4 PROTOTYPING FOR THE DESIGN SPACES OF THE FUTURE

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OVERVIEW

Prototypes have been used throughout design history as a means of bringing ideas to life before the ideas are built or manufactured. But just as design today is undergoing radical change, so too are prototypes and the activity of prototyping. Prototyping is becoming a participatory activity. I propose a new view on prototyping and describe how we can use prototyping to help us not only give shape to but also make sense of the future. It is only through collective thinking and acting that we will be able to use design to help address the social and cultural issues we face today. We know how prototypes are used to help us shape the future, but what does it mean to use prototyping to make sense of the future?

THE CONTEXT OF DESIGN IS CHANGING

Four manifestations of change can be seen today in design: a shift in the focus of design, the rise of creative activities for nondesigners, the interest by business people in design-thinking and the obsession with cocreation by all kinds of people. These manifestations of change reveal the need for new tools, methods and mindsets to support collective forms of creativity.

The shift in the focus of design is described in Figure 4.1 and shows how the design domains are in the midst of a radical transformation. Design has been, until recently, primarily concerned with the making of 'stuff'. The traditional fields of design education are characterized by the type of stuff that designers learn to make (e.g. industrial designers make products and architects make buildings). Prototypes made during the traditional design process represent objects, such as possible future products, spaces or buildings. The languages that designers learn in school are specialized for the creating of these types of objects. For example, traditional design embodiments for making stuff include sketches, drawings, prototypes and models.

Design practice is now moving from a focus on the making of stuff to a focus on making stuff for people in the context of their lives. The emerging design

old the traditional design disciplines	new the emerging design disciplines				
visual communication design	design for experience	design for service	design for innovation	design for transformation	design for sustainability
industrial design					
interior space design					
architecture					
interaction design					

Figure 4.1 Old and New Design Domains. The design domains are transforming from a focus on the objects of design (old) to a focus on the purpose of design (new). Credit: Elizabeth B.-N. Sanders.

domains on the right side of Figure 4.1 are focused on intent, or the purpose of design—for example, design for the purpose of serving or healing or transforming. Thus, in these new design domains, there is, the need for telling and enacting stories—that is, stories about how people will live and how they wish they could live in the future. There is the need for alternative forms of conceptualization and embodiment beyond stuff. Alternative embodiments for describing and enacting experience include stories, future scenarios, narratives, performance art, documentaries and timelines of experience.

Another manifestation of change in design is the increase in the number of people seeking creative activities. There is now the growing recognition that all people are creative. This can be seen in the growth of the DIY (do-it-yourself) industry and the resurgence of crafting at all levels. The rise of social networks and other means of online sharing have contributed widely to this phenomenon; www.etsy.com is a good example. The rise of creative activity-seeking by nondesigners may also be a reaction against the overemphasis on consumption that marks much of the world's people today. Or perhaps it is a seeking for the 'convivial tools' that Illich (1973) described over forty years ago. We are finally learning that we need to balance consumptive and creative opportunities for everyone.

A third manifestation of change is the recent interest and enthusiasm in what is called 'design thinking'. The phenomenon is particularly popular in the business community (Martin 2009). Design thinking is already of such interest that business schools within universities around the world are attempting to revamp their curricula to meet the needs of business students who do not want to play the business as usual game.

Concomitant with the rise in creativity that we see from everyday people and the interest from the business community in design thinking is the recent obsession with cocreation (Sanders and Simons 2009) at all stages of the design development process. This change brings with it the need for new forms and means of supporting and inspiring collective creativity—that is, creativity shared by people.

DESIGN IS CHANGING

The manifestations of change that we see in the contextual landscape of design have resulted in a number of shifts in how designing is done today. The shifts can be seen in where it is happening, when it is happening and who is involved.

WHERE IS IT TAKING PLACE?

In the past, design took place in the studio, and design research took place in the laboratory or in the field (i.e. the context of use). Today design and research occur anywhere designers and researchers meet. The meeting places are just as likely to be online groups as they are to be shared offices or coffee shops. Designing takes place out in the world. This extends the possibilities for using experiential and environmental contexts for inspiration and imagination.

WHEN IS IT HAPPENING?

Ten to fifteen years ago design research played a strong role in the evaluation of design ideas and concepts. Since then, design and research activities have been moving progressively towards the front end of the design process. Today most design research firms are playing in (or attempting to play in) the arena of the fuzzy front end, or the predesign phase in the design development process. It is here that the design and research activities focus on exploring the landscape of opportunities in order to determine what to design and why. We are also learning that it is the place to determine what *not* to design and why not.

WHO IS INVOLVED?

Design has become an increasingly collaborative activity. This is particularly true in the fuzzy front end where participation from people in all disciplines is now recognized as being important. Most of them are not trained in design or design research, and they come with their own disciplinary tools, methods and mindsets. The challenges we face today are large and complex. Physical manifestations of product ideas are no longer adequate to visualize the emerging design spaces where we are facing challenges of large-scale social issues.

A SHORT HISTORICAL PERSPECTIVE ON PROTOTYPING

The activity of prototyping, from the design perspective, has been about making physical artefacts to represent a 'product' before it is completed. Prototypes can be two- or three-dimensional, at a smaller or full scale, high or low fidelity, handmade or machine-made, and so on. Depending on the stage in the design process, prototypes can be used to:

Experiment/explore ideas
Identify problems
Understand and communicate a form or structure
Overcome the limitations of two-dimensional work
Support the testing and refinement of ideas, concepts and principles
Communicate with others
Sell the idea to the client.

The role that prototypes have played in design has changed over the years. In the 1980s prototypes tended to be look-alike models with rich visual detail. They were most often made near the end of the design development process as a means of communicating to (and often convincing) the client what the final product would (or should) look like. Hand skills and craft were critical in the process. Skilled model builders were often an integral part of the design team as the details were often determined in the making (Simons and Sanders 2010). With the introduction of computer modelling tools in the 1990s, the product could be seen much earlier in the design process. Highly accurate machined parts made from the computer-aided design (CAD) data could be more easily produced. Today it can be hard to distinguish a prototype from a manufactured product and, in fact, they may even be the same thing.

The emergence of interaction design as a field and as an offer has also impacted our thinking about prototyping. Early efforts in this field focused on the development of software-based tools for prototyping that attempted to mimic the real thing. But it was soon established that less realistic representations of screens and interaction sequences were actually more useful early in the design process (Rudd, Stern and Isensee 1996). We learned that people are more likely to respond with constructive feedback to a rough prototype of an interactive sequence than to an interactive sequence that looks final. The value of paper-prototyping and the use of Post-it™ notes as a means to quickly mock up information architecture are now well-known design tools in the interactive domain.

There is now a split in the evolution of prototyping. On the one hand, prototypes are more quickly and easily produced in very realistic forms. The value in these forms of prototyping is that you can share (or sell, as the case may be) the idea much more easily, before there is a commitment to tooling or construction. The concept can be shown to potential purchasers who can more accurately evaluate it when it looks, and possibly acts, real. On the other hand (and at the same time), prototypes are taking shape much earlier and in very rough forms. We see this development in the design of both hardware and software. One positive attribute of the trend towards roughness is that prototyping can occur very early in the design process. In fact, it is taking place now throughout the entire design process, with progressively more realism as the process continues. Rapid and early prototyping enables learning through making. Another positive attribute of roughness is that it invites the participation of a wide range of other stakeholders (who are likely to be nondesigners) into the design process at an early stage of the decision-making process.

NEW FORMS OF PROTOTYPES ARE EMERGING

Note that the use of the word prototype in design has focused on the physical manifestation of an idea—that is the object of design. This is so because the traditional design domains have been organized around the object of the design: product design, visual communication design, interior space design, architecture, and so on. The meaning of the word 'prototype' to designers has developed in this context. However, the common meaning of 'prototype' is that it is the first of its kind—the first or preliminary model of something. With this broader definition in mind, we can imagine prototyping to take place not only in space (i.e. physical manifestations) but also in time (e.g. storytelling and scenarios). It is this expanded meaning of prototyping in space and time that will be used in the rest of this chapter.

As the landscapes of design theory and practice have been changing, new types of prototyping have emerged to support and facilitate new ways of designing. Some of these new forms of prototyping are explorations in ways to embody ideas about experience and include empathy probes (Mattelmäki and Battarbee 2002), primes/sensitizing tools (Sleeswijk Visser, Stappers, van der Lugt and Sanders 2005) and video prototypes (Westerlund 2009).

In speculative design, we see another new category of prototyping that includes critical design objects (Dunne and Raby 2001), cultural probes (Gaver, Dunn and Pacenti 1999) and provotypes (Mogensen 1992). Speculative designs are hypothetical products that are meant to challenge narrow assumptions—preconceptions and givens about the role products play in everyday life. Critical designs, probes and provotypes challenge the status quo and make us think about the future implications of what we design and produce.

A DEFINITION OF PROTOTYPING FOR THE NEW DESIGN SPACES

In traditional design spaces, the focus has been on using prototypes to help us give shape to the future—that is to *help us see* what it could be. It has become

apparent that prototyping needs to come in many forms so that all kinds of people can participate in the front end of the design process. In the emerging design spaces, on the other hand, the focus will be on using prototyping to help us, all of us, to *make sense of the future.* In the new design spaces, prototypes will not just be seen as representations of future objects but as tools for collectively exploring, expressing and testing hypotheses about future ways of living in the world. With the expanded definition of prototyping, there is a place for everyone at the table.

As the problems that designers deal with become more complex and pressing, it has become apparent that a new design language that everyone can use is needed. Ideas need to be communicated to and understood by others or they will not be made or enacted upon in the future (Westerlund 2009). Prototyping can be a tool for externalizing the visualization process. The participatory prototyping cycle is a positive step forward in that direction.

THE PARTICIPATORY PROTOTYPING CYCLE

The participatory prototyping cycle (PPC) is a framework for action in design (see Figure 4.2). It emerged during reflection on over thirty years of experience in the practice of design research. The PPC acknowledges the need for prototyping

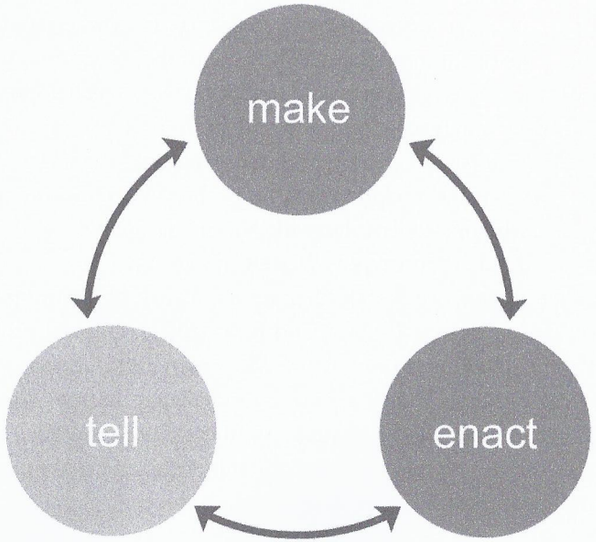

Figure 4.2 Participatory Prototyping Cycle: A Model for Cocreation in Design. The participatory prototyping cycle (PPC) is a framework for action and a model for cocreation in design. Credit: Elizabeth B.-N. Sanders.

Figure 4.3 Participatory Prototyping: Making. An interdisciplinary team is engaged in a collective making experience in the fuzzy front end of the design development process. Credit: Elizabeth B.-N. Sanders.

in space as well as in time. It describes the interplay between making, telling and enacting. Prototyping unfolds as an iterative loop of making, telling and enacting in the future design domains.

In making, we use our hands to embody ideas in the form of physical artefacts. The nature of the artefact changes from early to later stages in the design process (see Figure 4.3). Artefacts made early in the process are likely to describe experiences, while artefacts made later in the process are more likely to resemble the objects and/or spaces.

Telling is a verbal description about future scenarios of use. We might tell a story about the future or describe a future artefact (see Figure 4.4). But this can be difficult for people who do not have verbal access to their own tacit knowledge.

Enacting or pretending refers to the use of the body in the environment to express ideas about future experience (see Figure 4.5). Acting and performance can also be considered forms of enactment that are particularly useful later in the design process. There has been some interest in various forms of enactment as design tools (e.g. Buchenau and Suri 2000; Burns, Dishman, Johnson and Verplank 1995; Buxton 2007; Diaz, Reunanen and Salmi 2009; Oulasvirta,

Figure 4.4 Participatory Prototyping: Telling. This participant is telling future stories about the magical device that she has created that will help her live a better life and manage her Type 2 diabetes every day. Credit: Elizabeth B.-N. Sanders.

Kurvinen and Kankainen 2003; Simsarian 2003), and some of this work has been done collaboratively with end users and other stakeholders.

The PPC is a model for cocreation in design. It invites relevant stakeholders into the design process and supplies them with tools, methods and activities that they can use without having education or experience as designers. For example, making is a skill that many adults do not necessarily feel adequate in using these days. They find it easier to rely on or hire the 'makers' to embody their ideas. Telling and enacting, on the other hand, are skills that everyone has familiarity with and may be more comfortable using, especially in inviting environments. The PPC combines making, telling and enacting and uses each activity to fuel the next. By putting making together with telling and enacting, you can empower people who are not skilled in making to externalize their visualization process.

The differentiating characteristic of the PPC model (versus the other new forms of prototyping) is its emphasis on the cyclical and iterative relationship between making, telling and enacting. You can enter the PPC at any point—that is by *making* things or *telling* stories about the future or *enacting* future experiences. And from each entry point, you can move in any direction as these examples indicate:

First make a prop and then use it in telling stories about how it might fit into people's future ways of living.

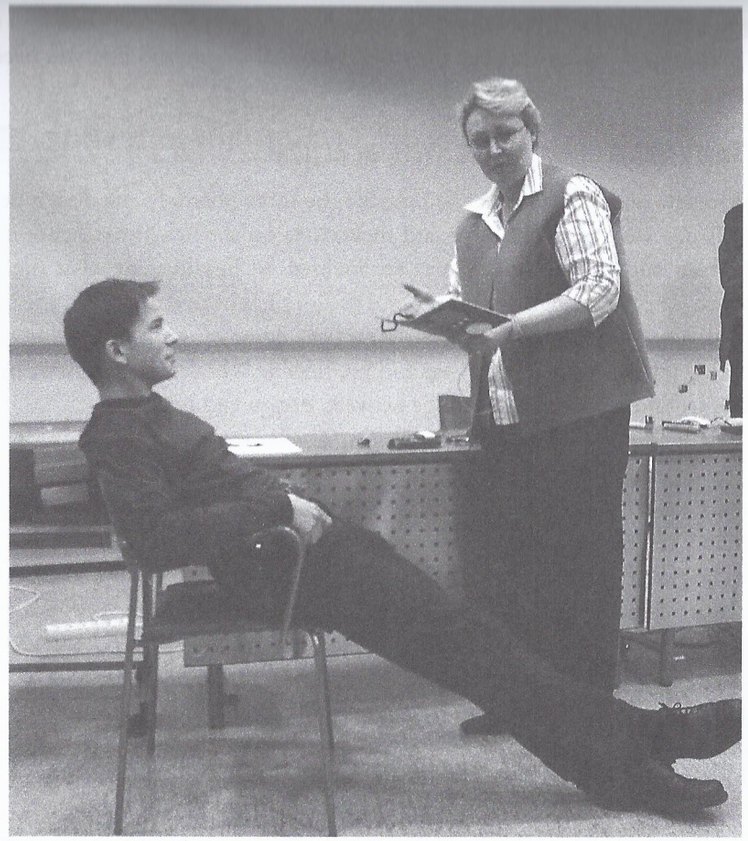

Figure 4.5 Participatory Prototyping: Enacting. A designer and a medical professional enact a situation about the future in which hypothetical mobile technology will enhance the relationship and communication between the patient and the caregiver. Credit: Elizabeth B.-N. Sanders.

Make a prop and enact a scenario of use with it.

First tell a story about the future and then make things that will help you to tell the story more effectively.

Tell or write a story about the future and then enact it using the actual environment as the stage.

First enact a scenario about the future and then make props to help make the enactment more real.

Enact a future scenario and then turn it into a story.

You may find yourself going around several times. For example, you may write or tell a story about the future and then enact it. Then you could make stuff that

people would need to live in the story, and enact it again. You may then find that you need to go back and rewrite the story. You might even find that you need to write a new story.

THE PARTICIPATORY PROTOTYPING CYCLE IN ACTION

The squiggle diagram (Figure 4.6) presents the three phases in the design development process today. The large and messy area on the left of the figure is the fuzzy front end where the activities are focused on figuring out what the idea might be. The black dot is the idea. Once the idea has been established, the traditional design process, shown on the right of the figure, unfolds forward in time, becoming progressively more linear and predictable. The overlapping area in the middle around the idea is the bridge between design and research.

How does the PPC work in the design development process? Think of the PPC as a generative seed moving and tumbling across all phases of the design process over time. The leading activity (i.e. making, telling or enacting) will vary by phase. The leading activity may also vary based upon team composition and on the project type.

In general, enacting is the PPC mode that is in the lead in the pre-idea space as shown in Figure 4.7. The purpose of the pre-idea phase is to explore experience (i.e. past, present and future experience) and to understand experience. Enacting is the ideal medium for this. Enacting can be done alone, but the results are far more evocative and provocative when done collaboratively. Enacting will be further synergized when followed by making and telling activities.

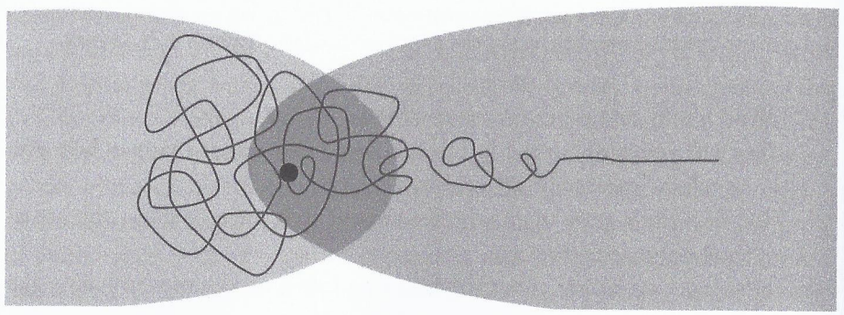

Figure 4.6 The Participatory Prototyping Design Development Process. The squiggle diagram is a three-phase model of the design development process today. The pre-idea space is shown on the left, the cross-over space is shown in the overlap and the traditional design process is shown on the right. The black dot is the idea. Credit: Elizabeth B.-N. Sanders.

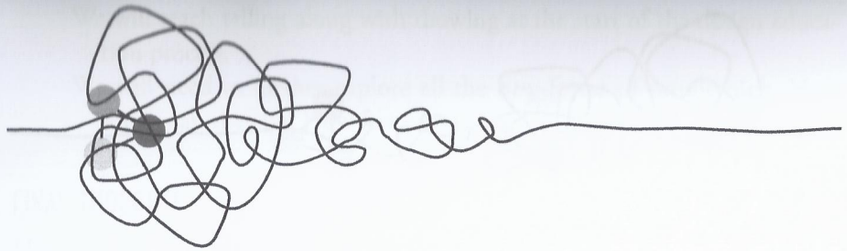

Figure 4.7 The Participatory Prototyping Design Development Process: Pre-idea. In the pre-idea space, enactment is the lead activity because the focus is on exploring and understanding experience. Credit: Elizabeth B.-N. Sanders.

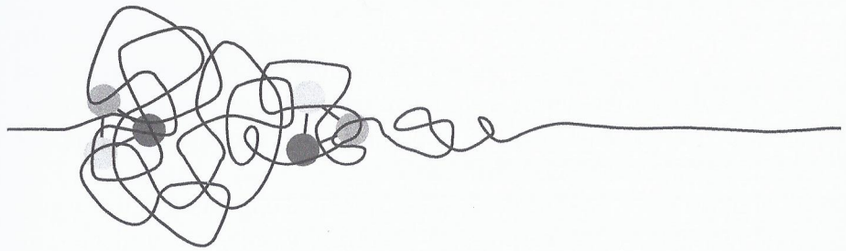

Figure 4.8 The Participatory Prototyping Design Development Process: Making. In the cross-over area between research and design, making is the lead activity because visualization of the idea is the key. Credit: Elizabeth B.-N. Sanders.

Making is the PPC mode that is in the lead *on the bridge*—that is, in the cross-over domain between the pre-idea space and the design development process as shown in Figure 4.8. The purpose here is to explore and visualize ideas in order to figure out what the future situations of use might be. The various forms of making give shape to the future. In the bridging stage, making is the focus of the effort, with enacting and telling acting as ways to enrich, extend and extrapolate the made artefacts. The earliest forms of making include maps, timelines and collages. Later forms of making include props, Velcro models and really rough prototypes. The traditional forms of prototyping will be seen later in the design development process.

Telling is the PPC mode that is in the lead later in the design process as shown in Figure 4.9. The purpose of telling is to keep the idea alive and evolving. If a participatory process has been used throughout the process, the primary activities here will be telling or sharing, since buy-in to the idea by the stakeholders is already likely to have occurred. On the other hand, if a participatory process has

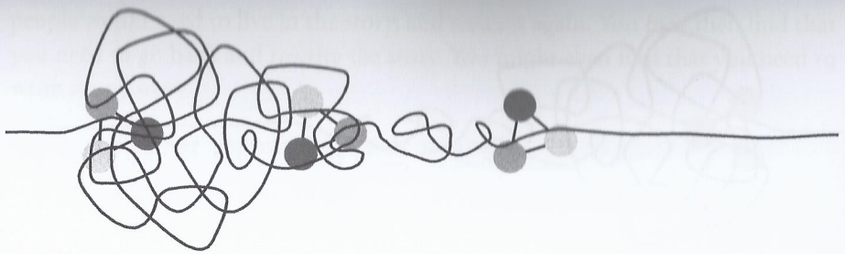

Figure 4.9 The Participatory Prototyping Design Development Process: Telling. In the traditional portion of the design development process, telling is the lead activity since attention must be given to keeping the team on board. Credit: Elizabeth B.-N. Sanders.

not been used, the primary activity can be better described as selling, since the stakeholders who will be affected by the design may still need to be convinced that the idea is good. The earliest forms of telling include descriptions of the made artefacts or the stories that are imagined. Later forms of telling include presentations and selling events.

The primary advantage of the making/telling/enacting model is that it provides for alternative forms of expression for all the stakeholders in the design process. Some people will respond best to stories, some to the enactments and others to the props and models. By utilizing all three in an iterative cycle, everyone who has a stake in the experience domain can contribute to the conceptualization process and find a means of externalizing their visualizations.

THOUGHTS ON THE CURRICULUM FOR DESIGN

The shift from object-oriented designing (where prototyping focuses on physical representations) towards purpose-driven designing (where prototyping takes place in space and in time) will certainly lead to changes in the design curriculum for the future. What does the PPC model imply for design educators?

We will need to understand what foundational skills are needed for a designer to be proficient in the three modes (making, telling, enacting) and in designing tools for others to use in all three modes.

We will need to provide even more room for exploration, intervention and experimentation in space and time.

There will be hands-on courses that focus on provocation and intervention.

We will teach pretending along with drawing at the start of the design education process.

We will need to learn from storytellers, performers and sellers.

We will teach telling along with drawing at the start of the design education process.

We will need to further explore all the new forms of prototyping. How rough can they be? How fast can we go?

FINAL THOUGHTS

How will the PPC play out across the design disciplines? For example, will it be different for industrial design versus architecture versus interaction design? Or will the PPC be instrumental in helping to integrate the traditional design disciplines as they are put to use in the emerging design domains that are based on the purpose of the design? Answers to these questions are emerging as the framework has now been used successfully to organize and critically reflect on the very wide ranges of tools and techniques that have been published in the participatory design literature (Brandt, Binder and Sanders 2013).

By repurposing prototyping into a collective activity, our challenge as educators will be to facilitate the relevant and timely application of the PPC. We will need to be clear on what can be learned from each prototyping activity and choose the appropriate methods, tools and materials. For example, how will the properties of the materials involved affect the results of a given PPC activity?

These new views on the scope, nature and purpose for prototyping may help us to realize what it means to bridge the gap: the gap between research and design or the gap between the researcher and the designer. Collective prototyping of activities and artefacts can be the bridge over the gap. They can be what we will walk on to get from the pre-idea space to the end of design development process.

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