INQUIRY BY DESIGN: TOOLS FOR ENVIRONMENT-BEHAVIOR RESEARCH

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Chapter 1

DESIGN: IMAGES, PRESENTATIONS, TESTS

"Inquiry is the creation of knowledge or understanding; it is the reaching out of a human being beyond himself to a perception of what he may be or could be, or what the world could be or ought to be."

C. West Churchman
The Design of Inquiring Systems

During a physical design project, an individual or team generates ideas for changing the existing physical environment and presents them in a form to guide construction. Design begins when an individual or team first thinks about the project—for example, a building, an open-space plan, or an object. It includes a stage when detailed working drawings of a project are given to contractors instructing them how the designers expect the project to be built. It includes a stage when contractor and designer negotiate changes in design to respond to problems that arise during construction. The process formally ends when construction is completed. Designers conventionally break down this process into contractually binding stages: programming, preliminary design, final design, working drawings, construction supervision.

Design is difficult to describe because it includes so many intangible elements such as intuition, imagination, and creativity—which are essential to research as well. Nevertheless, several analysts have done a remarkable job of articulating parts of this process (Hillier & Leaman, 1974; Korobkin, 1976; and others). Their descriptions apply to a prototypical design process that, in an architect's office, might go something like this:

> Posed with a design problem—let us say for a new elementary school—an architect gathers information about the specific site and about elementary schools generally. She does this by visiting the site, having discussions with clients and users, and studying books.
>
> Through a series of trials, she generates a preliminary mental image of an "elementary school," responding to the information she has gathered, her personal experiences, and mental images of schools she knows and likes.
>
> She draws general rough sketches or diagrams to begin to flesh out this image and reviews them with people in the office, with the client, and by herself. Possibly she even begins to present her concept by building rough working models.

Stepping back from her presentations, she asks herself whether they do justice to her concept and to the information she has. She might feel she needs to gather more data to adequately assess them. In this way the architect tests and refines her concept and her information.

She repeats this process several times within days, hours, or even minutes until she feels she has begun to generate a clearer mental image, one that corresponds both to her sketches and to the information.

Until now, each sketch might be different from previous ones, yet influenced by studies of previous sketches. She may even have developed several alternative but equally fruitful concepts.

Concept sketches and diagrams at this stage include ideas about overall building image, major spaces, and relationships among building components. These she shows to her clients and possibly to the building's eventual users. Both groups may have been consulted earlier in the process as well. Now they may suggest revisions, discuss alternatives, or request the designer to pursue a whole new direction.

After appropriate groups improve and approve concept sketches, the architect and her team think about and then draw schematic drawings—the first step in moving from concept to building. Schematic drawings begin to present specific room relationships, how big rooms are, where doors and windows are located, and where facilities will be.

As the architect designs schematic drawings, she repeatedly checks to make sure drawings are true to the agreed-upon concept, to government regulations, and to performance standards dictated by theory and empirical work.

She simultaneously develops and refines the overall design concept, paying attention to how its individual parts relate, how the whole building "hangs together," and how the building fits in context.

This process of design development results in "presentation drawings": plans, sections, elevations, perspective renderings that give clients an idea of what the final product will be. Such drawings specify what attributes the building will have, from dimensions to material to color.

When client groups review presentation drawings, they once again may respond with suggestions for improvement. At this point the designer again negotiates with clients in order to make decisions meet their needs.

After presentation drawings are approved, the architect and her team articulate their ideas in "working drawings." Working drawings detail for the contractor how each part of the building is to be built—from foundation to doorknobs.

While working drawings are being drafted, each decision is checked again to see that it meets legal regulations such as building and safety standards and that it reflects the initial design concept. Major conceptual design shifts made this late in the process can be costly.

When the design team feels that working drawings adequately present its ideas, when regulatory personnel have checked that working drawings meet legal standards, and when specialist consultants have reported that their criteria have been met, working drawings are complete. At this point a contractor is hired to construct the building.

The contractor constructs the building according to the drawings and written specifications in documents. If he does not understand a specification, has difficulty securing materials, or for some reason feels a change is necessary, he reports the problem to the architect. When both agree that a change is required, the architect issues an official change order. At this late stage, modifications in design are carried out with great care.

In most cases architects remain as construction supervisors on their projects until specifications have been officially fulfilled and the project is considered built.

Architects may return to their buildings after occupancy to learn more from what they have done. This information is useful for future design.

WHY DESCRIBE DESIGN?

Describing the design process may help designers and teachers of design understand their own behavior and thereby improve their design ability. Analysis may also be useful for researchers and designers who want to work together.

Although outsiders can directly observe behavioral and representational parts of designing, they cannot directly observe cognitive design processes taking place inside someone's head. Research evidence for describing what is going on when designers think is, therefore, necessarily indirect and inferential or introspective. Evidence includes personal experience (Jones, 1970; Korobkin, 1976), participant observation (Zeisel, 1975), stream-of-consciousness reports by designers designing (Foz, 1972), and analysis of successive design drawings (Foz, 1972). Some design theorists look to other disciplines to provide illuminating analogies: linguistics (Hillier & Leaman, 1974), artificial intelligence (Foz, 1972; Hillier & Leaman, 1974), biological evolution (Hillier & Leaman, 1974).

Design methodologists' theoretical, personal, and practical reasons for analyzing design result in their emphasizing different elements and using different analogies to describe how parts of the process fit together. In a particular situation one description may be more helpful than another to designers or researchers in achieving their ends. Comparing such descriptions is likely to provide both a useful, multifaceted picture of design and interesting problems for further study.

FIVE CHARACTERISTICS OF DESIGNING

Physical design inventively mixes together ideas, drawings, information, and a good many other ingredients to create something where nothing was before. Design can also be seen as an ordered process in which specific activities are loosely organized to make decisions about changing the physical world to achieve identifiable goals. However one thinks about design and for whatever purposes, five characteristics emerge as useful tools for understanding what designers do.

Five Design Characteristics
I. Three Elementary Activities The complex activity called "designing" interconnects three constituent activities: imaging, presenting, and testing. *II. Two Types of Information* Information used in designing tends to be useful in two ways: as a heuristic catalyst for imaging and as a body of knowledge for testing. *III. Shifting Visions of Final Product* Designers continually modify predictions about their final result in response to new information and insight. The design process is thus a series of conceptual shifts or creative leaps. *IV. Toward a Domain of Acceptable Responses* Designers aim to reach one acceptable response within a range of possible solutions. This domain of acceptance is measured largely by how well a product is adapted to its environment and how coherent constituent parts of the product are with one another. *V. Development through Linked Cycles: A Spiral Metaphor* Conceptual shifts and product development in design occur as the result of repeated, iterative movement through the three elementary design activities.

I. Three Elementary Activities

Designers working on an actual project do not just sit down and "design"; it is not a one-dimensional activity. Rather, like other developmental processes, such as writing a book or bringing up children, design is a complex activity more usefully thought of as including several analytically distinct elementary activities: imaging, presenting, and testing.

The first activity I will discuss is imaging (Korobkin, 1976). I might have said "The first activity in design is imaging," but this would have reinforced the false popular idea that using one's imagination is the most important element in creative action and that any design process must begin with an act of imagination. In reality, the starting point for any developmental process is among its least important aspects (Bruner, 1973: 160; Popper, 1972: 34, 72, 104).

Imaging. Imaging is the ability to "go beyond the information given," as Bruner (1973) calls the process of seeing something where nothing seems to have been before. This activity, often called "real creativity" by laypersons, might most accurately be called "imaging" after the verb *to image*, which the *Oxford English Dictionary* defines as

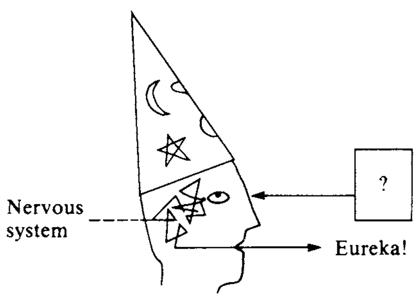
> to form a mental image of: to conceive (a) something to be executed: to devise a plan, and (b) an object of perception or thought: to imagine, to picture in the mind, to represent *to oneself*, as in Coleridge, 1818, "Whatever is admitted to be conceivable must be imageable," and in Browning, 1855, "Image the whole, then execute the parts". . .

Imaging means forming a general, sometimes only fuzzy, mental picture of a part of the world. In design as well as in other types of endeavors, images are often visual; they provide designers a larger framework within which to fit specific pieces of a problem as they are resolved.

How a designer's image is formed has been the topic of much discussion but little empirical research. The concept is well expressed in Jones' picture (1970: 46) of a "black-box designer," reflecting his interpretation of how Osborn (1963), Gordon (1961), Matchett (1968), and Broadbent (1966) describe design.

Designers can use their visions of eventual solutions to define better the design problem they are working on and to guide their search for answers. Comparing a design against a mental image makes visible where the design can be improved and perhaps where the image itself might be modified (Foz, 1972). One hypothesis about the nature of images is that they are deductive constructs akin to the "conjectures" that Popper (1963) describes as essential to scientific progress; that is, these visions of a "solution in principle" developed early in a design process parallel researchers' working hypotheses (Hillier, Musgrove, & O'Sullivan, 1972). Just as working hypotheses are refined during scientific exploration, images are developed during design activity.

Images, however, are more than just a person's internalized pictures. They represent subjective knowledge, used to develop and organize ideas in such areas



Black-box designer. From *Design Methods: Seeds of Human Futures*, by J. C. Jones. Copyright 1970 by John Wiley & Sons Ltd. Reprinted by permission.

as visual perception and learning (Bruner, 1973), language (Polanyi, 1958), child development (Piaget & Inhelder, 1969), and economics and politics (Boulding, 1956).

In understanding an internal process like imaging, we are unfortunately constrained to studying its external manifestations: (1) how designers present their images to others and to themselves and (2) how their observable behavior changes while developing internal images of situations.

Presenting. Designers sketch, draw plans, build models, take photographs, and in many other ways externalize and communicate their images. It takes skill not only to present an idea well but to choose the mode of presentation best suited to a particular time in the design process. Designers present ideas to make them visible so that they themselves and others can use and develop them. Presenting includes the very important characteristic that for each design one must choose and organize only some elements from a larger number. Presenting includes both variety reduction, in that "more and more specific drawings . . . exclude more and more detailed design possibilities" (Hillier, Musgrove, & O'Sullivan, 1972: page 29.3.9), and opportunity expansion, in that new problems for further design resolution are made explicit.

Of course, if images and their presentations were identical, it would not be possible to use one to clarify the other. Rather, designers present not images themselves but the implications of images (Simon, 1969: 15). The importance of "representation" may be stated in an extreme way by asserting that "solving a problem simply means representing it so as to make the solution transparent" (Simon, 1969: 77). Whether or not this conscious oversimplification is tenable, "a deeper understanding of how representations are created and how they contribute to the solution of problems will become an essential component in the future theory of design" (Simon, 1969: 77).

In a pilot study of how architects with different design experience solved a short two-hour sketch problem, the more experienced architects tended to be better able to make decisions in the form of presentations (Foz, 1972). They did not agonize over decisions as did beginners. Skilled designers used "three dimensional representation . . . more often, more quickly, more realistically" (1972: 72). In other words, the more experienced designers could quickly sketch out an idea, draw it, or build a model—even though that presentation may not have been perfect. They knew that soon they would return to the model with a fresh eye to evaluate and improve it.

Testing. Appraisals, refutations, criticisms, judgments, comparisons, reflections, reviews, and confrontations are all types of tests. After presenting a design idea in whatever form, designers step back with a critical eye and examine their products (Hillier et al., 1972; Korobkin, 1976), sometimes in groups and sometimes alone (Christopherson, 1963). Design testing means comparing tentative presentations against an array of information like the designer's and the clients' implicit images, explicit information about constraints or objectives, degrees of internal design consistency, and performance criteria—economic, technical, and sociological.

An interesting dimension of the design activity of testing is that designers look both backward and forward simultaneously: backward to determine how good a tentative product is, forward to refine the image being developed and to modify the next presentation. While reviewing, criticizing, and analyzing any presentation, designers are preparing the way for the next creative leap.

Although testing contributes to design innovation, it also makes a designer's task more manageable in the face of the potentially infinite number of alternative responses to any problem (Jones, 1970). Testing in design makes it "possible to replace blind searching of alternatives by an intelligent search that uses both external criteria and the results of partial search to find short cuts across the unknown territory" (Jones, 1970: 55).

Testing is a feed-back and feed-forward process, adjusting the relation between a design product as it develops and the many criteria and qualities the product is intended to meet.

In sum, imaging, presenting, and testing are elementary activities constituting a complex process called "design."

II. Two Types of Information

During a project, designers define problems that require them to add to what they know. Gaps in knowledge may be specific (what is the lightest readily available building material in Nigeria) or general (what about life in Nigerian universities is applicable to the university I have been asked to design there). Among the problems designers face are technological, chemical, economic, cultural, psychological, esthetic, social, and ecological ones. To cope with the great amount of information they need, some designers and researchers propose rationally organizing explicitly formulated architectural information to make it easily retrievable.

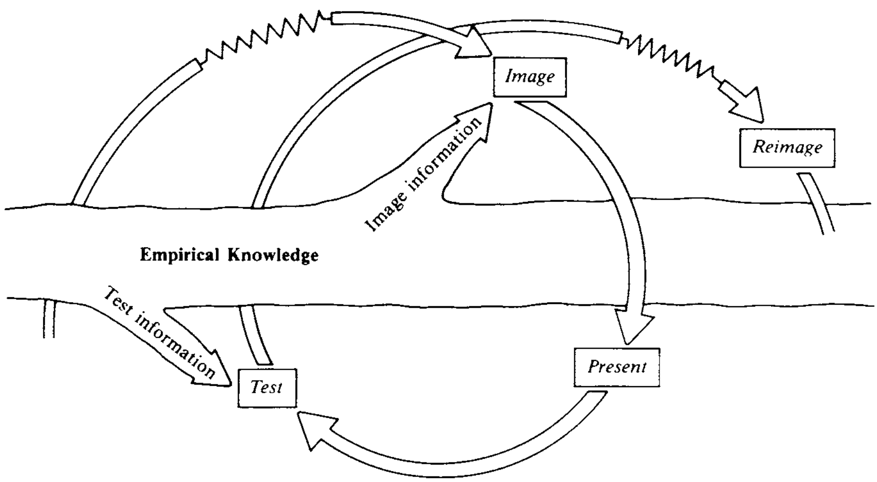
Many practicing designers and some design methodologists react by pointing out that proposals that fit discrete bits of scientific information into an artificially rationalized design process hinder design creativity and overlook more important information needs that designers have (Hillier et al., 1972; Rapoport, 1969a).

Korobkin (1976) elegantly resolves this debate, reasoning that having a clear idea of what different forms of information are useful to designers, and when, can stimulate design innovation. Korobkin groups information in the design process into two categories (1976: 20):

> *Image information* . . . provides a general understanding of important issues and of physical ideas pertinent to their resolution.

Test information . . . [is] directly pertinent to evaluating the good and bad points of a given hypothesis design.

This distinction is not necessarily one of information content. It primarily clarifies different purposes that the information serves.



Designers use "image information" heuristically as an empirical source for basic cognitive design decisions: What is the meaning of a school in a child's life? What is life like for a handicapped person? What do teenagers see as their neighborhoods in suburban areas? Image information conveys a feeling or a mood of some environment. It cannot be used to evaluate isolated specifics of a design concept. Test information drawn from the same body of knowledge is useful to evaluate specific design alternatives. For example, is it easier for most elderly handicapped people to push themselves up with a horizontal grab bar next to a toilet or to pull themselves up on a slanting grab bar? (For most, a horizontal bar is easier.) (Steinfeld, 1975: 98).

Using the same information in this twofold way is remarkably efficient and contributes directly to design as a learning process. It also provides an important link to understand the relation between how research and design are carried out, in that "information which has been used heuristically [to help generate conjectures], can also be used to test the new conjectures" (Hillier, Musgrove, & O'Sullivan, 1972).

III. Shifting Visions of Final Product

What happens when designers test the responses they present? What do designers image? How do designs develop once conceived? Discussing questions like these may shed light on the dynamics of design.

As we have seen, designers form images of future products they intend to design. One reason designing is intriguing is that "the final outcome of design has to be assumed before the means of achieving it can be explored: designers have to work backwards in time from an assumed effect upon the world to the beginning of a chain of events that will bring the effect about" (Jones, 1970: 9–10). Designers must predict the future and then figure out how to get there! Of course, such predictions are not precise; they are approximate solutions that the design process is meant to make less approximate.

Images rarely appear fully formed in one cataclysmic blinding vision. Most images are developed and refined by means of a series of modest "creative leaps." The process by which such leaps are made has been called many things: variety reduction (Hillier & Leaman, 1974), reworking subobjectives (Archer, 1969), restoring balance (Sanoff, 1977), hypothesis refinement (O'Doherty, 1963), transformation (Schon, 1974). Creative leaping is triggered by testing the presentation of a tentative design response against quality criteria within the situation and its context to find out where the response is strong and where it is weak.

Making explicit tacit attributes of a design through testing helps designers reimage and re-present their designs with greater precision (Schon, 1974). Testing makes contradictions apparent (1) among elements of a design at a particular stage of development and (2) between the design and previously accepted requirements it was intended to meet. Designers can at any time generate and draw on additional information to refine their ideas and trigger further conceptual leaps.

Designers use the design process to learn, through testing, from themselves: "New [design] options are versions of earlier ones growing out of the thinking that went into the rejection of earlier ones" (Schon, 1974: 17–18). Critically analyzing tentative design responses and adding new information can progressively improve designs (Asimow, 1962; Guerra, 1969).

Designs develop cumulatively. Concepts originating in general form are developed to an acceptable level in a series of presentations, tests, and reimages. But what does "an acceptable level" mean? What is optimization (Markus, 1969) or fit (Alexander, 1964)? When do designers stop reducing variety? What is the goal of the design process?

IV. Toward a Domain of Acceptable Responses

Built buildings, manufactured objects, or enacted regulations may be looked at as preordained, perfect end points that people reach by designing. To improve the way we design, however, it may be more useful to see final design products as unique responses to particular problems. These theoretically fall within a set of alternatives controlled by things like our imagination, available technological knowledge, ethical values and personal skills, resources in the actual design situation, and our definition of quality.

We can influence available alternatives by adjusting any of these values—for example, by using our imagination, increasing our substantive knowledge, or finding additional time and money resources. Paradoxically, however, no matter what designers do to control it, there is an infinite array of equally good potential responses in any *domain of acceptable responses* (Archer, 1969: 83).

If we think of design as a process of choosing the best solution from among possible alternatives, we run into difficulties. First, among an infinite number of possible alternatives there will be an infinite number of best ones. Second, for complex problems there may be no such thing as a best solution—and any problem can be as complex as one wants to see it.

> When we come to the design of systems as complex as cities, or buildings, or economies, we must give up the aim of creating systems that will optimize some hypothesized utility function; and we must consider whether differences do not represent highly desirable variants in the design process rather than alternatives to be evaluated as "better" or "worse." Variety, within the limits of satisfactory constraints, may be a desirable end in itself, among other reasons, because it permits us to attach value to the search as well as its outcome—to regard the design process as itself a valued activity for those who participate in it [Simon, 1969: 75].[1]

After such a discussion one may well ask how designers decide what is acceptable. On what basis do they test and improve their designs? How do they decide on a final design to be built? In other words, what are their criteria for acceptability and quality?

Acceptability and quality criteria. These difficulties become clearer when we see designing as something going on in response to actual problems in actual situations. In such situations designers make decisions about practical, substantive attributes of the objects being designed. Such attributes might be, for example, material properties, like weight, elasticity, strength; properties of the physical setting of the object, like light, degree of urbanization, soil conditions; or administrative properties of the object, like cost, marketability, construction scheduling. Designers use such attributes, along with available real-world resources, to help test and improve their ideas and to help them decide when to end this process for any particular project.

Attributes of designed objects in actual settings can be grouped into two categories. The first is *contextual responsiveness,* or the degree to which objects respond to external conditions. In southern climates, for example, do buildings protect users from direct sun while allowing breezes to provide natural cross-ventilation? In different cultures do building forms respond to the cultural expectations of residents (Brolin, 1976)? The second is *internal coherence,* or the degree to which components of a design object are consistent with one another (Archer, 1969: 101; Jones, 1970: 30). For example, in a northern climate do material selection, room arrangement, and site orientation each contribute to

[1] From *The Sciences of the Artificial,* by H. A. Simon. Cambridge, Mass.: MIT Press, 1969.

protection from the cold, or does one decision—say, to plan open spaces—counteract the effects of others?

The use of responsiveness and coherence as criteria to evaluate designed objects constitutes a significant link between design and science, as Simon succinctly points out:

> Natural science impinges on an artifact through two . . . terms . . . : the structure of the artifact itself and the environment in which it performs; and symmetrically, an artifact can be thought of as a meeting point—an 'interface' in today's terms—between an 'inner' environment, the substance and organization of the artifact itself, and an 'outer' environment, the surroundings in which it operates [Simon, 1969: 6].

A complementary, two-sided approach to improving and evaluating the acceptability of a designed object underlies the work of the design methodologist Christopher Alexander (1964). Identifying the importance of design appraisal, he describes acceptable designs as those that achieve a degree of "fit" between a "form in question and its context." To him the artifact of design is form and context seen as one, not form alone.

This deceivingly simple idea has profoundly influenced design theory. The term *form* as Alexander (1964) uses it can be replaced by *internal coherence,* and *context* can be replaced by *external responsiveness:*

> *Form [Internal Coherence]:* Indeed, the form itself relies on its own inner organization and on the internal fitness between the pieces it is made of to control its fit as a whole to the context outside [p. 18].
>
> *Context [External Responsiveness]:* The context is that part of the world which puts demands on this form; anything in the world that makes demands of the form is context [p. 19].
>
> *Fitness [Acceptability]:* Fitness is a relation of mutual acceptability between these two. In a problem of design we want to satisfy the mutual demands which the two make on one another [p. 19].

A difficulty still remains, however. How do designers decide to stop developing a product? When do they accept it as ready to be built?

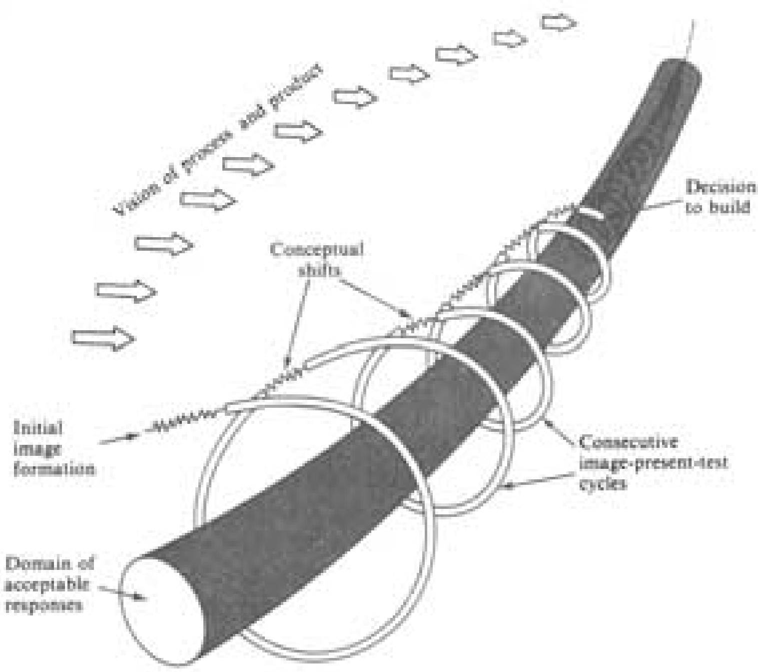
Stopping. Changing an environment has effects and side effects. Some may be visible beforehand, others not. Choosing to stop making one's product better means deciding one is willing to risk unintended side effects. What is an acceptable mix of knowing and risk taking in any actual situation reflects conditions like established professional norms, available resources, personal preferences, costs and rewards, and perceived competition.

Actual settings in which people design provide tools for making these decisions. The process of improving a design may stop, for example, when the allotted time and money have been spent and a design review team in the office judges that the product meets office standards. If the designer has an agreement with a client group that it has final say on the project, the group may be used to make the decision to stop.

There are innumerable ways designers can use their surroundings to help them decide when a project is acceptable enough. What is significant is that using quality criteria to improve a design keeps the process going. One cannot rely on the same criteria to set limits—to stop the process. Stopping is the result of someone's deciding that he or she is willing to live with potential, and as yet unseen, side effects of the decision.

V. Development through Linked Cycles: A Spiral Metaphor

The metaphor of design as a spiral process can be used to look at how the various elements in design fit together. A spiral process reflects the following characteristics of design: (1) designers seem to backtrack at certain times—to move away from, rather than toward, the goal of increasing problem resolution; (2) designers repeat a series of activities again and again, resolving new problems with each repetition; and (3) these apparently multidirectional movements together result in one movement directed toward a single action.



Design development spiral

Backtracking. Throughout a design project, designers return to problems already studied to revise or adjust earlier tentative decisions (Archer, 1969: 95). For example, a landscape architect designs a park assuming the final budget will support construction of both a wading pool for children and a decorative fountain. Later, finding that the larger playing field he wants costs more than expected, he combines the two water projects into one, which serves as both a fountain and a wading pool.

It might seem more efficient to choose problems to resolve early in the process that do not have to be reexamined later. But this is seldom possible. Each decision designers make, even if they think it is final, has consequences for future steps in the process and, as we have seen, for past ones as well. Problems arise which earlier decisions did not foresee and which cannot be resolved unless a previous decision is revised (Jones, 1970: 68). Backtracking is not only unavoidable, it is essential to improve design quality (Amarel, 1968). One can hope that later knowledge will not necessitate radical changes in earlier decisions, but of course this too occurs. Not surprisingly, a highly valued skill among designers is the ability to foresee consequences of later design decisions for earlier ones.

Testing can be seen as a form of backtracking. "Whenever the designer pauses to evaluate what he has done . . . [he occasions] . . . feedback loops, shuttle action, and other departures from linearity indicated in most models of the decision sequence. These are introspective and retrospective acts; for he looks back to earlier decisions" (Markus, 1969: 112). In sum, backtracking to adjust earlier decisions is an integral part of design, and a spiral metaphor indicates this activity.

Repeating activities with shifting focus. In separate cycles of a design project, designers present, test, and reimage responses to a set of related problems. Each repetition focuses on a different problem. For example, in one cycle a designer may focus on architectural style; in another, on kitchen hardware. A decision in one cycle may determine the context for a decision in the next (for example, a decision about architectural style may limit the range of choices for hardware), but this does not mean that foci are necessarily sequential by size. Designers may find it more efficient to examine very large, very small, and then very large questions than to progress linearly either from large to small or from small to large questions. Urban design decisions about street width may be followed by decisions about street hardware, which in turn are followed by decisions about the modes of transportation the streets will allow.

Design decisions in different cycles can vary also by subject: physical elements like materials or room sizes at one point; at another, systems like heating or plumbing; and at still other times, psychological and social issues like territory or privacy.

Imaging, presenting, and testing may not be equally important in each cycle. Designers may spend more time developing images in earlier cycles and more time presenting them in later ones. Testing can take place so quickly that designers appear to skip it entirely in a cycle; for example, when designers "think with their pen," testing can take place almost simultaneously with presenting and reimaging. In such cases neither actor nor observer may be able to differentiate the activities.

The time designers spend in image/present/test cycles varies. One cycle may last days or weeks before a conceptual leap and eventual reimaging take place. Another may last only seconds. And each activity in a cycle does not begin and end at a discrete point. Where one activity ends and another begins is not clear. Each contains remnants of the previous activity and roots of the next.

One way to envision re-cycling and repetition is to think of design as a conversation among three activities: imaging, presenting, and testing. The discussants remain the same, but the intensity and topics of the conversation change as time passes.

One movement in three. Designers are like good hunters and trackers. They appraise their goal not by rushing straight at it but by continually readjusting their position to gain new perspectives on their prey. Backward movement, repetitions at different levels, and progressively linked cycles combine into one movement leading designers through continual improvement toward the goal of an acceptable response.

Growth and learning are essential parts of design. It is a process that, once started, feeds itself both by drawing on outside information and by generating additional insight and information from within: "In the course of cycling the loop, the designer's perception of his real world problem, his concept of the design solution, grows" (Archer, 1969: 96).

The many adaptations, revisions, and conceptual shifts that take place during design are guided by a designer's vision of the design process leading to action. Something is built.

OVERVIEW

Farmers design when they figure out where and when to plant various crops. Lawyers design when they prepare a strategy for a client's defense. "Everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (Simon, 1969: 55).

What architects, landscape architects, some planners, and other physical designers do can be seen as applying basic principles of action to solving a particular type of problem. Physical design as a formal set of disciplines presents opportunities for self-consciously analyzing design.

This chapter proposes that to organize our own design behavior to achieve the ends we want, it is helpful to see design as a loose ordering of three main activities: imaging, presenting, and testing. The chapter proposes that using a