (see e.g. ISO 9401-11). Human Factors (e.g. Huchingson, 1981) and Ergonomics (e.g. Osborne, 1982) have focussed especially on the influence of products on human

health. On the contrary, the recent movement on ‘user experience’ or ‘user empathy’ have promoted pleasure as an ideal for design (see e.g. Jordan, 2002). And, technical engineering traditionally values performance, which is measured against technical criteria (see e.g. Krick, 1969).

The above listing in Table 1 only roughly maps the various traditions of designing. For example, Ergonomics considers a number of aspects around health, such as workspace and feelings of comfort (Osborne, 1982). Table 1 also combines a large variety of issues on dramatically different scales under single terms. For example, goals may refer to an organisation’s goals (like “being the leader in the market in year 2015”) or to an individual user’s goal (such as “sending a greeting to a Friend”).

Figure 1 simplifies the above categories by looking at the issues from the point of view of *reference*. Such a simplification may allow for the study of the social design action in design meetings. Whenever designers refer one of the aspects outlined in the Figure 1, they are addressing the value of a product.

In designers’ face-to-face interactions the value of a design may become evaluated through personal impressions, such as “Hey, that’s a good idea!”, by evaluative tools, such as Personas, “Would this wheelchair Persona be able to use it?”, and in separate evaluation activities against specified criteria. Evaluation may comprise various designs in order to discover the relative value of a design, and to find the preferred solution.

GROUNDING IN EXPECTATION

Designers need to rely on their *expectations*. These are coherent structures that enable designers to evaluate situations: are things going as they are supposed to? Is the situation similar to the previous ones? What is new? Expectations do not

von Wright’s category	Ideal of design	With reference to
Utilitarian goodness	Usefulness	Goals
Instrumental goodness	Usability	Goals
Medical goodness	Ergonomics	Health
Hedonic goodness	Pleasure	Emotions
Technical goodness	Performance	Criteria

Table 1: A rough association of von Wright’s (1963) varieties of goodness to design

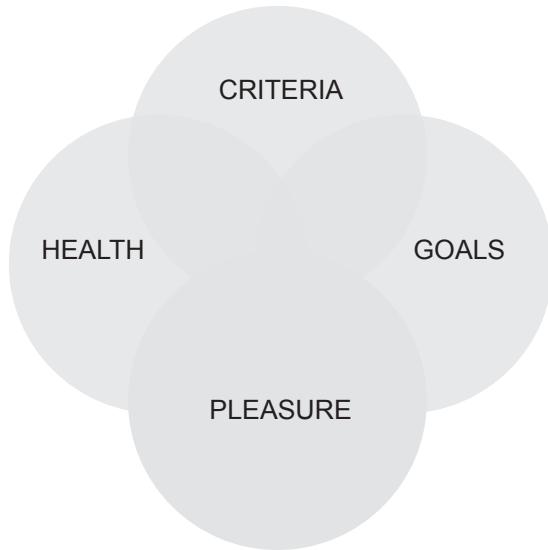


Figure 1: The value-aspects of designing derived from von Wright's varieties of goodness.

implicate that something is true or not, but rather, help perceive a new situation with the perspective provided by an earlier synthesis of experiences.

Designers' skill to perceive situations develops through experience. Perceiving a situation against the memory of an earlier situation enables a designer to compare the similarities across the situations as well as the differences between them. This is supported by Lawson's (2004) finding that expert designers are able to apply ideas from other domains into the current design task and combine solution ideas that appear to originate from seemingly unconnected sources. According to Lawson expert designers are better equipped to solve design situations because they attend to task by seeing something recognizable in it. In a way they are able to utilize precedents as a form of schemata which enable them to narrow down and recognize the possible solutions – or gambits as Lawson has named these guiding principles and patterns (Lawson, 2004).

In traditional cognitive psychology schema was defined as a knowledge structure that is stored in the brain, or mind, to assist an individual in the interpretation of an experience. Schemata allow for a quick pattern matching against a summary of prior experience, whereby, such structures allow for the making of rapid judgements. The idea of schema was first introduced by the psychologist Frederick Bartlett in 1932. He used the term schema to refer to an idea of 'organised settings'. This emphasised the dynamic adaptation of schemata in the interaction between individuals and their social and cultural environments.

Expectations bear also questionable aspects for designers' performance. Bartlett (1932) displayed in his celebrated study on remembering how people fill in and change details as they are asked to retell a story. He utilised an old story that was taken from a foreign culture to the ones who were supposed to retell it. When people retold the story after varying time periods, the story had changed remarkably. The changes, however, were not arbitrary, but followed principles of re-construction of memories (Bartlett, 1932). When designers memorise the details of a user site visit, the situation is fundamentally similar: the construction relies heavily on what they already know and expect. Expectations guide action and perception, whereby, they are fundamental ingredients of the *biased* design knowing of designers.

In the light of his studies, Lawson (2004) claims that designers rely heavily on knowledge that is not so much theoretical or semantic, but more experiential or episodic in origin. Such a way of seeing a situation offers a practitioner a personally unique way of seeing the situation. According to Collin (2005, 81) designers' experience functions both "as means for learning and as the content of learning". Experience helps the organization of work as well as fuels the analysis of situations and solutions. Also Hakkarainen et al. (2004) contend that expert performance requires more than mere general intellectual abilities as it builds on relevant domain knowledge.

GUIDED BY ORIENTATION

Designers always have a 'position', when approaching a design task. Orientation towards the design task is provided by the project organisations, target product categories, project aims, and by the dynamics and personal characteristics of a design team. Moreover, designers (like any people) bring their personal biases, abilities, memories and aspirations into their way of seeing a situation. A person, who admires detail, will pay attention to detail while someone interested in human power structures will notice how people treat each other. The orientation guides where the emphasis is put and which aspects of reality become promoted over the others.

The orientation may be intuitive and spontaneous, but may as well be intentionally adopted for a project. For example, when designers utilise interpretation models, such as what Beyer and Holtzblatt (1998) propose, the models will guide the designers' observations to the action sequences, physical layout, social tensions, users' roles, and their artefacts. Similarly the intention to construct Personas

(see e.g. Grudin and Pruitt, 2002, or Cooper, 1999) will guide designers to focus on the characteristics of people.

Orientation is related to the issue called ‘framing’ (e.g. Schön, 1983). The term framing is utilised with several meanings, for example, Rowe (1987, 5) explains how “the designer began to frame his intentions with the ideas of providing a strong sense of corporate image, giving a strong sense of address on the major thoroughfare, and making use of the wooded amenity of the site.” Striking in how Rowe phrases the example is the way the activity of framing governs the whole perception of the design task. Schön’s (1983) exposition of an architect student’s process of designing is perhaps the most famous example of framing. A student at first tries to create a structure for a school building, but fails to create a satisfactory solution. When the professor hints towards the ‘screwyness’ of the site, she reframes the whole design task around this idea. The new framing reorients the student to look the whole design task from a completely different overall position – looking at ways how the screwyness might guide the construction of the whole design.

Orientation hence arises out of the designers’ background building on the ‘constancy of appreciative system’ that Schön (1983, 272) talks about. It, however, develops through the course of design action as the overall intentions become clearer. Raijmakers et al. (2006, 230) speak of the phenomenon in terms of ‘developing a perspective’: *“Design teams may thoroughly research the people and situations for which they are designing, but they must also develop a perspective – a prioritised view – to direct their work.”*

BOTH SOCIAL AND MATERIAL

Designing is essentially social and the sociality of it brings a completely new level to the whole. Designing becomes coloured by the personalities, aptitudes and persuasive skills of the designers. Brereton et al. (1996, 320) crystallise this by saying that “the content of the evolving design depends heavily on negotiation strategies, among other more subtle and ubiquitous social processes”. Designers, for example, adapt their strategies of persuasion to fit their team mates positioning and to their commitment to design ideas. They also moderate their commitment to ideas carefully in-situ in order to allow for the ideas to remain amenable to negotiation. (Brereton et al., 1996) Bucciarelli (2001, 297) links the sociality to design knowing by claiming that design involves “negotiation of

interests and proposals of different participants; hence the process is social and knowledge socially construed”.

Brereton et al. (1996) observed that designers appeal to common sense, design theories, standard practices, expert practices, user preferences and demonstrations with physical hardware in order to persuade. Designers also employ a variety of other kinds of references, such as to the representations and to photographs that describe the use context, as they go about constructing design ideas. Basically all collaborative design employs shared materials to explore, make sense, and present understandings of design challenges. These materials function as resources for collaborative construction, sharing and negotiation – and hence contribute to the direction of the activity, and to the results.

The sociality of designing brings also forth the aspect of building a shared understanding. Collin (2005), for example, elevates inter-subjectivity as the key concern in collaborative designing. Shared frames are the precondition for coordinated social action, and sensible interactions and the orchestration of co-design activities entail shared meaning structures across designers.

As design grows more complex and collaborative it becomes ever more important to facilitate the collaborations across various people. Fuelling collaborations across discipline borders is very valuable for design, and also designers must pay attention to properly motivating the participants of a design session. It is important to pay attention to how the people are invited, how the place is arranged and decorated with proper materials, and how the discussions are encouraged. As an example, Ylirisku and Buur (2007) introduce the idea of ‘social glue’ with reference to how video empowers designers to invite others in designing. Cardboard materials, pens, sticker tapes, and other tangible tinkering tools have similar function when introduced properly (see e.g. Ehn and Kyng, 1991).

EMBODIED

Following the tradition that dates back to Plato knowledge used to refer to a correspondence between a belief and the configuration of reality. Knowledge was considered to be a ‘justified true belief’ (Niiniluoto, 1997). It was something about reality rather than something effective *in* reality. Design knowing, on the contrary, is embodied in the dynamic material and social whole where designers act. Schön (1983) concluded that the process of reflection-in-action is central to skilful

design practice; in professional practice the knowing is in action and develops through action. This kind of knowing in action is often implicit in the practice; it enables designers to make judgements through moving ahead, i.e. through building on presented ideas, and thus omitting the explicit articulation of the evaluation criteria.

Schön (1983) refers to this kind of implicit knowing in practice as *tacit* – a concept stemming from Polanyi (1983). Polanyi famously stated that “our knowledge may include far more than we can tell” (Polanyi, 1961, 133). Tacit knowledge should not be understood as hidden structures that underlie a practice but simply as the kind of knowing that we demonstrate in skilled action, such as in bike-riding. Cross (2006) emphasises that despite knowing in design is often non-verbal it is not invisible. It is displayed by designers, by their action as well as by their designs. In this sense tacit knowledge can be studied by studying the activity, the designers, and the products (including the intermediate designs, such as affinity diagrams) that designers create.

CONTINUOUSLY PRODUCED IN A SITUATION

Designers continuously adjust their activities in relation to the contingencies of a situation in order to get their work done. Schön (1983) studied the kind of knowing in which competent practitioners engage and concluded to consider design as an example of reflexive activity constructing knowing through action. This idea is supported by Polanyi’s (1969) contention that knowledge is an activity which would be better described as a process of knowing and that knowing becomes constantly produced in a situation.

Collin (2005) stated that formal and practical knowledge are integrated and fused in everyday practice into a whole, which cannot be extricated into separate factors without doing serious harm to the quality of the whole. She (Collin, 2005) argued that the separation of theory and practice is artificial from the point of view of the designer. Orlikowski (2002) emphasises the character of knowing as neither being attributes nor incorporated in external objects or systems. Instead they emerge from situated and ongoing interrelationships of activity, context, intentions, actions and structure. She defines knowing as a continuous social accomplishment which is constituted and reconstituted in everyday practice.

Design knowing is interactively translated, mediated and re-constructed in every situation anew. The

means to produce and communicate knowledge are not intermediaries that can be black-boxed in order to deliver the exact replica of the original subject; the input is never a reliable predictor of the output (cf. Latour 2005). Knowledge and action in reality are mediated by linguistic and technological infrastructures, and language is not simply a vehicle for passively transporting meanings or mirroring the object (Blackler & al., 1998).

DIVERGENT

The fundamental aspiration of design is to develop something new. This, however, is very problematic from the point of view of knowing. How is it ever possible for designers to bear something useful and relevant to a new situation and appreciate the unique qualities in the new? How it is possible to learn from previous projects, if every design challenge is new, and in a sense unique? The situation resembles the dramatic conclusion on wicked problems by Rittel and Webber (1984/1973, 139): *“Every solution to a wicked problem is a ‘one-shot-operation’; because there is no opportunity to learn by trial-and-error, every attempt counts significantly”*.

Although situations are unique and cannot simply be presumed, there are always aspects that sustain from previous situations. Otherwise we would need to assume a radically chaotic reality that would lack any continuity whatsoever. In such a reality all learning would be impossible. The uniqueness of a situation is hence always relative. Some things persist, some vanish, and some emerge. Given this, central to design knowing is designers’ ability to relate situational details to existing understandings. Schön (1983) calls this ability reflection-in-action.

An important aspect of reflection-in-action is the ability of designers to bear past experience to a situation (Schön, 1983). With this experience, designers are able to see familiar patterns in the whole. An illustrative example of this is a situation in a user study at the University of Art and Design Helsinki that aimed to find new opportunities to enhance the working conditions of ageing workers. The situation started when designers saw how an ageing worker closely observed a leaking water sink in order to inform a plumber. Designers first saw this as a familiar “he needs a pictorial communication feature” situation. When they later asked the worker would it have helped to have the possibility to take a picture of the water sink and send it to the plumber, he replied that it would not have helped. This surprised the design-

ers, since the solution had appeared so obvious. In this case, however, the exact sizes of the parts of the special water tap system in the chemistry lab were the fundamental issue, and pictures would not have helped with it. This observation of the unique qualities of the situation led into further discussions and reconsiderations of the potentials of pictorial communication.

Designers who try to learn about new opportunities for design need to find a sensitive balance between perceiving the already known and familiar and the new in the situation. And, even more importantly, they need to discover how the new is related to the already known. The core of knowing in a situation is actually that of bringing the old knowledge into the new situation and exploring how these are related. Orlikowski (2002, 253) emphasises that designers must strive to achieve knowledgeability in a situation:

“People’s ongoing engagement in social practices, and thus their reproduction of the knowing generated in those practices, is how they reconstitute knowledgeability over time and across contexts. Continuity of competence, of skilful practice, is thus achieved not given. It is a recurrently but nevertheless situated and enacted accomplishment which cannot simply be presumed.”

The activity of producing knowing in a situation, in its turn, transforms the existing structures employed in knowing more relevant for the current situation. As a result the ability of designers to know in a situation, and the “repertoire of examples, images, understandings, and actions” that Schön (1983, 138) talks about, grows more diverse while being rooted in what persists.

CONTEXT-SHAPED

Conversation analysts emphasise that each turn in a conversation is both *context-shaped* and *context-renewing* (Heritage, 1996/1984). In conversation the phenomenon is displayed in how people align their turn to what they just heard and saw, and at the same time, in how they adjust their utterance to what they want to achieve in the particular situation. Similarly designers’ actions are adjusted to what they just perceived and at the same time directed towards driving designing further. For example, Kurvinen (2005) presents how the discussion in a design meeting depends on which aspects of an illustration about a design idea becomes introduced first.

In addition to the immediate interactive influence that the sequences of action bear to the social

situation, the context of a design session refers to the broader relevant setting that surrounds the focal activity. This may mean the physical environment, the tools and representations available, also the people who are present may form a context for designing. And importantly, the timely context of a situation refers to the presence of earlier situations in a particular moment. The earlier situations may be brought into a design session as personal memories, as representations of earlier moments, and as constructions made earlier in the process. When effective, the relevant remnants of earlier situations are available to be referred to in a design session.

CONTEXT-RENEWING

Each action provides the background for the next. For example, when designers create field recordings, craft their notes, sketch ideas, discuss experiences, or inform others, they change the context for future situations. The ability of designers to influence the context is one remarkable way how designers may guide designing towards a more relevant path for a desired outcome. Designers may transform situations to be more favourable for designing by such means as involving others, giving tasks, arranging and decorating the physical settings, and bringing some tools into the design sessions, such as puppets and tinkering materials, to provide a richer and more relevant context for designing.

One technique to intentionally influence the context of designing is sensitizing, which is introduced by Sleeswijk Visser et al. (2005) as “a process where participants are triggered, encouraged and motivated to think, reflect, wonder and explore aspects of their personal context in their own time and environment.” After reflecting on their personal context for some time from a given point of view, such as “paying attention to the situations when they use their mobile phones”, the participants are much more aware what they do, and more ready to express their thoughts about what they do. Moreover, when they have been pondering a topic, for example “thinking what kinds of opportunities there could be to enhance your baby stroller”, before having a participatory design meeting with them, they are likely to have developed some initial ideas and issues that are usually relevant for the design project at hand.

In the EU-funded Active@work project assigning tasks for participants was utilised to foster the discussions in design meetings. Participants were given tasks to introduce the Persona descriptions

in the design meeting. This enabled the design team members, who came from various parts of the country, to become acquainted with the user study material and bring this knowledge also present for others in the design session. The physical leaflets that represented the personas were also brought to the session to enable them to serve as physical placeholders for the discussed ideas about the Personas.

Another technique that was utilised in the project was 'situated make tools'. It is based on the utilisation of tangible artefacts that the user can configure in order to express her wishes for a tangible tool (see Ylirisku and Vaajakallio, 2007). The physical toolkit together with a structured process enabled the ageing workers to design tangible tools that they would utilise during the observation. After the tool was built, it was taken into the real work activities. The new context of working that the tangible mock-up established allowed both the worker and designers reflect on the activities from the perspective of the possible change that such a design might bring about.

CONCLUSION

At the moment design plays a more central part than ever before in company activities at all levels of different organizations. The expertise of designers has expanded to cover wider areas and more tasks and the role of the designer has diversified (Valtonen, 2007). The practice of design has expanded to comprise a great variety of different activities. The way this chapter discusses knowing in design relates especially to designing in action but it also represents a certain way of seeing design activity as a professional practice. As the diversity of professional design increases, it is becoming increasingly difficult to separate design from other professional practices, where the professional knowing evolves in dynamic relationships between individuals in activities.

The discussion in this chapter is closely related to the recent conversations in educational research and organizational studies. For example, organizational researcher Blackler's (1995) analysis of knowing in organizations presents many similarities to conceptions of designerly knowing in that knowing is situated, distributed and material. Blackler sees knowing as something that people do rather than interprets knowledge with a compartmentalized and static approach as something that people possess.

"It is becoming clear that traditional conceptions of knowledge as abstract, disembodied, individ-

ual, and formal are unrealistic". (Blackler 1995, 1034)

In design research the new understanding of design knowing requests a shift of focus from domains and types of design knowledge towards systems through which designers achieve or create their knowing in interaction and towards processes which enable and generate knowledgeability in design.

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