Nov 17th, 12:00 AM

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Towards a domain-specific ontology.

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The title of this paper implies a repositioning of the notion of 'design know how' as tacit knowledge developed through practical experience into a questioning of the identity and being of design. This is not to valorise one form of knowing (through practice) over another (through cognition) but in recognition of the problematic of the definition of design.

This paper addresses a number of issues that underpin my current research – the development of a dynamic, domain specific, material, ontological framework for design. This research has come from a practical involvement with 'design problems' arising from the management of 'design knowledge' in developing digital resources for design education and research.

Debates about the definition of design, both as a discipline and an activity, are ongoing. As a formalized knowledge domain 'design still remains invisible, dispersed within other typologies' (Poggenpohl, 1998).The very term design is both ubiquitous and ambiguous – any definition will depend on whether it is considered to be an idea, a knowledge, a project, a genre, a process, a product or even a way of being.

This complexity has led many designers and theorists to yearn for simpler models. Attempts to find widespread agreement on a singular definition of design have proved impossible. It has been suggested a more useful approach to strengthening disciplinary identity would be to 'navigate among the different ways of reflecting on design' to 'bring them into relation with each other – as we seek… systemic integration' (Buchanan, Doordan & Margolin, 1988).

In scientific and linguistic disciplines, new research approaches and questions have developed through the use of computational systems. But within the so called creative industries little consideration has been given to ways digitization might affect cultural epistemologies or facilitate new disciplinary perspectives or research frameworks. The development of computational ontology, defined as a method of 'structuring and codifying knowledge about the concepts, relationships, and axioms/constraints pertaining to a specific discipline or domain in a computational format' offers some new and relevant approaches to the 'problem' of design, and its classification as a disciplinary identity.

The convergence of philosophical and computational ontology has led to a shift from a focus on the classification of entities in scientific fields into domains of practical activity. Such emergent frameworks are not just academic, but seek to provide a disciplinary specific system that can be utilized by the computer to aid the performance of tasks within a domain.

The lack of definition within the discipline of design may not be a negative attribute. Within the context of technological convergence, design is situated in an interdisciplinary position and may be better located to enable innovative solutions towards the identification and articulation of ontological issues of culture and computing than more rigidly defined, traditional disciplines. More significantly, any contribution to the articulation and ongoing formulation of design's ontological identity is vital to a deeper understanding of relationality and design.

Design How-to-Know: Towards a domain-specific ontology

The title of this paper implies a repositioning of the notion of 'design know how' as tacit knowledge developed through practical experience into a questioning of the identity and being of design. This is not to valorise one form of knowing (through practice) over another (through cognition), but to imply a certain fuzziness about the definition, purpose and meaning of design. While this paper addresses issues of design, ontology and computation in relation to certain philosophical and theoretical positions, it is important to emphasise that my engagement comes from a practical involvement and concern with 'design problems' arising from the development of digital resources for design education and research. I make this point to locate this paper and my project as being reflexive, in keeping with the notion that design must redesign both its discourse and itself'[1].

The New Zealand Digital Archive of Design (NZDAD) was established in 1999 to identify and document material and publish new research about New Zealand design history. The impetus for this project was to provide better resources for postgraduate design students in the Auckland University of Technology's newly established Masters and Doctoral programmes, to mentor interested staff in design research and generate publication about New Zealand design history, building on the strength of the school's reputation for design education. While the decision to set up the archive as a digital resource was pragmatic, the development and implementation of this system has fostered new lines of research enquiry, experimentation and publication that have shifted my own research focus from the collection of historical material to considerations of the potential of database and interface to enable multiple interpretative pathways, to the development of dynamic content-contribution systems and on the need for (and potential applications) of ontological modelling specific to the domain of design.

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[1] Klaus Krippendorff, 'Propositions for human-centeredness: A philosophy for design' Durling< D. and Friedman, K. eds *Doctoral Education in Design: Foundations for the Future*, Staffordshire University Press,Staffordshire,2000 p 56

Technological convergence has produced some at times unexpected inter-disciplinary relationships. For example the conjunction of philosophy (with ontology as metaphysics or the study of being) and of computer and information science (with computational ontology as 'a software (or formal language) artefact designed with a specific set of uses and computational environments in mind....something that is ordered by a specific client in a specific context and in relation to specific practical needs and resources')[2] may seem a miss-match of the esoteric and the pragmatic. There is, however, a growing recognition that information systems ontology is a continuation of traditional or philosophical ontology by other problems.[3]

Many of the problems faced by information systems ontologists are analogues of problems dealt with by philosophers in the 2000 year history of traditional ontology – problems pertaining to identity, to universals and particulars, to actuality and possibility – as well as the problem of realism and idealism, or in other words the problem of the relationship between our representations of reality and this reality itself.[4]

The convergence of philosophical and computational ontology has led to a shift from a focus on the classification of entities in scientific fields into domains of practical activity (such as law, medicine, engineering, commerce). Such emergent frameworks are not just academic, but seek to provide disciplinary specific systems that can be 'manipulated and utilized by the computer to aid human and machine agents in their performance of tasks within the domain'[5].

The development of computational ontology, defined as a method of 'structuring and codifying knowledge about the concepts, relationships, and

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[2] Barry Smith *Ontology and Information Systems*
http://ontology.buffalo.edu/smith/articles/ontologies.htm p.22
[3] ibid p 78
[4] ibid p 76
[5] Rajiv Kishore and R. Ramesh, *Introduction*, Call for papers, Special Issue on Ontologies in the Context of Information Systems,2003.
http://www.mgt.buffalo.edu/jais_special_issue_on_ontologies/CFP-JAIS-09052003.shtml.

Axioms/constraints pertaining to a specific discipline or domain in a computational format[6] offers some new and relevant approaches to the 'problem' of design, and its disciplinary identity.

Lev Manovich's analysis of the genealogy of new media[7] - from an underlying techno–logical initiative, mediated through old industrial media genres into new media forms (in particular of database and interface) - has some parallels with the genealogy, the changing contexts and the resulting problematic of design and its history, which has evolved as a discipline over the same period. This suggests that the classification and plotting of the 'kinds and structures of the objects, properties and relations' in the area of design via computation could be a fruitful arena of research.

There has been an ongoing and at times vociferous debate about the nature and meaning of design, both as a discipline and an activity. In recent years, with the development of university based design research, postgraduate studies in design and a correspondent burgeoning of design conferences and specialist academic publications, this discourse has expanded to include a number of meta-theoretical and taxonomic propositions[8]. Yet as a formalized knowledge domain, design remains invisible, dispersed within other typologies:

'There is no database and/or Library of Congress (LC) classification: Design. Design literature resources are organized under databases of related fields such as architecture, psychology, business and economics, marketing, humanities and engineering. For example the sub-category 'industrial design'

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[6] Barry Smith *Ontology and information Systems* http://ontology.buffalo.edu/smith//articles/ontologies.htm 2001. p1
[7] Lev Manovich, *The Language of New Media*, (Cambridge, Massachusetts, The MIT Press, 2001)
[8] See for example, Terrence Love, Philosophy for design: A meta-theoretical structure for design theory, Design Studies 21,2000 or Ken Friedman, Design knowledge: context, content and continuity 2000, from the proceedings of the Conference Doctoral Education in Design: Foundations for the Future S.U.Press , 2000

is organized under the LC classification of 'technology' while graphic design is under 'art'.[9].

The very term 'design' is both ubiquitous and ambiguous. Any definition of design will depend on whether it is considered to be an idea, a knowledge, a project, a genre, an art, a process, a product or even a way of being. This complexity has led many designers and theorists to yearn for simpler models. Attempts to find widespread agreement on a singular definition of design have proved impossible - Tony Fry's definition of design history as 'various and competing explanatory models of design'[10] gives some indication that this contestation has been an ongoing and stimulating aspect of emergent design discourse.

It has been suggested a more useful approach to strengthening disciplinary identity would be to 'navigate among the different ways of reflecting on design' to 'bring them into relation with each other'.[11] The language used in this proposition, with terms like 'navigation' and 'relation' hints at computational solutions.

In scientific and linguistic disciplines, new research approaches and questions have developed through the use of computational systems[12]. Digital theorist Lev Manovich[13] has claimed that database is the key symbolic form of cultural expression of the computer age and that the computer's ability to automatically classify, index, link, search and instantly retrieve data might lead to the development of new kinds of narratives and ontological frameworks. But within the so called creative industries little consideration has been given

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[9] Praima Chayutsahakij, in 'Overview', *Visible Languages, Special Issue: An Annotated Design Research Bibliography; by and for the design community*, 2002 Volume 36 number 2 p.7. 2002

[10]Tony Fry, 'Geography of Power: Design History and Marginality' in Margolin, V & Buchanan, R. ed *Design Issues*: Vol.VI, Number 1, Fall 1989, p.15.

[11] Buchanan, R., Doordan, D. & Margolin, V. (1988) Editorial, *Design Issues*, 14 (1) spring.

[12] For example the use of GIS in geospatial research, or XML in linguistic analysis.

[13] Lev Manovich, *The Language of New Media*, (Cambridge, Massachusetts, The MIT Press, 2001) p.

to ways digitization might affect cultural epistemologies or facilitate new disciplinary perspectives. [14]

Most cultural heritage, image based, digital resource creation has been institutionally based and mimetic in that it has used the typologies and material from existing gallery, library or museum collections presented via digital versions that paralleled more traditional media of access and display (e.g. the virtual gallery, the online catalogue etc).

Scholarship in the areas of collection and museum studies confirms that collections are never neutral groupings of objects and that collectors are motivated by more than just pragmatics – collections are 'ways in which people make sense of the world by bringing elements together… through the accumulation and juxtaposition of material things'.[15]

Susan Stewart has noted that 'the spatial whole of the collection supersedes the individual narratives that 'lie behind it'. She recognizes that identifying the principals of organization used in articulating collections will help identify what the collection is about. 'It is not sufficient to say that the collection is organized according to time, space, or internal qualities of the objects themselves, for each of these parameters is divided in dialectic of inside and outside, public and private, meaning and exchange value.'[16]

Our experience and understanding of designed artifacts (and of design itself) comes not from museum collections but from the realm of the everyday - the

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[14] Some interesting questions regarding discipline specificity, image collections and digitization have been raised by art historians. The study of art history is based on the study of material artifacts. The identification, justification and presentation of these artifacts formed the canon of art history and the basis of its subsequent challenges and rewritings. To enable the analysis and explication of images, art history has long relied on techniques of image reproduction, and there are several pre-digital instances whereby the forms of such image technologies have influenced methodologies of analysis and pedagogy to the extent that they have become orthodoxies, intrinsic parts of the culture of art history. An example of this is the use of 'binary' image projections introduced by German art historian Heinrich Grimm, and popularized by Heinrich Wolfflin in the 1880's which over time became the dominant method used in the teaching of art history and the presentation of scholarship as the 'two carousel' slide lecture.

[15] Susan Pearce and Kenneth Arnold, The Collectors Voice (Aldershot; Ashgate Publishing Ltd, 2002).

[16] Susan Stewart, On Longing (Durham, Duke University Press.1993) p.152 – 153.

real world. Collections in design museums have tended to centre on 'celebrated products or the output of specific designers whose work is seen to embrace high standards of aesthetic distinction or cultural status."[17]. The motivations and parallels with art collections and art museums are very evident in such institutions[18]. In his recent book – a scathing critique of design - titled 'Design and Crime'[19], Hal Foster has written about the 'archival relations' existing between art practice, art museum and art history. He identifies patterns of interpretation and key moments in this relationship that shift between a dialectical notions of art as totality to that of art as fragment. [20]

Foster goes on to ask whether we might now be at another important juncture, and whether there might be another archival relation, another 'moment in this dialectics of seeing', enabled by electronic information. If so, he asks will it fracture tradition or 'permit the finding of ever more stylistic affinities, the fostering of ever more artistic values'. He wonders if this underlying historical dialectic (of the fragment and the whole) might become outdated and irrelevant in this new context and asks an important question: 'What cultural epistemology might a digital reordering underwrite for art practice, art museum and art history alike?'[21]

In light of the development of online galleries, virtual museums, the 'crises' in art history and emergent new media art practices this is a fascinating and still largely unanswered question. However, in the contexts of hyper-consumption, ecological crises and the knowledge economy it may be more provocative to reword this question, to inquire: What cultural epistemology might a digital reordering underwrite for design research, design collection and design history?

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[17] Jonathan Woodham, Twentieth Century Design, OUP, Oxford 1997 p154-159.

[18] Conran's Design Museum at Butlers Wharf, London is an example.

[19] A play on Adolf Loos famous essay and critique of ornamentation, *Ornament and Crime*, 1908

[20] Hal Foster, Design and Crime (and other diatribes), (London, Verso Books, 2002) p.65 - 82. Foster contrasts three historic sets of relationships between art history and collections (that of Baudelaire and Manet in the mid nineteenth century, of Proust and Valery at the turn of the twentieth century, and of Panofsky and Benjamin on the eve of World War Two) and concludes that 'in different ways the first figure in each pair projects a totality of art, which the second figure reveals, consciously or not, to be made up of fragments alone.'

[21] Foster ibid

Jan Verwijnen has argued that while design research subjects must relate to the world of theory and knowledge (epistemology) they must, above all, be based on a statement of what the world is like (ontology)in order for us to have knowledge of it.[22] He recognises that there are two ontological perspectives; a conventional view which recognises that things exist in the material and natural world, that their material characteristics are what determines and constitutes them and that they have a clear meaning outside of how they are represented; and a perspective introduced more recently through human and social sciences, that suggests that meaning is produced or constructed rather than just found or implicit. Context is crucial to how and why particular meanings are given or read.

The often contradictory meanings and readings of objects in the everyday world and objects in museum collections are beginning to be interrogated and explored within the context of New Museology[23]and are exemplified in a number of ways including deconstructivist approaches to museum display.

Within the virtual world, the language and methodologies of emergent digital resource creation practices implicitly recognise certain layered ontological complexities of digital objects (for example in the identification of 'surrogate' levels as a sort of strata of representation within various metadata schema). Such enquiry is generally positioned in relation to existing physical collections that are being digitised and, perhaps more significantly, are based largely on taxonomies derived from art and architectural objects in collections.

A brief consideration of the Art Information Task Force's 'Categories for a Description of Works of Art' (CDWA)[24] reveals the groundwork that has been done in this area as well as the limitations of such taxonomies (derived as

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[22] Jan Verwijen Design and Existential meaning in Durling, D. and Friedman, K. Foundations `Doctoral Education in Design: Foundations for the Future. Staffordshire University, Stoke on Trent, 2000. p36

[23] See Peter Vergo, The New Museology, London, Reaktion Books, 1989

[24] www.getty.edu/research/institute/standards/**cdwa**/

they are from second order representations [25]and from a different disciplinary arena) to an ontology of design.

The CDWA provides guidelines for describing works of art, architecture, groups of objects, and visual and textual surrogates. Funded by the Getty Foundation and the National Endowment for the Humanities, they were produced in the early 1990s by a group made up of representatives from the communities that provide and use art information: art historians, museum curators and registrars, visual resource professionals, art librarians, information managers, and technical specialists

The CDWA categories were formulated for academic research or scholarly needs. Some of the project aims identify the organisation, interoperability and accessing of information as primary goals. These have relevance to most digital resource developments in seeking to:

-Articulate a conceptual framework for describing and accessing information about objects and images:

-Provide vocabulary resources and information about descriptive practices:

-Make information residing in diverse systems both more compatible and more accessible:

-Provide a framework to which existing art information systems can be mapped and upon which new systems can be developed.

Other CDWA project aims are more specifically related to museum practices and collection management:

-Ensure accountability for objects: they can be used to define the objects that are owned by a museum, identify the objects, and record their location.

-Aid the security of objects: they can be used to maintain information about the status of objects and provide descriptions and evidence of ownership in the event of theft.

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[25]By this I mean that a collection of works of art is in itself a particular and selected and 'representation' of art

-Provide an historic archive about objects: they can be used to maintain information about the production, collection, ownership and use of objects and as a means of protecting the long term value of data

Some of these aims are pragmatic, even democratic, in aspiring to provide better access and a greater level of accountability. Others stem from older notions of connoisseurship (provenance being a prime example) and belie a very different disciplinary history and set of concerns than those that might underpin the formation of a digital resource about design that could be accessed (and co-developed) by designers, design educators, researchers and students.

At the more detailed level of metadata elements, these issues are further highlighted. The CDWA uses a core category 'Subject', in which levels of representation can be identified and described:

(Image: St George and the dragon by J. E. Boehm, circa 1870)

In this image the subject can be identified in at least three ways: quite literally as man, a horse and a dragon; mythologically as a depiction of 'St George and the Dragon'; and as a symbol of England.
We would not describe the subject of this image as painting because the artefact itself is a painting, and according to CDWA this existential given would be listed in the field for 'Work' or 'Type of Work'. But if we consider how to describe the 'subject' of a work of design it becomes difficult:

(Image: Toshiba Rice Cooker, 1957)

In this instance, we can clearly identify what the 'subject' of the photograph is (a rice cooker) but this is the subject of the surrogate image (a photographic representation of an artefact) not of the artefact itself. If we are asked to identify the subject of the rice cooker what can we say? We begin to recognise an ontological conundrum where design objects cannot be read,

described or understood within the same epistemological framework as art objects. [26]

With the shift from pre industrial to industrial and to post- industrial contexts, our relationship with objects has changed. This change in meaning is related to how subjects experience objects. Verwijnen notes;

The subject is no longer 'above the world' in a hierarchical sense of subject/object relation with things in the world, but is now in the world, situated in the world 'among' objects. Subjects no longer know objects- they now experience them. As a consequence the designed object….comes to take on ontological structure – a structure of meaning that is not reduced to epistemological and utilitarian functions but that allows the object to be invested with affect, desire, care to be lived by and lived with'[27]

We also invest many objects with feelings of ennui, impatience, disregard, and the intensity and volatility of the changing meaning we place and derive from objects is a significant part of the mechanisms of hyper-consumption and the creation of waste.[28]

The notion of objects as social agents, extending human action and mediating meaning between human beings has redefined the way we read, produce and understand objects, and this relationship has redefined the social as well as the material context in which we live. Daniel Millar has noted that 'mass goods represent culture, not because they are there in the environment within which we operate, but because they are an integral part of that process of

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[26] For a specific example of issues related to creating metadata fields for a fashion history collection see Marcia Lei Zheng, Metadata Elements for Object description and representation, 1999 http://www.slis.kent.edu/~mzeng/OCLCreport/cover.html

[27] Jan Verwijnen, Design and existential meaning p.37

[28] See Tony Fry and Anne-Marie Willis, *Waste not Waste*, Sydney: EcoDesign Foundation, 1996

objectification by which we create ourselves as an industrial society: our identities, our social affiliations, our lived everyday practices.'[29]

This shift in the way we read and understand the meaning of artefacts and their effect by and on the context of their production and consumption implies a profound change in the ways we might begin to research, document and analyse them as design.

Given that most digital resource systems have been created for the documentation, access and retrieval of material from extant cultural heritage collections it is unsurprising that epistemologically such systems are based on the traditional taxonomies and display conventions of collections of unique, pre industrial artefacts. These systems are linked to the scholarly methods of their related disciplines.[30] If resources about and for design are to be useful and relevant their development (and re-design) will require ontological structures that are specific to design.

An ontology is not a taxonomy, a terminology or a list of objects, but a general framework within which catalogues, terminologies, taxonomies can be suitably organised [31] If we return for a moment to the digital image/ of the photograph/ of the rice cooker and begin to think more 'subjectively' about this object, what it has meant or might mean to me, to you, to someone else, we will come up with a rich interpretative (narrative) schema:

As an icon of early Japanese modernist design (it was one of the first recipients of the G mark an award for aesthetic excellence in design instituted in 1957 by the Design promotion Council of the Japanese Ministry of trade and Industry[32]) it represents both the emergence of post-war Japanese industrial design strength and the globalising tendencies of western

[29] Daniel Millar, Material Culture and Mass Consumption, Oxford, Blackwell, 1987 p.215

[30] The discipline of art history is very separate from the discipline of fine art practice and education, one developing from collecting and connoisseurship the other from artisan traditions and apprenticeships.

[31] Roberto Poli, Ontology for Knowledge Organization in R Green (ed) Knowledge, Organisation and Change, Indeks, Frankfurt, 1996 pp 313 - 319

[32] See Woodham, 1997, p 173

modernism. As a precursor of the success of the highly successful Japanese domestic appliance industry its significance lies in its being an appliance developed for non-western (local) consumers that has infiltrated many western homes with the shift to more globalized or fusion cooking styles, or in its being representative of the burgeoning growth that has occurred in the development of all sorts of specialist kitchen appliances that cook and chop and blend and mash and fry and perform all sorts of very particular tasks that were previously performed with knife, board, bowl, whisk, fire, pot, a certain dexterity, strength, patience and know-how. Ecologically it might serve a sign of redundancy. For the working woman it was/ and is, one of the most practical, time saving, make-a- complicated-task-easy modern inventions (a symbol of technological utility, a continuation of the sort of design developments that have helped revolutionise women's roles in the domestic sphere and the workplace). For many Asian people it is iconic, associated with the home in the way a kettle is for English people, becoming a symbol of place. It also assumes the status of an archetype, as an object that associates the ancient ritual of cooking rice (which has the same sort of symbolic significance to the east as bread – 'the staff of life' - has in the west) to a simpler, more convenient ritual of eating. The culturally specific methods of rice cooking that existed across different Asian cultures are forgotten and rice in the electric cooker becomes the standard Asian way of preparation.

All these – and many other narratives – of use, of association, of place, facture, embodiment, innovation, and value etc–are invested in/drawn from/ can be read through this object. Representing such a complex, interrelated web of knowledge requires a structure that is ontologically based in design, and a system that enables both a fluidity of informational relationships and the accumulation of data from a diversity of perspectives.

Lev Manovich's theories of database and interface suggest that historically in the west writing has been oriented in two directions (or two competing imaginations) - the narrative which creates a cause and effect trajectory of events and the encyclopaedia, which represents the world as a list of separate items.

He proposes a contemporary equivalence between database and encyclopaedia, interface and narrative and suggests that these two approaches drive different forms of computer culture: CD-ROMS, web sites and other new media objects organized as databases correspond to structure, that is, data organized for search and retrieval. Whereas narratives, including computer games, correspond to algorithm - which is a process, a final sequence of simple operations that a computer can execute to perform a given task. Manovich recognises that data structures and algorithms are complementary kinds of software objects which have a symbiotic relationship: 'The more complex the data structure of a computer programme the simpler the algorithm has to be and vice versa.'[33] In computer programming data structures and algorithms need one another – both are important for a programme to work. In relation to the NZDAD proposal we are working on developing software that will contain a richness of data within a taxonomic structure that is ontologically based in design, and through which various interpretative and associative pathways can be traced. As a dynamic system information can be contributed by stakeholders, users and researchers, checked and edited by the moderators, and posted, to build up a richness and diversity of metadata and analytical perspectives.

Within the context of technological convergence, design is situated in an interdisciplinary position and may be better located to enable innovative solutions towards the identification and articulation of such complex ontological issues of culture and computing than more rigidly defined, traditional disciplines. The process and project may in turn contribute to the debate and ongoing formulation of design's ontological identity.

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[33] Lev Manovich, *The Language of New Media*, (Cambridge, Massachusetts, The MIT Press, 2001) p223