The State of Design Research
Susan Roth

Design research is an activity in search of a definition. The range of research methods and applications employed in design education and practice is broad, from the simple process of surveying existing products in the marketplace to the much more complex process of analyzing cultural and cognitive factors associated with new product development and use.

Research in professional practice employs multiple methods and approaches including those derived from the social and behavioral sciences, as well as strategic analyses adapted from business and marketing. The degree to which research plays a role in the design process depends on the size and scope of the design organization and its capabilities; it is always related to a specific project and conducted within a limited time frame. Information derived from this research is proprietary, and normally is not circulated outside the client-provider relationship.

In the academic environment, design research is becoming more common, but the number of graduate programs with a focus on structured methods and comprehensive theses rather than design production remains relatively small. While other professional disciplines have a tradition of advanced research in academia, design research is a more recent phenomenon. It has yet to establish universal standards related to process, presentation, and evaluation. Faculty with expertise in research are found primarily at large universities and, together with graduate students, they are generating a growing body of knowledge, employing innovative research techniques and focusing on current issues, especially those related to technology and design. Based on this virtual network of research studies taking place in design programs around the world, new knowledge is being produced. Unfortunately, while some of this information is published in journals and distributed beyond academic institutions, most is not.

Given the state of design research in practice and higher education, how is the topic regarded in the international forum? Proceedings and events associated with recent symposia on design research provide some insight into the nature of the discourse. Nigel Cross offered “criteria for research” during the Designing Design Research 2 conference at De Montfort University in 1998. Listing criteria by which referees of the Design Studies Journal evaluate the quality and appropriateness of articles submitted for publication, he identified the following itemized characteristics of research: “purposive, inquisitive, informed, methodical, and communicable.”


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Design Issues: Volume 15, Number 2 Summer 1999
cording to this model, a design problem or issue must be worthy of investigation and examined for purposes of generating new knowledge; studies should be conducted based on familiarity with previous, related research; and studies should be performed in a strategic and disciplined manner. Finally, findings should be reported and be capable of testing by others leading to further research. This view of criteria represents a relatively traditional model for design research.

Agreement on research criteria or models has not been achieved, however, as indicated by the ongoing debate on the true nature of design research. It has been argued that creative practice-based research focused on the production of an artifact is valid by some design educators as well as practitioners. Such programs could be considered an extension of the undergraduate approach to education, which, in the best institutions, requires that students conduct preliminary research in order to arrive at an informed solution. Some feel that traditional research is too boring or “academic,” and that a more creative approach to research and presentation is desirable. James Woudhuysen, representing the “pragmatic industry perspective” according to Alec Robertson, is quoted as stating: “I think design research has to be significantly visual for anything to qualify for it, since 50 percent of the term says design—outcomes such as exhibits should have that ‘delight factor,’ otherwise we may as well be in accountancy.”

Given the range of possibilities, Richard Buchanan states in Design Issues: “No one seems to be sure what design research means. Should design research follow the model of traditional academic disciplines, or should it seek a new model, based on the intimate connection among theory, practice, and production that is the hallmark of design?”

Design Research vs. Design Studies
As the academic discipline of design continues to mature, a body of discourse and theory known as design studies has grown up around it. During a recent international conference on design research in Helsinki, a distinction was made between design research and design studies. Design studies considers objects and processes from the perspective of critical theory and humanistic inquiry.” Victor Margolin, a proponent of design studies, states: “I prefer the term design studies to characterize my own conception of basic inquiry in design as distinct from design methods or project-oriented research....Design studies is an interpretive practice, rooted firmly in the techniques of the humanities and the social sciences, rather than in the natural sciences.” The distinction between project-oriented design research and the scholarly area of design studies reflects the extension of design from a form-giving activity to an interdisciplinary process dealing with complex systems and solutions. More mature professional disciplines such as architecture are characterized by a strong foundation in both theory and prac-

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tice, and a certain degree of interaction between the two. For a relatively new profession, diversity of opinion and approach could be a productive state if it leads to further exploration and new ways of thinking.

Creating a Research Agenda
Design research is tied to practice and is driven by its needs. Given this fact, which issues are worthy of investigation—which would appear on a research agenda for the future? Revolutionary changes in modern society brought about by new communication media, new technologies, new products, new markets, and new methods of production present challenges for all fields of design practice. Research is presented with an almost infinite number of topics and issues related to the transition from an industrial to an electronic age. Because rapid technological advances are running ahead of our level of understanding, questions continue to arise. For example, what is the effect of digital technology on the development and form of products? Which research tools and techniques are most effective for the design and evaluation of new products and systems? What are the social and cultural implications of the transition from print to time-based, interactive media? To what extent are changes in practice affecting programs of design education?

Sharon Poggenpohl notes: “Technology and the global economy are just two of the forces that alter the context within which designers practice. These forces require a broader and deeper intellectual foundation from which to operate.”

The traditional view of the designer as creative genius or (worse) stylist is evolving to a perception of the designer as team member, interpreter of complex systems, communicator, and problem-solver. To some degree, this is due to an increased expectation that it is necessary to understand characteristics of the “user” and the broader situated context of use. Margolin notes: “…designers need to know more about disciplines other than their own. They have to be familiar with literature in related fields such as the social sciences, engineering, and management theory.”

Research in Practice
Perhaps because the production and marketing of manufactured products involves considerable time and investment, the field of industrial design practice has been proactive in performing research, identifying problems, and establishing evaluation methods in order to minimize risk and improve the process of designing products. The early work of Bruce Archer focused on the development of design methods, and brought a scientific perspective to bear on the industrial design process that influenced a generation of designers.

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However, industrial design has moved into uncharted terrain with the rise of new world markets composed of "users" who are different in background and cultural experience from those proposing solutions. A 1991 study of industrial designers in the U.K. and Wales by Kasdogan found that "...the majority of designers employed themselves and their colleagues as models of users..." in projected (imagined) scenarios of use, disregarding more appropriate methods that would involve a representative sample of users in the context of use. A broader view of design research would acknowledge a source of information outside the designer's experience, and require a more collaborative approach to design. The growing employment of participatory design methods (involving users in early stages of the design process) indicates a positive change in this respect.

User-centered research in the field of visual communication or graphic design is uncommon, perhaps because print and electronic communications generally are more ephemeral than the products of industrial design. In any case, there is a need to explore legibility, readability, and the effectiveness of communication, as well as usability issues generated by the development of interactive computer-based media. The commitment to do so may require a change of attitude. Evaluating the effectiveness of design solutions often is performed late in the process, if at all. Paul Nini administered a survey on research and strategic planning in graphic design and concluded that little research is conducted because the designer is brought into the process toward the end when a solution has already been developed. Furthermore, the user is rarely asked to participate in either formative or summative evaluations. When respondents were asked if their design organization typically solicits user evaluation of communication prototypes, almost 68 percent stated they did not. The same question when applied to user evaluation of the final communication indicated that 71 percent of the organizations did not seek user feedback.

Most research literature in the emerging field of interactive design is found in the category of human-computer interaction (HCI) in the computer and cognitive sciences. Topics such as the amount of text users are willing to read on the computer screen and semantic aspects of icon-based desktop metaphors have been extensively explored in disciplines other than design, although design research has contributed some studies in these areas. Usability issues are key to successful interface design and interactive communications.

Categories of Inquiry
Topics of research range from the concrete and specific (defined by a specific situation), to the conceptual (extending beyond a specific instance to an entire class of situations), to the theoretical and philosophical (examining design practice and its artifacts in a broader

context). In order to illustrate how issues and questions might be expressed differently at these levels, examples related to interactive design are provided below.

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<th>Categories of inquiry</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Concrete/specific</td>
<td>Which visual attributes (typeface, color palette, etc.) are most effective and appropriate for a specific message and audience?</td>
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<tr>
<td>Conceptual</td>
<td>How does the user's conceptual map of an interactive program “space” affect navigation and the exploration of content?</td>
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<tr>
<td>Theoretical/philosophical</td>
<td>Is universal, cross-cultural design possible? What is “good” design? Does interactivity facilitate communication by actively engaging the user?</td>
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While much academic research, as well as professional practice, concentrates on addressing concrete issues and problems, productive topics for advanced and exploratory design research in both environments are found at the other two levels.

Methods and Paradigms
Considering methods and paradigms appropriate to a human-centered profession, design seems particularly well-suited to the employment of qualitative research methods applied within a constructivist paradigm. A discussion of methods and paradigms follows.

According to David Hamilton qualitative thinking originated with the writings of Immanuel Kant during the eighteenth century in reaction to the quantitative and objective thinking promoted by Descartes in the seventeenth century: “Kant revived the distinction between theoretical and practical knowledge. Practical reasoning—or applied social science—relates, therefore, to the application of moral/judgments in the realm of human actions. What we do relates not only to what is, but what ought to be.” It is in this aspect that design identifies most closely with the qualitative approach. Designers have always been concerned with what “ought to be” rather than “what is,” and strive to leave the world a better place as a result of their efforts. Human-centered qualitative research methods are key to understanding the issues surrounding design, although valuable information can be derived from quantitative methods as well. Some of the methods associated with quantitative and qualitative research are listed below.


*Note: A description of these methods as they are applied in design research is found in R. Robinson and J. Nims’s “Insight Into What Really Matters,” *Innovation*, Summer 1996: 18–21.

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<th>Research Methods</th>
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<td><strong>Quantitative</strong></td>
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<td>Written surveys</td>
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<td>Demographics</td>
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<td>Statistical analyses</td>
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<td>Anthropometrics</td>
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<td>Structural testing</td>
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<td>Standardized tests</td>
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<td>Experimental situations</td>
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The distinction between quantitative and qualitative research extends beyond methods for gathering information or performing analyses. It involves differing philosophical approaches or world-views. Thorbjoern Mann states: “At the core of the methodological difficulties of any discipline lies the question about the conceptual framework within which to discuss its subject matter. This question becomes more critical in times of uncertainty about aims and methods.”12

In the *Handbook of Qualitative Research* Lincoln and Guba describe several points of difference between quantitative and qualitative research including the attitude towards positivism and acceptance of postmodern sensibilities, capturing the individual’s point of view, examining the constraints of everyday life, and securing rich descriptions. The positivist tradition in the physical and social sciences promotes the belief that there is a definable “reality” that can be “studied, captured, and understood,” while the post-positivist position is that “reality can never be fully apprehended, only approximated.” Postmodern sensibilities attempt to reinterpret knowledge and ways of knowing through multiple or marginal perspectives (ethnic, feminist, environmentalist, etc.), while remaining aware of the inevitable bias of the observer or author and the multifaceted nature of any object of study. Other points of difference involve the degree to which researchers become involved with the subjects of study. Quantitative research attempts to remain objective and neutral through the use of standardized, experimental methods and a reliance on mathematical and statistical models. Qualitative research employs multiple methods, many of which rely on the complex context in which events take place and a more intimate or engaged involvement with the subject/participant.


**Research Paradigms**

Lincoln explains “…both qualitative and quantitative methods may be used appropriately with any research paradigm. Questions of method are secondary to questions of paradigm, which we define as
the basic belief system or worldview that guides the investigator."\textsuperscript{13}

The common belief is that such disciplines as mathematics, physics, and chemistry are "hard" sciences, and quantitative research methods are especially appropriate to the search for knowledge in these areas. Biological and social sciences are considered "soft," with the implication that research in these areas is less rigorous and less precise, and, therefore, less reliable. The bias or worldview of many researchers values precision over the necessarily imprecise nature of investigation into complex human situations.

There has been a shift in recent years in social and behavioral research towards methods associated with the qualitative approach. Guba and Lincoln categorize "alternate inquiry paradigms" according to four main worldviews: positivism, postpositivism, critical theory and related sociological positions, and constructivism.\textsuperscript{14}

These worldviews range, respectively, from a highly structured objective approach to a more qualified view which acknowledges the difficulty of fully understanding the truth about the subject of study, to an historical and dialectical interpretation of the subject in context, and, finally, to the belief that "multiple, intangible mental constructions" alter perceptions of reality, and the source of these constructions is the individual or group. Constructivism proposes that beliefs change over time as do the "realities" described by them.

**Participatory Research**

Human-centered design research involves those who will ultimately use the product or system, and provides a framework for achieving more successful solutions. Participatory design is one manifestation of this philosophy. A specific example of the application of user-centered research methods to design is provided by the development of an aircraft cargo loader by the international design firm Fitch, Inc. The loader was first developed in the usual manner (a review of existing products, concept generation, mock-ups, finish model, etc.), but an ongoing review of the existing product and specifications resulted in several different proposals by different designers that required constant revision of the model. In exasperation, the product designer/model builder constructed a working model with moveable parts that could be manipulated by an expert loader user. The expert worked with the model and rapidly developed the correct position for controls, rejecting some concepts as unworkable and suggesting others that had not been proposed. As a result, the control panel and interior of the loader cab were radically changed from the existing configuration to produce a more ergonomically efficient model with improved functionality. The participatory design process facilitated rapid development and resulted in a better product.

Generative, exploratory research methods also used at Fitch include collaging techniques intended to uncover implicit as well as


\textsuperscript{14} Ibid., 106.
explicit perceptions and needs through free association with words and images. Subjects provide verbal explanations following the collaging process, generating information that can lead to new directions for development. This method, in combination with others, was used by Limmer to explore the semantic properties of Websites from the user's perspective as compared to the designer's perspective, and by Appachu for a study of resource discovery using search engines on the World Wide Web. Combining research methods creatively is one way to generate new knowledge when working with new media and new design problems.

Getting From Here to There...
At present, a handful of educational programs in the U.S. emphasize advanced design research at the graduate level (e.g., the Institute of Design at Illinois Institute of Technology, North Carolina State University, University of Illinois at Champaign/Urbana, Arizona State University, and The Ohio State University, joined by several others in Europe and Scandinavia). However, there is generally inadequate distribution of research findings beyond these institutions and relatively few dedicated design research journals (e.g., Design Issues, Design Studies, Information Design Journal, Innovation, and Statements). Furthermore, the infrastructure and research grant support that serves other professional disciplines such as engineering and computer science does not yet support design. The near absence of a dedicated Ph.D. degree in design in the U.S. (the Institute of Design at the Illinois Institute of Technology being the exception) reduces opportunities to engage in long-term advanced design research.

Such observations, while seemingly disheartening, point the way to a positive expansion of research activities and opportunities. New doctoral programs are under development or consideration at a number of institutions. Pending the appearance of more refereed journals or newsletters dedicated to design research, the establishment of electronic publications and communications such as the online network maintained by the Design Research Society (DRS News, design-research@mailbase.ac.uk) and regular World Wide Web postings of global conference proceedings are significant, and should grow in number and scope given the ease with which these can be produced and distributed compared to print publications. As they become more interactive, they can create an international forum for discourse. The ability to gather substantive information from institutions and individuals around the world on topics related to design research could be an invaluable resource for educators, students, and practitioners.

Collaborations with professionals in engineering and computer science will provide additional areas of growth. At a recent interdisciplinary workshop entitled Design and the Information Age, sponsored by the National Science Foundation in the United States,
the need to make computer-based communication and information systems more accessible was a key point of agreement as participants from both science and design discussed the role of design in creating a usable interface for systems aimed at a broad audience.18 Lack of usability is reducing access to otherwise sophisticated information systems in which a great investment has been made, and there is increasing awareness on the part of non-designers that design can add value and improve the user’s understanding of new technologies. This is an opportune time for researchers to exchange information on methods and findings, develop a research agenda, and establish objectives to support design well into the twenty-first century.