Action case research: a method for the accumulation of design theory/practice knowledge in practice

Ching-Chiuan Yen
Martin Woolley
& Kuo-Jung Hsieh
Chang Gung University, TW
<ccyen@mail.cgu.edu.tw>

Introduction

Design research is a relatively young discipline and to date does not have a well-established cultural base in comparison to the sciences, humanities and other scholarly disciplines (Owen 1994). Generally, artists and designers undertaking formal research draw heavily on existing research methods from the Physical and Social Sciences. Recently, there has been an increasing debate about research as a discipline in art and design (Frayling 1993/4 & Press 1995) as art and design practitioners become increasingly involved in research. The nature of art and design has become one of the main topics for such debates.

However, industrial/product design is not art, craft or engineering, it has its own purposes, values, measures and procedures (Owen 1994). It can be assumed that there is a way of processing research for design as design knowledge is gained through both research and practice. More accurately, design studies could be described as a 'field of knowledge', because it is multi-faceted and draws upon many related disciplines (Creigh-Tyte 1995). Design, like many other occupations is seeking to establish itself as a profession, it is therefore concerned about the development of a service orientation, the continual growth of knowledge, based on practice and the evolution of a distinct body of knowledge that distinguishes designers from other professionals.

The increasing awareness of design research as an integral part of professional design practice has been accelerating rapidly in recent years. Designers should therefore recognise the need to extend the base of design knowledge as part of their professional responsibility. Thus, research has an important role to play in helping designers establish a knowledge base for design practice.

2 The evolution of the design study

The nature of design practice is dynamic and involves a series of interrelated processes of thinking and practising (or input and output). According to Cross (1984), the editor of Development in Design Methodology, four generations of concepts have been developed within the process of evolution of design methodology since 1962. Despite individual preferences of methodologists for 3, 4, or 6 stages in the design process within the different stages of evolution, the main change is the premise on which the philosophy of the methodology is based. Philosophy for design methodology emerged from the concern over the conflict between art (intuition) and science (rationality). The focus subsequently extended from a scientific systematic process to a humanitarian relationship. Such a relationship empowers individuals not only to explore the diverse qualities of personal experience but also to shape that of community and societal experience.

Experience gained through this process of evolution suggests that much of the practical failure of earlier stages of design methodology was based on inappropriate premises. More recently, 'pluralism', a more ideal premise, has been suggested by Margolin and Buchanan (1995) for design studies, which seeks to find the meanings of design on the basis of the study of many instances of design in a variety of circumstances. A pluralistic field of design may be "bringing theoretical understanding into direct relation with practice and production" (Margolin and Buchanan 1995). This not only maintains the merits of previous generations of methodology which mainly focus on design as a discipline, but also considers the contribution of different types of philosophic or cultural content. For example, 'product semantics' empowers users by transposing a linguistic method to develop a more meaningful product form.

Besides the meta-knowledge established from the pluralism of conceptions of the discipline, the design methodology also needs to be established through 'designerly thinking' (Archer 1984b). In order to devise a useful standard or additions to a methodology, it is necessary to identify the 'designerly' way of thinking and knowing. In Design Methods, Jones (1992) identifies 3 different types of designer as follows:
The designer as a black box (from the creative viewpoint): the result comes from the mysterious creative leap.
The designer as a glass box (from the rational viewpoint): the result is as a consequence of a completely explicable rational process.
The designer as a self-organising system (from the control viewpoint): the result is as a consequence of a strategy-plus-objectives design process.
The first two types may be inappropriate, as design is neither purely art nor science. The final type of 'designerly thinking' echoes the above concept. In his interpretation of design, Archer (1984) defines designing as a "goal-oriented problem-solving activity." As in all goal-oriented activities, a pre-requisite for getting there is knowledge of where 'the goal' is. In a conference for healthcare design, Dr. Kaiser echoes this statement and believes that design should make a 'value statement' before the physical construction begins (Bell et al. 1994). The ultimate success of a design project therefore depends a great deal on the accurate establishment at the beginning of the 'real' project goals. Therefore, success of design depends on the skill of establishing the right goals. Cross (1995:108) took this discussion further and claimed that to emphasise the role of the conjectured solution of goals is a way of gaining understanding of the design problem and states the need "to generate a variety of solutions precisely as a means of problem analysis." The imposition of a set of objectives or specific solutions as 'primary generators' for an initial design solution was originated and championed by Darke (1979). Instead of simply treating the methodology as a scientific and pragmatic approach to thinking, the ideal methodology should accommodate the intentions and responsibilities of design itself. Designers

therefore need to perceive and understand the relevant information to establish a 'value goal' before beginning the design. The outcome of a design study should therefore help designers to identify, collect and synthesise such information, in order to achieve a more appropriate solution to such a goal.

Based on such an aim in related to design practice, an analytic/synthetic, theory/practice research model was developed by Owen (1994) for generating and accumulating knowledge in the realm of theory and practice. New knowledge for design can be demonstrated by overall process regarding the synthesis of the theoretical and practical knowledge. A similar notion has been developed by Routio (1997) who claims that normally researchers for design should work simultaneously within these two realms. Routio argues that the way of looking at the two realms is natural to a designer. However, the designer starts his work in the realm of practice and first produces conceptual plans and projects for new products. The designer is not interested in producing theory; instead, he is keen to know how to apply such a theory into practice. Thus design research operates at the interface between academic inquiry and industrial practice, and the creative tension which can emerge from the sometimes differing world views can stimulate the demand for new knowledge generated by research. To approach these, Owen (1994: 2) claims that "it is probably best to abandon the term 'research' for a time and instead, look at how knowledge is used and accumulated - since building knowledge, after all, is the goal of research." The primary goal of design research has therefore become the examination of how knowledge is accumulated and deployed in the realm of theory and practice (Fig 1).

Fig 1: The ideal of design studies

3 Research methods for design practice

In this section, two main types of research method applied in the study of design practice are examined: action research and case study. Research techniques, such as surveys, interviews and questionnaire are considered to be a common associated factor in both forms of research as they might be used to a greater or lesser extent in certain research.

3.1 Action Research

Normally, knowledge is generated and accumulated through action. Action research is an approach which has proved to be particularly attractive to practitioners because of "its practical, problem-solving emphasis, because practitioners carry out the research and because the research is directed towards grater understanding and improvement of practice over a period of time (Bell 1993)". The essentially practical, problem-solving nature of action research make this approach attractive to practitioner-researchers who have identified a problem during the course of their work, see the merit of investigating it and, if possible, of improving practice.

3.2 Case study

Case study method is a favoured and traditional approach to the study of design practice (Svengren 1993, Hinnells 1993). A case study is an empirical inquiry that "investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of

evidence are used." (Yin 1989: 23) The use of these methods is concerned principally with the interaction of factors and events, particularly in practical applications (Bell 1993). For example, case studies for design involve an analysis and systematic evaluation of a single designer/product or a group of designers/products to demonstrate design interventions (Cross and Cross 1996). Yin (1989: 14) states that "case studies allow an investigation to retain the holistic and meaningful characteristic of real-life events, such as individual life cycles, organizational and managerial processes, neighborhood change, international relations and the maturation of industries." This description covers the ways in which the case study approach can be used in this study. When a new design methodology (knowledge) evolves, there are opportunities to examine changes in theory and practice for design, and it is these changes that can be documented as case studies. Studies focusing on user, designer, product and product manufacturers can be helpful in understanding the reasons for changes in design practice. The use of these methods becomes vital as Patton (1990: 54) states that "case studies are particularly valuable when the evaluation aims to capture individual differences or unique variations from one program setting to another, or from one program experience to another." Therefore, the essence of the case study is to illustrate a design methodology, to demonstrate its implications for the design practice. The knowledge and understanding is gained from the study of events and process rather than conjecture. However, such knowledge gained from a case study may not always be useful, as it cannot readily be applied to other cases, which might require practical remedies. A research method for design is therefore required as the aim of the study is therefore not only the desire to observe and understand the use of theory in practice but also to intervene in and change the process under the theory. The use of action study in parallel to case study can therefore fill the gap as it is not only focused on the existing process or theory, but also on intended changes or the discovery of new phenomena (Fig 2).

Fig 2: A proposed research (Source: Adopted from Braa and Vidgen 1997: 396)

3.3 Action case study

To response to the dilemma of interpretation and intervention as well as providing a pragmatic response to the issues of manageability of in-context research, a research method labeled "action case" was developed by Barr and Vidgen (1995) for Information System Design. This method has been successfully applied by numerous studies (Hughes and Wood-Harper 1999; Stenmark 2000). As shown in Fig 3, the area labeled action case represents a mix of interpretation/understanding and intervention/change. This name reflects that it contains elements of action research which "reflects the potential for research to change organizations resulting in changes to the social world" and case study which "reflects the necessity of weighing understanding gained from the findings (Barr 1995)."

Fig 3: Method location for action case (Source: Vidgen and Braa 1997)

To transposition such a research method into the context of design study, 'action case' is a hybrid of understanding of theory and its change to practice, designed to balance the

trade-offs between being either an researcher capable of making interpretations of theory to design and a researcher/practitioner involved in creating change in design practice. In this case, researchers operate as or collaborate with practitioners in studying and transforming such knowledge generated from the design theory into practice. The application of such a theory/knowledge to design practice through an action case study is an intrinsically goal-oriented problem solving case study activities. It attempts to lean general lessons from specific cases, to operate concepts, to develop comparisons and the like, through repeated case applications.

As the majority of the research is done (collaborated) by design practitioners themselves, the research results reflect their understandings of their system better than the work of external professional researchers alone could. These understandings are also conditioned by design practitioners' rights and obligations to act within their own system. Thus, pluralistic and action case in the research process is capable of producing both scientifically and socially meaningful research results.

4 Examples of action case studies

Within the confines of the research, five cases applied to the research method evoked. The detailed process involved have been written up in detail elsewhere and readers who want to get a sense of the empirical favor of these processes can consult these other sources (Yen 1998, Liaw and Yen 2002, Tseng and Yen 2002, Chin et al. 2001 & Hsu et al. 2001). Instead, the goals of this paper are to demonstrate the strength and weakness of the "action case" study within different situations to meet various research goals.

Action case projects have been conducted in two separate occasions. First, author's PhD project (Yen 1998), studied the application of patient-centred care to medical equipment through industrial design practice, attempted to generate and test rhetorical context of the action case study by developing a dialysis equipment within a self-conducted setting. The rests, four MA projects taking place at Chang Gung University, attempted to understand the application of such a method to design research and the results are summarized in Table 1. These action cases were carried out in real but dissimilar settings, such as a Taiwanese lighting, suitcase and wheelchair manufacturers, etc.

These cases included design process action from action research and the understanding of the design goals in a real-life context from case studies. These cases also dealt with the characteristics defined by Barr and Vidgen (1997) in the following ways: 1. real-time intervention: the projects were conducted in on-going product development processes, where the participants included the designers themselves, users and other relevant people. 2. short duration: the timescale is shorter than a typical action research. 3. reduction of complexity: focusing on one design theory/method at a time in order to gain clear case description from the action case. 4. real-life evaluation: the evaluation of the theory/method in a real-life context. The common activities carried within these action cases are as follows: 1. Area of concern, i.e. goal of the study, 2. method development, 3 problem context, 4. action, 5. evaluation and method refinement. The detailed case descriptions and outcomes are shown in Table 1 and Fig 4-8.

Product name
Medical equipment design
Street lighting system
Notebook bag
Personal communicator

Wheelchair
Goal
Patient-Centred Design
Product Serialization
Product protection
Analogy Methods
Functional Analysis
Outcome
See Fig 4
See Fig 5
See Fig 6
See Fig 7
See Fig 8
Reference
Yen (1998)
Chin et al .(2001)
Tseng and Yen (2002)
Liaw and Yen (2002)
Hsu et al. (2001)
Case description

This study is concerned with the application of patient-centred care (PCC) principles within the context of medical practice, in order to derive a PCC design methodology for designers engaged in medical equipment design.

A design methodology was generated by the study.

The use of PCC principles poses new challenges to designers to develop medical equipment, which fulfil not only the needs of clinicians but also those of patients.

This study is concerned with the application of modularity to product serialization of outdoor lighting, in order to derive a design methodology for designers engaged in lighting equipment design. This study collaborated with a lighting company in order to solve their problems as a consequence of cost struggling.

A combination of modularity and product serialization was introduced.

Several products based on the main unit were designed and will be the market within a few months time.

This study is concerned with the use of protection design concept to notebook bag, in order to derive a design alternative for suitcase industry.

An air protection concept was introduced and the final outcome won a design prize in Taiwan.

This study is concerned with the use of analogy methods in design concept development, in order to derive a design method for enhancing concept development.

The application of this study was based on a design competition "flowing" which aimed to design a future IA products.

This study is concerned with how to design a wheelchair which can positioning the disable in an appropriate position.

This project was collaborated with a local wheelchair manufacturer and the outcome was on the market and received a good response.

Table 1 The detailed information of individual action case

Fig 4: The positioning of PCC design methodology into design practice (Source: Yen 1998)

Fig 5: Product serialization of street lighting system (Source: Liaw and Yen 2002)

Fig 6: Air protection notebook bag (Source: Tseng and Yen 2001)

Fig 7: Application of analog design method to a personal communicator design (Source: Liaw and Yen 2002)

Fig 8: Functional analysis of positioning wheelchair (Source: Hsu et al. 2001)

5 Discussion and conclusion

The increasing awareness of practice-based design research as an integral part of professional design practice has been accelerating rapidly in recent years. Designers should therefore recognize the need to extend the base of design knowledge as part of their professional responsibility. A research method which began with action research ended with case study in the context of design practice was therefore recommended, in order to generate a new ' field of knowledge'. The purpose of using this method in design practice is to identify the significant influential factors of a specific design theory/ methodology and to show how they affect the implementation of that theory/methodology and individual methodological functions. In this way the design theory/ methodology can provide specific guidance on the conduct of action case research and the knowledge generated can therefore be used within a wide variety of design contexts.

The use of single 'case' study was chosen for the individual action case study to accumulate design knowledge. The reason for selecting this is that "the single case represents the critical case in testing a "well-formulated theory" and to determine "whether the theory's propositions are correct or whether some alternative set of explanations might be more relevant" (Yin 1989, p.47).

The advantages of using"action case" studies in design research are to:
add detail to the methodology/knowledge identified in theory generations.
discover new concepts which were not found in theory generations and in the context of design.
trace changes over time.
test existing notions to enhance the usability of the design methodology/knowledge.
Table 2 demonstrates a comparison the differences between action case and traditional action and case study research in terms of their research focus and concerns.

	Action research	Case study	Action case study
Researchers	Participation	Third-party	Participation
Research inquiry	Problem-oriented, might change during the process	Goal-oriented	Goal-oriented, problem-solving
Research process	Flexible, solution-oriented	Preplanned, some flexibility	Preplanned, flexible, goal-oriented
Dependency on the case	High	Low	High
Research objectives	Knowledge and understandings: focus on intended changes	Knowledge and understandings: focus on establish a new knowledge (know how)	Knowledge can be applied to all i8nstances of the same type. It contains mainly general rules.
Area of validity	Pieces of knowledge are detached and valid only in one case	Knowledge can be applied in several instances	Knowledge can be applied in several instances of the same type. It contains mainly general rules.
Reliability	Difficult	Possible	Difficult
Intervention by researchers	Allowed and desirable	Not allowed	Allowed and desirable
Analysis concern (pragmatic criterion)	Credibility/consistency and workable for client	Credibility/consistency	Credibility/consistency and workable for other instances
Mode of presentation	The essential sense of 'tacit' knowledge cannot be explained verbally	Tradition. Exemplar. Skill of trade. Many important points of these cannot be presented verbally.	The knowledge can be explained as a design models

Table 2: A comparison of research focus and concerns between action case and traditional action and case research. (Source: The comparison between action research and case study adopted from Svengren 1993)

The research method 'action case' has been an attempt to create input to a new research method accumulating design theory/practice knowledge in practice. On balance, the evidence favors action case study. Future research is necessary for testing the method in various research projects in different context and settings. This is essential in order to refine and correct the method of action case study.

6 Acknowledgments

References

Archer, L.B. (1984) Systematic Method for Designers, in Cross, N. ed. 1984. Developments in Design Methodology, Chichester: John Wiley & Sons. 57-82, (Originally published by The Design Council, London 1965.)

Bell, J. (1993) Doing Your Research Project: A Guide for First-Time Researchers in Education and Social Science. Buckingham. Open University Press.

Braa, K. (1995) Beyond Formal Quality in Information Systems Design. PhD Dissertation. University of Oslo.

Braa, K. & Vidgen, R. (1995) Action case: exploring the middle kingdom in is research methods. Proceedings of Computers in Context: Joining Forces in Design. Aarhus, Denmark.

Braa, K. and Vidgen, R. (1997) An information systems research framework for the Organizational Laboratory. in Kyng, M. and Mathiassen, L. eds. Computers and Design in Context. Cambridge, Massachusetts: MIT Press.

Chin, C. C. Liaw, W.U., Tseng, Y.L. & Yen, C.C. (2001) A Case Study on Product Serialization Design with Reference with Outdoor Lighting Design. 2001 Teaching and Technology Conference, 16 November, 2001, Mingchi Institute of Technology. 79-84. (Published in Chinese).

Creigh-Tyte, A.E. (1995) The supply and demand for design research in the UK: Quantifying the debate. Design Interfaces Conference Proceedings Vol. 3, Design Theory Design Education. 11-13 April 1995, The European Academy of Design. Salford: University of Salford.

Cross, N. (1984) Developments in Design Methodology. Chichester: John Wiley & Sons.

Cross, N and Cross, A.C. (1996) Winning by design: the methods of Gordon Murry. racing care designer. Design Studies. 17, 91-107.

Darke, J. (1979) The primary generator and the design process. Design Studies. 1(1). 36-44.

Frayling, C. (1993/4) Research in art and design. Royal College of Art Research Papers. 1(1). London: RCA.

Gray, C. and Pirie, I. (1995) 'Artistic' research procedure: Research at the edge of chaos?" Design Interfaces Conference Proceedings Vol. 3, Design Theory Design Education. 11-13 April 1995. The European Academy of Design . Salford: University of Salford.

Hinnells, M. (1993) Environmental factors in products: how to gather the evidence? Design Studies. 14(4): 457-475.

Hsu, C.L., Chen, U.W., Chiou, Y.M. & Chiou, W.C. (2001) The design process of positioning wheelchair to Taiwanese children and its recommendation. 2001 Teaching and Technology Conference, 16 November, 2001, Mingchi Institute of Technology. 85-89. [Chinese].

Hughes, J. and Wood-Happer, T. (1999. Systems development as a research act. Journal of Information Technology. 14: 83-94.

Jones, C.J.(1997) PhD Research in Design. DRS_NEWS. 58. July-September. 4-6. Available: http://www.mailbase.ac.uk/lists-a-e/drs/ (cited 07.09.97).

Jones, C.J. (1992) Design Methods. 2nd edit. New York: Van Nostrand Reinhold. (Originally published by the Council of Industrial Design, London, UK).

Liaw, W.U. and Yen, C.C.(2002) The application of analog design methods to design innovation. Proceeding of 2002 Design Research Symposium. 4 May 2002. Chinese Institute of Design. Taipei: National Taiwan University of Science. 93-98. (Published in Chinese)

Margolin, V. and Buchanan, R. (1995) The Idea of Design. Cambridge, Massachusetts: The MIT Press.

Owen, C.L. (1994) Design research, building the knowledge base. Design Processes Newsletter. 5(6): 1-6.

Patton, M.Q. (1990) Qualitative Evaluation and Research Methods. 2nd edit. Newbury Park, CA: Sage.

Press, M. (1995) Its research Jim. Design Interfaces Conference Proceedings Vol. 3, Design Theory Design Education. 11-13 April 1995. The European Academy of Design. Salford: University of Salford.

Routio, P. (1997) Arteology or the Science of Artefacts. Helsinki: University of Art and Design Helsinki (cited 10.06.97). Available: http://www.uiah.fi/tm/metodi/110.htm.

Svengren, L. (1993) Case study methods in design management research. Design Studies. 14(4): 444-456.

Stenmark, D. (2000) Collaborative aspects of information retrieval tools: Summarising three action case studies. in Svensson, L., et al. Proceedings of IRIS 23. Laboratorium for Interaction Technology. University of Trollhattan Uddevalla.

Swann, C. (1995) Paradigms in design research. Design Interfaces Conference Proceedings Vol. 3, Design Theory Design Education. 11-13 April 1995. The European Academy of Design. Salford: University of Salford.

Tseng, Y.L. and Yen, C.C. (2002) The use of new material to protection design within new product development process. Proceeding of 2002 Design Research Symposium. 4 May 2002. Chinese Institute of Design. Taipei: National Taiwan University of Science. 771-774. [Chinese]

Vidgen, R. and Braa, K. (1997) Balancing interpretation and intervention in information systems research: the "action case" approach. Proceedings of IFIP WG8.2. Philadelphia, USA.

Yen, C.C. (1998) The Application of Patient-Centred Principles to Medical Equipment through Industrial Design Practice. PhD Thesis. Birmingham: University of Central England in Birmingham.

Yin, R.K. (1989) Case Studies Research. Newbury Park, CA: Sage Publication.