Closing the implementation gap: a critical model for architectural research

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ABSTRACT: As design innovations become the center figure in architecture, teaching research methods and skills is gaining momentum in architectural education and in most architecture schools nowadays. This paper calls for the development of a model which encourages researchers, who utilize a range of methodologies, to acknowledge the values and assumptions implicit in human behavior with buildings. This demands attention to epistemological issues involving knowledge, its nature and forms, how it is acquired and how it is communicated, and pay attention to ontological issues concerned with the relationship between man and its environment. This paper introduces different methodological frameworks for architectural research in the past decades. Although there are a variety of orientations discussed, philosophical, conceptual, and technical, most studies reflect an understanding of people and objects as discrete entities interacting in a unilateral and passive way. This understanding is found to be the essential cause of the 'implementation gap' between architectural research and practice. For the gap to close, the development of a new research framework is needed which encourages researchers to acknowledge the ontological and epistemological issues associated with architectural practice, research, and education.

Conference theme: new methodologies in architectural research
Keywords: architectural research, design and practice, implementation gap.

INTRODUCTION

A conclusion of 'Research in Design Thinking' (Cross 1992), concludes the problem of knowledge transfer, from research to education and practice, to three main factors: first, the lack of a clear direction; second, the lack of a shared research methodology; and, third the lack of a broad theoretical framework. Closing 'the implementation gap' (Sommer, 1990) is a responsibility of researchers who are working in a 'critical' mode in architectural practice, education, and research. More closely, the paper calls for the development of a framework which encourages researchers, who utilize a range of methodologies, to acknowledge the values and assumptions implicit in human behavior with buildings. This demands attention to epistemological issues involving knowledge, its nature and forms, how it is acquired and how it is communicated (Cohen, 1989), and pay attention to ontological issues concerned with the relationship between man and its environment.

To introduce the argument for such an approach, the paper begins with a critical review of methodological research undertaken in architecture in the past decades. Around this time, researchers made extreme efforts to look away from architecture and its constituent elements and seek an external framework for their inquiry into the nature and development of

design process and practice (Rowe, 1987). The review shows that research in architecture has operated, for the most part, with a dualist understanding of the world; an understanding which regards people and objects as discrete entities interacting in a passive and unilateral manner. Giving priority to an alternative dialectic view which asserts that 'people and their environment mutually include and define each other ' (Bognar, 1985), this paper, supported by the research review, suggests that it is the dominant dualist understanding with its associated conceptions of design, education and research that prevents 'the implementation gap' from closing. For the gap to close, researchers must be prepared to accept, as a holistic theme for their inquiry, the experiential and interpretive quality of human thinking, feeling and action.

1. CURRENT RESEARCH METHODOLOGIES IN ARCHITECTURE

In reviewing methodological studies in architecture, three main orientations emerge which are referred to as 'philosophical', 'conceptual', and 'technical' oriented researches.

1.1. Philosophical research: an espistemological focus
Influenced by modern science's rejection of

metaphysics, philosophical inquiry has been largely epistemological in nature, that is, it has dealt with the basis of knowledge, its nature and forms, how it can be acquired and how it is communicated (Cohen, 1989). For the most part, these aspects of inquiry have been addressed exclusively by the method of inquiry. 'It was especially the idea of method, or of securing the path of knowledge in accord with the guiding ideal of certainty, that brought a unified meaning of knowing and knowledge to the fore (Gadamer, 1986)

From 1950s, the appropriateness of 'the scientific method' came under attack by an increasing number of researchers. The logical criticisms of Popper (1959), the sociological concerns of Kuhn (1962) were of significance for designer researchers. Abel (1982) argues against an explicitly laid down method of inquiry, preferring to adopt the extreme position that there should be as many approaches to design research as there are researchers. His argument rests on the belief that research is about self-enlightenment and self-fulfillment. In this sense, individual approaches to inquiry are seen to be more appropriate than those promoted by the research community; a view influenced by the earlier discussions by Kuhn of sociological barriers to methodological change.

Contributing to the understanding that design involves conjecture and analysis rather than analysis, synthesis and evaluation was research by Popper (1963). Counter to the traditional inductivist or deductivist views, Popper believed that scientific investigation proceeds by conjecture then refutation. While Popper concerned himself with the refutation aspect of research, design researchers (Hillier & Daley 1984) emphasized the conjecture element of designing. For them methodological research should concentrate on providing designers with knowledge on how human beings respond to objects, particularly designed objects.

1.2. Philosophical research: an ontological focus
Behind all research, including that of an epistemological nature, are assumptions regarding the relationship between human beings and the world. Despite extensive acknowledgment of these ontological concerns in sociology and psychology, there has been very little explicit response by the design disciplines such as architecture. Of the studies relevant to architecture, most have tended to borrow from research that is either rationalist oriented or empiricist oriented. Very few studies reflect holistic views characteristics of existentialist phenomenology and hermeneutics. Among the exceptions are studies by Coyne and Snodgrass, Schon, Dilnot and Norberg-Schulz.

Influenced by Gadamer and Heidegger's hermeneutic phenomenological philosophy and Dewy's pragmatism, Coyne and Snodgrass criticize the dual knowledge thesis traditionally attributed to design thinking. For them, the thinking associated with designing involves negotiation between what is expected and what is presented in the situation. In other words, Coyne and Snodgrass see designing as an experiential and interpretive process. A similar understanding of

designing and professional practice in general, was conveyed in earlier studies by Schon (1983) who called on research to support designers in their reflective conversation with the materials of the situation. According to Schon, designers should be encouraged to analyze critically the tacit and explicit understandings of those involved in designing as well as the organizational structure in which design and designing are embedded.

Also of significance to architecture and a phenomenological understanding of design and designing is research to do with dwelling carried out in geography (Ralph, 1985) and philosophy (Mugerauer, 1985). Underlying these studies is research by the philosopher Heidegger. For Heidegger (1962), dwelling is a way of existing, or 'being-in-the-world'; a 'being' which originates in a person's everyday active involvement with the world. Subsequently, to understand the nature of this existence demands attention to the action and the context in which the action is grounded. An area of study which focuses on understanding in this way is hermeneutics.

Despite the apparent relevance of hermeneutics and phenomenology, very few studies have been undertaken in architecture. Of the studies undertaken, those by Norberg-Schulz are the most extensive. According to Norberg-Schulz (1980:5), 'man dwells when he can orientate himself within and identify himself with an environment, or, in short, when he experiences the environment as meaningful'. Rather than basing the design of a building upon general types and principles, Norberg-Schulz advocates that architecture should aim to concretize economic, social, political and cultural intentions in a way which captures the 'genius loci' or 'sense of place' of an environment.

1.3. Conceptual research: a psychological focus
There are two dominant types associated with conceptual research; a psychological focus, and a man- environment focus. Researchers adopting a psychological focus tend to see designing as one or a combination of the following: a 'rational' process involving information processing; a constructive process in which designers actively draw on knowledge from past experience, particularly past design experience; a creative process utilizing an intuitive form of reasoning.

Each of these conceptions in turn reflects a specific view about knowledge and subject-world interaction. For example, researchers who understand designing as information processing regard knowledge in terms of two basic types of information: substantive information, or 'facts' about the real (objective) world; and, procedural information which indicates how to arrive at a factual understanding of objective reality. For them, research is driven by the goal of matching knowledge with problem.

In architecture, research concerned with the nature of design problems (Rittel & Webber, 1973), problem definition and solution generation (Thomas & Carroll, 1984), and design knowledge (Drake 1984 & Eckersley, 1988) reflects attempts by researchers to

apply the theory of problem solving developed by Newell and Simon (1972) to designing. The descriptive model by Akin (1986) illustrates the result of such an attempt.

Describing the design process, Akin refers to it as a problem solving process comprising three major activities: problem representation; problem transformation utilizing a particular body of knowledge; and, searching which involves the designer in matching resources with the task at hand. Integral to these activities are three types of knowledge: representational knowledge, transformation knowledge and procedural knowledge. For managing the information there is a design information processing system (DIPS) similar to that proposed by Newell and Simon (1972). While the system has performed well in computer simulation tests, its use in a range of individually and socially constructed situations has yet to be demonstrated.

This model and others, including Mitchell's (1990), while psychologically framed, are ultimately technically oriented. Underlying and guiding their mechanistic approach to research and their 'technical fix' attitude to practice is an atomistic, deterministic appreciation of the world; a world where the relationship between people and objects is perceived as static and discrete.

1.4. Conceptual research: a man-environment focus
While some researchers have been concerned with the cognitive factors associated with behavior, other researchers have been working from a man-environment research, focusing, for the most part, on the social and cultural factors involved in individual and group behavior. In the 1970s, this research, together with an increasing awareness of social and environmental issues, influenced architecture and design in a number of ways. In response to the newly emerging awareness of 'social' reality and the growth of community-oriented programs, for instance, design researchers turned their attention to the collective rather than individual consciousness, to shared meaning rather than idiosyncratic meaning, to collaborative designing rather than autocratic designing.

In line with the conception of designing as collaborative, research focused on the development of methods and models that could support client/user participation in the design process. Wisner *et al.* (1991) provides a detailed overview of participatory and action research since its emergence in the 1960s, identifying among others the simulation games of Sanoff (1978) and the environmental models of Lawrence(1982). In general, the models developed reflect various dimensions of the conception of collaboration in designing. One typical dimension is the understanding of collaboration as a method to arrive at an inter-subjective understanding of the design situation. What is generally emphasized in these cases is communally shared information about requirements. Underlying this approach is a belief that reality for an individual is socially constructed and that individual behavior is determined chiefly by social and cultural norms.

In 'recent' studies of design practice Blau (1984), and Cuff (1991) highlighted problems caused by a discord between professional ideology and practice which has its own values, language, power structure and practices. According to Cuff's ethnographic study, these aspects of practice culture are reflected in the practitioners' theories-in-action. In many cases these theories are contradictory to the theory of practice as espoused by the profession and the various schools of architecture. From this understanding of architecture as a socially constrained process, Cuff called on educational institutions and professional bodies to encourage architects to 'reconstruct their vision of their task'.

Research by Cooper Marcus (1972) has also focused on the meaning of place; in particular how people feel emotionally and spiritually about specific designed settings. While the outcome of her studies of public housing such as Easter Hill Village have provided useful substantive information for designers, they also have contributed in a normative sense by highlighting the need for post occupancy evaluation, and in a procedural sense through the development of various techniques including participant and non-participant observation, focused and nonfocused interviewing and archival searching.

Research by Rapoport (1990), on the other hand, focuses on culture and its influence on built form. From studies of vernacular architecture, Rapoport has concluded that 'place' has more to do with social, cultural and psychological factors than it has with the built environment. At the basis of his research is an explicit desire to make architecture 'more scientific' by replacing it with a research emphasis. Rather than making research applicable for designers, ' . . . it was designers that needed changing, to see research as essential'. In effect then, design would become applied environment-behaviour research but with one major qualification; it must remain 'rational'. Consciousness raising, existentialism, phenomenology, holism and hermeneutics are not considered by Rapoport to be 'rational' and, consequently for him, do not constitute valid or valued research.

Despite a tendency for research such as that by Cooper Marcus to be deterministic through its attempt to identify patterns of behavior and to attribute cultural or social causes to these patterns, it is more aligned with a dialectic appreciation of man-environment interaction than the dualist conceptualization of Rapoport. Phenomenology is a methodology which has attempted to remain true to the view of human 'being' as dialectic. As opposed to seeing designing as a social or cultural process, phenomenological researchers in architecture understand it as a phenomenological process. Because of its ontological orientation, the influence of this methodology in architecture and architectural research is described in the following section dealing with philosophical research.

1.5. Technical research: a systematic focus
Technical research is distinguished from the other

orientations by its emphasis on procedure as the main determinant of effective design. There were several factors that contributed to its emergence in the 1960s. Of these the most pervasive was the dominance of consumerism and industrialized production (Easlea, 1973). In this context, design knowledge was regarded as instrumental in improving the efficiency and reliability of production, in adapting and developing production procedures to suit particular products, and in the conceptualization and execution of 'designs' aimed at accommodating and stimulating consumer demand.

By the 1950s, architecture and the other design disciplines at the forefront of industrialization, engineering and industrial design, were finding it increasingly difficult to respond effectively to demands for improved production. Consequently, with performance as a goal, researchers began to look for ways to make the design process more efficient and reliable. In this respect, they were influenced by various substantive and procedural 'advances' in technology and science, particularly in management science, communications science, computer science and behavioral psychology.

Focusing on psychology, for instance, Rowe (1987) in his book, *Design Thinking,* identifies the doctrine of behaviorism as contributing to an understanding of design behavior as a process that " could be clearly and explicitly stated, relevant data gathered, parameters established, and the ideal artefact produced". Contributing, in turn, to the behaviorist understanding of behavior as environmentally determined was the scientist demand for detached observation, quantification and replication. Fundamentally, it was the emphasis on a 'rational' approach to knowledge acquisition that prompted design researchers to conceive of efficiency and reliability in terms of the systematic application of technique; a move which helped to produce and continued to reinforce a mechanistic, deterministic conception of designing.

This understanding of designing as comprised of parts or stages bound by an identifiable and widely applicable 'law' is reflected in the various models and methods produced in the 1950s and 1960s. A de-compositional method for establishing the requirements of a design situation was among those produced for architecture. The method proposed by Alexander (1964) (a mathematician and architect) reflects the Cartesian process of breaking down a problem until the 'truth', or solution in this case, becomes self-evident. Specifically, for Alexander, this involved mathematically analyzing and explicitly representing the problem in terms of a hierarchy of subsets of requirements. Identification of these subsets and their pattern of interaction provided the logic for the recombination of the subsets in physical form. The basis of this approach is the belief that design is concerned with the 'invention of physical things', and that designing begins with an effort to achieve fitness between two entities: the form in question; and, the problem situation.

1.6. Technical research: a computational focus

In the 1980s, the systematic frame-of-reference which had informed research such as Alexander's developed more conclusively into a computational frame-of-reference. Researchers working from this platform regarded designing as a process amenable to symbolical (numerical) representation, interpretation and management by a computer. The emergence of this view can be attributed to early research involving information processing and cognition (Eastman 1979) , and to more research in cognitive science and artificial intelligence (Mitchell, 1990).

In architecture, as in other design disciplines such as engineering and industrial design, research with a computational focus has moved in two main directions: computer-aided design (CAD); and, knowledge-based design. As by the 1980s, CAD had proved to be beneficial in many areas of design process and practice including information storing, retrieving, processing and printing.

The book, *Computer-Aided Architectural Design,* by Mitchell (1977) is significant in summarizing the developments in computer-aided design up to the beginning of the 1980s. In addition, it also supports a computational model for understanding and improving the architectural design process. According to Mitchell, each project can be viewed as proceeding by the performance of various functions, each marking the achievement of some identifiable goal. Performance of each function requires the execution of some design procedure, which requires certain data as input, produces certain data as output, and consumes certain resources. As a design project progresses, the output from procedures accumulate, and an extensive, complex, project data base is built up. The project is complete when this data base contains a sufficiently complete, consistent, and detailed description of the proposed building to form a basis for a contract and for actual construction work.

With this conception of designing, Mitchell saw the computer as having considerable potential for architectural design. In his later work *Logic of Architecture* (1990), he draws extensively upon advances in artificial intelligence, cognitive science and the theory of computation in an attempt to demonstrate that the structure of architectural design reasoning can be understood by analyzing logically (through the notation of first-order predicate calculus) how architects conceptualize form and function. Here the distinguishing feature of Mitchell's thesis is the belief that the construction world, and subsequently, the design process, is for the most part, controlled by a formal language. Specifically, this language comprises a vocabulary and rules of usage (a typology) which have evolved over time for various parts of a building and, in some cases, for the building as a whole.

While CAD proved to be effective in handling well-defined problems, in managing ill-defined problems it was severely limited. In general, ill-defined or ill-structured problems (Simon 1973) do not possess any definite criterion for testing a proposed solution nor a mechanical process for applying the criterion. As a

result, the designer is forced into an iterative mode of proposing tentative solutions which are then tested by stimulating the situation through drawings and models. Responding to this conception of designing as heuristic search involving closure of a goal state (Wade, 1979), a new field, which is described generally as knowledge engineering, was established. Concerned with improving designers' knowledge of the relationship between potential solutions and desired performance characteristics, knowledge research has concentrated on producing systems that contain the problem solving 'facts' and rules associated with specific types of design problems; rules involving simulation, generation and optimization.

Predictions for future research operating within this rationalist paradigm include the improvement of networking capabilities, the development of automated criticism systems that behave increasingly like human critics drawing on different knowledge bases, and the development of 'professional' memories containing collections of shape rules for access by designers.

1.7. Technical research: a management focus
Research in CAD and knowledge engineering has focused on specific design problems involving building form and its realization. Attempts, however, to address the complex array of professional practice issues have been insignificant by comparison. Reviewing the state-of-the-art in architectural management research, Akin (1990) identifies only a limited number of studies undertaken in architectural management in the last few decades. Among those identified are socio-historical accounts of office practice by Gutman (1988) and Cuff (1991), research by Mackinder and Marvin (1982) concerned with design information and its management, and studies by Haviland (1981) which found attempts by practitioners to formalize management restricted almost entirely to organizational structure and its generalist, studio, departmental or matrix model.

In response to the demand for more extensive architectural management research, studies aimed at confronting the newly emerging forces of architectural practice are currently under way.

In summary, design researchers who are 'technically oriented' define their role with respect to the efficient and effective production of objects. As previously mentioned, the tendency to understand efficiency and effectiveness as the systematic, mechanical matching of form with requirement dominated methodological research in the 1950s and 1960s leading to the development of various 'rigid state models' including the de-compositional method by Alexander. It was not long before the inadequacies of these methods in coping will the ill-definition and uncertainty of design practice, became apparent, motivating researchers ' to look behind the methods at the conceptual processes which were generating them (Evans et al., 1982).

1.8. Research methodologies' conclusion
As the review shows, methodological research in architecture has occupied, for the most part, a

'technological fix' role in society. An investigation of the context of methodological research reveals several factors contributing to the consolidation of this situation. These include: consumerism and its emphasis on production efficiency and effectiveness; technical, social and environmental problems caused, in many cases, by industrialization itself; and, scientific and technological development with its underlying atomistic and deterministic consciousness. Influenced by these factors, researchers have been preoccupied with developing methods that could improve the efficiency and reliability of the design and production process. As noted, this is evident to a large extent in technical research where researchers have adopted a systematic, computational, or management-focus.

Despite the deficiencies of these methods and a transition to conceptually oriented inquiry with its associated psychological and man-environment focus, researchers have persisted in adopting a *mechanistic*, *deterministic* approach. This has occurred even though a considerable amount of environment-behavior research has sought to move away from a dualist understanding of man-world interaction towards a more dialectic understanding. Ultimately, most researchers regard environmental factors such as culture as the primary origin or cause of behavior and its concrete manifestations.

2. A PROPOSED MODEL FOR ARCHITECTURAL RESEARCH

Following a critical framework for research will require certain fundamental changes. Ontologically, it will demand a change from a dualist understanding of people and the world to one that is dialectically oriented. Epistemologically, it will require that explicit attention be given to the interpretative and context-bound nature of knowledge. Such changes will have various implications for how design, designing, learning to design and research are conceptualized.

Alternative to an understanding of design in purely physical and formal terms will be the understanding of it in qualitative terms. While the role of design can be described with respect to its technical involvement in meeting basic functional and commodity demands, it can also be viewed as something which, via the medium of form and its quality, is an integral part of experience and, as such, is instrumental in how people relate to the world. From this viewpoint, it is the role of the designer to inquire into the nature of this relationship.

To characterize how something is apprehended, thought about or perceived is by definition a qualitative question. In this qualitative context, designing is critically reflective rather than systematically mechanical. In this qualitative context, initial consideration is given to experience as the source and mediator of knowledge rather than to the world as it is physically removed from its context of meaning. In this qualitative context, learning does not happen passively through the transmission of knowledge from expert to novice but as a *reflective dialogue* with the materials of

the situation. Experientially, the materials of the situation include the factors that influence how those involved in learning, conceptualize, perceive and understand various aspects of, and various phenomena in, the world around them.

Teaching designing, like designing, requires insight into how understandings of particular phenomena are constructed. Not only is this seen to be instrumental in the development of technical knowledge and skills but when approached explicitly and contextually, it also equips students with new ways of seeing things; ways which help them, personally and professionally, to make sense of a changing and uncertain world.

In view of these alternative conceptions of design, designing, and learning to design, research will be required to shift its initial emphasis from prescriptions to description. As well as changing the focus of inquiry, researchers should also be prepared to adopt a second-order perspective. They must be willing to accept, as a worthwhile starting point, the designers and students' experiences rather than attempting to describe designing and learning as concepts independent of their context (a first-order perspective). On the whole, for research to be more relevant to educators and practitioners, it must operate within a framework where there is a commitment by researchers to explore critically, rigorously and ethically the *ontological* and *epistemological* issues associated with architectural practice, education and research.

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