Social, environmental and ethical factors: their implications for design theory

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This paper is concerned with social, environmental and ethical matters and how they are incorporated into design theory.. The ways that social, environmental and ethical design factors need to be construed in an abstract theoretical manner is discussed. It is argued that the comprehensive inclusion of social, environmental and ethical factors into design theory necessitates a central focus on 'designing as a human activity' for both design theory and design research.

Introduction

This is a report on my research for a doctoral thesis at the University of Western Australia. Two contributions to knowledge were developed in this research;

- A new paradigm of engineering design theory which includes human values alongside existing functional, artefactual and informatic design theories.
- A critical review of existing engineering design theory from a meta-theoretical perspective.

These were the consequence of attempting to include social, environmental and ethical factors in engineering design theory in a more satisfactory manner.

The original plan was simple: firstly, pin down the theoretical characteristics of social, environmental and ethical factors and secondly, identify which engineering design theories could include them. It became apparent, however, that there were fundamental problems in engineering design theory and that many of them had a bearing on the area of interest. During this research some of these theoretical difficulties have been addressed and their resolution has become as significant as resolving the original research problem.

The research was based on the premise that social, environmental and ethical factors have not been satisfactorily included in theories of engineering design. Preliminary research pointed to the need for new theory and led to two research hypotheses. These are;

1. That existing paradigms of engineering design theory do not provide an adequate basis for the inclusion of social, environmental and ethical factors and human values.

2. The inclusion of social, environmental and ethical factors along with human values in engineering design theory can be achieved by;

   a. Finding an epistemologically appropriate basis for theorymaking about engineering design.

   b. Developing definitions of 'design' and 'design process' based on that epistemological perspective.

   c. Developing new taxonometric structures for the disciplines of Engineering Design and Research into Engineering Design.

The Problem

Superficially, the problem is one of adverse social and environmental consequences of the use of technology and the associated ethical difficulties. Engineering design theory is implicated in these problems because it is theory that influences designer education and because technology depends on designing for its existence.

There is sizeable literature on engineering design and design theory but the literature represents a diversity of opinion rather than the development of theoretical agreement. In the literature matters relating to mathematics, engineering or scientific principles about technology, specifications or artefact definition present few problems. The biggest difficulties lie in the area of theorymaking about designing. Terminologically, semantically, conceptually and theoretically there are problems with confusion, conflation, overgeneralisation and underjustification in the theorymaking about the activity of designing engineering artefacts. These problems have been apparent since the 1960s (Lewis, 1963; O'Doherty, 1963; Slann, 1963; Eder, 1981; Talukdar, Rehg & Elfes, 1988; Dixon, 1989; Pugh, 1990; Ullman, 1992; Hollins, 1994; Reich, 1994). Choice of research paradigm and imbalance in the program of research have been suggested as the reasons for them(Gregory, 1981; Hollins, 1994; Reich, 1994)

Theoretical Framework and Research Method

Social, environmental and ethical **factors** that are the focus of the research method. Society sees the consequences of technology. Designers, however, function cognitively and perceived potential social, environmental and ethical consequences act as influences on more or less partially completed potential 'futures' envisaged within a designer's mental 'design worlds'.

Human values have an important role in the internalised cognitive activities of designing. Positivism and its associated mechanistic and deterministic ontologies do not provide an adequate basis for research in this area. For this a post-positivist philosophy is needed. The theoretical perspective used needed to be able to cope with both analysing existing scientific design theories, and the interpreted constructed value laden 'worlds' of designers' cognitions.

Popper's theories offered a means of bridging the positivist/post-positivist gap and these were combined with the constructivist perspective of Guba which provided the theoretical means of addressing the constructed interpretative nature of design cognition—a similar combination to the 'practicism' which Reich discusses (Reich, 1994; Guba, 1990; Popper, 1976) A critical methodology was used—as advocated by Franz (1994) and Reich (1994)—alongside techniques of meta-theoretical analysis. The latter was used for deconstructing theoretical abstractions and deducing their relationships.

Analysis

The situation thus far; there has been a conflict between the theories, models and methods of engineering design which are predominantly quantitative in nature and based on a positivist philosophy , and the intrinsic qualitative, phenomenological nature of social, environmental and ethical matters in designing.

When the English language literature on engineering design (1962 to 1995) was reviewed two points became clear. Firstly, there were almost as many definitions of design and design process as there were design theorists; secondly, there is a strong linkage between, on one hand, the subject domain and culture of the author and, on the other, the author's definitions and theory . Critical analysis was used to identify the underlying philosophical positions implicit in different theorists definitions of design and design process and six different sorts of engineering design theory were identified. All six lay within the positivist, scientific paradigm of theorymaking. None offered a satisfactory means of incorporating social, environmental and ethical factors.

A taxonometric method of meta-level abstraction analysis was developed to assist with the detailed analysis of terms, concepts and theories—it provided a basis for deconstructing the semantics of theoretical entities at different levels of abstraction. There were two outcome of the use of the method: firstly, it brought out the importance of disciplinary structure in providing contextual semantic support for terminology, conceptualisation

and analysis; secondly, it indicated that of the definitions of design or design process reviewed non offered an epistemologically satisfactory basis for new theory.

It was concluded that;

- Social, environmental and ethical issues are fundamentally qualitative in nature
- Engineering design theory is confused, with no theories either paramount or, at first inspection, comporting well with wider aspects of human knowledge.
- No theory of engineering design competently addresses the fact that designing is a human activity and takes account of human values and assumptions.
- Disciplinary structure is important for providing contextual support in resolving semantic and conceptual ambiguities.
- New definitions of 'design' and 'design process' are needed that epistemologically reflect the human aspects of designing and design cognition.

Building New Theory

The new design theory must have several other characteristics besides accommodating social, environmental and ethical factors. These are,

- Ontological and epistemological necessity
- Improving the ways that design theory fits with knowledge in other related disciplines
- The resolution of many of the contradictions inherent in existing design theories
- Providing a complete and coherent structure for design theory making
- The establishment of clear boundaries to the discipline of engineering design theory

These were added to the more particular aspects of the new theory that have been identified earlier,

- Design is an activity performed by humans
- Internally, human designers function qualitatively rather than quantitatively

- Most activities previously included in 'design process' are associated activities (necessary supporting activities like sweeping the floor, but not essentially relevant) and thus may be dealt with separately.
- Human values and assumptions are foundation for the activity of designing and considering social, environmental and ethical issues.
- 'Feeling' is one of the mechanisms of design cognition.
- Design is experiential (experiential is here used in a wide sense as to also include cerebral or theoretical experiencing).
- The quantitative data used in design is intimately bound with human values and assumptions and this must be acknowledged. That is, new design theory must reflect the demise of the fact-value dichotomy.

From these criteria came a definition of 'design' as 'an intentional experientially based activity'

The traditional view of the engineering designer was a Romantic one—the designer as creative genius. Systematic engineering design replaced that view with the idea of designing as a scientific systematic process. The systematic perspective evolved into a view of design as 'transformation of information'. Combining the idea of designing as an internal subjective activity with information processing as an objectively observable external activity suggests the following definition of design process

Design process = design + information process + other activities

Applying Popper's three 'worlds' model of objects, subjectivity and theory to design theory shows the distinction between design theory pertaining to the subjective internal activities of designers and the externally observable aspects of design process. Thus, theory can be seen in three different ways,

- As theory qua theory.
- Theory as a provider of objective data.
- Theory as a human internalised influence.

Confusion between these three aspects of theory can be avoided by the use of meta-level abstraction analysis.

Many engineering theories (e.g. stress analysis of beams) have two sides to them. On the one hand their role is to provide information—data which

designers use whilst designing—they are part of the external information process. On the other hand, such theories, if internalised and integrated into a designers being, contribute directly to the designers creative skills. That is, the internalisation of relevant theory improves a designers ability to use feeling to direct the cognitive and conscious activities in designing.

These issues are relevant in developing a coherent structure for the discipline of design—deciding what is within and what is outside the ambit of engineering design theory. A simple test is to try to decide whether a particular topic or activity is better considered in some other discipline. Where an activity is already well researched elsewhere it is necessary to try to ascertain whether the same activity used in designing is fundamentally different. Removing these elements of disciplinary structure brings the focus back to designing. What is left is a discipline of design in which the human act and the human consequences of design are central.

Summary

What I am left with is;

- Design theory in which many ancillary activities previously considered to be part of design are relocated back to their original fields of study.
- Theory whose ontological basis is that of designing as an intrinsically human activity (like thinking or feeling)
- The location of 'intelligence in design' in humans rather than in external processes or objects
- A theory which is validated as theory by its coherence with other theory
- A theory which is based on the internalised management of information being qualitative in nature
- A theory which is based on postpositivist epistemologies
- The intrinsic inseparability of human values, assumptions and biases from the activity of designing.
- A two sided view of design process as both an essentially subjective internal activity and an observable, objectifiable external process.

The gains of the new theory are that it,

- Provides a more coherent and justifiable description of the activity of designing
- Establishes a more rigorous basis for the development of design theories, methods, techniques and aids
- Satisfies criteria for theory development drawn from the principles of Philosophy of Knowledge
- Includes the justifiable knowledge embedded in previous engineering design theory
- Provides a theoretical basis for the development of design practices in which social, environmental and ethical issues may be included in creative design activities.

What remains unresolved?

The above theory is not complete. Its development is based on the resolution of theoretical inconsistencies incorporated within previous theories. Studies of the ontological and epistemological bases of post positivist paradigms indicate that other hermeneutic, phenomenological or constructivist paradigms may eventually supplant the Popperian paradigm used in this thesis. In justification, the Popperian paradigm provides the language, techniques and concepts to refute aspects of existing engineering design theories and to develop new coherent and well justifiable theory which permits the inclusion of factors previously excluded by positivistic or scientistic limitations. As other post positivist paradigms become better developed, it is to be hoped that they also will be applied to engineering design theory to develop its descriptions of the activity of designing still further and guide the development of more effective methods, techniques and aids for designers.

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