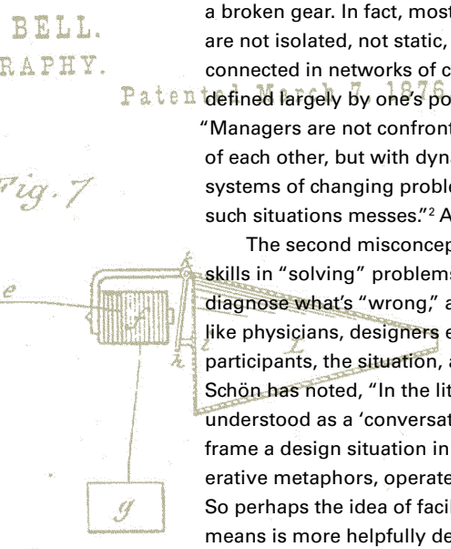
WHY WE SHOULD STOP DESCRIBING DESIGN AS "PROBLEM-SOLVING"

HUGH DUBBERLY

The world today faces multiple intertwined crises, including the COVID-19 pandemic and the resulting economic depression—on top of economic disparity, racial injustice, global warming, and more, which arose in a context of large and intertwined technological, economic, and social changes. Designers have proposed for several decades that the world needs design (or "design thinking") to solve these problems.[1] Even today, such a proposition seems self-evident to many designers. But this mindset reflects misconceptions about the world in which designers work and what designers do.

The first misconception is that the world is composed of "problems" and that each problem can be neatly carved out from the next, fixed in time, and defined in an objective way so that anyone can find a lasting "solution"—like a watchmaker replacing a broken gear. In fact, most issues facing the world (and designers) are not isolated, not static, and not clear; they are "systemic," connected in networks of cause and effect, ever changing, and defined largely by one's point of view. In 1979, Russell Ackoff wrote, "Managers are not confronted with problems that are independent of each other, but with dynamic situations that consist of complex systems of changing problems that interact with each other. I call such situations messes."[2] A neutral term might be "tangles."



The second misconception is that designers have special skills in "solving" problems, that they stand outside a situation, diagnose what's "wrong," and prescribe the "right" therapy. Instead, like physicians, designers engage in a back-and-forth with other participants, the situation, and their tools and materials. As Donald Schön has noted, "In the literal sense of the word, designing can be understood as a 'conversation,' a dialogue among individuals who frame a design situation in different ways, employ different generative metaphors, operate from different appreciative systems."[3] So perhaps the idea of facilitating a conversation about goals and means is more helpfully descriptive of the design process than that of "problem-solving."

This paper explores the myths of design as problem-solving—their origins in design history, issues that call into question the validity of the problem-solving frame, and alternative ways of framing the process.

The Problem-Solving Frame

If design is problem-solving, then the "problem" is the designer's basic unit of work. It has many synonyms:

- Breakdowns / malfunctions / opportunities
- Context / environment / situation
- Goals / jobs to be done
- Functions / requirements / constraints
- Human needs / wants / desires / values
- Tasks / scenarios of use / use cases

The process of "problem-solving" is framed as rational. It, too, has many synonyms:

- Addressing issues
- Changing existing situations into preferred ones
- Creating order
- Ensuring clarity, reliability, and safety
- Improving efficiency
- Increasing effectiveness
- Reducing costs
- Removing pain points

An axiom of modernist design is that defining a problem reveals its solution.[4] The problem-solution pair forms two sides of an equation. Implicit in this axiom is the idea that the problem *has* an objective definition and that the designer's role is not only to solve it but also to define it.

Many models depict the design process as linear, with a clear beginning, middle, and end.[5] For example, the "double-diamond" model includes four steps: "Discover, Define, Develop, Deliver."[6] In practice, the design process is iterative, and the proposed solution is often a redefinition of the problem.

Despite its popularity, describing design as problem-solving does not make it true; rather, it is one of several possible frames—stories designers tell themselves and others. These stories are myths that support political agendas, position designers in relation to organizations, and help sell services.

How did we get here?

1.0 Origins

Many designers have sought a rational basis for their work.[7] This search gained momentum at the end of the nineteenth century and accelerated throughout the twentieth as Beaux Arts approaches to architecture and design were replaced by late-modernist ones—and as the frame of design as decorative art was replaced by the frame of design as problem-solving. This shift had several dimensions:

from		*to*
slow, rural, agrarian ethos	→	fast, urban, machine ethos
handcraft-making	→	planning-for-manufacturing
lesser art	→	science of the artificial
skilled trade	→	expert professional service

1. For example, Tim Brown and Don Norman.

2. Russell Ackoff, "The Future of Operational Research," *Journal of the Operational Research Society* 30, no. 2 (February 1979): 93–104.

3. Donald Schön, "The Design Process," in *Varieties of Thinking, Essays from Harvard's Philosophy of Education Research Center*, ed. V. A. Howard (New York: Routledge, 1990), 137.

4. For example, Louis Sullivan, Max Bill, George Nelson / Armin Hofmann, Christopher Alexander, Charles Eames, William Peña, et al.

5. Hugh Dubberly, "How Do You Design? A Compendium of Models," 2004, http://www.dubberly.com/wp-content/uploads/2008/06/ddo_designprocess.pdf.

6. In 1996, Bela Banathy proposed the double-diamond design process; in 2005, the British Design Council made it popular.

decorative art ⟶ problem-solving
idiosyncratic intuition ⟶ repeatable method
subjective ⟶ objective

Statements framing design as problem-solving are common throughout the modernist canon, beginning with its origin documents and continuing today, underscoring how foundational such a frame is for design practice and design education.

Let's consider some of those statements.

1.1 Louis Sullivan

In 1896, as modernism began, American architect Louis Sullivan declared, "Form ever follows function" and, "The design of the tall office building must be recognized and confronted at the outset as a problem to be solved—a vital problem pressing for a true solution." He added, "It is of the very essence of every problem that it contains and suggests its own solution. This I believe to be natural law."[8]

1.2 Deutscher Werkbund

The shift to modernism also had roots in Europe. In 1907, Peter Behrens[9] and Hermann Muthesius helped found the Deutscher Werkbund. The Werkbund's motto was "From sofa cushions to city buildings," framing design as concerned with everything from product details to large systems. Muthesius read Frederick Taylor, who gave management of manufacturing a "scientific" basis and turned it toward problem-solving. Muthesius brought the "science" of experimentation, efficiency, and standards to the Werkbund and its designers.[10]

1.3 Constructivism

In 1922, in the opening statement of the avant-garde design journal *Veshch*, El Lissitzky and Ilya Ehrenberg wrote, "The new art is founded not on a subjective, but on an objective basis. This, like science, can be described with precision and is by nature constructive. It unites not only pure art, but all those who stand at the frontier of the new culture. The artist is companion to the scholar, the engineer, and the worker."[11]

1.4 Bauhaus

In 1919, Walter Gropius (who had worked for Behrens) formed the Bauhaus in Weimar; in 1920, Lenin formed the VKhUTEMAS in Moscow. Both schools shared many of the Werkbund's goals. The rise of fascism in Germany created a diaspora of Bauhaus faculty and students in the Soviet Union, Switzerland, and the United States, where many found influential positions. The problem-solving frame appeared frequently in the writings of former Bauhaus faculty:

7. For example, Leonardo's "Vitruvian Man," Le Corbusier's "Le Modular," and Henry Dreyfuss's "The Measure of Man."

8. Louis Sullivan, "The Tall Office Building Artistically Considered," *Lippincott's Magazine*, March 1896.

9. Behrens employed future stars Walter Gropius, Ludwig Mies van der Rohe, Le Corbusier, and Adolf Meyer.

• In 1937, Lászlo Moholy-Nagy wrote, "We don't teach what is called 'pure art,' but we train what you might call the art engineer. . . . But to you—the industrialists—we offer our services for research. We shall work on your problems."[12]

• In 1955, Gropius wrote, "My intention is . . . to introduce a method of approach which allows one to tackle a problem according to its peculiar conditions."[13]

• In 1963, Josef Albers used the word *problem* fifteen times in the short text of his masterwork, *Interaction of Color*; he wrote of "solving our problems" and titled his student exercises "problems"—framing them as questions with answers that are either right or wrong, like problems in math or physics.[14]

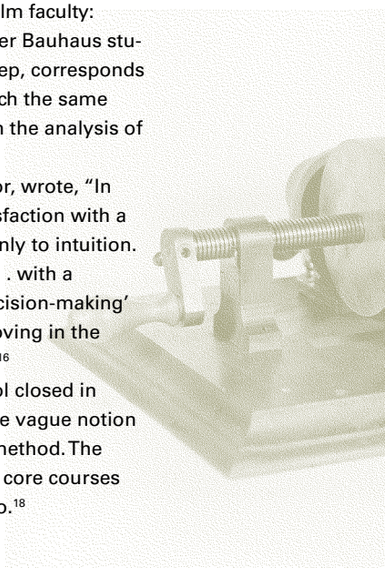
1.5 HfG Ulm

In 1953, the modernist movement received an infusion of energy with the opening of the Hochschule für Gestaltung (HfG) in Ulm. The problem-solving frame continued in the writings of Ulm faculty:

• In 1974, Max Bill, Ulm's first rector (and a former Bauhaus student), wrote, "The creative process, taken step by step, corresponds to a logical operation and its logical verification. Much the same applies to all my activities. They are always based on the analysis of the problem and its logical, verifiable solution."[15]

• In 2002, Tomás Maldonado, Ulm's second rector, wrote, "In all of us, especially myself, there was a deep dissatisfaction with a didactics (and a design activity) that had appealed only to intuition. In this context an increasing interest in disciplines . . . with a heuristic function such as 'problem-solving' and 'decision-making' [emerged]. We were very curious about anything moving in the world that was concerned with scientific questions."[16]

Another design diaspora ensued after the school closed in 1968.[17] One of Ulm's lasting legacies was to recast the vague notion of problem-solving into a standardized, repeatable method. The resulting curricula focused on design methods, with core courses such as the Scientific Problem-Solving Design Studio.[18]



1.6 Allgemeine Gewerbeschule Basel

Meanwhile, the Allgemeine Gewerbeschule Basel (originally a

10. Ivan Rupnik, "Projecting in Space-Time: The Laboratory Method, Modern Architecture and Settlement-Building, 1918–1932" (PhD diss., Harvard University, 2015).

11. El Lissitzky and Ilya Ehrenburg, "Statement by the Editors of *Veshch/Gegenstand/Objet*" (1922), in *Art in Theory 1900–1990*, ed. Charles Harrison and Ed Wood (Oxford: Blackwell, 1994), 321. (I am indebted to Lou Danzinger, who pointed to El Lissitzky as a source, and to Elizabeth Byrne, who helped me locate the reference.)

12. Sibyl Moholy-Nagy, *Moholy-Nagy: Experiment in Totality* (New York: Harper and Brothers, 1950), 149–50.

13. Walter Gropius, *Scope of Total Architecture* (London: Allen and Unwinn, 1956), 21.

14. Josef Albers, *Interaction of Color: Revised Edition* (New Haven: Yale University Press, 1971).

15. Eduard Hüttinger, *Max Bill* (Zurich: ABC Editions, 1978), 212.

program to train high-school students in typesetting) expanded into an international graduate school of design (led by Emil Ruder and Armin Hofmann), attracting many notable designers. Its graduates formed a third design diaspora.[19]

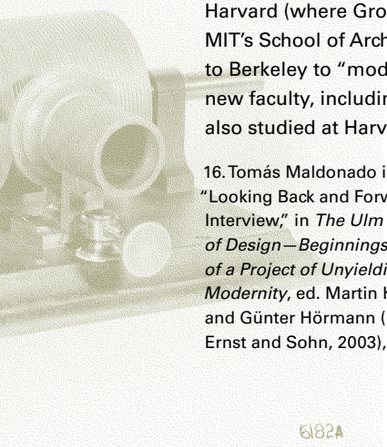
• In 1965, George Nelson wrote in his preface to Hofmann's *Graphic Design Manual* that Hofmann believed "that if problems can be correctly stated, they can be solved."[20]

• In 1967, Ruder's *Typographie* (a primer for generations of designers) began on the flyleaf, "After 21 years of teaching typography, the author is concerned in this book with the problems of form which confront the typographer in the practice of his craft."[21]

• In 2019, Baseler Ken Hiebert confirmed, "Problem solving was embedded in every aspect of learning in the Basel Program."[22] While Basel focused on "form," problem-solving remained a central metaphor in its curriculum.

1.7 Design Methods

William Wurster embodied the transformation of design in the twentieth century. At the University of California, Berkeley, he studied architecture in the Beaux Arts tradition; he went on to Harvard (where Gropius was teaching) and later served as dean of MIT's School of Architecture and Planning. In 1950, Wurster returned to Berkeley to "modernize" its School of Architecture. He recruited new faculty, including, in 1963, Christopher Alexander, who had also studied at Harvard, and Horst Rittel, who had taught at Ulm.



16. Tomás Maldonado in "Looking Back and Forward: Interview," in *The Ulm School of Design—Beginnings of a Project of Unyielding Modernity*, ed. Martin Krampen and Günter Hörmann (Berlin: Ernst and Sohn, 2003), 241.

17. Some notable examples: Bruce Archer went to the RCA; Tomas Gonda to OSU; William Huff to Buffalo; Klaus Krippendorff to Penn; Horst Rittel to Berkeley. Along with Gui Bonsiepe, Karl Gerstner, Martin Krampen, Tomás Maldonado, and other Ulm alumni, they affected the course of design education and design practice for decades.

18. The author's first design studio course, in 1976, at the University of Colorado's College of Environmental Design, was run by graduates of Berkeley and influenced by Ulm. I would like to thank Caroline Hightower, former executive director of the AIGA—who in exasperation once told me she wished she would never again hear design described as problem-solving—for planting the seeds of doubt in me about my education.

19. In 1965, Ken Hiebert joined the faculty of PCA (now University of the Arts). Others soon followed Hiebert into teaching, including Hans Allemann (PCA), Dan Boyarski (CMU), Philip Burton (Yale, Illinois), Inge Druckrey (Yale, PCA, etc.), Jim Faris (CCA), April Greiman (KCIA), Dan Friedman (Yale), Terry Irwin (CCA, CMU), and Helmut Schmid (Hong-Ik, etc.). Many other Baselers went on to teach and practice around the world.

20. Armin Hoffman, *Graphic Design Manual: Principles and Practice* (New York: Van Nostrand Reinhold, 1965).

21. Emil Ruder, *Typography: A Manual of Design* (Basel: Verlag Arthur Niggli, 1967).

Both Alexander and Rittel were instrumental in the Design Methods Movement, a series of conferences and publications from the early 1960s through the early '70s, which borrowed ideas from military planning, information theory, operations research, and cybernetics in an attempt to put design on a "scientific" basis. For them, design as problem-solving was a given.

• In 1964, Christopher Alexander wrote, "Every design problem begins with an effort to achieve fitness between two entities: the form in question and its context. The form is the solution to the problem; context defines the problem. In other words, when we speak of design, the real object of discussion is not the form alone, but the ensemble comprising the form and its context."[23]

• In 1964, Horst Rittel wrote, "Science and design are usually taken as polar contradictions. . . . What do the words science and design mean and what do they have in common? . . . [a] activities, [b] names for the results of activities, [c] associated with social institutions . . . [d] directed to the achievement of new realities . . . [e] problem-solving activities, . . . [f] unpredictable results."[24]

• In 1968, the Nobel-laureate economist and artificial-intelligence pioneer Herbert Simon published *The Sciences of the Artificial*, positioning design as a branch of science encompassing all the professions (e.g., architecture, business, engineering, law, medicine). He wrote, "The natural sciences are concerned with how things are. . . . Design, on the other hand, is concerned with how things ought to be, with devising artifacts to attain goals." He proclaimed, "Everyone" designs who devises courses of action aimed at changing existing situations into preferred ones." He noted, "Human problem solving, from the most blundering to the most insightful, involves nothing more than varying mixtures of trial and error and selectivity. . . . There is now a growing body of evidence that the activity called human problem solving is basically a form of means-ends analysis that aims at discovering a process description of the path that leads to a desired goal."[25] In short: feedback. In 1972, with Allen Newell, Simon published *Human Problem Solving*, laying a foundation for a rationalistic approach to the development of AI.

• In a 1969 interview, Charles Eames noted, "Design depends largely on constraints. . . . Here is one of the few effective keys to the Design problem: the ability of the Designer to recognize as many of the constraints as possible; his willingness and enthusiasm for working within these constraints. Constraints of price, of size, of strength, of balance, of surface, of time, and so forth. Each problem has its own peculiar list."[26]

• In 1977, architect William Peña wrote, "You can't solve a problem unless you know what it is." He defined "programming" as "the search for sufficient information to clarify, to understand, and

22. Ken Hiebert, email correspondence with the author, April 2019.

23. Christopher Alexander, *Notes on Synthesis of Form* (Cambridge, MA: Harvard University Press, 1964), 15–16.

24. Horst Rittel, "The Universe of Design," in *The Universe of Design: Horst Rittel's Theories of Design and Planning*, ed. Jean-Pierre Protzen and David J. Harris (New York: Routledge, 2010), 48.

to state the problem." For Peña, "Programming is problem seeking" and "design is problem solving." He believed each required different attitudes and different skills that were rarely found in the same person.[27]

Three other books also illustrate the central role the problem-solving frame played in the discourse of midcentury design:

• *The All New Universal Traveler: A Soft-Systems Guide to Creativity, Problem Solving, and the Process of Reaching Goals*, by Don Koberg and Jim Bagnall (students of Rittel at UC Berkeley) (1972), a common textbook for design students of the time.

• *How to Solve It*, by George Polya (1945), a primer for math students, recommended by *The Universal Traveler* as a reference tool for designers.

• *The Vignelli Canon*, by Massimo Vignelli (2010). In this primer, Vignelli summarized his beliefs after fifty years of practice, describing designers' three levels of responsibility: "One—to ourselves, the integrity of the project and all its components. Two—to the client, to solve the problem in a way that is economically sound and efficient. Three—to the public at large, the consumer, the user of the final design. On each one of these levels we should be ready to commit ourselves to reach the most appropriate solution, the one that solves the problem without compromises for the benefit of everyone."[28]

1.8 Design Thinking

By the late 1970s, interest in design methods had waned; however, it reemerged in the late 1990s, rebranded as "design thinking." Two books were important in describing the history and laying a foundation for the future; both discussed problem-solving at length.

• *How Designers Think: The Design Process Demystified*, by Bryan Lawson (1980), a survey in three parts: "Part One: What Is Design?"; "Part Two: Problems and Solutions"; and "Part Three: Design Thinking."

• *Design Thinking*, by Peter Rowe (1987), a comprehensive and rigorous history of design methods of all types.

Today, design thinking is often associated with the consultancy IDEO and Stanford's d-school. Both link design thinking and problem-solving.

• In 2008, IDEO chair Tim Brown wrote in *Harvard Business Review,* "No matter where we look, we see problems that can be solved only through innovation: unaffordable or unavailable health care, billions of people trying to live on just a few dollars a day, energy usage that outpaces the planet's ability to support it, education systems that fail many students, companies whose traditional markets are disrupted by new technologies or demographic shifts. . . . They require a human-centered, creative, iterative, and practical approach to finding the best ideas and ultimate solutions. Design thinking is just such an approach to innovation."[29]

• In 2021, the website for Stanford's d-school put it plainly: "Design thinking is a methodology for creative problem solving."[30]

1.9 DesignX

In 2014, thought leaders Ken Friedman, Yongqi Lou, Don Norman, Pieter Jon Stappers, and Patrick Whitney proposed "DesignX" as a new way of "addressing many of the complex and serious problems facing the world today."[31] Now many of these same experts are involved in a project titled the Future of Design Education.[32]

2.0 Issues

As the statements above suggest, "the 'problem/problem-solving' language frame . . . has been near ubiquitous in the design literature."[33] This positioning will likely continue well into the future because it is convenient and has the clear benefit of promising change with little risk—on time and on budget.

Why should we question it?

Because it creates confusion about both the subject of design and the process of designing.

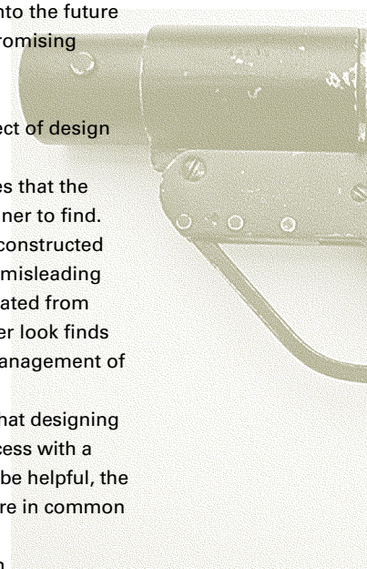
The word *problem* is misleading because it implies that the subject of design already exists out there for the designer to find. A closer look, however, suggests "the problem" is co-constructed by people involved with the "project." Problem is also misleading because it implies that the design situation can be isolated from the larger systems in which it is embedded, but a closer look finds designers are increasingly involved in the on-going management of those larger systems.

Problem-solving is misleading because it implies that designing is an algorithm guaranteeing results, a mechanical process with a clear beginning, middle, and end. While checklists may be helpful, the design process is a generative conversation having more in common with play and world-building than problem-solving.

Let's consider other ways in which framing design as problem-solving can be misleading and create confusion.

2.1 Mistaking Evolution for a Straight Line

Describing the design process as problem-solving suggests that it proceeds in a straight line and can be managed, when it's



25. Herbert Simon, *The Sciences of the Artificial* (Cambridge, MA: MIT Press, 1968), 111, 132, 195, 211.

26. Charles Eames, interview, "What Is Design?" (1969), in *Eames Design: The Work of the Office of Charles and Ray Eames*, eds. John Neuhart, Marilyn Neuhart, and Ray Eames (New York: Harry Abrams, 1989), 14–15.

27. William Peña and Steven A. Parshall, Problem Seeking: *An Architectural Programming Primer* (New York: John Wiley and Sons, 1977), 5.

28. Massimo Vignelli, *The Vignelli Canon* (Zurich: Lars Müller, 2010), 31.

29. Tim Brown, "Design Thinking," *Harvard Business Review*, June 2008, https://readings.design/PDF/Tim%20Brown,%20Design%20Thinking.pdf.

30. Stanford d-school, accessed February 15, 2021, https://dschool.stanford.edu/resources/getting-started-with-design-thinking.

31. Don Norman et al., "DesignX," *Shè Jì: The Journal of Design, Economics, and Innovation*, 1, no. 1 (Autumn 2015).

32. The Future of Design Education project's website is at https://www.futureofdesigneducation.org/.

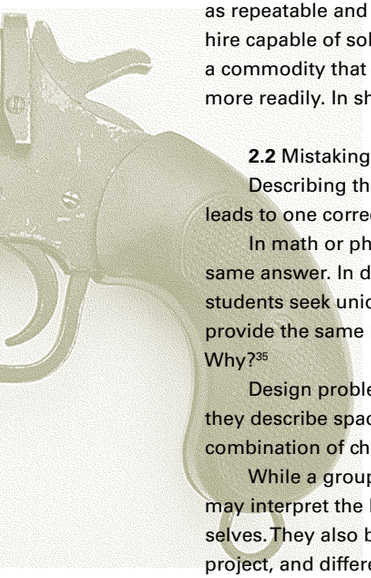
33. Steve Harfield, "On Design 'Problematization:' Theorising Differences in Designed Outcomes," *Design Studies* 28, no. 2 (March 2007): 160–61.

often more like a random walk with many dead ends—an evolution not entirely controlled by the designer.

In the early stages of most design projects, the path forward is unclear; often not even the goals are agreed upon, much less the means. As yet, innovation has no recipe; it does not happen on a schedule. No one can guarantee a solution—or a "hit" product—because the process is largely unknown. Each situation is particular, and the "right " design process must be found—just as the "right" design "solution" must be found—by experimentation, by trial and error, by iteration.

One reason designers describe their work as "problem-solving" is to make it less frightening to potential clients. Proposing a linear process with milestones, delivery dates, and hours makes it seem manageable. For example, the double diamond may seem like a set of instructions but is in fact a promise, an aspiration, a goal.

The problem-solving frame also positions the design process as repeatable and designers as objective professionals, experts for hire capable of solving problems of any type. It turns designing into a commodity that consulting firms, schools, and the media can sell more readily. In short, it's marketing.



2.2 Mistaking a Solution Space for the Correct Answer

Describing the design process as problem-solving suggests it leads to one correct answer, when no answer is "right."[34]

In math or physics classes, each student ideally arrives at the same answer. In design classes, many answers are possible, and students seek unique answers. In design competitions, sponsors provide the same brief to all participants and expect different results! Why?[35]

Design problems may result in a range of solutions because they describe spaces with many dimensions, and each solution is a combination of choices along each dimension.

While a group of designers may start from the same brief, they may interpret the brief differently, redefining the problem for themselves. They also bring different levels of design experience to the project, and different levels of knowledge about the problem domain and the media in which they work. And finally, they bring different values and traditions, all of which may drive different trade-offs.

2.3 Mistaking "Satisficing" for "Optimizing"

Describing the design process as problem-solving suggests an optimal solution can be found, but this is rarely possible; most "solutions" merely satisfy or suffice—"satisfice."[36]

On the one hand, one's time and budget may not allow for a thorough search of a huge solution space, particularly if it's dynamic. On the other hand, the criteria may also be dynamic as stakeholders learn new things.

34. Victor Papanek, *Design for the Real World: Human Ecology and Social Change* (New York: Pantheon, 1971), 5.

35. Harfield, "On Design 'Problematization,'" 165.

36. Simon, *The Sciences of the Artificial*, 27–30.

2.4 Mistaking What-to-Do Questions for How-To Questions

Policy questions differ from engineering questions. Describing the design process as problem-solving suggests that the problem—the goal—is known, defined, clear, that what to do is understood and that the designer merely needs to figure out how to do it. In design practice, such situations are rare. Most of the time designers must define both the "what" and the "how."[37]

2.5 Mistaking Designers for Experts

Describing designers as problem solvers suggests they have "expertise" other stakeholders may not have. But while designers may be more experienced in designing, they are no more knowledgeable about the situation than other stakeholders.[38]

Describing designers as problem solvers may create asymmetry—a power imbalance—by putting them in control of the situation and disenfranchising other stakeholders who rightfully "own" the problem and who should "own" its definition.

A further consequence of framing design as problem-solving is that outsiders may impose their beliefs on insiders. This may happen, in part, because the frame of problem-solving obscures key questions:

- Whose problem is it?
- Who has the power to decide questions?
- What politics should the resulting artifacts have?

2.6 Mistaking Delivering for Finishing

The framing of design as problem-solving emerged with the industrial age; it has roots in mass production, which requires that plans be nearly perfect because mistakes are expensive. It also involves a handoff from designer to manufacturer, which often ends the designer's role. Yet the delivery of a "final plan" is an anomaly of mass manufacturing and may lead to a distorted view of the design process as having an end point.

As hardware manufacturing has become enmeshed in software development and as stand-alone products have become enmeshed in networks of services, "continuous improvement" and "continuous deployment" have become norms. Today's product-service ecologies are never finished. Likewise, the information revolution has changed the way designers work. They have become stewards with ongoing roles in their firms, and their stewardship is never finished.

2.7 Mistaking Systems for Individual Objects

The association of problem-solving with manufacturing may lead to another distorted view: that designing is concerned primarily with individual objects detached from context. And it may lead to ignoring the social-technical systems in which designers and their work are embedded.

37. Rittel, "Dilemmas in a General Theory of Planning" (1972), in *The Universe of Design*.

38. Rittel describes this as "the symmetry of ignorance."

In 1983, systems analyst Geoffrey Vickers wrote: "To focus on problem solving is to divert attention from the far more important function of problem definition and to confuse the continuing process of system regulation with the episodic activity of seeking specific goals and the much more frequent and radically different activity of averting specific threats."[39]

2.8 Other Critiques

Prior efforts at reforming the problem-solving frame deserve mention:

• In 1968, Rittel and Webber noted that problems are not all of the same type. They introduced the idea of "wicked" problems (political problems about which agreement is not possible), to be distinguished from "tame" problems (engineering problems about which agreement is not disputed).[40] In 1987, Rowe proposed three levels of problems: **1.** simple, where the goal is agreed upon; **2.** complex, where the goal is being discussed; and 3) wicked, where stakeholders cannot agree on the goal.[41]

• A recurring critique is that problems are not "objective." In 1986, Terry Winograd and Fernando Flores wrote, "The critical part of problem-solving lies in formulating the problem." They noted that any "space of alternatives" exists in relation to some "observer." And they underscored the subjective nature of problem-finding. "A problem is created by the linguistic acts in which it is identified and categorized."[42]

Schön shared a similar view: "A designer forms a representation of some initial design situation, framing a design problem that includes, when it is 'well formed,' elements from which to construct design options, a description of the situation in which options may be enacted as moves, and criteria sufficient to evaluate the effectiveness of proposed solutions."[43]

While framing a problem may suggest solutions, prototyping a solution may likewise affect the framing. In 1996, Winograd wrote, "There is no direct path between the designer's intention and the outcome. As you work a problem, you are continually in the process of developing a path into it, forming new appreciations and understandings as you make new moves."[44] For many "problems," designers may not be able to define "requirements" a priori; "fit" may have to be achieved through iteration in context.

Lucy Suchman questioned the idea that a designed solution emerges from the clear formulation of a plan; instead, she proposed that a definition of a problem emerges while exploring possible actions in a context.[45]

In other words, framing design as problem-solving reduces it to a mechanical feedback process seeking a clear, unchanging goal. In practice, the process of designing leads to the discovery of both alternative means and alternative goals.

3.0 Alternatives

In 2017, designer Kees Dorst noted, "When people started trying to understand design . . . the first model they devised was of design as a problem-solving process."[46] A few alternatives:

• Art: The model of design as fine art—pursuing an artist's vision rather than a client's need—has little relevance in practice but persists in schools for primarily financial rather than ideological reasons. Such design programs attract students, whose tuition pays for other programs. Critical design—critiquing design and society—may be an exception, a design practice akin to art practice.

• Drawing: Illustrator Milton Glaser maintained, "Drawing is thinking."[47] Computer scientist Bill Buxton argued that designing is sketching. Buxton focused on drawing, though he included prototyping broadly.[48] Drawing needn't be art; it can be a process of learning.

• A Third Culture: Reasoning that design is neither art nor science, systems expert Bela Banathy suggested that design is its own way of knowing and acting in the world. Similarly, historian Andrew Pickering suggested a "weak knowledge" contrasting with the "strong knowledge" of traditional science. Pickering built on Heidegger's notion of *poiesis* to describe "performative experimentation" or "experimental dances," offering as examples the work of cyberneticians like Ashby, Beer, and Pask, which bears similarities to designing.[49]

• Play: In "Design and the Play Instinct," Paul Rand wrote, "The play principle serves as a basis for serious problem-solving."[50] Rand saw design and play as improvisation within rules, exploring the constraints and possibilities of a system.

39. Geoffrey Vickers, "The Poverty of Problem Solving," in *Systems Analysis in Urban Policy-Making and Planning*, ed. M. Batty, B. Hutchinson, NATO Conference Series 12 (Boston: Springer, 1983), 17–18, https://link.springer.com/content/pdf/10.1007/978-1-4613-3560-3_3.pdf.

40. Rittel, "Dilemmas in a General Theory of Planning" (1972), in *The Universe of Design*.

41. Peter G. Rowe, *Design Thinking* (Cambridge, MA: MIT Press, 1987), 39.

42. Terry Winograd and Fernando Flores, *Understanding Computers and Cognition: A New Foundation for Design* (Norwood, NJ: Ablex, 1986), 147.

43. Donald Schön, "The Design Process," in *The Reflective Practitioner: How Professionals Think in Action* (Basic Books, 1983), 111.

44. Terry Winograd, *Bringing Design to Software* (Reading, MA: Addison-Wesley, 1996), 5.

45. Lucy Suchman, *Plans and Situated Action: The Problem of Human-Machine Communications* (Xerox Palo Alto Research Center, February 1985).

46. Kees Dorst, *Notes on Design: How Creative Practice Works* (Amsterdam: BIS Publishers, 2017), 19.

47. Milton Glaser, *Drawing Is Thinking* (New York: Overlook Duckworth, 2008). 5.

48. Bill Buxton, *Sketching User Interfaces: Getting the Design Right and the Right Design* (San Francisco: Morgan Kauffmann, 2007).

49. Andrew Pickering, "Poiesis in Action: Doing without Knowledge," in *Weak Knowledge: Forms, Functions, and Dynamics*, ed. Moritz Epple, Annette Imhausen, Falk Müller (Frankfurt: Campus Verlag, 2019).

50. Paul Rand, "Design and the Play Instinct," in *A Designer's Art* (New Haven: Yale University Press, 1985).

Thomas Edison patents the incandescent electric lamp

• World-building (or World-forming or World-making): Filmmaker Alex McDowell has described world-building as "a narrative practice in which the design of a world precedes the telling of a story."[51] World-building[52] is fundamental to movies and game design. World-building also plays a role in service design and interaction design. Indeed, software pioneer Ted Nelson described software design as a branch of moviemaking.

Designer Cheryl Heller has written, "People talk about design as problem-solving . . . but that's a limited view." In contrast, she describes design as creating "new ways of being on this planet, and with each other."[53] The idea that the world needs to be "in transition" also suggests world-forming, as does Arturo Escobar's concepts of the "pluriverse" ("a world in which many worlds fit") and "ontological design" ("a conversation about possibilities" for action).[54]

3.1 Establishing a New Foundation

In *Understanding Computers and Cognition: A New Foundation for Design*, Winograd and Flores questioned the foundations of artificial intelligence. In a review, former Ulm student and teacher Gui Bonsiepe wrote, "Winograd and Flores launch particular attacks on the tendency that was widespread in the sixties to see design as a process of problem-solving underpinned by decision theory."[55] As Winograd and Flores note, "A 'problem' always arises for human beings in situations where they live—in other words, it arises in relation to a background. Different interpreters will see and talk about different problems requiring different tools, potential actions, and design solutions. In some cases, what is a problem for one person won't be a problem at all for someone else."[56]

Winograd and Flores also questioned the foundations of design. "In order to understand the phenomena surrounding a new technology we must open the question of *design*—the interaction between understanding and creation. . . . How a society engenders

51. University of Southern California, School of Cinematic Arts, World Building Institute website, accessed February 15, 2021, https://worldbuilding.institute/about.

52. The concept of *Weltbild* (whether translated as "world-formation" or "world-building") comes from Heidegger's insistence that the human being be defined as world-forming (as an extension of his idea of being-in-the-world). See his *Fundamental Concepts of Metaphysics: World, Finitude, Solitude*. (I am grateful to Rachel Churner for this observation.)

53. Cheryl Heller, quoted on the Arizona State University website, 2019, https://asunow.asu.edu/ 20190403-cheryl-heller-joins-asu-director-design-integration.

54. Arturo Escobar, *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds* (Durham, NC: Duke University Press, 2018), xvi and 110. Escobar builds on Winograd and Flores, who also draw on Heidegger.

55. Gui Bonsiepe, "Through Language to Design," in *Interface: An Approach to Design* (Maastricht: Jan van Eyck Akademie, 1994), 139 (quoting from Winograd and Flores, *Understanding Computers and Cognition*, 1986).

56. Winograd and Flores, *Understanding Computers and Cognition*, 77.

inventions whose existence in turn alters that society. We need to establish a theoretical basis for looking at what devices do, not just how they operate."

3.2 Deliberation and Conversation

Winograd and Flores proposed an alternative to Simon's problem-solving. Simon described designing as a sequence of steps:

- framing a problem;
- outlining a solution space + selection criteria;
- determining values + probable outcomes;
- selecting a solution.[57]

For Winograd and Flores, a "breakdown" results in a "situation of irresolution . . . in which the course of activity is interrupted by some kind of 'unreadiness.'" Moving "from irresolution to resolution is 'deliberation.' . . . conversation (in which one or many actors may participate)." Deliberation may include:

- selecting from a space of possibilities defined by the original frame;
- generating new possibilities (changing the dimensions of the existing space);
- changing the frame (creating a new space of possibilities);
- rejecting the frame (deciding there really isn't a problem after all).[58]

3.3 Systems

In "The Poverty of Problem Solving," Vickers wrote that management consists not in solving problems but rather in "regulating systems."[59] For example, children are not "problems to be solved"; they are living things to be nurtured. So too are the systems we design, particularly software and services.

A new frame of design is emerging. Ensuring that "systems" thrive—that they learn, regenerate, and adapt—becomes important. The "problem" becomes a "network of relationships"; the "solution" becomes "dynamic equilibrium."

This emerging shift parallels the earlier shift from Beaux Arts to late modernism:

from		*to*
fast, urban, machine ethos	→	organic-systems ethos
planning-for-manufacturing	→	stewarding continuous deployment
science of the artificial	→	the political or rhetorical
expert professional service	→	co-creation
problem-solving	→	facilitating generative conversation
repeatable method	→	directed learning
objective	→	negotiated

3.4 Solving Problems vs. Becoming Responsible

A final note: Claiming that design can solve the world's myriad problems is a mix of hubris, marketing, and misunderstanding. The

57. Simon, *Sciences of the Artificial*, 51–83.

58. Winograd and Flores, *Understanding Computers and Cognition*, 147–50.

59. Vickers, "The Poverty of Problem Solving," 18.

"problems" that matter—the wicked problems, messes, or tangles that threaten our existence—cannot be "solved" in the sense of "put right" so that they disappear. Instead, we must manage them on an ongoing basis, both globally and locally, through generative conversations.

This requires a change in our view of the world, of ourselves, and of design.

The literature of systems design points to ethical propositions that might help:

Bonsiepe noted, "[Winograd and Flores] go to the heart of the matter concerning design: 'We encounter the deep questions of design when we recognize that in designing tools we are designing ways of being.' . . . 'We create and give meaning to the world we live in and share with others. . . . We design ourselves (and the social and technological networks in which our lives have meaning) in language.'" Bonsiepe added, "Designing means entering into an obligation to ensure that the world meets our intentions."[60]

In his essay "Metadesign," Humberto Maturana concluded, "It is not information that constitutes the reality that we live. The reality that we live arises instant after instant through the configuration of emotions that we live. . . . But if we know this . . . we shall become responsible of what we do."[61]

Cybernetician (and designer) Heinz von Foerster vowed, "[I shall] act always so as to increase the number of choices."[62] His "ethical imperative" foregrounds our responsibility to enable others to decide for themselves; it suggests that a designer's role is to help bring forward valid options, not just many versions of the same thing but true 'variety'—the diversity needed for resilience. That is, we are responsible for maintaining generative conversations.

60. Bonsiepe, "Through Language to Design," 139–40.

61. Humberto Maturana, "Metadesign," for "TechnoMorphica," 1997, https://www.pangaro.com/hciiseminar2019/Maturana_Metadesign.pdf.

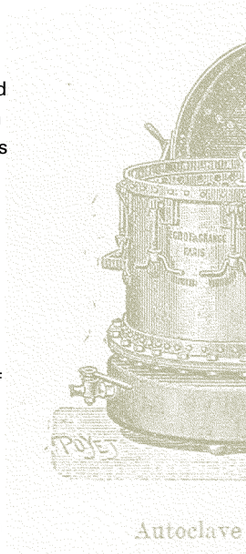
62. Heinz von Foerster, "Ethics and Second-Order Cybernetics," in *Understanding Understanding: Essays on Cybernetics and Cognition* (New York: Springer, 2003), 295.

TECHnoCRITICISM

SHARON HELMER POGGENPOHL

It may seem commonplace to spell it out: Technology changes our lives in complex and profound ways. But leaving this generality unacknowledged is a mistake; it needs to be brought to design. In "Why We Should Stop Describing Design as 'Problem-Solving,'" Hugh Dubberly notes that the frame for design action—the way in which we frame design questions—changes how we work and how we solve problems.[1] Values and processes are realigned as new stakeholders appear, as collaborative partners appear, as interdisciplinary works appear. More than ever, design and technology are intertwined, but I hardly need to mention theirs is an unequal partnership.

Yet if technology's effects are omnipresent, where are the critics of technology? Given the speed with which its products appear, it is hard to find critical voices and compete with hyperbole-driven advertising. Yet critics are present, if often unheard. Two voices from the late twentieth century are important. In 1986, Abraham Moles, a French sociologist, wrote about micro-anxieties in the seminal essay "The Legibility of the World: A Project of Graphic Design."[2] These micro-anxieties are revealed when our digital tools fail us and we are distracted from the task at hand. Technology is rife with such failures—new software updates with minimal improvement; endless new configurations for seldom-used websites; ever-widening connected services; more equipment planned only for the short term, resulting in obsolescence; lack of attention to continuity for the user; changing things to make them "new" rather than improving function; the list could go on. Uncertainty claims our attention with regard to the immediate future. Thus, micro-anxieties, such as those mentioned, are a tax on focused activity. They prevent us from achieving Mihaly Csikszentmihalyi's "flow"—a desired state of complete, uninterrupted concentration.[3]



A second important critic is the communication theorist Neil Postman, who observed that how people are dealt with is also a technological product.[4] Underlying every instrument or service are social, sensory, emotional, political, and content attitudes. Postman offers ten principles with which to assess and critique technology. For example, as he notes in number 5, "Technological change is ecological; it changes everything." Digital medical records, for example, often change the nature of a medical visit, for the doctor may spend more time addressing the record's device than attending to the patient. But the potential transparency and collaboration between patient and doctor is an upside.

A writer of more recent vintage is Nicholas Carr, the former executive editor of the *Harvard Business Review*, who follows technology closely and critically. His concern is whether we are in or out of the digital future. Artificial Intelligence (AI) can replace

1. Hugh Dubberly, "Why We Should Stop Describing Design as 'Problem-Solving,'" in this volume, TK–TK.

2. Abraham Moles "The Legibility of the World: A Project of Graphic Design," *Design Issues* 3, no.1 (1986): 43–53.

3. For more on the concept of flow, see Mihaly Csikszentmihalyi, *Flow: The Psychology of Optimal Experience* (New York: Harper and Row, 1990).