

Design Research Methodology: Introducing Evidence Based Design

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Introduction

Design research is a comparatively new field of endeavour that appeared as the new design professions were incorporated into higher education institutions in the 1980s. Typically tertiary education institutions require research as a corporate objective and therefore design education required a research profile. Research practice existed in the scholarship of architecture, which has a long university tradition and is arguably the founding design-based profession. Today design-based professions such as industrial design demonstrate surprisingly advanced research profiles' considering the limited time design research has existed and the variety of relevant subject matter.

However the practice of design is fundamentally different to practice in existing professions and this has affected the development of design research. Industrial Design is a good example of a design profession that has confronted these differences and emerged with a research profile that is fundamentally sound. To better understand design research it is important to review the changing background and review some of the practice issues that impact on design research.

Background

In the table below the changing nature of industrial design can be viewed in terms of the professions role and activity.

Table 1 - History and role of design. (Groppen, 2008)

Decade	Role	Design Activity
1950s	promoting the nation	the designer as creator
1960s	involving industry	the team: design, marketing and manufacture
1970s	rise of ergonomics	design for user understanding
1980s	design management	design as coordinator
1990s	brand building	design for creating experiences for the customer
2000s	innovation	design as an innovation driver
2010s	design ecology	design as a sustainability driver

The changing role of industrial design since the 1950s indicates an evolving design responsibility that is typical and indicative of an emerging profession. It is also one of the reasons why design research in industrial design has had difficulties in terms of definition and description. Design research has changed and developed throughout this period and it will probably not be a stable form of scholarship for some time to come. Design practice is continually changing and responding to market, the user and environmental demands and in this sense, design research may never be predictable in any form.

Design research is different to research in other professions and to appreciate this difference we need to consider design as an independent activity, how it is unique and why as a researcher we need to consider some of the issues that are specific to the activity of design that will impact on the way we undertake research.

Design Thinking or How Designers Think.

Designers think differently and the differences need to be recognised and research organised to respond to the characteristics of Design Thinking. These characteristics can be categorized into three sections namely, problem formulation, solution generation and process strategy. The three separate sections represent over two decades of research into design thinking and are well supported by the prominent researchers in this area. For example the following description of problem formulation illustrates the differences in design thinking compared to a more research acceptable iterative thinking process 'designers are solution led, not problem led...for designers it is the evaluation of the solution that is important, not the analysis of the problem (Cross, 2001).

Creativity

The importance and emphasis placed on creativity is another fundamental difference between design practice and other professions. The primary focus in design is creativity, the creative process and the resulting designs. This must be a consideration when we think about research and design. Fieldman (1994) views creativity as the 'achievement of something remarkable and new, something which transforms and changes a field of endeavor in a significant way...the kinds of things that people do that change the world'. Creativity can be valued independently of other intellectual qualities and is therefore independently nurtured. Intelligence, for example, is seen to be largely unrelated to creative (divergent) thinking, 'there seems to be creative personality traits that are characteristic of creative individuals,

certain types of divergent thinking skills can be improved with training and practice' (Fieldman et al, 1994). The point being made here is that designers in the context of the activity of tertiary level research are fundamentally different people who work and think in ways that are at odds to mainstream research thinking.

Definition of Terms

Design Research : Design and Practice

The main issue for Design is the variety of research activities and this results in some writers maintaining that it difficult to apply a single definition (Barnacle, 2003). However, the following three proposed definitions for practice related research, practice-based, practice-led and traditional or formal research can respond to design research objectives, the purpose and direction of the research and the way it is conducted. Downton (2003) refers to Design as 'a way of inquiring, a way of producing knowing and knowledge; this means it is a way of researching'. The concepts of improvement and ethical responsibility are common themes in Design research and in recent times the activities of creative people are regarded as essential to national economic development and prosperity. The idea of creative industries that discover new ideas and ways to commercialize these ideas is clearly associated with design professions (Barnacle, 2003). Increasingly, there is a growing interest in practice-based research, for example, the RMIT website describes a process of reflective research (practice-based) where the university seeks out 'practitioners who have developed a body of work demonstrating mastery of their field, invite them to reflect upon the nature of that mastery within a critical framework, to speculate through design on the nature of their future-practice and to demonstrate their findings publicly' (van Schaik, 2000).

Candy (2006) identifies different forms of practice and research:

Practice-Based Research

'If a creative artefact (artwork/design) is the basis of the contribution to knowledge, the research is practice-based'. In order to understand or examine the research, a comprehensive dissertation and the artwork/design, must be viewed and analyzed together because of the significance of creativity to the research. Currently, there is no clear agreement on a theory verses practice ratio, as institutions are still developing this form of doctoral research.

Practice-Led Research

'If the research leads primarily to new understandings about practice, it is practice-led. The research does not normally include creative work and is presented as a formal thesis document similar in presentation to more traditional doctoral documentation (Candy, 2006).

Traditional Research

This form of research requires recognizable and relevant research skills, such as a generic (traditional) research process that includes a statement of research aims and objectives that are contextualized through a literature review, identification and description of appropriate methodology for addressing the stated aims, and analysis and conclusions. Following this process means the research is recognized and accepted across disciplines and in this sense contributes to a shared body of interdisciplinary knowledge (Douglas, Scopa & Gray, 2000).

Traditional or Formal Research is an accurate description for much of the research in Design. If we accept that Design is a form of problem solving, then it follows that the subsequent solution(s) can be assessed in relation to the original problem. Solutions can be tested, the tests forming the basis of an experimental program where results are analyzed and contribute to an improved solution; this in turn can be retested and analyzed. Testing may involve different constraints such as engineering, ergonomic and marketing criteria. The data generated from this testing and experimental process is original and is effectively new knowledge. In this context, the Traditional approach to Design research is appropriate as it includes all the steps described above in Traditional research and is therefore readily accepted by the research community. For the majority of research in Design, existing or traditional approaches to research are adequate as they stand and require little adjustment or redefining.

Design Methodology : validating the research process

Research methodology is only one component of a greater understanding of research as a process. Crotty (1998: 2) states that all research should address the following four questions:

What methods do we propose to use?

What methodology governs our choice and use of methods?

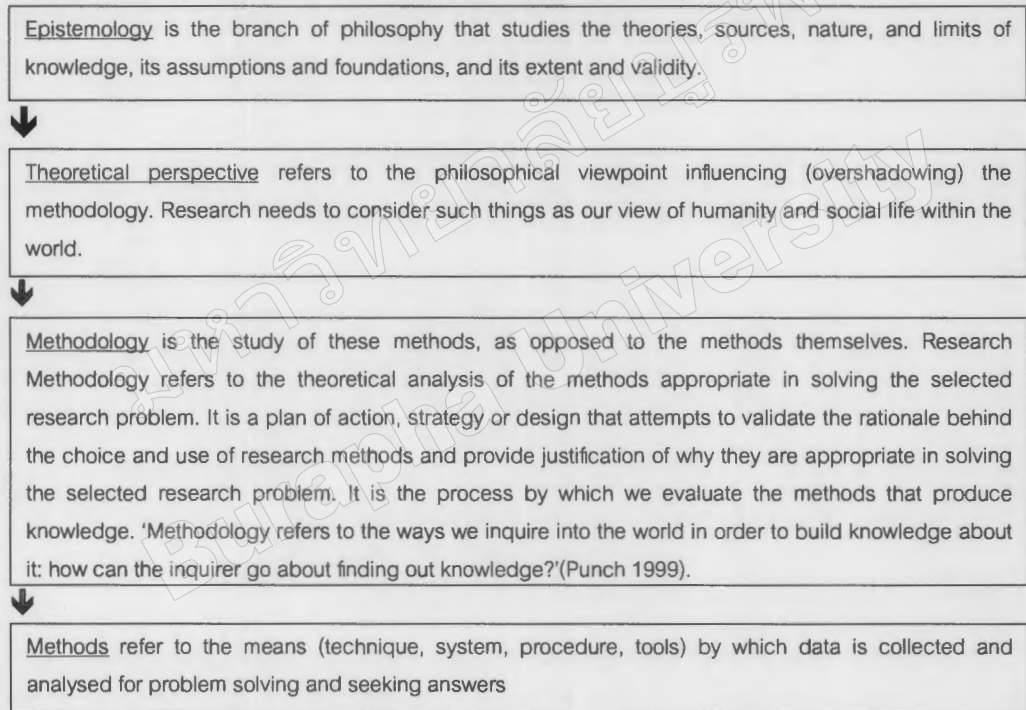
What theoretical perspective lies behind the methodology in question?

What epistemology informs this theoretical perspective?

If the researcher can answer these question, and their interaction with one another, they will provide the knowledge for developing a research process that is tailored to solving a particular research problem. This is because the four questions form the basic structural elements of any research process. They can be explored and answered via a process known as 'scaffolded learning' (Crotty 1998) that leaves it to the learner to set up longer-term structures, which they can build on, as they comprehend, expand and shape their research (Pianca, 2008).

To understand the research process we first need to not only define and explain each individual element but also to appreciate their relationship to each other.

Table 2 – Hierarchy of the structural elements in the research process (Pianca, 2008)



The following Table 3 identifies the relationship between the four structural elements of the research process. Further explanation of the terminology can be found in research texts. Using this structure to understand research, candidates can deploy the elements identified above and subsequently have a means of justifying research decisions, especially decisions concerning design methodology and method.

Table 3 Relationships within the structural elements of the research process (Crotty, 1998)

Epistemology	Theoretical Perspective	Methodologies	Methods
Objectivism	Positivism	Experimental research	Sampling
Constructionist	Post-positivism	Survey research	Measurement & scaling
Subjectivism	Interpretivism	Ethnography	Questionnaire
	<ul style="list-style-type: none"> ■ Symbolic Interpretivism ■ Phenomenology ■ Hermeneutics 	Phenomenological research	<ul style="list-style-type: none"> ■ Participant ■ non-participant
	Critical Inquiry	Grounded theory	Interview
	Feminism	Heuristic inquiry	Focus group
	Postmodernism	Action research	Case study
	etc.	Discourse analysis	Life history
		Feminist standpoint research	Narrative
		Qualitative research	Visual ethnographic methods
		Quantitative research	Statistical analysis
		etc.	Data reduction
			Theme identification
			Comparative analysis
			Cognitive mapping
			Interpretative methods
			Document analysis
			Content analysis
			Conversation analysis
			Etc.

New knowledge: developing research questions

Prior to establishing appropriate methodologies and methods, primary research questions need to be established and this can be achieved by questioning the form and extent of the anticipated new knowledge the study may generate. New knowledge is critical to doctoral research as it differentiates the study from a Masters research program and enables the candidate to eventually emerge as a qualified researcher. The following questions relate to new knowledge and probably underpin a large amount of doctoral research activity and subsequently, permit the development of research questions:

- 1 What new knowledge is this research trying to uncover?
- 2 Why is it important to discover this new knowledge?
- 3 How will this new knowledge be discovered?

Research Aims

As discussed, understanding how new knowledge influences research is important, and for successful doctoral research it is essential. The candidate can develop a picture of the intended study by examining their research in the terminology of a generic Research Aims process (see below), it is then possible to identify where the development of new knowledge is likely to occur. The table below has been developed to cater for design research and is appropriate for Traditional or Formal Research and in some cases is an appropriate model for practice-based research.

Table 4 Research Aims

Aim 1	Identify a research area
Aim 2	Perform a problem identification stage for the research area as problems and related issues are identified from a thorough literature review
Aim 3	Develop an appropriate research methodology framework in which to identify and propose functionality for the problem/issues identified in point 2
Aim 4	In response to point 3, develop and construct a range of design responses for the purpose of generating qualitative and imperial data through comparative testing.
Aim 5	To summarize the results of the investigation and propose recommendations for future research

Existing Research Methodology

Design research can employ and integrate with current research theory by adapting existing research methodologies and methods. This can be seen in the following table.

Table 5 Examples of Research Methodologies and Methods (Babbie 2002).

Methodology	Method
Experimental research	Experimental Phenomenography (Usability trials method, Computer modelling/simulation method)
Survey research	Subject to particular research
Field research	Ethnomethodology, Grounded theory, Ethnography, Action research, Participatory action research, Phenomenological research (Naturalistic Phenomenography, Discursive Phenomenography), Heuristic inquiry, Discourse research
Unobtrusive research	Content research, Existing data research (Hermeneutic Phenomenography), Historical/Comparative research
Evaluation research	Subject to particular research

Design researchers can deploy existing research methodology/methods to generate new data for example; Field Research is an appropriate methodology classification for data generation methods that survey and question consumers and/or specific study groups.

We can now begin to identify methodologies that are design specific, and that can be termed design methodologies. User Centred Design is a good example of a research methodology that is design specific and the manner in which the research is implemented would constitute design methods. For example, User Centred Design is effectively Experimental Research, and conducting a user trial would then effectively be the design method. This leads to the idea of Evidence Based Design as in one sense the Design Process could be viewed as a design methodology with the approach or approaches used to achieve the design solution representing the design methods.

Evidence Based Design (EBD)

In this final section the concept of Evidence Based Design is introduced. The term is taken from medical science 'Evidence Based Medicine' where medical practitioners have to prove that what they are doing (diagnosis and treatment) works by recording and monitoring patient progress and recovery.

Design is obviously not confronting the same issues, however the concept of describing and justifying design research methodologies and methods is relevant to design research. EBD identifies design methodologies that facilitate a variety of design methods that are important to resolving and testing design problems in order to substantiate and verify the design solution.

EBD incorporates three design theoretical perspectives or methodology divisions; the user, the product and the market which are described as User Centred Design, Product Analysis and Market analysis. EBD utilities these design perspectives to analyze research problems in terms of identifying ways, means or approaches to the problem that will involve the development and analysis of new data, which importantly, can be viewed as new knowledge.

The table below is based on the assumption the design is fundamentally a constructionism epistemology where 'all knowledge (meaningful reality) is constructed by humans via their interactions with each other and the world, and developed and transmitted within an essential social context' (Crotty, 1998). In this context the terms User Centred Design, Product Analysis and Market analysis could be seen as Theoretical Perspectives however

the distinctions are not important. The table includes proposed design methodologies and methods and examples of the forms of data that could be expected from the specific methods. The methodologies and the methods identified in the table are not described in this paper.

Table 6 Evidence Based Design

Product Analysis

Methodology	Method	Data Expectation
Value Engineering	Primary/secondary function	Project Documentation
Use Analysis	Functional analysis Pragmatic, Syntactic, Semantic	Project Documentation
Structural Analysis	How is it made?	Project Documentation
Bionic/Biomimicry	Study of natural models	Project Documentation
CPE Analysis	Design evaluation Design judgement	Survey Data
Design Ecology	Design and sustainability Green Design	Project Documentation
Many more examples...		

User Analysis

Methodology	Method	Data Expectation
User Centred Design	Ergonomics	Survey Data
	Principles of UC Design	Project Documentation
	Ethnography	Survey Data
	User Trials	Survey Data
Many more examples...		

Market Analysis

Methodology	Method	Data Expectation
Market Structure	Product Placement	Matrix Documentation
	Competitor Analysis	Matrix Documentation
Market Environment	Market Opportunity	Matrix Moodboards
	Environment Images	Moodboards
	Consumer Images	Moodboards
Consumer Evaluation	Survey / Sample groups	Survey Data
Many More examples...		

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