

# A ROLE FOR INFORMATION ARCHITECTURE IN DESIGN EDUCATION: CONCEPTUALISING INDETERMINATE PROBLEMS IN DESIGN THINKING

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## Abstract

*When faced with complex problems that are situated in social reality many design students struggle to formulate meaningful and articulate responses to these problems. The cognitive skills required to solve complex problems are often learned only experientially. This paper argues for these latent, yet critical abilities, to be taught explicitly as part of a tertiary design education. This paper initially reviews the theoretical underpinnings of design thinking with a specific focus on the reciprocal relationship of the design problem and the subsequent solution. A range of the formative cognitive requirements needed to solve complex problems situated in broader society and within disciplinary practice are described in reference to the theoretical framework. In the subsequent sections of the essay, approaches to solving design problems are discussed particularly in reference to the theory of cyberdesign. In the concluding section of the paper the authors argue that the theory of cyberdesign may in a practical visual form be used as a tool for the development and representation of cognitive decisions while constructing meaningful design responses to complex problems.*

**Key Words:** *design cognition, complexity, social and institutional reality, cyberdesign, problem solving*

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## Conceptualising complexity in design education

This paper arises from our reflections gained over the last three years, teaching a user-experience design (UX) course to third- year interactive design students at the University of Johannesburg. During the UX course, students are presented with a problem that for the first time in their studies sits originates from outside their discipline of practice, in the broader world.<sup>1</sup> In our experience, design students when faced with high-level complexities of a problem framed outside the disciplinary practice are not sufficiently cognitively equipped to construct meaningful design solutions. These thinking skills that include problem analysis and framing as well as the construction and scope of reciprocal solutions are often only latently taught. Our contention, described in the remainder of this paper, is that design is foremost about the kind of activities listed above and as such the abilities required to assess and respond to complex problems should be an explicit aspect of design education.

Design thinking (DT) has come to be recognised as the umbrella term for systemic, transdisciplinary cognitive approaches to solving complex design problems empathetically, effectively and creatively. Design thinking as a field of academic study consists of a considerable body of work developed over the last forty years by a diverse range of scholars. However due to DT's ability to stimulate innovative problem solving, it has attracted considerable attention from the business world (Lockwood 2010: xii) over the last few years. Design companies such as IDEO have presented design thinking to the business world as a methodology that could be procedurally practiced (Nussbaum 2011 [o]). The result of this positioning is that DT is highly prominent as a creative approach to business strategy but, beyond sexy flowcharts and description of activities, steps and methodological structures, the details of the actual thinking skills required to practice DT are sketchy at best, hidden behind each design company's intellectual capital and professional know-how (see Figure 1).

Beyond the commoditisation of design thinking as an approach to innovative business practice, the Design thinking philosophy provides numerous approaches to conceptualising and responding to

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<sup>1</sup> An example of the kind of problem we are referring to would be our 2010 design problem: How can we as designers encourage customer usage of the Rea vava (BRT) transport system in Johannesburg?

complexity. In order to reclaim DT for the design world, we feel it is necessary to return to the academy in order to review a selection of the formative and contemporary theoretical accounts of DT that address the nature of the complexity facing practitioners in the field of design and begin to explicitly identify the enabling cognitive requirements needed to solve design problems that exist in complex systems. Complexity can be said to occur within a system when the system's elements and structures cannot be simulated nor easily predicated and thus present unexpected and unanticipated behaviour (Rosen, in Resmini & Rosati 2011: 61).

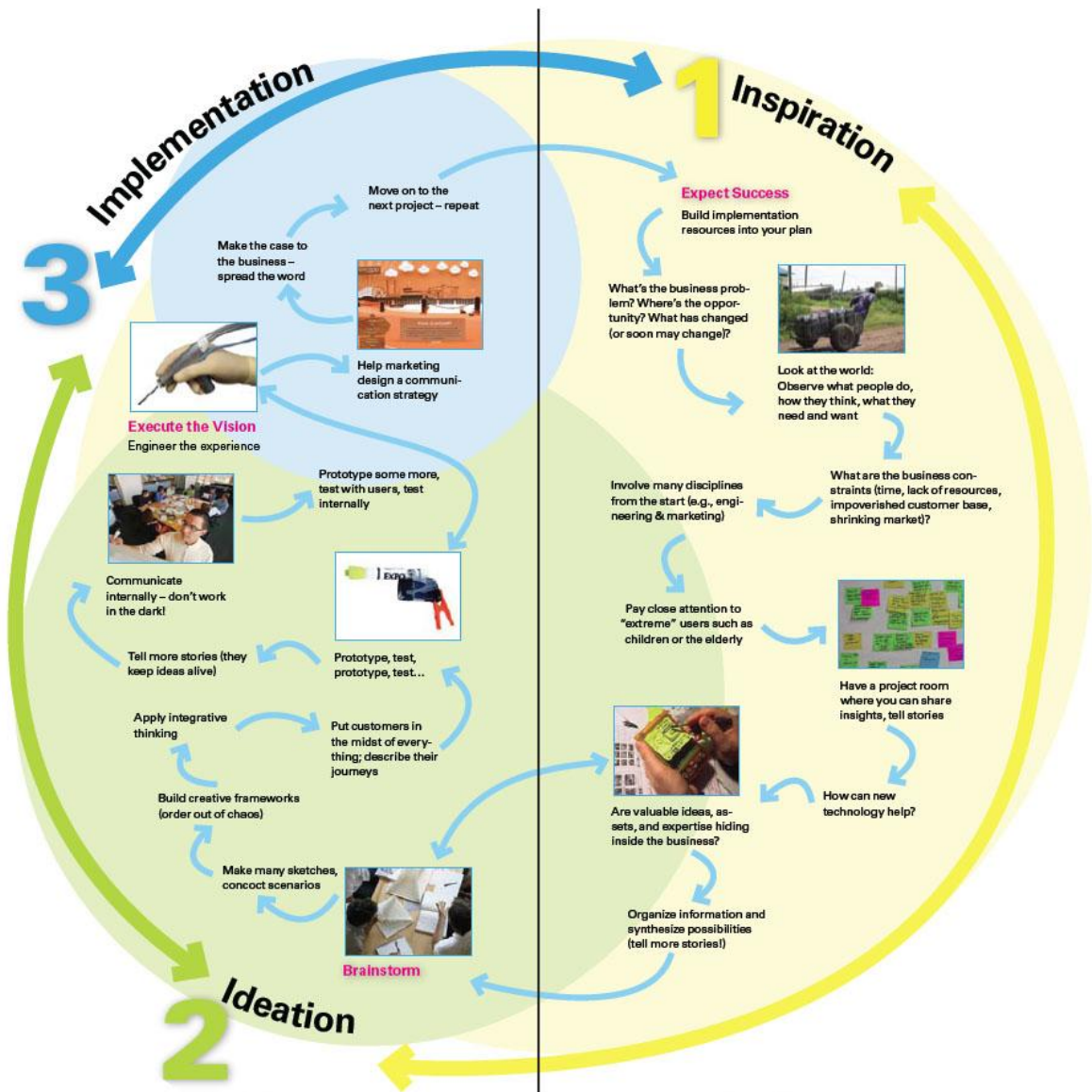


Figure 1: Tim Brown's IDEO Design Thinking diagram

Numerous models representing the philosophical and cognitive approaches described as DT can be found in various fields of design practice with perhaps the most famous example that of Tim Brown's IDEO Design Thinking diagram (Brown 2008: 88-89). In the IDEO diagram cognitive aspects of design are described under catch phrases such as 'Build creative frame works (order out of chaos)', 'apply integrative thinking' and 'prototype, test'. Many of these catch phrases imply cognitive abilities that are developed through years of experience and practice. Of course the IDEO diagram is only a representation of the intellectual capital that the company applies in its design practice but due to the fact that IDEO is a business, their modes of practice are their trade secrets.

Neil Brown (2000) points out that in reality there can be no functional separation between design practice and the cultural consumption of design. Therefore, we position the practice of design thinking as occurring in the two intertwined systems of social reality and that of institutional design practice

## Approaching complexity as social reality

Horst Rittel and Melvin Webber's formative discussion on the nature of indeterminacy and problems in their iconic publication *Dilemmas in a General Theory of Planning* (1973) establishes the design thinking approach for accounting for the hyper-complexity of social reality by delimiting the area of contextual relevancy through the positioning of the design problem.

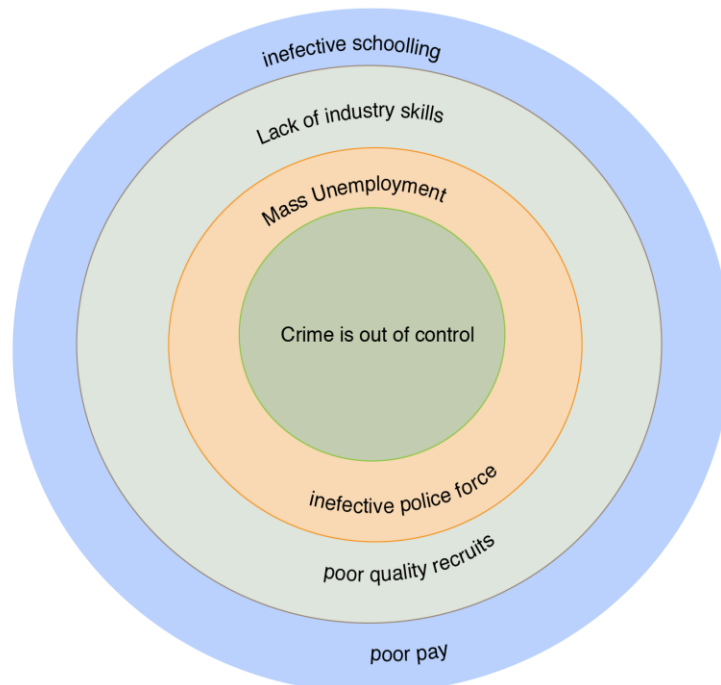
In the previous hundred years, design problems had been assessed in terms of functionality and efficiency (Rittel & Webber 1973: 156) and human beings were expected to organise their lives around the 'developing' modern world<sup>2</sup>. *Dilemmas in a General Theory of Planning*, discusses the authors' contentions that the growing consequences of public opinion and public acceptance has just as much influence on the success of a design as the design's functional requirements (Rittel & Webber 1973: 156). Rittel and Webber (1973: 159) describe the complexity of solving design problems as a socially relevant matter:

"We have been learning to see social processes as the links tying up open systems into large and interconnected network of systems, such that outputs of one become inputs of another. In that structural framework it has become less apparent where problem centre's lie, and less apparent where and how we should intervene even if we know what aims we seek"

Design problems that had been viewed as technical were then considered to be ill defined, reliant on subjective social agreement and *wicked* in the sense that before they could be solved they needed to be tamed, defined and limited.

Rittel and Webber emphasise the mutual relationship shared between design problems and design solutions and they state that the process of identifying, understanding and forming the problem is a prerequisite for solving the problem, that is to say *the formulation of a wicked problem is the solution* (1973: 161).

Rittel and Webber further describe the nature of the problems that designers seek to solve as elusive as what can appear to be the problem may actually be a result of a different problem at a higher level (1973: 165). For example, a spiralling inner city crime problem may be the result of a legacy of poor schooling in the area.



**Figure 2: An illustration of a hypothetical example of the various levels of a problem, showing two different approaches to the scoping of the problem.**

<sup>2</sup> Terry Smith, gives an excellent account of the impact of modernism on American Society in *Making the Modern: Industry, Art, and Design in America*. University of Chicago Press

According to Rittel and Webber the direct impact of the concept of ill- defined problems on design practice is that each design problem is complex and original (1973: 164), as each problem, even those similar in nature on the surface, would be solved with reference to a specific positioning, in a specific culture, in relation to specific goals. Therefore 'wicked' problems have any number of potential solutions and many different possible solutions (1973: 161). Consequently, as each design problem is unique and has its own contexts, there can be no prefabricated solutions to solving design problems.

To begin to solve wicked problems requires the following general cognitive understandings:

- That design problems are social phenomena and that problems and solutions exist in relationship to social reality
- The role that the formation of the problem plays as the essential structuring agent in the cognitive decision making process.
- The ability to conceptualise problems as systemic, that at different levels problems may appear to warrant different solutions and that a solution at one level may yield a problem at a different level.
- That each design problem is complex and original and subsequently there can be no prefabricated solutions to solving design problems

### Approaching institutional complexity

As important as problem framing is, design is ultimately concerned with finding solutions to the problems that have been recognised. Nigel Cross (2006:78, 80) explores the co-dependency of the problem and solution in design. Expanding on the notion that the problem defines the solution introduced by Webber and Rittel, Cross (2006: 78) states that problems are cognitively defined by designers, in relation to solutions. Designers tend to solve problems by testing the problem against solutions leading to a greater understanding of the problem, the recognition of new problems and the amendment, acceptance or discarding of parts of the solution. The co- dependency of problems with design solutions introduces and allows for the natural bias of the designer's identity, personal aspirations and world experience as well as that of the design discipline to permeate the design process.

Balancing the need to solve societal problems whilst utilising validated institutional knowledge and approaches is a decision making process that has its own dilemmas. In *Wicked Problems* (1992), Richard Buchanan emphasises the importance of approaching design problems and solution pairings in an iterative, systemic and interdisciplinary manner due to their indeterminate nature, thus negating the temptations of applying assumptive design solutions (1992:10).

A *category* according to Buchanan can be considered the collective descriptive facets and encompassing rules that define the characteristics of a design object that designers commonly default to when solving design problems. Hypothetically, if the design problem is the need to communicate to a wide audience, a graphic designer would traditionally apply a *built in* discipline solution such as a poster. Primarily, the quality of the solution was assessed in reference to the discipline's concept and conventions of the category: *Poster*. Buchanan questions the designer who relies on the predetermined design solutions, describing the repercussions of a categorical approach to design as '*mannered imitations of an earlier invention that are no longer relevant to the discovery of specific possibilities in a new situation*' (1992:12). Applying *categories* of design automatically in response to design problems, without a rigorous investigation into the nature of the problem, implies that design problems are consistently alike. In addition an over reliance on design categories can embed institutionalised conventions of practice that may be context invalid, for example, cars as the solution to the problem of mass transport. The integration of *categories* in the design disciplines is so ingrained that often the fields themselves are misrecognised for the sum of their practice based outputs, as opposed to the cognitive process that informs the 'making'<sup>3</sup>. Cross (2006: 82) in his description of the 'fixation' effect describes a similar phenomenon that limits particularly inexperienced designers to "*reuse features of existing designs rather than explore the problem and generate new features*"

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<sup>3</sup> Example web- site design, music video design, typography etc.

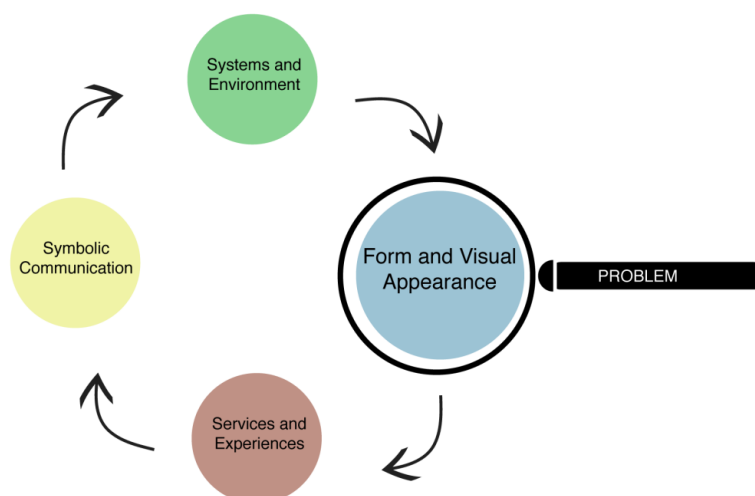
The over reliance on approaching design education from the point of *categories* is exemplified in countless university briefs that present already considered answers to design problems by stipulating which product category the envisioned design solution should take. The student designer only has to then incrementally change the category. For example, a brief requiring a student to design a website for an imagined business makes an assumption that the media type 'website' is the correct solution to the design problem. The problem is partially solved as a number of strategic decisions have already been defined by the brief writer. The problem is rendered un- complex and the student only has to focus on functionality and appearance.

The crux of Buchanan's (1992:12) thinking is that the conceptualisation of design practice is fundamentally flawed. Rather than a collection of different fields of practice that have their own built in product solutions, design is a field of practice within which, the fundamental activity is the conceptualisation and development of solutions purely in response to the context of the particular problem at hand. Therefore the subject, scope and the possible design approaches utilised in the formation of the problem and solution are directly related to the circumstances and placements of the problem.

Buchanan (1992:9) suggests that in order to avoid prefabricated, non-innovative solutions, design problems can be resolved by continuous recontextualisation of the design problem and solutions, under a number of cognitive approaches he refers to as *placements*. The four placements described by Buchanan are:

- **Symbolic and visual communications** that broadly address the problems of communicating information, ideas and arguments through the synthesis of words and images. Examples of this field include typography, graphic design, information design and film
- **Design of material objects** that address the problems of form and visual appearance of products through diverse interpretations of the physical, psychological, social and cultural relationships between products and users
- **Design of activities and organized services.** The central themes of this placement are the connections in everyday experiences and the consequences of these connections on the structure of action. An example of this placement would be the layout and organisation of supermarket.
- **Design of complex systems or environments for living, working, playing, and learning.** This placement addresses the role of design in sustaining, developing and integrating people into broader ecological and cultural environments, shaping these environments when desirable or possible and adapting to them when necessary

Two critical points underpin the theory of *placements*. Firstly, design problems should be assessed within reference to each *placement* category. For example, how the solution will symbolically communicate and function as a product, behave and interact with the user, exist and operate within a system/s and with reference to a variety of environments.



**Figure 3: An illustration of showing the different placement 'lenses' that can be used iteratively to assess solutions**

Secondly, that the *placements* collectively share a systemic iterative relationship (Buchanan 1992:10) to each other in an ecological system. Within this homeostatic environment, a change within one *placement* of the design will have a ripple affect requiring a reconsideration of the other *placements*, which in turn may result in a return and re-edit of the initial *placement*. “Innovation” according to Buchanan “comes when the initial selection is repositioned at another point in the framework, raising new questions and ideas” (Buchanan 1992:12).

Johann van der Merwe<sup>4</sup> in a *Natural Death is Announced* (2010:1), summarises Buchanan’s view of design as *placement- led*, describing design as a discipline- neutral groundless field of knowledge that constantly sources knowledge, skills, practices and contexts from other fields of knowledge as dictated by location of the ‘*specific design problem*’ (2010:3). Design, van der Merwe suggests is therefore a field of practice that is inherently transdisciplinarian in nature as each design problem is situated within its own constructed discipline that is uniquely different to any other constructed discipline.

To structure responses to design problems at an institutional level requires:

- A solution or range of solutions for the designer to measure the problem against
- An understanding that design practice is problem- led not product- led
- The conceptualisation and development of solutions is purely in response to the context of the particular problem at hand
- The continuous re- contextualization of design problems and solutions in reference to the four areas of design cognition in an iterative and systematic manner
- The ability to construct a unique discipline of practice informed and contextualised by the design problem

## Responding to indeterminate problems

Van der Merwe (2010:3) proposes that in order to cognitively account for the complexities of social and institutional reality aspects of systems theory and cybernetics could be implemented as a unified system in a constructivist design paradigm, which he terms *Cyberdesign*.

Systems thinking<sup>5</sup> is an umbrella term for the study of how individual activities, occurrences and phenomenon relate to and affect the environments that they inhabit and are in turn affected by these environments (Schmitt 2006: 23). Systems thinking supports a design process that is the antithesis of analytical enquiry as it is expansionist in nature, constantly widening the focus of the understanding of the problem (Schmitt 2006: 24). Cybernetics shares many similarities with system thinking, most notably that they are both systems of control that over time become concerned with social systems of reality (van der Merwe 2010:3). While systemic thinking focuses on the generic characteristics of all systems, such as the connected relationships between elements, to each other and within the system, cybernetics can be understood to be about the purposeful achievement of specific goals within a system (Pangaro 2011 [o]). Although cybernetics is thus teleological in aspiration, it has a strong focus on how the goal is achieved. Practitioners of cybernetics use models of organizations, feedback, goals, and conversation to understand the capacity and limits of any technological, biological, or social system. Van der Merwe (2010:3) believes cybernetics to be a crucial aspect of approaching indeterminacy as it is discipline neutral or absorbent and can be applied to multiple contexts.

Cyberdesign theoretically supports the cognitive requirements needed to resolve design problems while dealing with the complexity of the two interwoven systems of institutional reality.

- Firstly, cyberdesign recognises reality as a uniquely constructed discourse and therefore acknowledges the nature of problems as social phenomena contextualised by the reality of the particular problem.
- Cyberdesign conceptualises problems as systemic and because of its expansionist nature of enquiry allows for problems to be understood at different levels.

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<sup>4</sup> Professor Johann van der Merwe is the Head of Department: Design and Informatics at the Cape Peninsula University of Technology

<sup>5</sup> Systems *theory* is specialised transdisciplinary field of systems thinking that aims to investigate the general principles of systems and secondly, provides models which can be used to describe the principles (Heylighen & Joslyn: 1992 [0]). However in this essay we will use the term *systems thinking* to bracket both terms.

- Van der Merwe (2010:3) describes the flexibility of cybernetics as appreciative of “*the necessity of selecting from a wide range of approaches, plus a range of tools and corresponding methods, that best fit—the type of system, the purpose and nature of the inquiry, and the specific problem situation*”. Cyberdesign therefore allows for solutions to emerge in context to the problem rather than prescribing product led solutions.

Interestingly though, Van der Merwe limits cyberdesign to an academic study of design phenomena (2010:4). Perhaps this is due to the difficulties that the repurposing of design education as the systemic enquiry and conceptualisation of design problems would present design curricula because of the lack of a straightforward procedural structure (Brown 2002).

We propose that cyberdesign could be incorporated into design education in an explicit, visual manner to introduce aspects of design cognition to novice designers. The visual models that are aspects of cybernetics and systems design can be used according to (Heylighen & Joslyn 1992) to describe the principles they represent. Hence the models of cyberdesign could be applied to represent cognitive approaches or techniques to problem solving on a Meta level as well as during actual design problem solving. In this sense learning how to use and or develop the visual model would encompass the formal and applied learning of the cognitive acts embedded in the model. To develop cyberdesign as an explicit, visual approach to solving indeterminacy would rely on a number of factors such as analysis of required cognitive skills, selection of models that embed the respective cognitive skills and design of learning activities that support the transfer of the cognitive principles through the use of the visual models.

However beyond the requirements needed for solving indeterminate problems described earlier, developing cyberdesign as a collection of visual models that variously represent aspects of design cognition could be potentially advantageous for a number of other reasons.

Firstly, the visual models while systems in their own right could be applied within a larger teleological design system in relation to other visual models. Therefore the act of arrangement would in essence be a creative one as opposed to a rigid method or structure and thus as a flexible methodological procedure would tend according to Fricke (in Cross 2006: 87) to produce meaningful solutions.

Secondly, the model instead of representing only the thinking behind the process could in many cases particularly in the fields of interaction design, wayfinding and information design, can be the actual design solution albeit at a low- fidelity prototype stage. The cyberdesign model would in many cases evolve into the end solution.

Thirdly, by utilizing visual models that embed the theory of cyberdesign, the ‘*reflective conversation*’ (Schon and Wiggins in Cross 2006: 85) embedded in the activities of sketching could emerge.

To conclude, designers are often faced with solving problems that are not always easily definable. Many of these thinking skills are not taught explicitly but are learned experientially. This paper argues for these latent yet critical abilities should be taught explicitly as part of a tertiary design education as students often struggle to develop meaningful solutions when faced with indeterminate problems. A critical aspect of these complex problems is the framing of the problem in relationship to broader social culture. In design an understanding of the problem can be said to directly impact the solution of the problem. As designers tend to solve problems by applying types of design solutions to problems, the cognitive act of constructing design solutions within the discipline critically impacts on the construction of meaning.

This paper advocates a discipline neutral systemic placement led cognitive approach to solving design problems over a categorical product orientated approach. Cyberdesign is presented as a theoretical approach to solving indeterminate problems that exist in relation to societal and disciplinary complexity. In light of these positions this paper argues that an explicit representation of cyberdesign in the form of visual models could potentially support the learning of the cognitive requirements needed for solving complex design problems

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## Short Biography

**Terence Fenn** has worked in the Department of Multimedia since January 2003. He is responsible for the interactive design and research orientated components of the multimedia programme. Originally trained as a fine artist, in 2001 Terence was awarded an Aus-Aid Nelson Mandela Scholarship to study a Master of Art and Design Education at the University of New South Wales in Sydney. Terence is currently the coordinator of the Multimedia Department's BTech programme. His primary area of interest is the role that design can play as an agent of support and positive change in the lives of people.

**Jason Hobbs** has been practising information architecture and user experience design since 1997. He pioneered the user journey design method and is internationally recognised in his field. For the past six years jh-01 / Human Experience Design has been one of the few truly beautiful and independent user experience (UX) design companies in South Africa. The services offered include user-centered research and testing, strategy and design. Jason is an Affiliated Researcher at the University of Johannesburg's Research Centre Visual Identities in Art and Design. He is presently a part-time lecturer at the same university. He regularly presents at International conferences and actively works to grow the local community of practice through the SA UX Forum which he founded five years ago.