Title: A Meta-Theoretical Basis for Design Theory

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Abstract

Conceptually and terminologically, design research and design theory is problematic. A neglect of the foundations of design theory has led to terms, concepts and theories being used in a variety of different and inconsistent ways. The ensuring terminological and theoretical confusion is now well embedded in the last thirty or so years of literature on design research. This paper describes an epistemologically well-justified meta-theoretical structure that provides a means to build coherent design theory, and to clarify existing theories and concepts. It offers the basis for building a Philosophy of Design to support high-quality research, theory making, analysis, education, and practice relating to designing. The paper concludes by drawing attention to new issues that emerge as a result of meta-theoretical analysis of the structure and dynamic of the abstractions that underpin design research.

Introduction

Conceptually and terminologically, the literature and traditions of design research are problematic in that concepts, terminology, theories, data, and research conclusions are ill-defined, and are often confused, conflated and confabulated (Hubka & Eder, 1988; Pugh, 1990; Roozenburg, 1992; Talukdar, Rehg, & Elfes, 1988; Ullman, 1992). These problems stem mainly from a lack of attention to the underlying theoretical assumptions. In Hamlyn's (1990) terms, the epistemological and ontological foundations of design research need "thickening" to allow the concepts, terminology and theories of design research to be "thinned" to the extent that they have singular meanings. Addressing these problems via existing design terminology is compromised by its inconsistency, and attempting to redefine the terminology by reference to design theory is made difficult by a lack of coherence between design theories themselves. The problem can, however, be resolved by clarifying *both* theory and terminology together through a meta-theoretical analysis (Indurkhya, 1992; Rosen, 1980; Smith, 1990; Stegmüller, 1976). This meta-theoretical approach is further facilitated by the removal of those issues that are more properly problems of other domains (Konda, Monarch, Sargent, & Subrahmanian, 1992; Love, 1999).

The meta-theoretical approach proposed here focuses on building design theory from coherent epistemological and ontological foundations. It is a pragmatic pursuit aimed at finding a solution to a problem, albeit an abstract one, rather than identifying 'truth'. This approach aligns with that of Argyris (1980)on rigorous research, Feyerabend (1975) on research methodology, Flood (1990) on systems research, Giddens (1987) on social research, and Guba (1990) on paradigmic analysis and post-positivist research. It fits well with those who see research as a complex of different fields, and those who regard cognitive constructs in terms of their utility (see, for example, Coyne, 1990; Daley, 1982; Enc & Adams, 1992; Hoover, Rinderle, & Finger, 1991; Konda et al., 1992; Robinson, 1986; Rowan & Reason, 1981; Rowan & Reason, 1981). It conflicts, however, with the positivist perspective used in much of the literature of design research, and with researchers who have argued against positivism but wish to replace it with a single post-positivist paradigm (see, for example, Coyne & Snodgrass, 1993).

The domination of positivism has lead to human issues being poorly addressed in design research (Coyne & Snodgrass, 1993; Dilnot, 1982; Love, 1998). These human issues include creativity and, especially, human values (Heath, 1993; Lawson, 1993; Love, 1998). The important role of human values in design research is evident in many ways. For example:

- Human values are a necessary aspect of explaining cognition.

- Human values underpin explanations of the socio-cultural aspects of designing.

- Designing is socially, environmentally, and ethically situated. That is, designing and designs are meaningless without regard to these factors, each of which is imbued with human values.

Meta-theoretical analysis of design theory is unlikely to be satisfactory unless it includes the role of human values in shaping the ontological and epistemological foundations of design theory.

The foundational approach proposed in this paper echoes recent changes in the systems disciplines (Flood, 1995). During the last decade or so, systems researchers have looked to post-positivist and constructivist approaches as providing more appropriate foundations for systems theory because the earlier focus on positivism had led to problems of philosophical justification, lack of theoretical integrity and poor practical applicability (Ellis, 1995; Flood, 1995; Flood, 1990; Flood & Carson, 1988; Flood & Jackson, 1991; Hutchinson, 1997). This suggests that similar changes to the theoretical and philosophical foundations of design theory are indicated because of its close relationships with systems theory (Holt, Radcliffe, & Schoorl, 1985; Love, 1995).

Ontology and epistemology

All terminology, concepts and theories are *abstract* human cognitive constructs in the sense that they are particular aspects of reality abstracted, and symbolically represented in the realm of theory, on the basis of particular sets of assumptions and human values. Concepts and theories are abstract elements, philosophically-defined building blocks, that can be shaped, defined, and arranged together to form coherent theoretical structures.

Using and structuring abstractions in this way goes back at least to the earliest Greek philosophers, but the academic world has been divided in its interest in these abstract foundations of theory-making. In subjects such as Anthropology and Sociology, whose theoretical foundations are not amenable to Cartesian validation, the development and justification of concepts and theories is a significant issue that is widely addressed (see, for example, the Grounded Theory of Glaser and Strauss (Glaser & Strauss, 1973), and the Action Science of Agyris (1980)) (see, also, Berger, 1980; Guba, 1990; Illich, 1978; Mohr, 1988; Shipman, 1981). In contrast, attention to the ontological and epistemological foundations of theory-making has remained rare in disciplines such as design that have been dominated by positivism (Giddens, 1987; Guba, 1990). In disciplines requiring that the ontological, epistemological and methodological assumptions that underpin research be made explicit, researchers are required to identify and justify the theoretical framework that they have used, and make clear in their theses the ontological, epistemological, and methodological assumptions that have been used. This contrasts with the neglect of ontological and epistemological considerations common in the natural sciences where the meanings of concepts, terminology and theories are more clearly established.

Working from epistemology and ontology towards clarifying design theory and terminology is straightforward compared to the alternatives because:

- It is relatively independent of the 'correctness' of meanings of design terminology.

- It is not sensitive to faults of description, argument or theorisation in existing theories because it is a parallel theoretical structure grounded on coherent foundations.

- An ontological and epistemological focus provides, at an early stage, a structure against which different aspects of the existing literature can be compared and contrasted. It enables terminology and theory to be built on elements of knowledge and theory which are already accepted as well-justified.

- Starting with the ontology and epistemology of design theory allows a shift of focus from ‘designed artefact’ to ‘the activity of designing’, which then is able to include human characteristics and values.

Meta-theoretical Analysis

A meta-theoretical perspective clarifies design research and theory-making through investigating the structure, dynamics, validity, coherence and appropriateness of the interrelated abstract entities that make up design theory (see, for example, Popper, 1976; Rosen, 1980; Stegmüller, 1976). The meta-theoretical approach changes the focus of theory clarification from "What does 'X' mean?" to "What meaning should be allocated to 'X'?”.

Meta-theoretically, theoretical elements (such as concepts, theories and terms) relate to other theoretical elements both hierarchically and in parallel at similar levels of abstraction. The hierarchical relationships define the internal validity and correctness of theoretical developments. The parallel relationships validate theories in terms of other issues. This combined hierarchical and lateral approach to the validation of theory comports well with arguments that all theory is unprovable in isolation and depends upon a wider theoretical ecology that it both supports and is supported by (see, for example, Guba, 1990; Murray, 1986; Phillips, 1987; Phillips, 1990; Popper, 1976; Reason & Rowan, 1981; Rosen, 1980; Smith, 1990; Stegmüller, 1976). For mathematically-expressed theories, the resolution into hierarchical theoretical structures is a trivial problem. For other theories, such as design theories, the appropriate relationships are not necessarily self-evident, and some form of meta-theoretical hierarchical structure is needed to assist with decomposition. Such a hierarchical structure is described below.

Meta-theoretical hierarchical structure to clarify Design Theory

The meta theoretical structure described below grounded in the layered model of research methodology of Reich, the taxonomy of design theory developed by Franz , and Popper’s classification of forms of knowledge (Franz, 1994; Popper, 1976; 1994; Reich, 1994). A more detailed version of the arguments leading to this model can be found in Love (Love, 1998).

Reich separated the underlying factors that define research into:

- 'World views'

- Research heuristics

- Specific issues

These combined with Franz' taxonomy result in the following basic hierarchy of design theory:

Philosophical issues
General theories of design
Theories about design cognition
Theories about object behaviour

The above categories are still too coarse, however, for detailed critical analysis particularly at the lower levels where most differentiation is needed - especially as most existing theory lies there. Popper's model separates:

- Theory as individual cognition (subjective world)

- Theory written down (objective world)

- Theory *qua* theory (theoretical world)

This implies that an additional level is needed to include the human ability to objectivise internal subjective realities, so that the theoretically-primitive aspects of human action relating to identifying objects and circumstances, and creating initial concepts can be included. This addition is important because it takes into account that anything given a name or conceived as an entity can be theorised about. Together these lead to the more comprehensive version of the meta-theoretical hierarchy.

Level	Classification	Description
1	**Ontology of design**	The ontological basis for design theory. It includes human values the fundamental assumptions and beliefs of researchers, designer others implicated in designing.
2	**Epistemology of design theory**	The nature, grounds, limits and criteria for validity of design theo and knowledge.
3	**General design theories**	Theories aiming to describe the act of designing and its relationsh to designed objects and the environment.
4	**Theories about the internal processes of designers and collaboration**	Theories about internal functioning of designers, of negotiated de in collaborative design teams, and of socio-cultural effects on designers' output.
5	**Theories about the structure of design process**	Theories about the underlying structure of processes that include designing based on domain, culture, artefact type and other attrib and circumstances.
6	**Design methods**	Theoretical representations of design methods and techniques.
7	**Theories about mechanisms of choice**	Theories about how choices are made between different theoretic elements including; designed objects, processes, and systems.
8	**Theories about the behaviour of elements**	Theoretical descriptions of the behaviour of elements, designed objects, processes and systems, e.g. 'the camshaft rotates at 600 rads/sec'.
9	**Initial conception and labeling of reality**	The transformation of experiences into informatic/theoretical representations of objects, processes and systems. For example th representation processes resulting in; ' a rose', 'a sketch', 'sitting' 'desk', 'hearing' 'noise', 'smelling' an 'exhaust', and 'watching' 'sunsets'.

This meta-theoretical approach does not presume a coherent design 'super-theory' in the manner of, for example, geometry. Theories at large, small and middle scales do not necessarily follow logically from each other, but only relate to and depend on other theories, concepts and assumptions at other levels as described by Giddens (1987). Design theory is viewed as a chain of abstractions with one end grounded in the concreteness of reality, and, the other shaped by the assumptions and beliefs that humans make about existence and reality. At the lowest level of abstraction is the translation and reduction of sensual perception of reality into informatically-defined abstractions by the naming of phenomena - the first level of abstract cerebral processing. The highest level relates to human ontological or religious beliefs about existence. Between these two bounds—the conceptualisation of direct perceptions of 'reality' and beliefs about 'what is fundamental

about existence'—are the layers of theoretical and everyday abstractions which are the stock in trade of communication and reflection in occupations such as journalism, art, technology and design.

The above meta-theoretical hierarchy provides:

- A taxonomy for classifying theoretical aspects of design research.

- A hierarchy for clarifying the meta-theoretical relationships between design theories.

The above meta-theoretical approach categorises theories according to their relationships as *theoretical abstractions*, rather than focusing primarily on their *content* or *meaning*. The hierarchy separates and orders different aspects of design theory so, for example, theories relating to mechanisms of choice in level 7 are concerned with the selection of particular design elements whose *behaviours* are described in the theories and concepts of level 8, and which are, in turn, based on *empirical experience raised as concepts* in level 9. These theories about mechanisms of choice also depend, consciously or unconsciously, on privileged *assumptions and beliefs* at higher orders of abstraction contained in levels 1 to 6. For example, assumptions about design method and process, about what designing is, or more abstractly still, about what the world is. Different fields of design have a different balance at each level in the hierarchy. In all fields, however, hierarchical relationships exist between theories and concepts at all levels, *whether or not they have yet been identified*.

The advantages of using the above meta-theoretical hierarchy for the critical analysis of design theories include the following:

- Any design theory or concept can be evaluated, as an abstraction, in terms of its relationships with other well-justified abstractions at all levels.

- When a new concept is proposed at any level, the hierarchy assists with identifying whether new terminology is needed to distinguish the new concept from other concepts at the same or different levels of abstraction.

- Where new theories and concepts are proposed at any level, the necessary associated abstractions can be identified for all other levels.

- The meta-theoretical hierarchy provides a means of testing whether general theories of design are complete and contain a coherent set of well justified abstractions at all levels.

Conclusion

A meta-theoretical hierarchy has been described that offers the means for building coherent design theory and resolving many of the problems of existing theory and terminology.

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