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Design Research: a disciplined conversation

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Design research is alive and well, and living in an increasing number of places. I find encouraging evidence for this in the growth of research-based journals in the design world over the last ten to fifteen years. For example, *Design Studies* was launched in 1979; *Design Issues* first appeared in 1984; the *Journal of Design History* in 1988; *Research in Engineering Design* in 1989; and *Languages of Design* in 1992. These are not the only ones; and there have been others, of course, in other languages, such as *Temes de Disseny* (Catalan and Spanish), 1986;*Revue Sciences et Techniques de la Conception* (French), 1992; *FormDiskurs* (German), 1996.

There has also been a lot of design-oriented research reported in a wide range of journals concerned with artificial intelligence, human-computer interaction, and so on. Compared with the academic design scene in the 1970s, we now have a rich culture in which to grow our design research seedlings.

Each of these design research journals draws upon scholarship paradigms from the Sciences or the Arts. A history-based journal such as *Design History* clearly draws upon paradigms of scholarship in the arts and humanities, and an engineering-based journal such as *Research in Engineering Design* leans heavily on the research paradigm of the natural sciences. But the important thing is that collectively we have the possibility of adding to these other paradigms and of developing our own design research culture.

At the *Design:Science:Method* conference of the Design Research Society, in 1980, Bruce Archer gave a general definition of research, which is that 'Research is systematic enquiry, the goal of which is knowledge'. [1] Our concern in design research has to be the development, articulation and communication of *design knowledge*. Our axiom has to be that there are forms of knowledge peculiar to the awareness and ability of a designer, just as the other intellectual cultures in the sciences and the arts concentrate on the forms of knowledge peculiar to the scientist or the artist.

Where do we look for this knowledge? I believe that it has three sources: people, processes and products.

Design knowledge resides firstly in *people*: in designers especially, but also in everyone to some extent. Designing is a natural human ability. Other animals do not do it, and machines (so far) do not do it. We often overlook the fact that people are naturally very good at design. We should not underplay our abilities as designers: many of the most valued achievements of humankind are works of design, including anonymous, vernacular design as well as the 'high design' of professionals.

One immediate subject of design research, therefore, is the investigation of this human ability - of how people design. This suggests, for example, empirical studies of designer behaviour, but it also includes theoretical deliberation and reflection on the nature of design ability. It also relates strongly to considerations of how people learn to design, to studies of the development of design ability in individuals and how that development might best be nurtured in design education.

Design knowledge resides secondly in its *processes*: in the tactics and strategies of designing. A major area of design research is methodology: the study of the processes of design, and the development and application of techniques which aid the designer. Much of this research revolves around the study of modelling for design purposes. Traditional models are the sketches and drawings of proposed design solutions, which in contemporary terms now extend to 'virtual reality' models. The use of computers has stimulated a wealth of research into design processes; so has the development of new practices in industry such as concurrent engineering.

Thirdly, we must not forget that design knowledge resides in *products* themselves: in the forms and materials and finishes which embody design attributes. Much everyday design work entails the use of precedents or previous exemplars - not because of laziness by the designer but because the exemplars actually contain knowledge of what the product should be. This is certainly true in craft-based design: traditional crafts are based on the knowledge implicit within the object itself of how best to shape, make and use it. This is why craft-made products are usually copied very literally from one example to the next, from one generation to the next.

As with the design knowledge that resides in people, we would be foolish to disregard or overlook this informal product knowledge simply because it has not been made explicit yet; that is a task for design research. So too is the development of more formal knowledge of shape and configuration - theoretical studies of design morphology. These may be concerned as much with the semantics as with the syntax of form, or may be concerned with prosaic matters of efficiency and economy, or with relationships between form and context - whether ergonomics or environment.

My own taxonomy of the field of design research would therefore fall into three main categories, based on people, process and products:

• design epistemology - study of designerly ways of knowing

• design praxiology - study of the practices and processes of design

• design phenomenology - study of the form and configuration of artefacts

What clearly has been happening in the field of design research in the last decade or so is that there has been a growing awareness of the intrinsic strengths and appropriateness of design thinking within its own context. There has been a growing acceptance of design on its own terms, a growing acknowledgement and articulation of design as a discipline in its own right. We have come to realise that we do not have to turn design into an imitation of science; neither do we have to treat design as a mysterious, ineffable art. We recognize that design has its own distinct intellectual culture; its own designerly 'things to know, ways of knowing them, and ways of finding out about them.' [2]

This view of design as a distinct culture is also embodied in attempts to break away from C. P. Snow's 'two cultures' view of Western intellectual tradition - the two cultures of Arts and Sciences. It has to be recogized that there is at least one other culture, which we might regard as the culture of Design, which can be articulated in comparison with the other two.

For instance, the 'things to know', the respective fields of knowledge are the natural world for science, human experience for art, and the artificial world for design; the 'ways of knowing', the values of science are rationality and objectivity, those of art are reflection and subjectivity, and those of design are imagination and practicality. Similarly, the 'ways of finding out', the intellectual skills, can be differentiated: those of science are experiment and analysis, those of art are criticism and evaluation, and those of design are modelling and synthesis.

The above categorisations may be rather simple, but many researchers in the design world have been realising that design does indeed have its own strong and appropriate intellectual culture, and that we must avoid totally swamping our research with different cultures imported either from science or art. This does not mean that we completely ignore these other cultures. On the contrary, they have much stronger histories of enquiry, scholarship and research than we have in design. We need to draw upon those histories and traditions where appropriate, whilst building our own intellectual culture, acceptable and defensible in the world on its own terms. We have to be able to demonstrate that standards of rigour in our intellectual culture at least match those of the others.

In *The Sciences of the Artificial,* Herbert Simon went so far as to say that "The proper study of mankind is the science of design'. [3] (Of course, the quotation is a corruption from Pope's original version, that 'the proper study of mankind is man'.) What Simon was suggesting was that the study of design could be a fundamental, interdisciplinary study accessible to all those involved in the creative activity of making the artificial world (which includes all mankind). For example, Simon wrote that 'Few engineers and composers . . . can carry on a mutually rewarding conversation about the content of each other's professional work. What I am suggesting is that they *can* carry on such a conversation about design, can begin to perceive the common creative activity in which they are both engaged, can begin to share their experiences of the creative, professional design process.'

This, it seems to me, is the challenge for design research - to help construct a way of conversing about design that is at the same time both interdisciplinary

and disciplined. We do not want conversations that fail to connect across disciplines, that fail to reach common understanding, and that fail to create new knowledge and perceptions of design. It is the paradoxical task of creating an interdisciplinary discipline.

For some leading examples of this developing conversation, we might turn to the series of papers which, in recent years, have won the annual *Design Studies* Award for the best paper published in that journal. These examples have originated in design research conducted in different domains and with different methodologies, but each individual contribution has had something to say to members of the wider design research community.

The Award was first instituted in 1987, and the winners have been:

1987: Robert Davies and Reg Talbot [4] (Management Sciences, UMIST, UK)
Experiencing Ideas: Identity, insight and the imago
Identification of common features of the critical moment of insight in creative design, from interviews with successful designers

1988: Donald Schön [5] (Urban Planning, MIT, USA)
Designing: Rules, types and worlds
Analysis of design protocols to identify patterns of reasoning based on rules derived from type-concepts

1989: Jacob Burr and Myrup Andreason [6] (Engineering, Lyngby University, Denmark)
Design Models in Mechatronic Product Development
Analysis of the properties of design models, leading to proposals for models appropriate to mechatronic product design

1990: Stephen Little [7] (Information Systems, Wollongong University, Australia)
Task Environment versus Institutional Environment: Understanding the context of design decision making
Investigation of the conflicts between the task environment and institutional influences on complex technical design decisions

1991: Richard Coyne and Adrian Snodgrass [8] (Architecture, Sydney University, Australia)
Is Designing Mysterious? Challenging the dual knowledge thesis
Theoretical argument based on hermeneutical philosophy against the view that designing is inherently mysterious

1992: Frances Downing [9] (Architecture, Texas A&M University, USA)
Conversations in Imagery
Study of the role of memory (mental imagery of memorable places) in the architectural design process

1993: Robin Roy [10] (Design & Innovation, The Open University, UK)
Case Studies of Creativity in Innovative Product Development
Studies of creative individual designers to gain insight into the creative process and innovative product development.

1994: Bill Hillier and Alan Penn [11] (Architecture, University College London, UK)
Virtuous Circles, Building Sciences and the Science of Buildings
The spatial modelling of buildings and its application to the creation of feedback for progressive improvement of building performance.

1995: Gabriela Goldschmidt [12] (Architecture, Technion, Haifa, Israel)
The Designer as a Team of One
Comparative analyses of an individual designer and a small team tackling the same design problem.

1996: Terry Purcell and John Gero [13] (Design Science, Sydney University, Australia)
Design and Other Types of Fixation
Experimental studies of problem solving in design, aimed at understanding the causes and effects of fixation.

What these examples of 'best practice' in design research have in common include the following characteristics.

The research is:

Purposive   - based on identification of an issue or problem worthy and capable of investigation
Inquisitive   - seeking to acquire new knowledge
Informed   - conducted from an awareness of previous, related research
Methodical   - planned and carried out in a disciplined manner
Communicable   - generating and reporting results which are testable and accessible by others

These characteristics are, of course, normal features of good research in any discipline. I do not think that such normal, academic criteria inhibit or preclude research that is 'designerly' in its origins and intentions. However, they would exclude works of so-called research that fail to communicate, are undisciplined or ill-informed, etc.

I think also that we should draw a distinction between works of practice and works of research. I do not see how normal works of practice can be regarded as works of research. The whole point of doing research is to extract reliable knowledge from either the natural or artificial world, and to make that knowledge available to others in re-usable form. This does not mean that works of design practice must be wholly excluded from design research, but it does mean that, to qualify as research, there must be reflection by the practitioner on the work, and the communication of some re-usable results from that reflection.

The design fields covered in the selected papers, above, have included architectural design, engineering design and industrial design, and the methods of inquiry underlying the research have ranged from philosophical analysis, through case studies and interviews, to protocol studies. They are examples drawn from an ongoing research 'conversation' about design which

is being shared by members of widely differing professions and disciplines. They draw upon the research paradigms and methods of both the Arts and the Sciences, but they also contribute to the emerging paradigms and methods of design research.

One of the dangers in this new field of design research is that researchers from other, non-design, disciplines will import methods and approaches that are inappropriate to developing the understanding of design. Researchers from psychology or computer science, for example, have tended to assume that there is 'nothing special' about design as an activity for investigation. However, developments such as artificial intelligence and other computer modelling in design have perhaps served mainly to demonstrate just how high-level is the cognitive ability of designers, and how much more research is needed to understand it. Better progress seems to be made by designer-researchers, and for this reason the recent European series of workshops and symposia on descriptive modelling of design by Cross et al. [14], Akin et al. [15], Birkhofer at al. [16], featuring a younger generation of designer-researchers, has been extremely useful in developing the methodology of enquiry in design research. As design grows as a discipline with its own research base, so we can hope that there will be a growth in the number of emerging designer-researchers.

Another of the dangers is that researchers adhere to underlying paradigms of which they are only vaguely aware. We need to develop this intellectual awareness within our community. A good example here is the work of Kees Dorst [17], in making an explicit analysis and comparison of the paradigms underlying the approach of Herbert Simon, on the one hand, and Donald Schön on the other. These two scholars have been the most influential in our field, representing positivist and constructivist philosophies, respectively. Simon's positivism leads to a view of design as 'rational problem solving', and Schön's constructivism leads to a view of design as 'reflective practice'. These two might appear to be in conflict, but Dorst's use of the two paradigms in analysing design activity leads him to the view that the different paradigms have complementary strengths for gaining an overview of the whole range of activities in design.

We are still building the appropriate paradigm for design research. My personal 'touch-stone' theory for this paradigm is that there are 'designerly ways of knowing' [18]; many of the examples of design research I have referred to are contributions to building our understanding of this concept of particular, designerly ability. I believe that building such a paradigm will be helpful, in the long run, to design practice and design education. We still know relatively little about the mystery of design ability, and that limits our 'proper study of mankind'. This is the goal for design research.

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