4 A New Vocabulary

> Locke, in the seventeenth century, postulated (and rejected) an impossible language in which each individual thing, each stone, each bird and each branch, would have its own name; Funes once projected an analogous language, but discarded it because it seemed too general to him, too ambiguous. In fact, Funes remembered not only every leaf of every tree of every wood, but also every one of the times he had perceived or imagined it.
>
> —Jorge Luis Borges, "Funes the Memorious"

In chapter 3, we characterize designing as a dialogue. Seeing designing as a dialogue lets us conceive of designing as a dynamic, continuously transformative act that in turn affects and changes those who participate in the dialogue. The dialogue is a recursive motif that appears at different levels through which we study designing.

In this chapter, we stare at, poke, prod, and analyze dialogue in designing. We observe snapshots in time, we draw from different wells of thought, and we construct what can be best termed a bricolage—carefully chosen pieces that when joined together offer us a tantalizing whole, a glimpse into a complex human activity.

The Dance of Design

In our conception of designing, the impulse to design is a human one. Therefore, to understand the dialogue in designing, we have to start with the people who design. What happens when people come together to create?

Imagine that you are sitting in your favorite chair in front of a dark stage. A spot of light seeks a figure you can sense in the darkness. A hip sways, and the essence of grace is distilled in that one movement. A body arcs from those sweat-stained arms to the nerves lining the neck, pulled by an unknown thread that is taut. The body seems drawn to another body that is gliding into that pool of light, too. Now what you see are two bodies that almost touch, enough for their breaths to commune with the same rhythm.

In that moment, time shatters. Space rearranges itself, and you cannot see one or the other in isolation any more. It is as though the landscape in front of you has altered permanently. You can no longer perceive the two bodies as separate individuals. They become one composite entity. The past seems like the uncertain stages of a rapid chemical reaction, and what you behold now has the grace of compounded stability. It is a unison that carves out space and time. It is now time to tango.

Every slight tap, every step, every breath is a negotiation with the music and the mood, with each other. Moments of order and disorder are punctuated by stillness. There is a persistent dialogue that flows like the rhythmic undercurrent. It governs but does not bind the complicated footwork. This dialogue, using a shared vocabulary of gestures, pressure, and movement, is constructed with purpose, a communing that determines the next move.

As time spins ahead with the tempo, the conversation races at the speed of thought, matched by moves that make you forget to breathe. You transcend the senses, and the experience now borders on the spiritual. What you witness is an effortless control over space and time that births meaning and infinite beauty. The unison is perfected, the conjoining complete.

Thus, the dialogue in designing can also be seen as a dance, with different people coming together to create paths into the unknown. In order to understand that dance, we journey to southern India, where a community of dancers has lived, breathed, and practiced dance for the past twenty-five years. This place is known as Nrityagram, a conjoining of *nritya* (dance) and *grama* (village). It is a *gurukul*, which is a place where students reside with their gurus or teachers and learn from them. With over two hundred students, Nrityagram has nurtured an artistic community dedicated to the study, practice, and teaching of Indian classical dance, especially Odissi.

The sinuous movements of Odissi, a classical Indian dance form, draw inspiration from temple sculptures in Orissa, a state in East India. Over

the past twenty-five years, Nrityagram has developed a distinct style of Odissi that is practiced and perfected by the Nrityagram Dance Ensemble, which is internationally renowned and applauded by dance aficionados. To describe Nrityagram's art, life, and work is an exercise in futile hyperbole; no superlative seems sufficient. A *New York Times* reviewer echoes this sentiment when he says, "The only proper response to dancers this amazing is worship."[1]

In July 2012, we spoke to acclaimed choreographer and artistic director of Nrityagram, Surupa Sen, about creating *Samhara*, a collaboration between Nrityagram and Chitrasena Dance Company from Sri Lanka.[2] Heshma Wignaraja, the artistic director of the Chitrasena Dance Company, assisted Surupa Sen. The production was a dialogue between Odissi and Kandyan, a traditional dance form from Sri Lanka. After premiering at the Chowdiah Memorial Hall in Bangalore, India, in February 2012, *Samhara* toured the world. At the Joyce Theatre in New York, *Samhara* was performed to a packed audience that included the legendary dancer Mikhail Baryshnikov and renowned choreographer Mark Morris.

For us, the creation of *Samhara* was akin to designing, a dialogue between two different disciplines. The process of creating *Samhara* was, in our eyes, a metaphor for how the dialogue unfolds in designing.

Many Ways, Many Grounds of Seeing

The confluence of the two dance forms presents a challenge similar to two different disciplines coming together to design. Does it make sense to start with the similarities, or would the differences be a better starting point? According to Surupa Sen, there were both differences and similarities. Odissi comes from a classical tradition where poetry, music, and mythology are all attached to the dance, and therefore, it is multilayered. Kandyan is a ritual form where the music is rhythmic beating of drums, making it more athletic and dynamic but much less layered than Odissi. Therefore, to find a common substrate on which to build a conversation between the two forms was hard.

At the same time, there were similarities, she said. Kandyan was like a masculine counterpart of Odissi, and it seemed to have parallels to a tradition that arose out of the East Indian region, such as Chau, which is another athletic dance form. Although the basic wide stance, where dancers

stand with their legs apart, bent at the knees, is similar in both the forms, Kandyan overall is more masculine. It could be because it used to be practiced only by males in places of worship. Therefore, to find that common ground was a challenge, she said.

It is the same challenge we face when different disciplines come together to design. What is the starting point? How do we build a common foundation?

If everyone saw the world in the same way, it would be quite simple. But is it so?

If you spoke to cognitive scientists in the late 1960s, they would have told you that it is indeed the case. There is one way of seeing the world. The reasoning behind such a view is as follows: People are endowed with brains, which process information. Humans are thus no different from machines because both can perform intelligent tasks as information processing systems. How does a brain or a machine process information? It is processed by representing information as symbols and by manipulating those symbols. By processing information thus, the brain solves different kinds of problems. Given a goal, the brain mobilizes its problem-solving capacity and searches through different alternatives by which it can reach that goal. Designing is thus nothing but an individual solving a problem.

If the same idea is applied to a group of people from different disciplines designing together (say, in an organization), the behavior of the organization is an aggregation of different individuals organized hierarchically. Early cognitive design research adopted this model and performed numerous studies of individual problem solving starting with design problems in architecture and fields in engineering. This worldview of designing led to the creation of expert systems in a number of fields in engineering.

But when we observe people designing, we realize that it is not as straightforward as the "mind as machine" metaphor that encapsulates the 1960s and 1970s vision of cognition.[3] For starters, designing is an exploration into the unknown.

Let us return to the creation of *Samhara*. When Surupa described the process of bringing together Kandyan and Odissi, her descriptions stressed the uncertainty of the process. She said that the dancers did not understand the process of her choreography, so she gave them tasks to do, which involved thinking about the dance. She saw the results and then told them what to

do. "A lot of the time, they have absolutely no clue. They are floundering with me," she said. Even if she explained what her thought process was, the dancers were unsure what the outcome would be. "Because I am finding my way through it just as much as they are," she said. "But somehow I trust I will find my way."

In designing, too, there is a strong element of that uncertainty regarding the outcome. Yet there is a process underlying that journey, and although the outcome is unknown, expertise and experience are guides. The insights reveal themselves in doing, in creating, in the actual practice of designing. Just like Surupa's dance, designing relies on doing and is rooted in practice. In other words, it is situated, and one strand of cognition is called *situated cognition*, which explains such a conception of designing.[4]

Let us illustrate with an example. For instance, your father is putting together a new dish that involves him invoking his experience to identify the edible items in the fridge that can palatably go together, whereas a molecular gastronomist would use her knowledge of physics and chemistry to create a new dish. What is common to both designs is an ability to perceive patterns and articulate theories to explain what is common. These theories are particular and situational. Therefore, the way people perceive and understand is contextual. What this means for designing is that context is crucial, and we cannot flatten different perspectives stemming from different contexts into one uniform one-size-fits-all conception of an individual.

If cognition is situated and if the way we perceive the world depends on the situation we are embedded in, then where do we begin when we start designing together? Once again, what is the starting point?

Building a Common Ground

In Surupa's case, she discovered a starting point, a common ground, during the first workshop she did with both the Odissi and Kandyan dancers. Both cultures worshipped the elements, and she found a common language to express the elements through dance movements. Finding this common language was the starting point, and it helped the two distinct dance forms come together.

The process of building on the common ground involved the dancers listening to Surupa's ideas, working on reflecting those ideas through dance,

and performing it back to her. The common ground grew in reworking those movements. The dancers' bodies, therefore, became a site for building a common ground.

In designing the material setting, the external representations of thought—such as gestures, symbolic representations, visual aids, and natural environment—play a crucial role in building a common ground. Cognition in designing thus can be seen as distributed between people and their material setting:

> The distributed cognition perspective aspires to rebuild cognitive science from the outside in, beginning with the social and material setting of cognitive activity, so that culture, context, and history can be linked with the core concepts of cognition.[5]

Distributed cognition is based on the premise that internal representations in the mind, whatever their status may be, interact with external representations. It is this interaction that leads to coordinating different activities among people and to tackle the problem at hand. External representations are a way to cope with the limitations of the ability to manipulate internal representations. For example, solving a large set of equations is not possible within your head, but writing down the calculations helps you tackle them easily. When you reread what you have written, you collaborate with your own self, and in this sense, cognition is distributed across time. Thus, the conception of designers collaborating with themselves over time (as mentioned in chapter 3) and having a dialogue with their self is underpinned by theories of distributed cognition.[6]

Building a Common Vocabulary

The process of building a common ground between different perspectives in designing takes time and effort. The dancers from Chitrasena Dance Company stayed in Nrityagram for the entire time that *Samhara* was choreographed. This close interaction meant that the process of creation could take its time, and both Surupa and Heshma Wignaraja, the artistic director of Chitrasena Dance Company who assisted Surupa in the choreography, could understand each other.

Heshma said that she and Surupa would have dinner together and talk over the section they were working on and Surupa's thoughts about the work they had done. She said that during these conversations she began to

understand what Surupa sought from her, but Surupa would insist, "Don't give me what I like. Give me what works for you!"

According to Heshma, one of the major differences between Odissi and Kandyan lies in what accompanies the dance. Kandyan is married to the drum, and music and lyricism are in a way absent from the dance form. Although folk songs are used as part of the traditional dance, neither the musicality nor the meaning of the words in the songs' verses are used much in the dance. Traditional Kandyan can be likened to ballet, which is abstract movement in space. The drums give it a joyous and fiery energy. On the other hand, Odissi is accompanied by a vocalist, string instruments, wind instruments, as well as rhythm, making it more layered. Therefore, building a common ground meant finding a musical bridge.

According to Surupa, the challenge was in creating a soundscape that could blend the rhythm of Kandyan with Odissi. She gave the dancers exercises invoking the elements, and they performed the results back to her. For instance, the dancers would have to depict air or water, and she pushed them to discover a new vocabulary to depict these elements, which could evolve into a common language. "So you take the five elements, and you create the first substance. That was the idea," she said.

When the dancers go back to think about their exercises and discover a new language, there is a dialogue between the body and the mind, where the dancers' bodies perform two functions—mediation and a forging of a cognitive common ground between the people involved in the production. In designing, such mediators are referred to as boundary objects.

Boundary Objects

Boundary objects, a concept explained by social scientists Susan Leigh Star and James R. Griesemer, help coordinate between people from different disciplinary backgrounds. They exist at the boundaries of different disciplines. They do not require people to rewrite those disciplinary boundaries.

Consider a stuffed bird at the Museum of Vertebrate Zoology at the University of California, Berkeley.[7] Star and Griesemer studied different people in this museum as part of their work on boundary objects.

Annie Alexander, a passionate patron and administrator of the museum, who was also an amateur animal collector, had a problem: how could she engage people who had little or no interest in conservation (such as

trappers and traders) in obtaining more species for the museum? Describing problems with a trapper who wanted to sell skins to the museum, the administrator said, "It seems next to impossible to persuade a trapper to kill an animal without whacking it on the head."[8]

Alexander was the museum's primary patron, and she funded salaries, provided for upkeep, and also acted as an administrator who managed operations. She was not a theoretical scientist, and her commitment to the museum stemmed from her commitment to conservation and educational philanthropy. As Susan Leigh Star and James R. Griesemer wrote in their paper "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–1939": "The museum was a way of preserving a vanishing nature, of making a record of that which was disappearing under the advance of civilization. For her, as for many social elites of the period, natural history was both a passionate hobby and a civic duty."[9] Such conservation efforts require the participation of amateur collectors, who contacted farmers, trappers, and others who could provide them with specimen. Star and Griesemer's essay talks about different people, including animals, professionals, and amateurs, who participate in scientific work.

On the one hand lies the grisly act of killing an animal, and on the other lies a commitment to conservation and educational philanthropy—and different perspectives have different takes on the ethics and the imperatives of the situation. By citing this example, we are not taking a stance here. We intend it to be an exemplar to further talk about boundary objects and to continue the dialogue on how seeing the museum only as a clinical space for research and conservation is to ignore other actors involved in the process.

For example, a zoologist and a trapper would see a bird sitting on a tree very differently. For the zoologist, the bird is of a particular species and will probably fit nicely into an empty space in the museum. For the trapper, it is a nonedible creature that won't fetch any money. How can the two coordinate?

Star and Griesemer, who studied the museum, tell us about the concept of a boundary object.[10] Suppose that you ask the trapper and the zoologist to share a boundary object (say, a model stuffed animal) and both agree on it. This means that the trapper will be careful with the animal and the zoologist will feel comfortable that the species is maintained intact. The

boundary object thus manages the tension between these different viewpoints, helps in negotiation, and serves to support cooperation between participants. For example, if the trapper is not interested in either conservation or environment, money for the specimen is decided as a basis of participation without agreement about the classification of the object and actions:

Discipline 1	Boundary object	Discipline 2

Earlier we spoke about the second function performed by the dancers' bodies: they helped create a shared understanding. In other words, they performed a cognitive function too. Similarly, boundary objects have to rest on what we term a *cognitive scaffold* to transcend disciplinary boundaries to instill a shared understanding.

To understand more about boundary objects and the cognitive scaffold they rest on, let us crash into the retirement party of a mechanical engineer at a power equipment firm.[11] The mechanical engineer has stepped down after a long and fruitful career. The person who was supposed to take over his position received another offer and failed to join the firm. As a result, by the time the vacancy was filled, the mechanical engineer had gone on a long-awaited vacation to Papua New Guinea. The new recruit decided the job would not be difficult. All the mechanical engineer did was to evaluate the electrical engineers' design specifications and finalize a design specification document for drafting and manufacturing.

Electrical engineer's design specifications	Sent to	Mechanical engineer (who evaluates and finalizes the document)	Sent to	Drafting and manufacturing

Within a month, there was chaos in the firm. No one understood how the retired mechanical engineer, currently training his binoculars on a bird of paradise in a rainforest, had done the job.

After receiving frantic messages from his colleagues on his answering machine, he returned to his office and his former desk and took out a diary. In this personal notebook was a classification of all the designs done over the past thirty years and personal copies of entire design folders for some

designs that were unique in certain ways. The mechanical engineer had become a librarian. In other words, he was a curator of shared memory and a custodian of the House of Nine Muses.

He had evaluated the electrical engineers' design specifications with respect to the classifications in his book. This enabled him to verify the design and finalize a design specification document for drafting and manufacturing.

What is the role of this crucial classification system that the engineer had painstakingly handwritten in his notebook? It is a cognitive scaffold. The classification remained invisible to both the electrical engineers and the drafting and manufacturing folks. The retired mechanical engineer, who sat at the crossroads of information flow between the two groups, had provided a cognitive scaffold for these boundary objects (design and manufacturing specifications), a necessary link between the two groups.

Electrical engineer's design specifications	Sent to	Mechanical engineer (who evaluates and finalizes the document) using his personal classification system	Sent to	Drafting and manufacturing (which receives revised design specifications)
Design specifications: Boundary object		Personal classification system: Cognitive scaffold		Revised design specifications: Boundary object

A change in the boundary object requires a corresponding change in the cognitive scaffold supporting it. With the goal of increasing productivity in the workplace, computer-aided design (CAD) was introduced. One study found that CAD increased productivity by no more than 5 percent in the first year and that the real productivity growth took place after five years.[12] An interpretation of this study was that the use of CAD tools requires significant conceptual shifts because of the fundamental extension to manual procedures. These shifts are required because of the CAD tools' capacity to manipulate and compose structures of geometry, things not possible in manual drawing. This change requires a shift in the models of drafting and manufacturing engineers.

Another study found that the introduction of CAD introduced new classes of errors because of new sets of operations whose semantics were

new to the user and not well understood. The primary observation here is that a technological shift in the creation of drawings (boundary objects) has created a conceptual shift with its attendant language and its interpretations (cognitive scaffolding), hence changing understanding of these boundary objects.[13]

Sometimes a boundary object acts like a cognitive scaffold when it becomes a link among one or more perspectives. The more the links the boundary object has to multiple perspectives, the more complex is the cognitive scaffold. The more complex the scaffold, the more tentative and fragile its status.

This brings us to the curious case of process N and process M, two transformer design processes that were used within the same company.[14] A transformer design process is the process through which the transformer moves from the design stage to the test stage. Design and manufacturing specifications are created at the design stage. Engineers evaluate these specifications using certain analytical tools and models. The design and manufacturing specifications are then sent to the test stage:

Design stage	Test stage
Boundary objects: Design and manufacturing specifications	
Cognitive scaffold: Analytical tools and manuals	

Now we come to the curious part. When transformers that had been designed through process N came to the test floor, their success rate was 60 percent. On the other hand, the success rate for process M was 98 percent. What accounted for this startling difference in performance?

The study revealed that the key to this difference was held in the hands of an engineer employed by the department in charge of process M. This engineer visited the manufacturing facility and the test facility every day to collect test data and performance data. This data was then fed to the analytical tools and manuals used to evaluate the specifications. This meant that any specification that came through process M was evaluated and could be used to predict the performance based on the most recent company-wide information on what caused failures. In the department in charge of process N, however, these updates were received almost two years later.

This meant those working on process N knew only what failures they were exposed to.[15] They often made ad hoc rules based on the little information they had. This led to costly rework, sometimes even after the devices were shipped.

The above example illustrates the fragility of boundary objects when they are not maintained to keep the different interpretations aligned through organizational and cultural dialogues.[16] The life of a boundary object occupies many niches in the dialogues between and among disciplines and perspectives. The boundary object and cognitive scaffolds are interrelated in the sense that scaffolds allow the boundary object to be interpreted. These cognitive scaffolds can be classifications in a discipline or in a specific context that serves a community of practice.[17] These boundary objects and cognitive scaffolds in many forms and media, in effect, are models (both encoded and physical) that serve the cognitive process that occurs at individual, distributed, social, and cultural levels.

We will henceforth refer to all boundary objects and cognitive scaffolds that serve cognition as models. Whether sketches, drawings, visuals, tables, charts, videos, audios, mathematical, or physical representations, they are all models. We create models, we design them, we have a dialogue with them in designing. Extending Donald Schön's idea of a reflective practitioner in a dialogue with herself, our idea of designing is that the individual and the social are in a dialogue with the models. All these entities involved in the dialogue evolve simultaneously. The dialogue is not linear but instead is emergent. It depends on the participants and their context.[18]

Creating a New Language

As the dialogue in designing unfolds and different disciplines begin to coordinate with each other through boundary objects, a shared common ground slowly emerges, articulated by a new shared language. In coming up with the new language, the disciplines themselves undergo a transformation as the dialogue informs the disciplines too. When describing the process of how the dialogue between Odissi and Kandyan unfolded, Surupa's choreographic process resonates with the process of designing. The process brought together rhythm (which is the lifeblood of Kandyan) and music for both Odissi and Kandyan to have a dialogue that transformed Kandyan

by "leaps and bounds," according to Heshma. "That was the biggest new ground that we broke on our part to really see how Kandyan works with music," she said.

Speaking about the transformation, she elaborated: "But then when you see the show [*Samhara*] after all that, the Kandyan sections are very different from the way we would have performed them here [in Sri Lanka]." She adds, "New ways of moving, new rhythm patterns—look like another form but are not. Everywhere there are definite connections to it being purely Kandyan. That was the most exciting part for me to understand how far can you throw yourself."

The process of creating choreography and finding common ground between Odissi and Kandyan gives us a sense that in the back and forth there is a sense of building a new language together. As Heshma says, the Kandyan performed in *Samhara* almost looks like another form, but it is not.[19] Here, language is not just a medium of communication. Rather, it is more like what the psycholinguist Herbert H. Clark calls a joint activity. In a joint activity, two or more people perform actions together. Thus, two people tangoing together are seen as a pair rather than as two individuals dancing. Functioning as a composite unit is a characteristic of a joint action.

When one person dances alone, he or she performs autonomous actions. When two dance together—even though they continue to dance on their own—their actions become participatory. Joint actions comprise participatory actions, and the reverse is also true. As Clark says, "we can look at a joint action either way—as a whole made up of parts, or as parts making up the whole" (as with our conception of a dialogue, the whole and part are not distinct but are constantly formed and reformed by the act of dialogue).[20]

Describing how Kandyan was transformed and yet remained the same through the dialogue, Heshma said that although the dance was created with the language she knew best, which was Kandyan, the process of working with Surupa made that language "completely fresh." During the process of designing, different models (including sketches, drawings, visuals, tables, charts, videos, audios, mathematical, gestural, and symbolic) become the vocabulary of the language that develops in designing. Both the models and the language help in mediating as well as developing a cognitive common ground.[21]

The Dance Revisited

When we describe designing as dialogue in chapter 3, we speak about the dialogue between the artifact and the context, the dialogue between the individual and the social and parts and wholes, and the dialogue between different disciplines. Our conception of designing is based on discovering the ecology of design in terms of designing as a dialogical process that is directed at achieving a desired outcome. The theories of distributed and situated cognition underpin our understanding of designing as a contextual process—a dialogue. Cognition and design are inseparable at all levels of designing. We do not exist only as individuals but live in a network that encompasses the social aspect of our lives, and designing is a cognitive act—a dialogue between the individual and the social. It is a dialogue that takes place in an interacting network of actors, disciplines, perspectives, models, and languages to achieve a goal in a given social context. We introduce the idea of mediators of this dialogical process, which enables a cognitive common ground that includes models such as sketches, drawings, visuals, tables, charts, videos, audios, mathematical, and physical representations. We describe the theory of boundary objects (drawn from the sociology of work) and ethnographic studies that led us to understand cognitive scaffolds to describe the functions that models perform. Over time, as the dialogue in designing unfolds, these models become the vocabulary of a common language that underlies the joint activity (drawn from cognitive linguistics) that is designing.[22]

Seen in another way, in this chapter, we design a model—a theoretical base that underpins our conception of a dialogue—and in doing so develop a nascent language to describe the dialogue in designing. (As you can see, we are fond of recursion.)

Given the central importance of models to our understanding of designing, in the next chapter, we turn the spotlight on these models. What are models? How are they created, managed, and reconstituted? How do they persevere? What are the implications for practice? These are some of the questions the next chapter addresses.

During the interview, Surupa said: "Not all the information is relevant. A lot of the time what choreography and creation are is how much and how well you edit." Keeping in mind this piece of advice, we have not included a lot of other associated theories in the main body of the chapter, and

we have included extensive footnotes for readers interested in exploring further.

The Story of Designing So Far

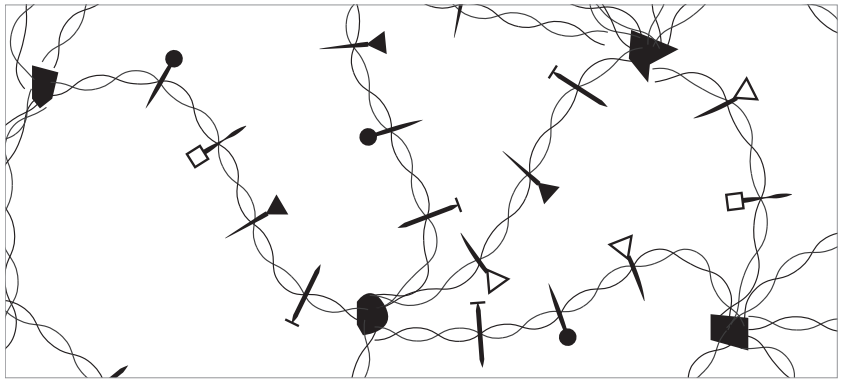

Figure 4.1
The dialogue in designing is mediated by models, which include boundary objects and cognitive scaffolds.

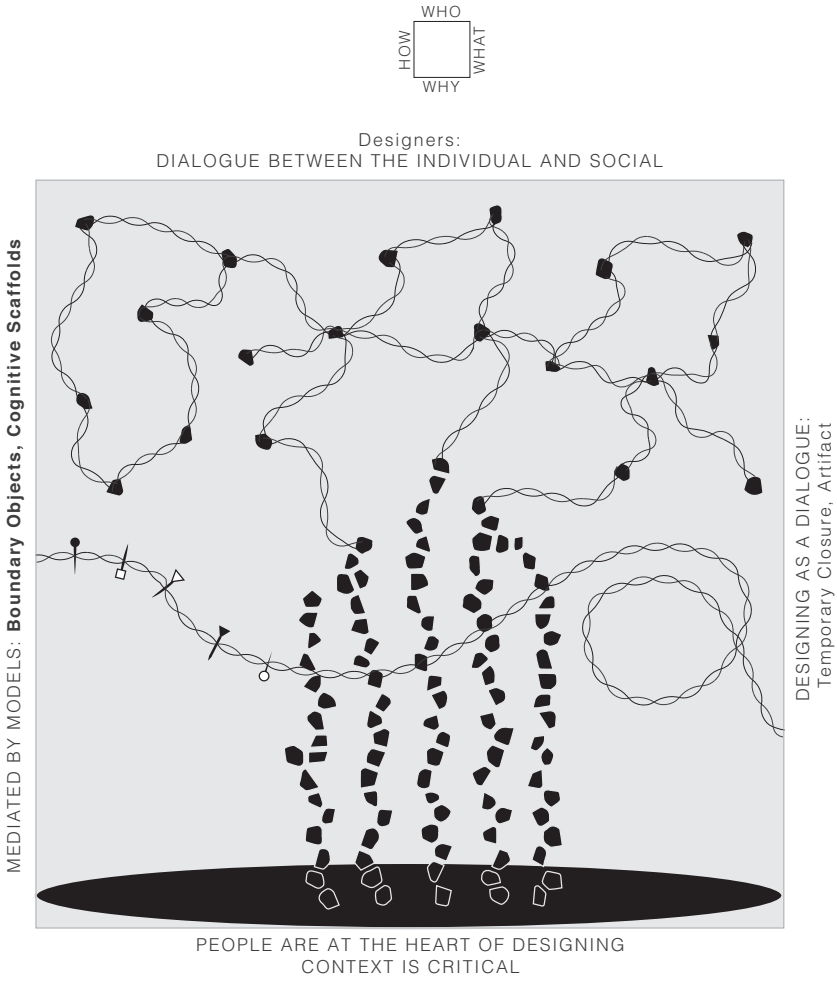

Figure 4.2
How the dialogue in designing unfolds.

We Are Not Users

Dialogues, Diversity, and Design

By: Eswaran Subrahmanian, Yoram Reich, Sruthi Krishnan

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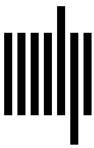

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