

Chapter 4

Design Hypothesis: Knowledge-Relevance Model



This chapter asks how constructive design researchers construe hypotheses. What guides the construal process, is it theory, research program, or design reasoning? We will argue that this question involves two sub-questions: one concerns the hypothesis that guides research, another the hypothesis that guides design. We argue that constructive design research has to balance both of these to be effective, and we also point out that many of the controversies we have discussed in the previous chapters are in fact efforts to grapple with the Janus-faced character of the discipline. It is this character that has inspired us to suggest the Knowledge-Relevance model that help the constructive design researcher to balance the core research activities when the process is driven by design.

The word hypothesis has made occasional entries into design research, mostly in the writings of Caroline Hummels (2000), Overbeeke et al. (2006) and Stappers (2007). We define a hypothesis as usual as an explanation based on theory. In design, obviously, theory is a loose concept and few theories are as precise as in the exact natural sciences. Theories in design function more like in the social sciences, where they are understood as a guiding light — or a sensitizing device — rather than provable or refutable facts. In constructive design research hypotheses take several forms ranging from graphic depictions, products/ spaces, services and systems (Buchanan 2001), and even social forms like communities (Anna Meroni 2017). In practical terms, when design researchers build hypotheses, they function the same way as any researcher would. They start with whatever hunch they have, do research in the libraries (for theory and literature) and in the market (for products), and start to rule out some alternatives, building a product that exemplifies their initial idea. This process leads to the formulation of more precise research questions that keep only some of the initial ideas alive.

At some point, research gets precise enough for constructing a design artefact that is then subjected to scrutinizing. The important point to note is that at this stage, there is a world of difference to the initial hunch: the process has created a theoretical world that gives meaning to the artefact. It is not the world of the layman anymore; it is a well-informed and precise world that builds on two several classes of

sources, including theory and literature, existing products, and the acts and practices of designing.

As this formulation suggests, just like design, design research is deeply embedded in what already exists (see also Mitcham 1986). Whatever they do, they have to confront the history of design and design research – not only in the beginning of their work, but all through it. Design, as Armand Hatchuel’s *C/K* theory (conception-knowledge) argues, always proceed as an interplay between novel concepts and existing knowledge (Hatchuel and Weil 2008, 2011), and this is true of research as well, we believe. This embeddedness is something many of the accounts of design are missing: they overstate the creative qualities of design, and forget the fact that creativity almost by definition builds on what already exists. As the research process goes on, it keeps making new things relevant, and incorporates some of these into the evolving composition. As our knowledge-relevance model suggests, many of the excursions out of knowledge bring researchers in contact with cultural, social and technological stakeholders.

4.1 Mapping Design Practice in Relation to Knowledge

There is a rich tradition in engineering and constructive design research to propose development models in the attempt of streamlining the design processes. The models developed for this book complement to existing models, and the Knowledge-Relevance model will in particular provide means to map out relations between practical design activities and existing theoretical knowledge. The reasons for models in design practice and design research are numerous: facilitating collaboration with others, ensuring soundness in decision making, ability to deliver on time etc. Figure 4.1 depicts four samples of characteristic development models in design.

Both the waterfall model and the iterative model are articulated in software engineering and development. The fuzzy front-end is well-known in product design pointing to the (often) need of challenging the brief and the question at hand in greater depth. The model is the authors illustration of the way of working promoted

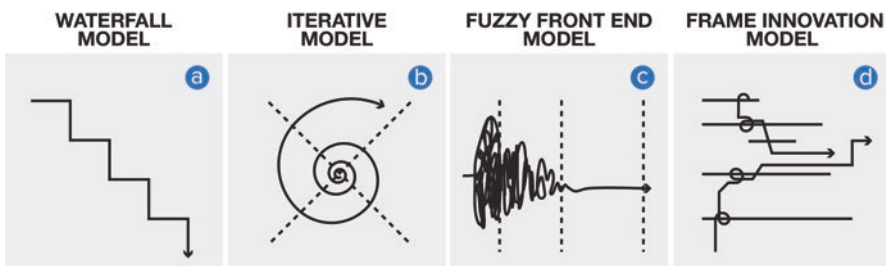


Fig. 4.1 The waterfall model, the iterative model, Fuzzy front model, Frame innovation model

by Dorst in his book *Frame Innovation* (Dorst 2015) where several ideas are kept on the table and all evaluated in relation to a variety of frames rather than assessed according to a particular design challenge. This is complementary to the underlying assumption of earlier models. In them, research processes are guided by a desire to converge to produce a piece of design.

Figure 4.2 attempts to depict the cognitive models of the practicing designer and shows how knowledge is related to the process. Nigel Cross (2018) is interested in illustrating the loop of analysis of synthesizing processes in (product) design. Stappers (2007) sees a designer as someone who scrambles together a set of ideas from a variety of places, and puts them together into a spiral-like form that ultimately leads to an outcome, which typically is a product. In his model, the product becomes a physical hypothesis. The red arrows describe knowledge entering and being disseminated in the process.

Other design models either adopt a language key to design but mostly unfamiliar to disciplines outside design (Binder and Redström 2006), or see design as a hybrid discipline build on theories, methods and evaluation schemes adopted from other disciplines (Zimmerman et al. 2007).

By reading through the corpus, we saw that constructive design research today has increasingly clear contours and contents outlining it to be a research discipline on its own right, however. As noted in Koskinen and Krogh (2015) constructive design researchers hold themselves accountable to design practice before any field of research outside design. Their aim is to be taken seriously by practitioners, but also ground their work on theory, whether ecological psychology (for example, Wensveen 2005), phenomenology (Deckers et al. 2013), symbolic interactionism (Katja Battarbee 2004; Ludvigsen 2006), or Situationism (Presence Project et al. 2001). They aim at contributing to theory and practice alike.

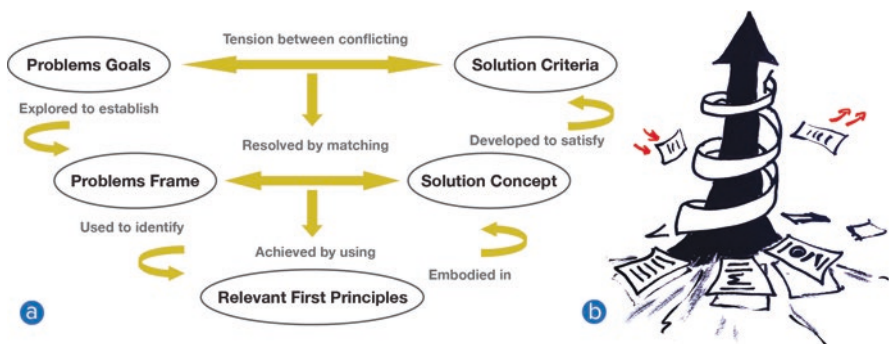


Fig. 4.2 Cross, model of designer working, Stappers ‘Arrow’ model

4.2 The Knowledge-Relevance (K-R) Model

As we have already argued, constructive design research is not a theoretical discipline that aims at describing and explaining the world, but also has a practical, constructive component. In the following we present the Knowledge-Relevance model in which the act of designing — the *design experiment* — is at the heart of the model. Along with *hypothesizing*, and *evaluating*, *design experimentation* is the core activity of what Donald Schön (1983) once described as an evolving ‘conversation with the material’. The prominence we give to *Hypothesizing*, *Design Experimentation* and *Evaluation* is reflected in that these are key concepts of Chaps. 4, 5, and 6 of this book. In our view these fundamental concepts of constructive design research are continuously brought into play in a dialectic process where the designer externalizes and manifests ideas, hunches, and concerns that ‘talk back’ to both herself and potential collaborators and thus helps constructing increasingly refined and thoughtful products. What is further significant to constructive design research is that this dialectics serves both *knowledge* production and *relevance*. The measure of *knowledge* creation is contribution to *theory* and the measure of *relevance* is *impact* i.e. the fitness and ramifications of the design experiment — and along the lines presented in Chap. 3, to whom and what constructive design research holds its self accountable to. The graphics of *knowledge* and *relevance* in Fig 4.3 indicate that a constructive design research project produce particular and limited contributions to basic underlying *theory* and *impact*. The proposed model may help both to frame processes of sketching, schemes of understanding full-fledged design proposals, and at scale of research project. The purpose of the Knowledge-Relevance model is to enable the constructive design researcher to keep track, model and facilitate discussion if the balance of research activities and concerns is prober and in accordance with the research pursuit. The model presented in this book builds on a prior version¹ informed and complemented by the work of Koskinen and Krogh (2015) (Fig. 4.3).

We will deepen the notion of design experiment and methods of experimentation in Chap. 5. At this point we need to remind the reader that the word *experiment* in our language does not refer to experimental research. Instead, we want to stress that although designers produce design objects, these can also be treated as experimental artefacts that produce knowledge. Seen through the model, a *hypothesis* articulates the premise(s) under which any research work must be read and understood. It articulates and limits the validity of the studies and frames the methodological landscape. Following this, the *evaluation* is a detailed accounts of what is subject to study, and point out appropriate research techniques and possible outcomes.

¹The model is a reworking of a model originally developed in cooperation with T Markussen, M Ludvigsen and A.L. Bang (Bang et al. 2012 as a part of the documentation of three doctoral courses hosted in Denmark between 2012 and 2014 also reported in (Krogh et al. 2015, Markussen et al. 2015).

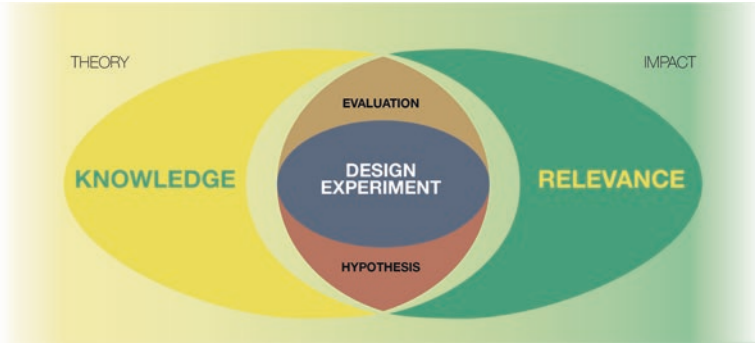


Fig. 4.3 The knowledge-relevance model

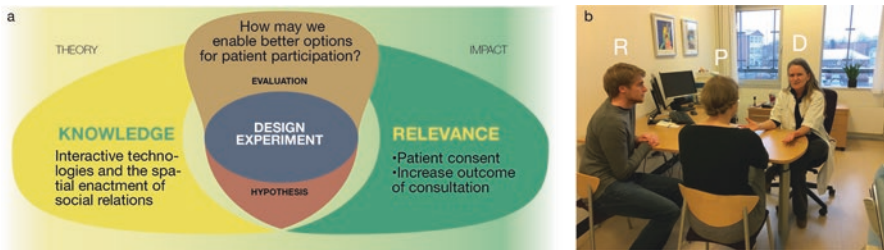


Fig. 4.4 Contextual interview and how it maps to the Knowledge-Relevance model

Against the backdrop of *theory* and *impact* at either side of its vertical axis the model points to the double concerns and contributions of constructive design research: *relevance* and *knowledge*. These are driven by different measures of criteria and incentives, and produce results of different value associated with either *theory* or *impact*. It is this duality that is key to constructive design research. In accordance with the activities of the central vertical axis in the model constructive design researchers oscillates between modes of analysis and synthesize. When doing so the focus of relevance and building of knowledge often inclines drift in objectives, means and measures of evaluation against the backdrop of *theory* and *impact*. In the context of literature we have dealt with earlier, the controversy about constructive design research often stems from such diversity. While some authors primarily bind design experiments to the artefact, others bind them to theory, research programs, and debate.

Vignette: an illustration of the model

We can illustrate the Knowledge-Relevance model as mapping tool by the work of Thomsen and Schnedler (2017 (master thesis); Thomsen et al. 2018). In Spring 2017, Thomsen and Schnedler found interest in the work of (Krogh et al. 2017) on how interactive technology conditions our enactment of social relations (Figs. 4.4, 4.5 and 4.6).

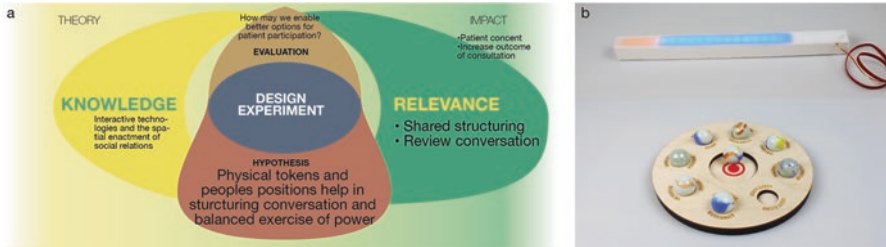


Fig. 4.5 Prootypes and how this maps to the Knowledge-Relevance model

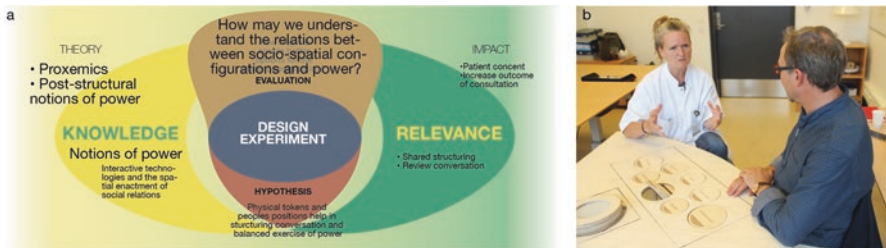


Fig. 4.6 The final prototype and how it relates to the Knowledge-Relevance model

Patient-doctor consultations in oncology were chosen as the domain of design. Thomsen and Schnedler assumed that they would be designing technologies for the doctor to better engage the vulnerable patient in the consultation to obtain informed consent on treatment (Fig. 4.4a).

A range of design activities were initiated including observations Fig. 4.4b, workshops, and prototyping Fig. 4.5b (as Preben Mogensen 1992 called prototyping that aims at provoking discussion) involving relatives, former patients and healthcare professionals. The key design concern of the project drifted in three ways:

- As the observations and workshops revealed that the patients needed better access to the material used during consultation because few patients were capable of remembering what was said during consultations. The varying capacities among patients (some very weak) also pointed to the need to go beyond abstract computer interfaces. The hypothesis of using physical tokens emerged to structure the consultations and balance the exercise of power (Fig. 4.5a).
- The project resulted in an interactive table fitted a microphone to record patient conversations, to serve recollection outside the consultations room and a series of physical tokens (Fig. 4.6b) that helps even very weak patient to participate actively in a consultation. This was the second major drift in the research pursuit pointing.
- The studies also saw a need to complement the design process with postmodern theories of power (Fig. 4.6a). This became the third major drift of the study.

4.3 Design Hypothesis in the Four Epistemic Traditions

There is a rich discussion about the nature of the prototype in constructive design research. We have already distinguished some perspectives. They range from the idea that design objects are physical hypotheses (Stappers 2007; Hummels 2000; Overbeeke et al. 2006) to the idea that they are things to be followed (Koskinen et al. 2011) or props that lead to debate (Jacob Beaver et al. 2009). More recent views have clarified their relationship to research (Koskinen and Frens 2017), to programs (Stappers et al. 2014), and to attempts to push design results from prototypes into products (Will Odom et al. 2016). Again, methodology and those theoretical beliefs that underlie it largely determine the way in which things are done. In caricature, writers from the Netherlands tend to build their view on the issue on their experience in engineering and the sciences, Nordic and American writers on the social sciences, some British authors on art, and in the most recent development, Vancouver-based researchers on post-phenomenological philosophy (Sabrina Hauser et al. 2018).

The debate about the nature of the products of design may be rich, but there has been relatively little discussion about how hypotheses are created. The procedures that lead to hypotheses are, for better or worse, implied in the debate about what manifests a prototype and the methodological discussion. A good starting point is the following observations: there is a range of ways in which designs objects become hypotheses, and these somehow depend on the epistemic tradition presented in Chap. 3, as we will go through in the following.

4.3.1 *Hypothesis in the Experiential Tradition*

The *experiential* epistemic tradition locates the development of a hypothesis in design practice. In this view, design interests come into research through design references that are treated the same way as design references would be treated in industry. Knowledge emerges from the intermediary artefacts that design produce. They are precedents that are carefully curated in the process of creating a design object. Research gives the overall frame and direction to research, but the hypothesis is primarily shaped by practice. The rationale is best expressed in the credo of *Presence project*. If we take Gaver's concept of aesthetic accountability (see Chap. 1) to its logical conclusion, design research is reduced to design referents. The logic is similar to that in design firms. When a design firm gets a commission, market competitors are scanned to see what already exists, and then the design firm curates a collection of possibly interesting objects at point of reference in the process. It breaks these references down into details whenever possible, and then starts to add elements from a variety of sources to the emerging design.

Some tools for working in this tradition have been captured in the concept of annotated portfolios by John Bowers (2012). These portfolios consist of a set or

references curated around the emerging design object, annotated with remarks, text, and links to other designs. Annotated portfolios are collections of examples, references, notes, sketches and mock-ups that build up towards a design artefact. Similar to folders design consultants do for their projects (and scientists log books), they provide a practical way to manage design development in research. Their purpose is to keep the emerging design proposal together.

Through annotated portfolios, a hypothesis is grounded in practice of design rather than a process or discourse. In contrast to design practice, annotated portfolios have a research component, however. The portfolios may be maintained from one project to another, and the research program can grow from connections between the design objects and projects. This is a luxury of the research world, where funding is more stable and where researchers can control their problems to a degree that would be difficult in business. Also, the outcomes are research contributions rather than marketable products: they are not tested rigorously, they are at best small series production (and more likely unique), and they get their value from the research story that surrounds them.

4.3.2 Hypothesis in Methodic Epistemic Tradition

The methodic epistemic tradition is exemplified by Pieter Jan Stappers and Caroline Hummels. They see design objects like prototypes as experimental vehicles that are essential to design research. As Stappers (2007) has noted, concepts fail to capture several crucial aspects of design. Only when a design is constructed, it can be assessed properly. There are many decisions that go into turning a concept real, and without a design object — or at least a prototype — researchers can hide behind the concept. Stappers mostly talks about physical products, but the same logic extends to other types of designs like spaces, clothing, interactive systems and services.

While the reason for constructing a design object may be clear, it is less clear what happens in research for it. If we follow the Dutch authors, one of the starting points of any research is literature review, but, as Josephine Thomsen and Jacob Schnedler (2017) show, its scope is modified and transformed by decisions during the design process. These decisions make design research different from, say, psychology, which proceeds by describing and explaining things and proves its point through causalities rather than by building things. If we follow Hummels and other Dutch authors, we get a cue about how literature is processed into a design. In their view, literature is processed into a causal model that leads to hypotheses that can be tested when the design object is evaluated. The prototype becomes an embodiment of a model that specifies it in terms of dependent, independent and intervening variables. In building this model, research grows out of a literature review into a theoretical model that tells what is important for the emerging design, what is not important, and how the variables in the simplified model are related.

In other words, theoretical work creates a structure of meaning that gives researchers design directions, and also a way to observe what happens in testing the

final design object, which becomes the *methodic* grounds of the research. Many other things happen around a design object. For example, it can also be regarded as a temporary conversational vehicle. The crux of the matter, however, is that a design object in research is more than the result of studio work. The model originating from a theory concern creates a detailed structure of meaning around the object, and this structure of meaning provides guidelines for interpreting it; increasing predictability and coherence between design intentions and impact of the designed object is ideal of contributions.

4.3.3 *Hypotheses in Programmatic Epistemic Tradition*

The *programmatic* epistemic tradition situates hypothesis to a research community. The most important proponents of this view have been John Zimmerman and Jodi Forlizzi of Carnegie Mellon University. In their view, the specificity of design research lies in discourse that may have theoretical components, but is also carried by designs and frameworks that extract knowledge from the designs. If they are correct, prototypes and other knowledge vehicles get meaning from research programs around them — thus the name of the epistemic tradition. Any design object can contribute to knowledge. It can target a gap in literature; it can be a critique of the received view; it can elaborate the received view; or it can clarify it by showing how previous research has worked with confounded concepts that need clarification. Theories and frameworks are needed, but so are design objects that serve an essential function in pushing research programs forward.

In this view, prototypes and other ‘design things’ (Binder et al. 2011) carry not only individual elements of research. They also carry subcommunities of disciplines and in this sense, have a collective dimension. They become key vehicles through which the field of design defines its world. The intersubjectivity of a community that we pointed to in Chap. 2.

This has been the case in several well-known design objects like *UTOPIA project’s* participatory methods (Ehn 1988), and *Nutrire Milano’s* community prototypes (Anna Meroni and Danila Sangiorgi 2011). These designs get their meaning from theoretical frameworks that discuss the meanings of these designs, and serve as handles for other researchers, but that cannot be understood without the concrete experiences of the design objects. The significance of the cardboard computers of *UTOPIA* are impossible to understand correctly without understanding the discourse of participatory design of the seventies.

If Zimmerman and Forlizzi get it right, hypothesis in constructive design research build on knowledge shared in conferences, journals, and books. Knowledge sharing clarifies arguments and spreads ideas and practices. This view differs radically from a craft-based idea of design in which design develops slowly through improvements in practice. The view may also explain how design research communities develop their specificities by developing a hard core of ideas that create identities to subcommunities and are non-negotiable (see Koskinen et al. 2011: 39).

Redström (2017) has recently taken this idea further by claiming that design is driven by ‘transitional theories.’ His view follows the idea that the field of design is like science, characterized on one hand by long periods of stable improvement in the margins, and on the other, abrupt change when there are enough explorations that question status quo. For him, theories are temporary devices in these transitions.

His views are still being evaluated in debate, but Zimmerman and Forlizzi’s view is echoed in an old publication that sought explanations for why Milan is the center of the design world. One possible explanation is that in Milan, design is seen as an intellectual discipline in that town. In contrast to, say, Scandinavia, where design is a craft-based activity, in Milan theoretical (usually semiotic) conversation keeps disseminating new opportunities in technology, materials, imagination, history, or poetry into the fore. Creativity in Italian design is a systemic property if this view is correct (see Bertola 2009).

4.3.4 Hypothesis Emerging in Dialectic

The *dialectic epistemic tradition* offers yet another way to locate the origin of a hypothesis. In it, a hypothesis is a result of a dialogue between a multitude of agents. When the object of research is seen as participation rather than strict methodic knowledge production, the hypothesis is seen as an emergent phenomenon designers cannot fully control because it develops in participatory encounters. It is different from the results of a methodic process, theoretical discourse, or an annotated portfolio.

Most authors describe their approach as dialogical. This is how Tuuli Mattelmäki (2006) described her take on probes, and how Ezio Manzini (2016) has described Politecnico di Milano’s approaches to service design and sustainability. For constructive design researchers in this tradition, a hypothesis is a construct that is built together with people involved in the design process. Designers have only partial control over the hypothesis, and this departure from control is made in name of participation and democracy — dialectically pointing to a potential future. Another word that has been used is debate, as in *Material Beliefs* (Beaver et al. 2009) and its Design for Debate framework, which implies a form of discussion in which several parties come together to talk about issues. They start from different — and sometimes even adversary — positions. In the course of the debate, they get familiar with the viewpoints of other parties, which may lead to consensus that may initiate change. In the language of this chapter, this consensus and the initiative to change are elements that form the hypothesis.

It is the adversarial aspect of experiences that has gained attention after Carl DiSalvo’s *Adversarial Design* (2012), which painted a picture of design as a process that brings adversaries to the same table. It lays bare their differences, and after confrontation, leads to a program that hopefully brings about change that lets the participants better achieve their collective ends. The same political ideal has animated most writing about design activism, which finds its roots in the disruptive

aesthetics of Rancière (2004), who in turn builds on Louis Althusser's structuralist Marxism. At bottom, these approaches are participatory and aesthetic rather than political. However, exactly how change is to be accomplished remains by and large open.

The one exception to this generalization is Scandinavian participatory design of the seventies and the eighties. It clearly aligned with Marxist and Social Democrat politics, which is well illustrated with one of its foundational projects UTOPIA (see Ehn 1988). The project worked with graphic workers' unions. Graphic work was going through a technological upheaval to computer-based technologies, and UTOPIA aligned with trade unions in an attempt to salvage the skilled factory jobs new technology was about to destroy. The political aim of the project was to combat deskilling and indirectly maintain the negotiation power of the unions against capitalists. There was no need for a theory of change; it was implied in the political commitments of the researchers.

The project's long tail in design research builds on the way it discovered the wisdom of using mock-ups and other 'design things' (Binder et al. 2011) that created a language game both graphic workers and designers could understand. If we look at its design proposals in terms of a hypothesizing, the work centered around mutual learning that served as basis for collective hypothesizing — the *dialectics* that build the common contribution. In these dialogues, design acts came to be a joint articulation of interests of a significant, well-paid group of workers whose work was about to be deskilled in the interests of owners of corporations like newspapers and printing houses. The hypotheses of the project reflected the dialogue in the workplaces, but also larger-scale social concerns.

Designers became activists who did not hide their politics into technical expertise or aesthetic theories but saw participation as a crucial element in encouraging hypothesis to emerge from mutual learning. A hypothesis like this is temporary and specific to the involved community, and it is not usually meant to be defensible in universal social terms. Knowledge gets measured in terms of whether it works through participation rather than whether it is valid in the traditional sense of the term: an expression that cannot be contested because it approximates truth. Design artefacts, in their part, carry knowledge in these discussions, but are not meant to serve as testbeds, or as carriers of a research community. Rather, they gain a meaning from the community whose interests researchers want to serve. In this tradition, research constructs like hypotheses get their meaning in communities of practice rather than theory alone.

4.4 Hypothesis in the Knowledge-Relevance Model

The purpose of the K-R model is to facilitate a continuous process of framing and reframing the actual research work. It center-stages the critical 'conversation with the material' (Schön 1983) when constructive design research oscillate between, hypothesizing, experimenting and evaluating nurturing both relevance and knowledge

production. The model builds on research and on an alternative model developed a few years back (Bang et al. 2012), and it is well in line with recent discussions. For example, Kees Dorst (2015) proposes that design is about framing and re-framing. In the view, expert designers can concurrently propose and test numerous hypotheses and questions while suspending decisions on solutions in pursuit of the most relevant question. Similarly, in the Knowledge-Relevance model, hypothesizing is seen as an ongoing process that happens in tandem with framing questions. The process is flavored by the researcher's motivation for doing the research, informed by provisional theories, anticipated measures of impact and recurrently challenged by the sobering question of 'what question is this experiment an answer to?' — the things you hold yourself accountable to.

We see the model as a map that helps researchers to clarify their contribution. It serves as a tool in the research process aiding the researcher to understand what is contributed (relevance and knowledge), what are the driving forces of the discussions and claims brought forward (hypothesis and evaluation), and what measures apply (impact and theory). And finally, it serves as a good reminder of what to take into account when designing a research project.

Looking at the model through the lens of drifting while construing a hypothesis, we can note that it only forms the ground of drifting, but it does not determine how drifting happens. The way in which designers define where they drift depends on the epistemic tradition that defines their concept of knowledge. For example, some authors — most recently, Johan Redström (2017) — have stressed design as a research discipline that gains its force primarily from theoretical statements. Others — like Gaver — contest this and locate the source of the force primarily in design practice instead. Participatory researchers see the hypothesis as a property of the community they work with. Most authors stand between these extremes and if we read carefully, this is the case of authors like Redström and Gaver too. Their arguments are sharp, but their practice is more complicated than these arguments.

Again, these differences point towards a larger context of research. Constructive design research sometimes happens in purely academic projects. Equally often, it happens in tandem with research projects built together with industry (or trade unions as in *UTOPIA Project* described by Ehn 1988). Design also contributes to cultural and even artistic production outside the market. The K-R model allows for the co-existence of diverse concerns and points to design experiments as the propelling factor of constructive design research; the key subject of the following chapter.