The information architecture of transdisciplinary design practice: rethinking Nathan Shedroff's Continuum of Understanding.

T Fenn
Department of Multimedia, University of Johannesburg, Johannesburg, South Africa
tfenn@uj.ac.za

J Hobbs
Department of Multimedia, University of Johannesburg, Johannesburg, South Africa
jason@jh-01.com

Abstract

Transdisciplinary design practice requires different approaches and different subject to those conventions applied to the teaching of traditional discipline-orientated design practice. This paper describes the cognitive requirements of design relative to a range of theoretical frameworks that position design as a transdiscplinary practice. These cognitions are discussed in reference to an account of transdisciplinary research practice. What emerges from the study is the need for explicit cognitive skills that can assist design students in dealing with the complexity that arises from transdisciplinary practice.

It is the authors' contention that the field of information architecture design contains many of the cognitive decision making tools required for transdisciplinary design practice.

Keywords

Design cognition, transdisciplinary research, transdisciplinary design, information architecture, data and information, analysis and synthesis, meaning-making, design thinking.

Introduction

In the decade since the publication of Robert Jacobson's *Information Design* (1999) the practice of design has undergone a radical conceptual shift that design education at tertiary level is only beginning to contemplate. In this time, design has transformed from a practice that emphasised aesthetics and product to a discipline that’s primary identity is formed around transdisciplinary problem solving that effectively, empathetically and sustainably seeks to improve the life experience of people.

Over the last ten years many of the positions articulated in *Information Design* have proven to be highly accurate and exemplified in many of the emerging fields of design such as human computer interactions, user experience design, service design and ubiquitous computing. Featured in *Information Design*, Nathan Shedroff's *Continuum of Understanding* serves as a fundamental model for a conceptualisation of design as an act of meaning making within which, the designer and users share agency.

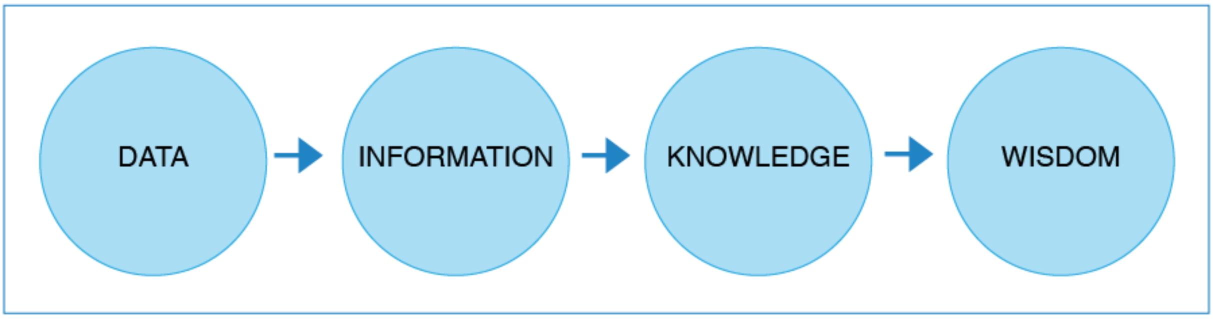
This paper describes design as a cognitive practice that seeks to resolve the complex problems facing humanity and the environment through a rich exploration of the contexts of these problems from the perspective of both the people in the environment, whom the problem affects and relevant disciplinary discourse. The emergent data from this type of exploration is the complexity that the designer attempts to resolve into a solution that considers both the problem and the social reality of the end- users. The initial discussion, contained within this paper, seeks to describe the cognitive activities involved in the iterative development of design solutions from, and in relation, to social complexity.

The emergence of meaning in the form of the design solution/s is then described from the perspective of a contemporary theoretical position that views design as uniquely transdisciplinary in constitution. The notions of what transdisciplinary practices include, are then detailed in a brief overview of transdisciplinary research design. Importantly, the discussion introduces the ‘Principle of the Included Middle’ (Nicolescu, 1984: 6, & in Max-Neef, 2005: 10) as a useful explanation for describing the tacit cognitive actions that mature designers utilise in problem resolution but which are often absent, at an explicit level, in undergraduate design education. The paper then moves on to argue the position that many of the cognitive tools used, overtly, in the field of information architecture (IA) could be incorporated into design education at an interdisciplinary level to support transdisciplinary practice.

A conceptual model for cognitive synthesis in design.

In *Interaction Design: A Unified Field Theory of Design*, Nathan Shedroff (1999: 271) provides a diagrammatic model titled the *Continuum of Understanding* (see, Figure 1) that is a representation of what Shedroff has identified as the four stages of understanding. The core concepts represented in Shedroff's continuum model is that information is a meaningful formation constructed by a designer from an assortment of data. However the value of the information presented is reliant on the extent to which the direct and underlying concepts that inform the 'meaning' in the formation can be understood, contextualized and applied by the end- user (ibid: 271).

Figure 1. Nathan Shedroff's Continuum of Understanding (adapted from Shedroff (1999: 271))



In this paper, Shedroff's model is used as a departure point for the discussion concerning a range of the fundamental aspects of design cognition and is amended at various points to reflect the developing theoretical discussion that articulates various aspects involved in the resolution of complex problems in design. Although the scope of our discussion will focus on the cognitive requirements involved in the design act of restructuring data to form meaning through the first two stages of continuum, it assumes the discussion is considered in reference to the human- centered notions embedded in the latter two stages.

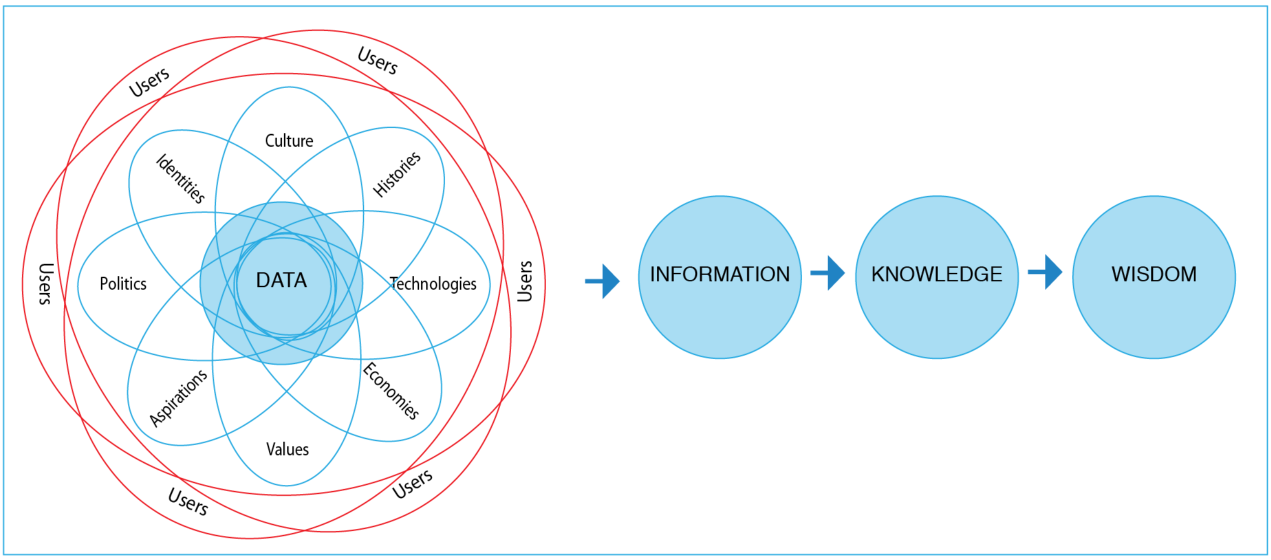
Data, as described by Shedroff (ibid: 272) is the raw material found in an environment used to create or build communication with and is "the product of discovery, research, gathering, and creation". Data, Shadroff continues, isn't valuable as communication, because it isn't a complete message (Ibid). Data can be concrete and measurable or discreet as well as either qualitative or quantitative (Mirriam, 2009: 85). Beyond statistics, data can include descriptions of experiences, opinions, feelings, knowledge, behaviors, and actions (ibid). Russel (2009: 149) describes data as the “minimum premise” for knowledge creation. He further regards data as the *cause* of other beliefs rather then the *premises* from which the beliefs are inferred (ibid). From these descriptions of data, we draw our definition of data as individual instances of information that operate at a level at which, the individual instances have no related meaning to each other. In this paper a ‘data set’ describes an identification and selection of a range of data by the researcher/designer that they consider relevant to the research objectives.

In *Dilemmas in a General Theory of Planning*, Rittel & 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 centers lie, and less apparent where and how we should intervene even if we know what aims we seek

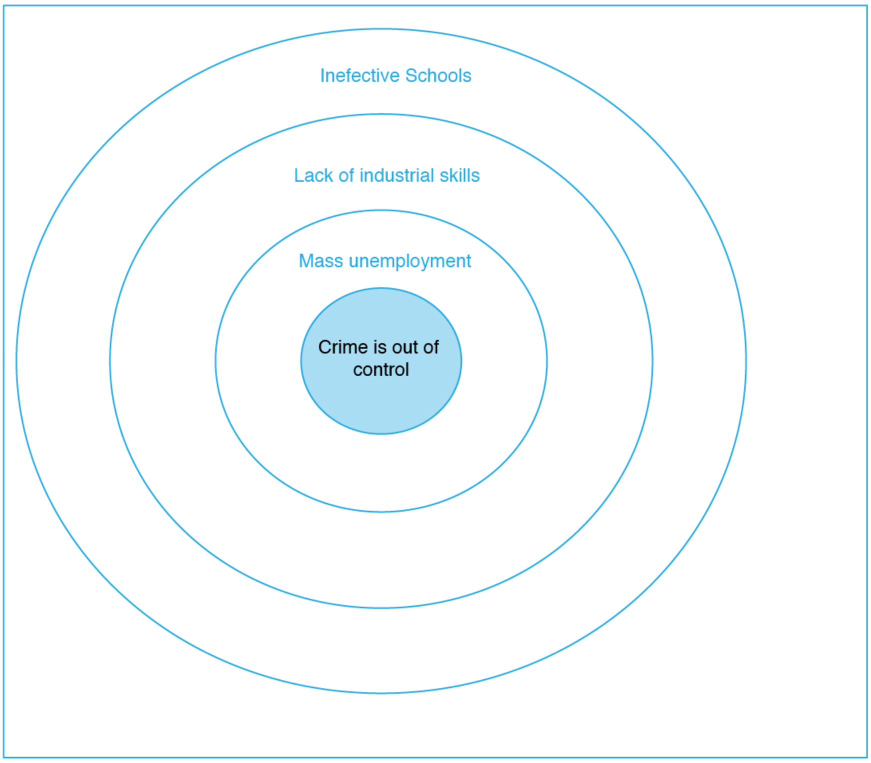
In this sense, the data of a design process can be considered to be the raw information existing within the structural framework of the social reality of the end- users, designers, and other agents affected by the problem and any potential solution and is *the complexity of the problem*. Figure 2 illustrates a range of the categories from within which relevant data may emerge.

Figure 2: The social complexities of the Data stage (Fenn & Hobbs)



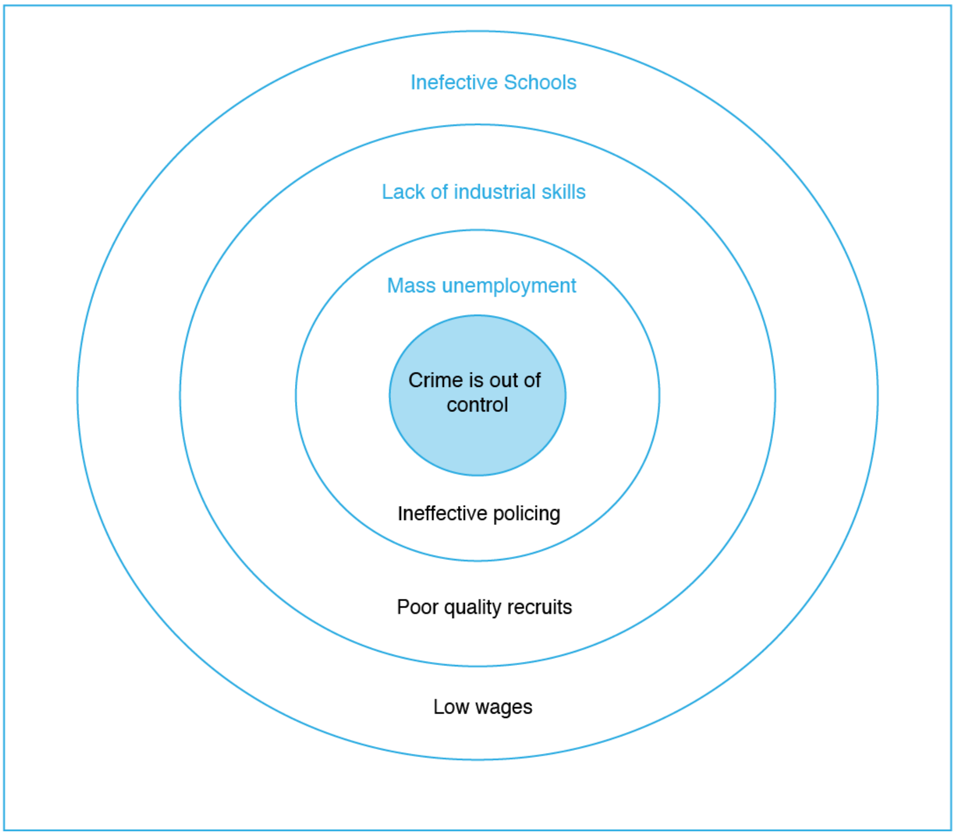
Rittel & Webber (1973: 153, 160) describe the process of understanding the problem, which can be consider as defining the data set most applicable to the design process, as ill- defined and reliant on subjective agreement. Defining social problems, Rittel & Webber continue, can in itself be a difficult task as the nature of societal problem are often elusive (ibid, 1973: 165), since what initially may appear to be the problem to solve may actually be a result of a different problem at a higher problem level. For example, as shown in Figure 3,[1] a spiraling inner city crime problem may actually be the result of a legacy of poor schooling in the area. Furthermore, Rittel and Webber (1973: 161) describe these societal problems as indeterminate in nature, as having any number of potential solutions and many different possible solutions as illustrated in Figure 4.

Figure 3: Different levels of a problem (after Buchanan (1992))



[1] **The example shown in Figures 3 & 4 is loosely based on an example described by Richard Buchanan in *Wicked Problems* (1992).**

Figure 4: An alternative understanding of a problem levels. (Fenn & Hobbs)



Subsequently, the process of recognising the relevancy of data moves beyond mere identification to involve subjective decision-making activities such as selecting, prioritising and strategising, as in reality, the complexity involved in the understanding of social systems, as represented in Figure 2, would be impossible to consider in its entirety.

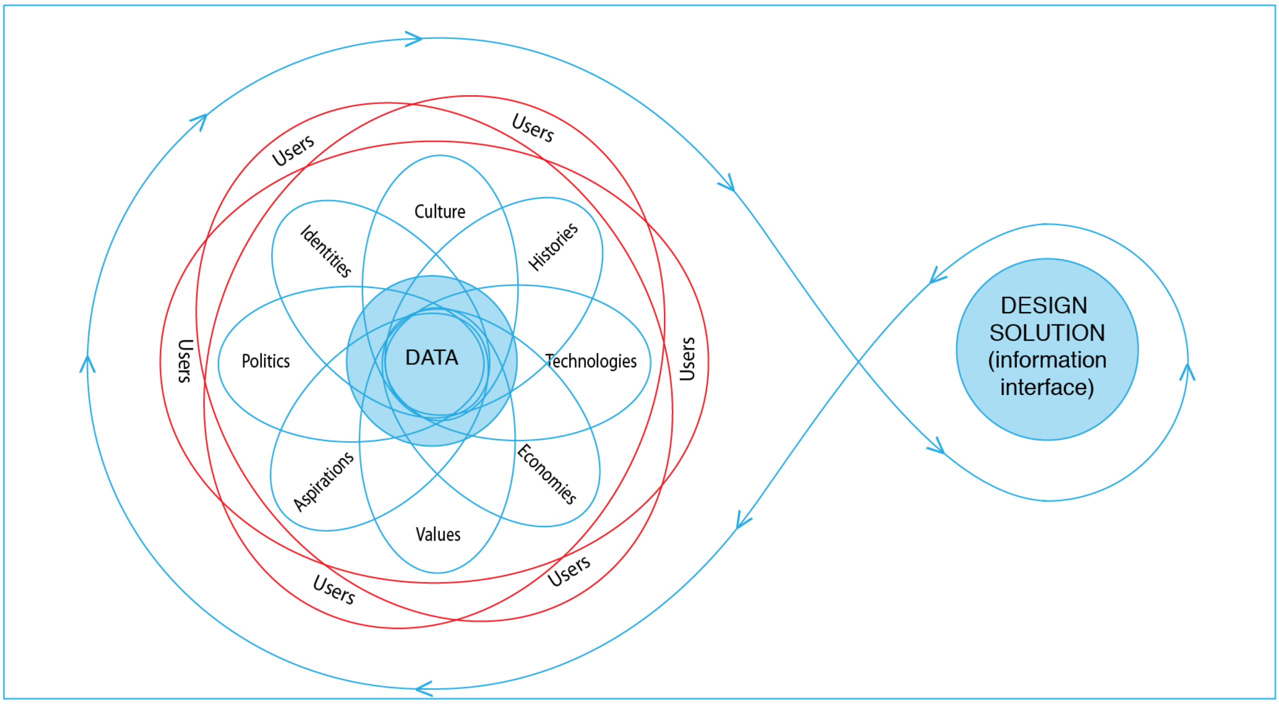
Returning to Shedroff's continuum, the second stage, *Information,* can be understood as a considered interface, formed by and representative of the designer's cognitive intention that the end- user is presented with. This paper continues this conceptual sequence but also broadens the use of the understanding of the stage to not only include information design but all forms of design interface. [2] Therefore our conceptual model as shown in Figure 5 conveys the notion that all design solutions are the interfaces of the designers' synthesis of selective data into conceptual, organisational or physical formations.

---

[2] Elzbieta Kazmierczak in *Design as Meaning Making: From making things to the design of thinking* (2003) refers to design as *cognitive interfaces* in a very similar approach to the one advocated in this paper. Interesting, although focused on communication design specifically and what would be in our interpretation the last two nodes of Shedroff's model, Kazmierczak arrives at similar outcomes. I.e. that Design is foremost about meaning making not objects that diagrammatic reasoning is important in design thinking that is not about product making, and lastly that there are "*inadequate rational tools"* to bridge this gap (2003: 45).

Rittel and Webber emphasise the relationship of problem resolution (i.e. understanding the data set) and the formation of design solutions, however they place both the context of the problem and any potential solution within an iterative loop that cyclically edits the understanding of both. Rittel and Webber (1973: 161) describe the requirements of design problem solving as follows: “One cannot understand the problem without knowing about its context; one cannot meaningfully search for information without the orientation of a solution concept; one cannot first understand, then solve.”

Figure 5: A representation of a problem and solution pairing (Fenn & Hobbs)

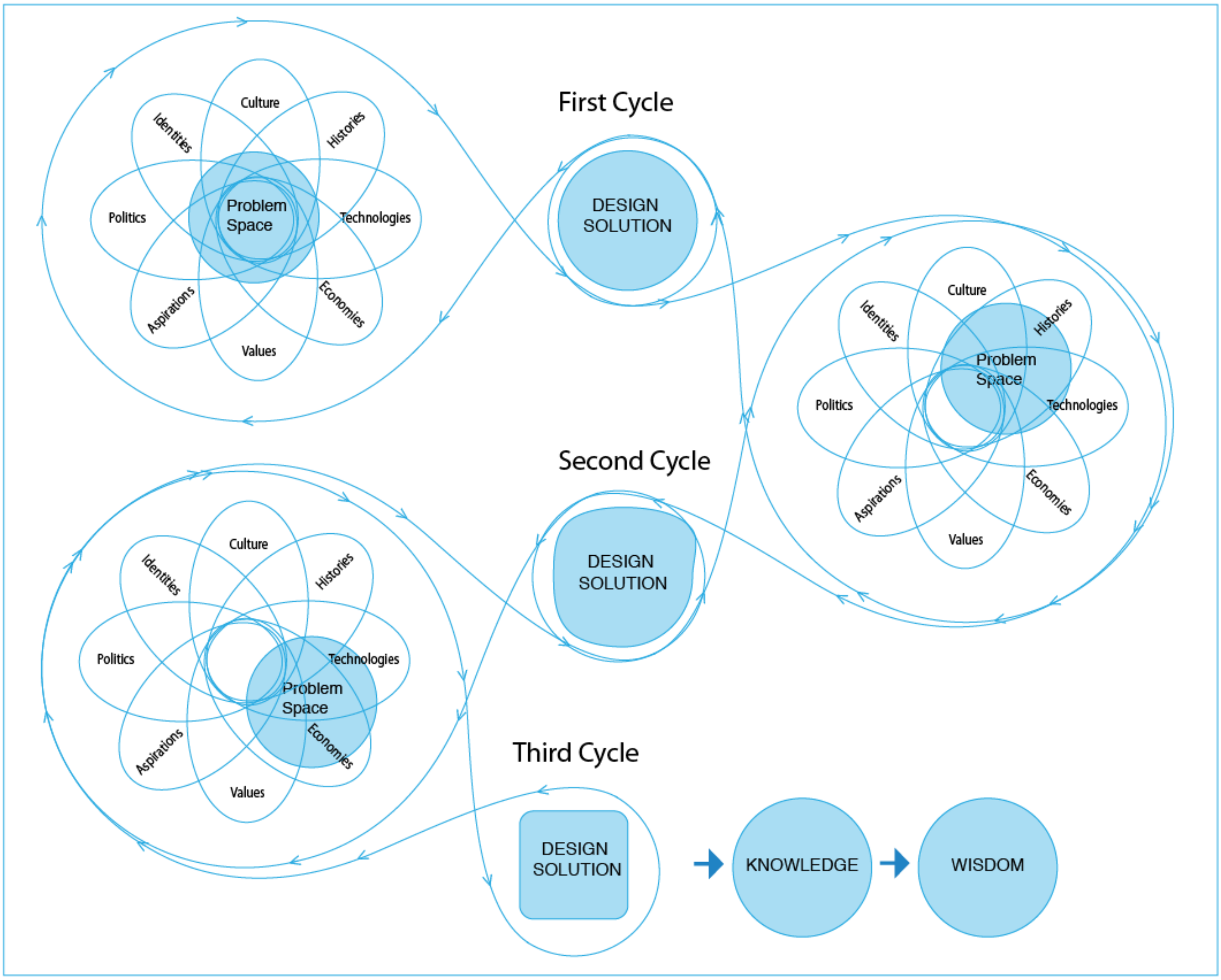


Nigel Cross (2006: 79) observes that this type of problem/solution conjecture is typical of the thinking employed by designers, as designers are “solution- focused”. The relationship between the problem and that of the solution aids in radically reducing the data range of complex problems. Cross and Kies Dorst (in, Cross, 2006: 79), describe the stages of defining mutual problems and solutions as:

> “The designer starts by exploring the [problem space], and find, discover, or recognize a partial structure. That partial structure is then used to provide them also with a partial structuring of the [solution space]. They consider the implication of the partial structure within the solution space, use it to generate some initial ideas for the form of a design concept, and so extend the partial structuring… They transfer

the developed partial structure back into the [problem space] and again consider implications and extending the structuring of the [problem space]. Their goal ….[i]s to create a matching problem-solution pair"

Figure 6: Amended model showing three iterations of a problem/ solution matching. The iterative cycles could in reality be many more (or less) than the three illustrated. (Fenn & Hobbs)



The formulation of matching problem/solutions pairs is a cognitive process that creates design solutions by iteratively reducing the range of relevancy though analysis while simultaneously forming meaning (the solution) through synthetic construction as represented in Figure 6. Reduction in this sense does not entail a simplification or discarding of aspects of the base of data but rather a lessening of the complexity load through categorisation, organisation and prioritising.

Importantly, problem/solutions matchings can also be viewed in less binary ways than Cross's 'pairs'. Often there can be multiple problem centres that can be addressed simultaneously for example, referring back to Figures 3 and 4, the problem of crime could be solved by finding solutions for problems that occur across the various problem levels. Problems can also have different solutions within the same design as seen in any website with more than one approach to navigation or the various ways that one can save a file in Microsoft word (Icon, Menu Tab, keyboard shortcut, etc.).

The final solution is most often comprised of multiple sub-solutions with enormous dependencies in the larger networked system, composed into one new harmonious structure: a new problem/solution ecology.

Towards transdisciplinary design practice

Although, the introduction of problem/ solution matching limits the data existing in a problem space to only that which is relevant, it also introduces an additional layer of complexity derived from the agency of the designer. As Rittel and Webber declare, “The information needed to understand the problem depends upon one's idea for solving it” (1973: 161), thus the influence of the designer is integral in the determination of ‘elusive political judgments’ (Rittel and Webber, 1973: 160) that define the strategy and tactics of the design solution.

While students of design naturally have a deep and meaningful experience of the world, their experience of design is primarily informed by their exposure to design education. Therefore how they are taught design and what they are taught design is, forms a large part of their ‘unconscious knowledge’ of design and their subsequent ability to formulate new design knowledge. Therefore the disposition of their design education enforces the student’s ability to formulate design solutions that in turn assist in formulating and understanding the design problem.

Students, in our experience, struggle to solve complex social problems in innovative ways. Principally, we believe this is because they have limited exposure to any form of design education that is disposed towards radical innovation or complexity. Exposing students only to modes of thinking that support continuous innovation may be useful when apprenticing the student to a discipline but falls short in providing the student with abilities to solve problems that originate from society.

The subsequent section of this argument discusses a number of the theoretical concerns of design thinking that question the dispositions of design education with regards to developing radical innovation design solutions, as opposed to merely generative solutions. In *Wicked Problems* (1992), Richard Buchanan re-emphasises the importance of the principles introduced by Rittel and Webber for treating design problems and solution as iterative and systemic due to their indeterminate nature. Buchannan advocates these design principles in order to stimulate radical innovation by negating the temptations of applying assumptive design solutions (1992:10) to complex problems. In addition to these principles, Buchannan questions the designer who relies on predetermined discipline orientated design solutions, describing the results of this dependence as "mannered imitations of an earlier invention that are no longer relevant to the discovery of specific possibilities in a new situation" (1992:12). Buchanan, terms this approach to design as *categorical* design. [3] A design category in this sense can be considered a default design product or service. They are generic built-in (mono) discipline solutions such as posters, websites or chairs for example. Applying *categories* of design automatically in response to design problems, without a rigorous investigation into the nature of the problem, implies that design problems all share the same problem data set and are consistently alike.

The crux of Buchannan'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 contexts of the particular problem at hand. Johann van der Merwe in a *Natural Death is Announced* (2010) similarly describes 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 the location of the "specific design problem" (2010: 8).

At this point a distinct shift between Rittel and Webber's and Buchanan and van der Merwe's position emerges. While the former regard consultation with end- users and other stakeholders useful for the acceptance of a design solution, Buchanan and van der Merwe argue that the process of understanding the social reality of those whom the design

---

[3] Nigel Cross (2006: 82) similarly describes what he terms the 'fixation' effect, a phenomenon that limits particularly inexperienced designers to "*reuse features of existing designs rather then explore the problem and generate new features*" as problematic

problem impacts on as the fundamental concern of design practice. While, how the understanding takes place in design, is what allows design to be regarded as a transdisciplinary research practice, it is the conceptualisation of design as an inherently discipline- neutral groundless field of knowledge that responds to the particularities of specific problems to create temporary, contextual disciplines of praxis from the knowledge, skills, practices and contexts of other disciplines and belief systems, that allows design to be considered as constitutionally transdisciplinary.

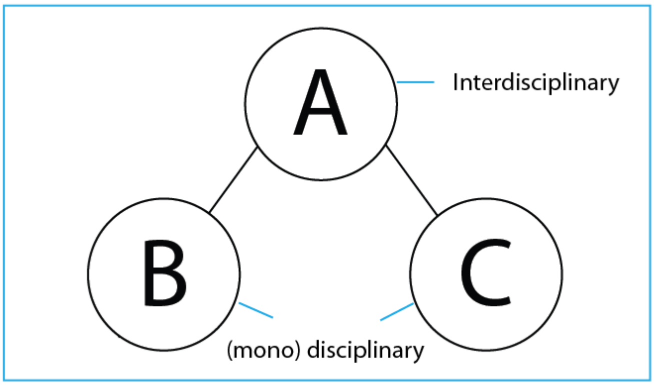
In order to describe transdisciplinary research practice a short overview of the different disciplinary modes of research such as monodisciplinary, multidisciplinary and interdisciplinary is necessary.

A monodisciplinary, referred to subsequently as disciplinary, research practice focuses on the self- contained praxis of a discipline (Max-Neef, 2005: 6).

A Multidisciplinary research practice is when more then one disciplinary research practice (i.e. cross-disciplinary) is conducted into the same problem but the findings are not integrated or synthesised (Wickson et al, 2006: 1049).

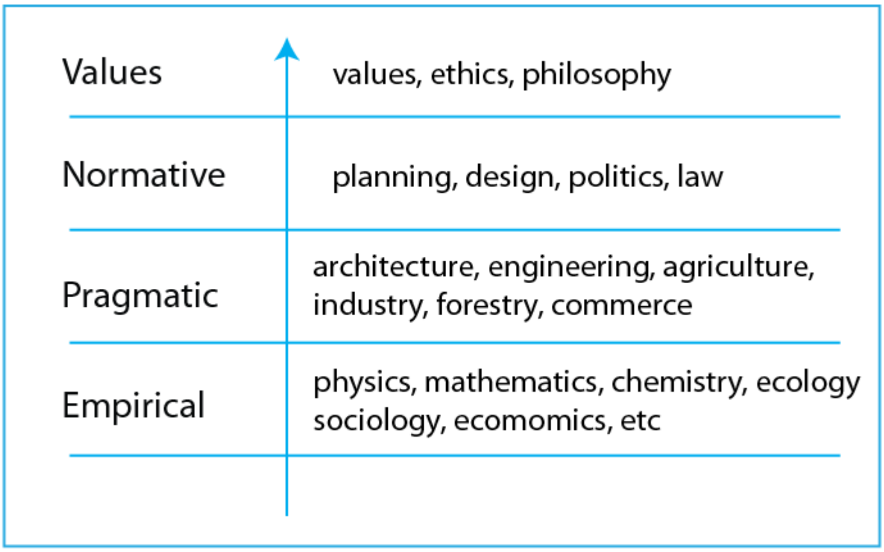
Interdisciplinary research (ID) practice is a cross-disciplinary focus on a common problem that is shared across a range of disciplines but unlike multidisciplinary research practice, methodologies and frameworks are shared (Wickson et al, 2006: 1050). Wickson et al, describe the nature of the research collaboration as occurring between different scientific disciplines (2006: 1050). Max- Neef describes the structure of interdisciplinary research as always operating on two hierarchical levels (Max- Neef, 2005: 7). In Figure 7, the structure of the two hierarchical levels of ID is depicted. While ‘B’ and ‘C’ represent the disciplines that sit as siblings on the hierarchical structure, ‘A’ represents the level of the ID practice. As the structure of the diagram implies, the ID practice invokes a parental organizing and controlling influence on the sibling disciplines (Schulz, in Max- Neef, 2005: 7).

Figure 7: Max- Neef's Two Hierarchical Levels of ID. While two disciplines (B&C) are shown in this diagram, more could exist in practice (adapted from: Max- Neef, 2005, 7).



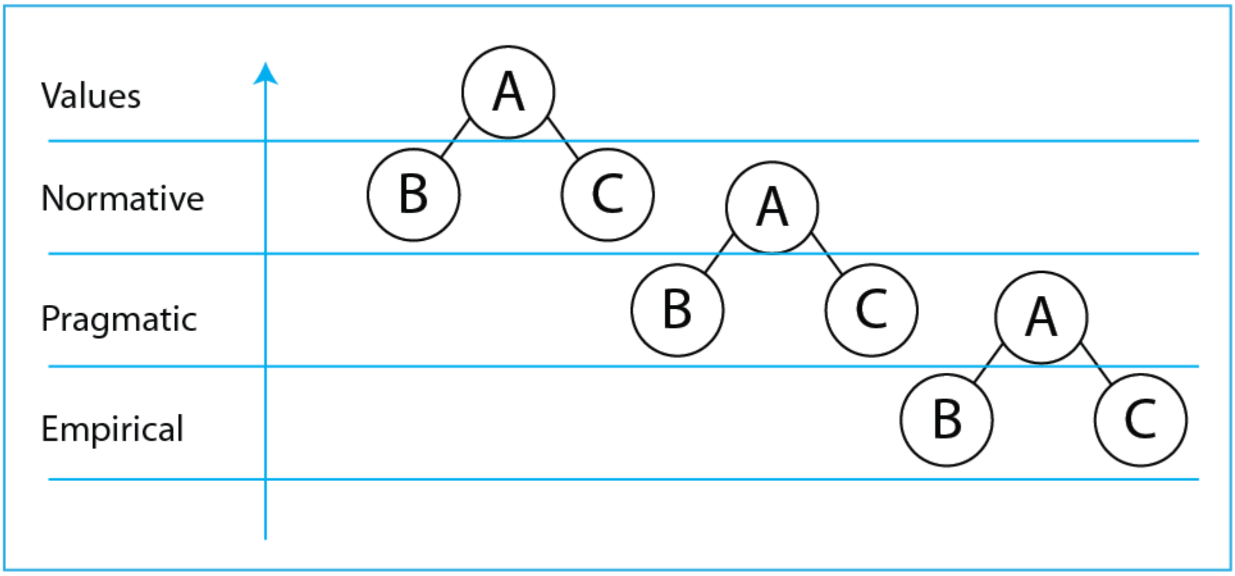
This conceptual model of the generative relationship of ID is itself orientated within a meta-hierarchical organization structure (Schulz, in Ibid) represented in Figure 8 and which, for the point of clarity, we will refer to as Schulz's model. At the bottom of the structure is the Empirical level, which involves disciplines that describe the world as it is. The next level up is the Pragmatic level, which includes the disciplines that seek to understand the capabilities of what has been learned from the disciplines at the empirical level. The third level in the structure is the Normative level that asks 'what is it that the broader goals of society aim for'. Lastly, at the top of the hierarchy are the disciplines at the Value level. These disciplines questions the values and repercussion of the actions of the lower level disciplines.

Figure 8: Schulz's meta- hierarchical organization structure (adapted from: Max- Neef, 2005: 8)



ID Practice, as described in Max- Neef's Two Hierarchical Levels, can only operate through two subsequent generations of Schulz's model at any given placement. For example as illustrated in Figure 9, the Value level can be the location of an ID practice that only directly effects disciplines in the Normative level but not the Pragmatic or Empirical levels.

Figure 9: The generative constraints of ID practice combining Max Neef's and Schulz's models. (Fenn & Hobbs)



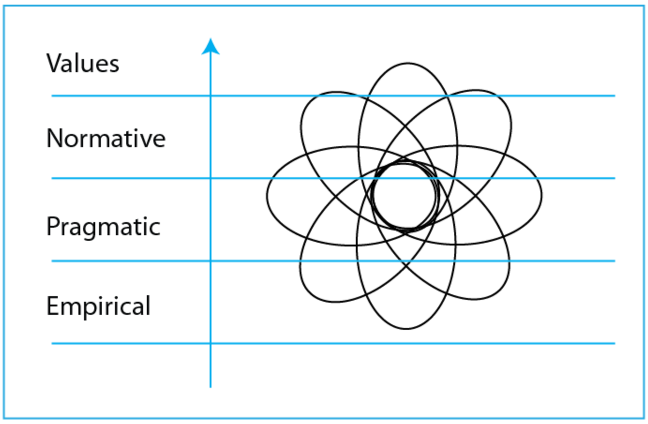
A definition of transdisciplinary research (TD) practice is often multifaceted as currently there is no universally accepted definition of TD (Wickson et al, 2006: 1046, Jahn et al 2011: 1, Max-Neef, 2005: 12). While theorists such as Max- Neef and Nicolescu frame TD practice as a new paradigm for scientific unity (Jahn et al, 2011: 1), Wickson et al and

Jahn et al in their survey reviews of the field tend to present a more pragmatic view of TD, a view that in turn is regarded as *weak* (or slightly superficial) TD by Max- Neef (2005: 10). Initially, this paper focuses on the shared characteristics and concerns of TD that all the mentioned theorists agree on and what is particularly applicable to design cognition as outlined in the preceding sections of this paper. Later sections of this discussion emphasise Max- Neef's Principle of the Included Middle and its potential usefulness for describing and explaining many of the cognitive requirements of design.

Firstly, returning to the comparison of ID and TD, the principle differentiation is how TD seeks to 'understand'. While ID remains within the collaborative boundaries of scientific research, TD practice extends ID's approach to the integration of knowledge and methods of various disciplines in the act of problem solving (Jahn et al, 2011: 2), to also include the intentional involvement of stakeholders in the definition of "real-world problems" (Jahn et al, 2011: 2, Wickson et al, 2005: 1048) as well as in the definition of criteria, identification of objectives and resources used in the analyses and resolution of problems (Wickson et al, 2005: 1051). The involvement of the stakeholder in TD is meant to be rich and meaningful with the researcher deeply engaged in trying to understand the problem first hand and from the perspective of the people the problem affects (Wickson et al, 2005: 1053). TD thus seeks to include, in addition to scientific concepts of knowledge generation, understanding as well (Max-Neef, 2005: 15). While knowledge seeks rational explanation, understanding can be considered to include relational explanation as well. Used together, knowledge and understanding allow for the inclusion of multiple realities (ibid) and any subsequent paradox that may occur (Wickson et al, 2005: 1053).

Secondly, while ID creates new knowledge that only ever directly affects two of the Schulz's model's hierarchical levels, Figures 8 & 9, TD aims for coordination between all the organization levels (Max-Neef, 2005: 9), iteratively as represented in Figure 10. This scale of integration across the hierarchical levels results in a high degree of complexity. This is purposeful as TD is performed with the explicit intent to solve problems that are complex and multidimensional (Wickson et al, 2006: 1048) such as sustaining the environment, managing mass-urbanisation, providing information clarity, and developing and protecting social and cultural equity.

Figure 10: Representation of the iterative integration of disciplinary and interdisciplinary practices with in a transdisciplinary practice (adapted from: Max- Neef, 2005: 9)



A third feature that ID and TD share is that of evolving frameworks and methodologies. Where TD develops differently from ID on this specific point, it is the recognition in TD, that because of the complexity and multi- dimensional nature of problems that originate in the real world, these problems cannot not confined by the boundaries of a single disciplinary framework (Wickson et al, 2006: 1048). Thus TD aims for an evolving, dynamic, or responsive methodology that is iterative and an ongoing part of the research process (ibid: 1051).

Lastly, as with ID, although TD crosses multiple disciplinary boundaries in a search for problem resolution, TD also seeks to involve disciplinary practice in a mutually beneficial manner (Jahn et al, 2011: 3, Max-Neef, 2005: 12).

Contemporary design cognition, as described in this paper, contains many similar ideological characteristics with TD. Design can be considered as a transdisciplinary practice for two distinct reasons; firstly, in its application of TD as a research practice for understanding the realities of societies and secondly, in the view shared by Buchanan and van Der Merwe amongst others, because of its constitution as a discipline agnostic problem resolving activity. Both of these reasons are interwoven as, because design is a discipline agnostic problem resolving practice, it needs to form unique new disciplines of operation and these new formations are orientated by research into the contexts of the design problem.

Design research, in its quest to understand the placement of the problem as inferred by the Data stage of the conceptual model, shown in Figure 2, can be considered to be TD for the following reasons:

- Design research views problems as complex and multidimensional
- Design research views problems as 'real-world' problems and therefore embedded in the experiences of people
- Design research aims for problem-specific integration of knowledge and methods
- Design research supports evolving frameworks and methodologies
- Design research allows for multiple realities of explanation particularly cognisant of beliefs, desires and assumptions as well as rational interpretation.

These aspects of design research are explicitly apparent in numerous user-centred research practices[4] embedded in design fields such as user experience design, usability studies, human factors studies and participatory design, and include practices such as user- interviews, user observation, contextual mapping, card sorting and action research.

In addition to sharing a framework that allows for both user- centric and discipline focused research, TD shares with design the need to resolve the problem rather then just articulate it. However, it is in reference to the cognitive act of synthesis that begins with the establishment of the boundaries and relevance of the data and concludes with the resolution of the problem, that TD perhaps offers the most beneficial insights into design thinking.

DT shares with design the concept of the open, indeterminate problem that may be solved in many different ways but always in the context of the realities of the problem. While TD and design both accept and utilise evolving frameworks, methodologies and solution, and TD and design both also see the mutual value of disciplinarity, interdisciplinarity and transdisciplinarity knowledge, it is the distinct disciplinary knowledge of design, summarised around the act of conceiving and constructing the design interface, that sets design apart from other TD practice. While acknowledging this difference, what is important to both design and TD "is the ability of the individual [researcher or practitioner] to fuse knowledge from a number of different disciplines and engage with stakeholders in the process of generating knowledge" (Wickson, et al 2006: 1051). This integration of knowledge from the disciplines and the stakeholders is, according to Jahn et al, the major cognitive challenge of TD (2011: 3).

[4] Mike Kuniavsky's *Observing the User Experience* is one example (of many) that provides examples of user- centric research methodologies used in contemporary design practice.

In design, this integration of knowledge takes the form of the problem/solution conjecture, which as discussed earlier and illustrated in Figure 6, takes the cognitive form of a problem/solution ecology. The complexity of the problem/solution ecology is that any one ecology may contain multiple problems centres as well as multiple interconnected sub-solutions. This construction of design cognition as cognisant of multiple problems and multiple solutions that operate systemically, evokes the Principle of the Included Middle described by Basarab Nicolescu (1984: 6, & in Max- Neef, 2005: 10). The Principle of the Included Middle, according to Max- Neef, is the logic of transdisciplinarity and complexity, which allows “through an iterative process, to cross different areas of knowledge in a coherent manner, and generating a new simplicity” (2005: 13). The Included Middle could be interpreted as descriptive of the synthetic act of composition that the cognitive practices of design entail in response to complexity. Design, as with TD, cannot afford to reduce complexity and solutions to archetypal extremes because both fields acknowledge the multiple realities of different disciplines, different perceptions of realities and different constructs of reality that need to be accounted for. It is within this Included Middle that the open structure of indeterminacy operates or as Max- Neef describes it “the permanent potentiality for the evolution of knowledge” (2005: 13). This allowance for indeterminacy is the struggle of design but is also where innovation and creativity happen. Rather than simply accepting that all design solutions are generic and applying them to a design research problem, this dimension of reflection requires designers to deconstruct and rebuild design solutions through exposure to other bodies of knowledge.

The Principle of the Included Middle in design, as positioned above, describes the cognitive jump that designers make when synthesising design solutions (information) from design research (data) so that the solutions will be accessible and useful to the end-users. The Included Middle can therefore be considered as descriptive of the site of the cognitive decision-making that precedes, identifies, selects and orientates the specific design disciplinary practices that construct the final interface(s). In the rest of this paper we will appropriate the term ‘the Included Middle’ to describe this area of synthetic cognition.

In Figure 11, the Included Middle of design cognition is represented by the diagonally shaded area across the three larger triangles. In the processes of design cognition, the problem space (E), in the diagram represents the research gathering activities of design that seek to ‘understand’ the context of the problem across stakeholders and disciplinary realities. The Discipline practice triangles within the larger triangles represent specific mono or interdisciplinary design praxis. Both the research gathering triangle and the Discipline practice triangles represent parts of the design process that are either currently part of tertiary design curricula or if absent can be adapted from contemporary research methodologies. What is largely absent from design education however, is the transfer of knowledge and practices that explicitly support the synthetic composition of open solutions.

Figure 11: The process of design cognition highlighting the Included Middle. (Fenn & Hobbs)

Key:

A- The Solution Ecology

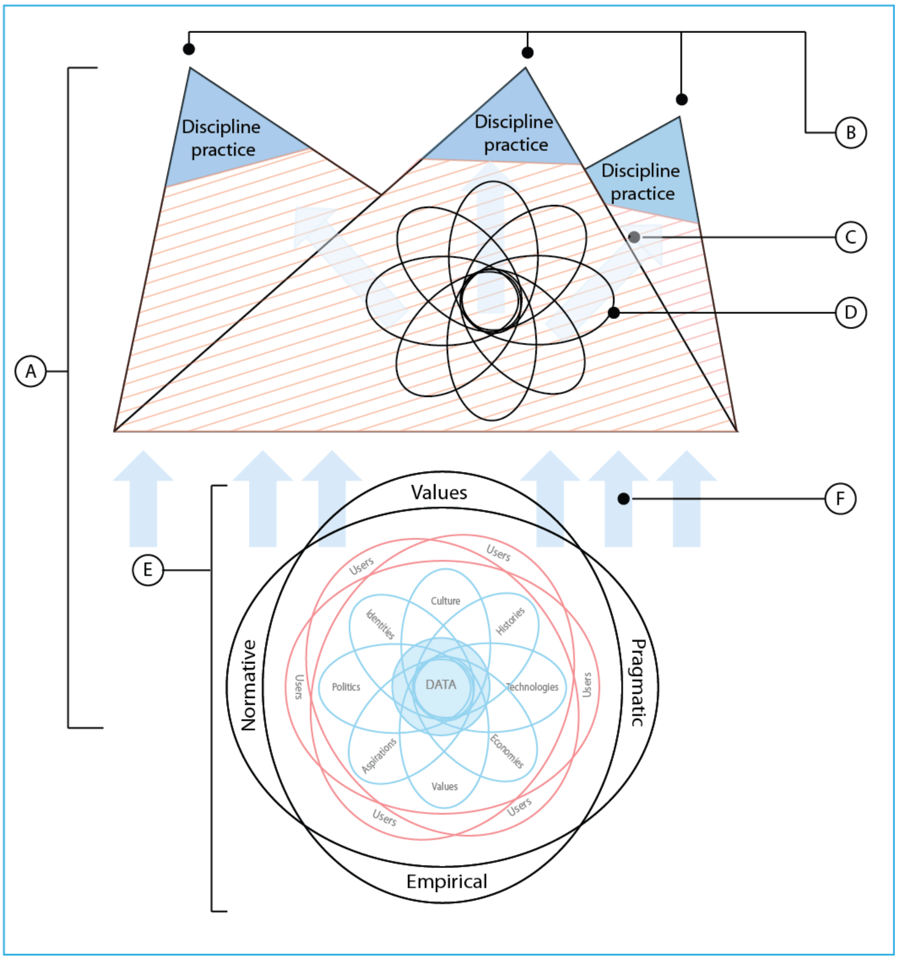
B- The final design interface solutions. These solutions could be single, multiple or cross-channel.

C- The Included Middle

D- A representation of the iterative synthetic composition

E- The problem/ solution space showing Schulz's ID organization levels and the complexity of social reality.

F- A representation of the multiple problems emerging from the problem space



Currently, transdisciplinary approaches to design are seldom part of tertiary design education particularly at undergraduate level. Neil Brown (2002: SA) speculates that this is because of the difficulty of re-purposing design education as a systemic enquiry and conceptualisation of design problems. Brown declares: “This problematises practical education insofar as practices present curriculum with no step-wise structure.” however he maintains (ibid) that there is no alternative to conceptualizing design as a transdisciplinary activity as in reality there can be no functional separation between design practice and the cultural consumption of the design. A secondary reason is that university departments and faculties are structured along disciplinary lines (Max- Neef, 2005: 5) this is true also of most design faculties.

It is not the argument of this paper that transdisciplinary design practice should replace discipline praxis at undergraduate level. We agree with Jamer Hunt (2009, SA), chair of Urban and Transdisciplinary Design at Parsons The New School for Design, who states the need for both transdisciplinary and disciplinary practices in design education

> It’s not an either-or situation. We need highly specialized people and we need people who can be more lateral connectors, who can understand a problem from multiple perspectives and also understand how to then use design as a process to move towards a solution.

However we do feel that there are a number of fundamental activities/ insights that should be included in all undergraduate programmes so as to build support towards transdisciplinary design practice in postgraduate[5] and industry practice.

These activities and insights include:

1. That design is conceptualised in undergraduate design courses as a practice that seeks to solve problems that impact the lives of people and that because these problems are often complex, design solutions are not always generic
2. That all undergraduate design students should be introduced to and taught multiple qualitative and ethnographic design research methodologies as part of design practice

---

[5] Examples of postgraduate design programmes that can be explicitly or interpreted as focusing on transdisciplinary research practice include Parsons’ New School of Design, Goldsmiths, University of Central Lancashire, Stanford university, and the University of Pretoria.

3. That all undergraduate design students should be introduced to and taught skills in dealing with complexity, specifically in the synthetic composition of solutions through the cognitive processes which we term ‘design’s Included Middle’.

At a pragmatic level points 1 and 2 can, as discussed, be incorporated into undergraduate curricula and in many institutions, learning areas such as human factors studies, user experience design, design thinking and usability studies are already part of design undergraduate programmes.

The gap, our exploration has revealed is the lack of explicit cognitive tools to assist design students (and educators) in synthetically resolving indeterminate and complex design problems through design’s Included Middle. We believe that the field of information architecture (IA) can provide many of these cognitive tools. The remaining section of this paper aims to introduce the field of IA in the context of the discussion and introduce a range of the cognitive tools used in IA practice.

The field of information architecture

The term information architecture (and information architecture design) is used in this paper in the sense first outlined by Richard Saul Wurman in his book *Information Architects* (1996) where he described an information architect as “…someone who enables data to be transformed into understandable information.” (SA). Wurman uses the term to cover the design of information across a variety of media, predominantly print, where the practices of information architecture and information design overlap greatly.

The term, and the practice of IA, has developed substantially with later texts such as *Information Architecture for the World Wide Web* (Rosenfeld & Morville, 2007) which emerged from the growing need for a set of skills that relate directly to design in information spaces of a digital nature including but not limited to websites, software and mobile applications. In their book, Rosenfeld and Morville defined information architecture as “the structural design of shared information environments” (ibid: 4).

In the design industry, it is probably fair to say that today the term has come to be most closely related to design in and for digital environments, within the larger umbrella practice of user experience design,[6] because of the proliferation of the Web and the devices, technology and infrastructure that have become accessible to so many. As a practice, information architecture design has also grown so substantially because of the need for those skills in solving indeterminate design problems that proliferate in the digital domain.

IA may be viewed as having three distinct but mutually inclusive dimensions (amongst potential others), which we will term bounded, cross-channel and poetic IA:

- Bounded IA tends to address single spaces of interaction and experience (for example a website, a mobile application or an intranet). It may derive its content and functionality from one or more sets of data however they manifest in that single space and the (IA) design is intended for that environment. In these circumstances the use and purpose of the IA intervention is clear and the design is outcomes-based.
- Cross-channel IA offers models of structure and organisation that endures across multiple environments and data sets be they digital or non-digital.[7] For example, a business requiring a pervasive IA across call centres, physical retail stores, a website and mobile application.
- Poetic IA[8] is unbounded, without physical or digital context and abstract in the sense that it is interested in the pure structure of data (potentially abstracted from a distinct outcomes based objective). It is principally concerned with composing meaning as an end in itself, in an undirected yet structural, semantic and ontological way. It is rare that one will find examples of poetic IA in a stand-alone manner and yet the shift it provides to one's experience of new information formations, and the meaning they hold, is profound enough to warrant identification and categorization here. An example of poetic IA could be the creation of a taxonomy that breaks from conventions within an industry sector that creates a

---

[6] The term 'information architecture' is still associated with print media in information design communities of practice and is also applied in the fields of IT and Application Architecture however for a different role, practice and set of skills. Our use of the term does not span the latter

[7] Resmini and Risoti (2011) have recently published what to date is the definitive text of pervasive IA and although the use of the term above does recall some concepts in their book it in now way is attempting to use the term as they may. For a full account of their definition read their book. At World Information Architecture Day, Johannesburg 2012 Mini Conference held at the University of Johannesburg on 11/02/2012, Resmini used the analogy of the rules of chess pervading although the experience is radically different when played on a board between two people, on a computer, against a computerized opponent and played in a park with a life-sized board.

[8] The term 'poetic' can mean many things however this is a working term that at this stage in the evolution of our thinking is applied loosely but intentionally to describe the manner in which meaning is created in IA design: through the (re-) composition of data at structural and sometimes sematic levels where meaning is formed through inclusion and exclusion of data and the inter-relationships of meanings formed through this process.

fundamental shift in the way people understand the industry, its purpose or promise.

As applied in this paper, these three dimensions can operate in isolation or as part of a whole. In designing a solution for a bounded IA project (for example a mobile application) one may be required or will appeal to pre-existent structures that already pervade related media (cross-channel IA), where a significant shift in poetic meaning could occur nonetheless just in that bounded instance. Or one may be required just to create a pervasive IA solution that can be used by other designers to inform bounded projects.

IA shares with transdisciplinary practice, a view of problems as systemic and being rooted in social realities. IA, when practiced, is most often solution driven and applies models of research, organization and feedback to understand and explore the system or systems in which the problem exists. IA methodologies and solutions are understood to be transient, iterative and evolving, as users and context are better understood and change over time.

Although many IA briefs are product- led in the first instance, the practice is problem- led, where solutions often result in displaying limitations in the product-led approach. Client briefs for websites for instance, often fail to recognize the integrated nature of media or the manner in which user's experience products and services across channels, resulting in on-brief, product- led solutions that are not aligned to a continuous experience across channels and touch points.

In conducting design research the information architect will often intentionally extend the scope of bounded IA briefs so as to reconsider the given (product- led) brief: organisational, and problem legacy will be explored; all stakeholders will be interviewed, so as to understand the problem from multiple and internal dimensions; the marketplace will be explored (including competitor analysis, best practice, benchmarking, related trends and macro-conditions related to the problem); the organisational backstage[9] is analysed; and end-users of the product, service or environment are investigated in their context of use.

---

[9] In service design the term 'backstage' has come to represent all operations, resources and processes within an organisation that facilitate the running of the organisation and the provision of the service experience to customers.

In this way information architecture applies ethnographic and user centered research techniques, amongst others, that attempt to gain an understanding of the problem/solution ecology in which their brief is presented. Thus, from the outset it is often understood in IA that although the requirement may appear closed, such as the redesign of a website interface, the success of the design can have dependencies that span business processes, product considerations, distribution mechanisms, human resourcing, training and capability development, pricing, marketing communications, etc., and thus render it in fact as a complex indeterminate problem.

In the case of indeterminate problems there are a large number of considerations and, as previously noted it is often difficult to locate the exact cause of the problem. So the process of exploring the context of the problem introduces new data that begin to form the ‘big picture’ or total context of the problem. The designer is now working with the known or inherent parts of the problem in addition to the discovered, contextual parts of the problem. This creates a very rich environment of data and information to work from. However when presented with a complex problem, analysis of the problem alone will not provide a solution; an additional step is required of the IA, one where the designer subjectively formulates the solution through synthesis.

Key characteristics of problem/solution ecologies include, amongst other things, paradox, conflict and contradiction and this is where a traditionally analytic approach to solutioning falls short as do often purely discipline-led approaches as they fail to grasp the larger complexities of the problem wherein paradox, conflict and contradiction often reside.

Unpacking the problem space into parts provides clarity, new perspectives and creates opportunities to reconfigure the parts to discover a solution by restructuring the problem. Rather than simply accepting a body of knowledge as ‘fact’ and applying it to a design problem, this dimension of reflection requires IA to deconstruct and rebuild bodies of knowledge through exposure to one another in a cognitive approach almost identical to that involved in the development TD research methodology (Wickson et al, 2006: 1053).

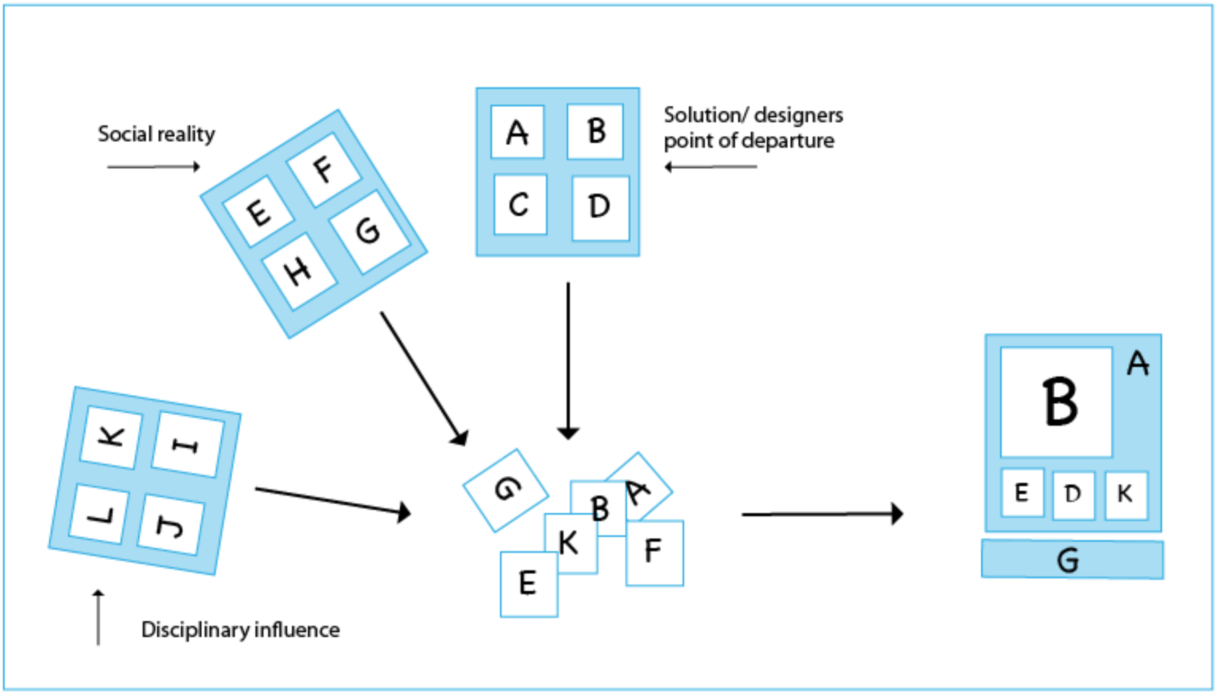
The process of analytical deconstruction is followed by synthetic reconstruction: a reformulation of the parts both in terms of how they are perceived and understood, their meaning in isolation and their meaning in relation to one another.

Having unearthed all relevant data and insight that constitute an understanding of the current dysfunctional problem-space, the IA designer will endeavor to re-organise the data into a new solution that accounts for the multiple realities of the stakeholders and end-users of the problem. Techniques applied include journey design, card sorting, scenario development, persona creation, concept and content maps and others.

For example, rapid ethnographic studies, user interviews and surveys produce data from which personas are developed. Personas are placed in scenarios that test the ability of the design solution/s to answer the needs of those personas, the contradictions and paradoxes of the problem ecology. Scenarios are then linked across larger user journeys that again test the interrelation of various problem spaces, their contradictions and paradoxes across the macro concerns of the problem ecology. The process then continues to iterate between personas and micro and macro concerns until a workable design solution is attained.

This area of complexity, which meets the description of designs Included Middle, as defined earlier in this text, is the space where many of the cognitive process and tools embedded in IA practice, explicitly support design synthesis and it is in this sense that information architecture is transdisciplinary in nature.

Figure 12: This diagram attempts to describe the process of analyzing the influences and sources of context and data (institutional, social and the designers' subjective reality), their decontextualisation, synthesis and the resultant reformulation of parts through restructuring, which provides new meaning. (Fenn & Hobbs)



Two examples of techniques used by IA's for synthesis are user journeys and card sorting. In the case of the former, user and business / organizational needs, content and functionality are mapped into engagement or relationship models that allow problems and related data from disparate sources (regions within problem ecologies) to come together in models that start to provide harmonies and solutions in paradox and conflict driven ecologies (see Figure 13 for an example of a user journey). The latter, card sorting, takes elements of content and functionality from the problem/solution ecology and presents them (as keywords on library cards or post-it notes) in no particular order to end-users of the system (where the users are representative of a cross-section of different user-types and profiles in the system). Users are then asked to organize (categorise or group) elements of content and functionality in ways that are meaningful to them. Through this collaborative design process IA designers are able to understand the conceptual-models used by users when they interact with the system and thus synthesise solutions in a manner freed from the pre-conceptions of the inherent structures of the problem/solution ecology held either by the designer or the internal stakeholders of the problem (see Figure 14 for a photograph of a user engaged in a card sorting exercise)

Figure 13: An example of a single lifecycle stage in a user journey created for an automotive website. (Fenn & Hobbs)

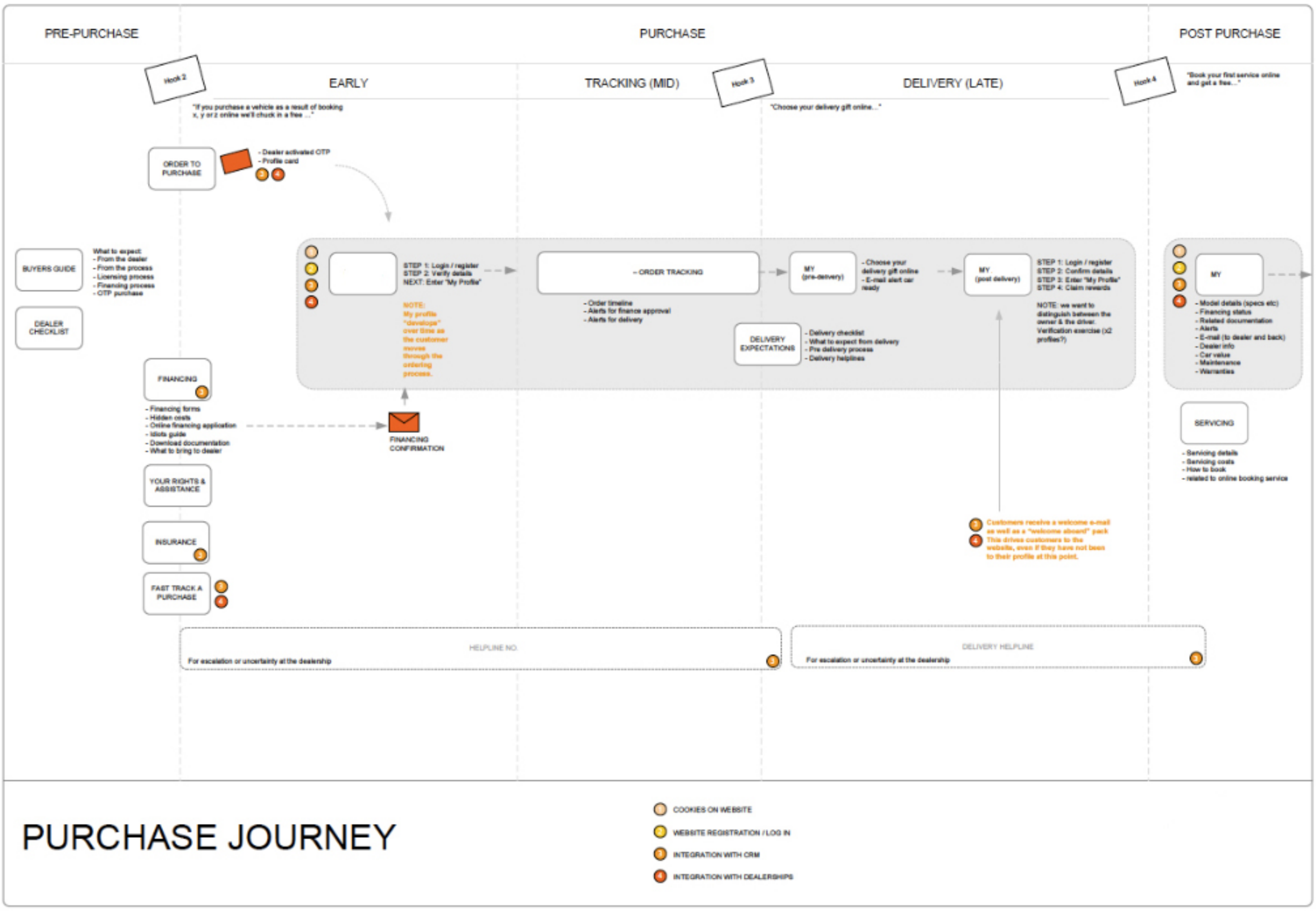


Figure 13 (insert): A close up- of the delivery tracking stage of the journey (Fenn & Hobbs)

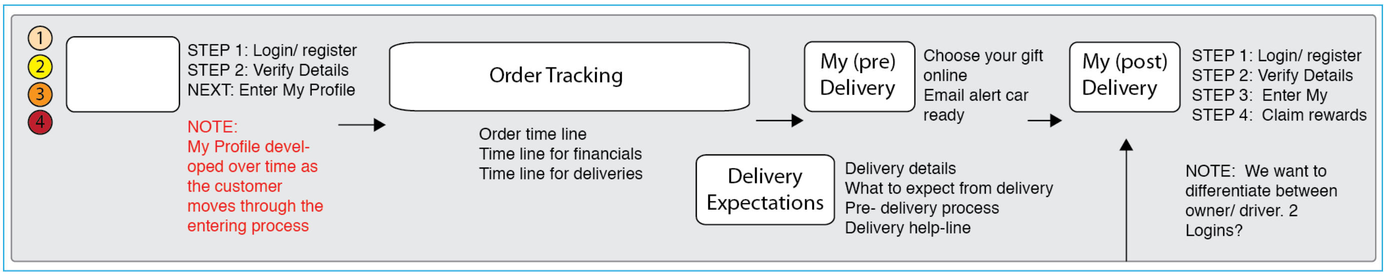


Figure 14: A photograph of a user organizing content and functionality in a card sorting exercise. (Fenn & Hobbs)

The transdisciplinary nature of information architecture design

Information architecture design provides the foundational structural solution to problems, however in the end- product, the artifact experienced by the end-user; the information architecture is often hidden.[10]

The IA is not the final, experienced artifact. In the case of a website, the graphic design, navigation design, functionality and content tend to be the explicit elements that make-up the user experience: they are directly experienced. The underlying structure that allows all these parts to sit harmoniously (or inharmoniously) together is the information architecture.[11]

---

[10] The popular community-based and practice-led website of IA "Boxes and Arrows" has used the tag line 'The design behind the design' for many years.
[11] It is worth noting that the IA that exists may not ever have been explicitly designed or have been created by someone that self-identifies with the role of IA. This is often the case when an original IA design has morphed over time into something that no longer holds the original principles and objectives of the design or when a programmer, graphic designer or even project manager has been tasked with designing a website when no skilled information architect is present to contribute to the thinking.

This is most clearly observed in the deliverables of IA. In website design site maps are used to show how content and functionality will be categorized into hierarchies that the end- user ultimately will click through (using hyperlinks), through the design of navigation and code programmed by a coder (see Figure 15). Task-flows reveal how pages should be linked, in what order, with what content and functionality within, so that the end-user can have an optimal experience in attempting to complete a task through their interaction with functionality, for example a log in process (see Figure 16). The information architect will also define the layout of navigation, content and functionality in pages and define different page-types that contain the rules for the display and behavior of pages at different levels of the hierarchy (see Figure 17) however it is the code used to build the webpages and the graphic design and content in the pages that the end-user will directly perceive and interact with.

Figure 15: A site map for a website. The tiers at right reveal how content and functionality will be displayed in navigation at different levels of the website. Note that each item of content and functionality has an associated code that references the page type and wireframe for that page. (Fenn & Hobbs)

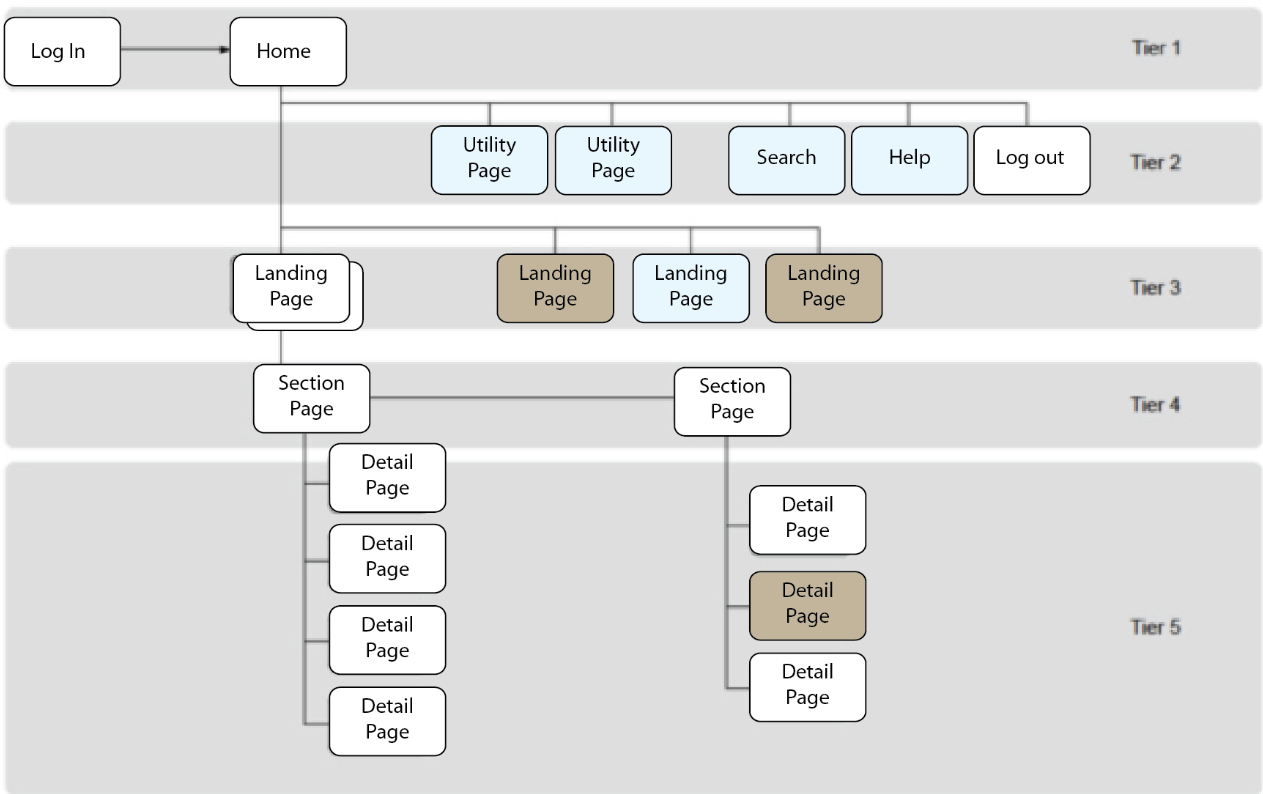


Figure 16 is an example of a task flow. Each block represents a page in a website (and flow). (Fenn & Hobbs)

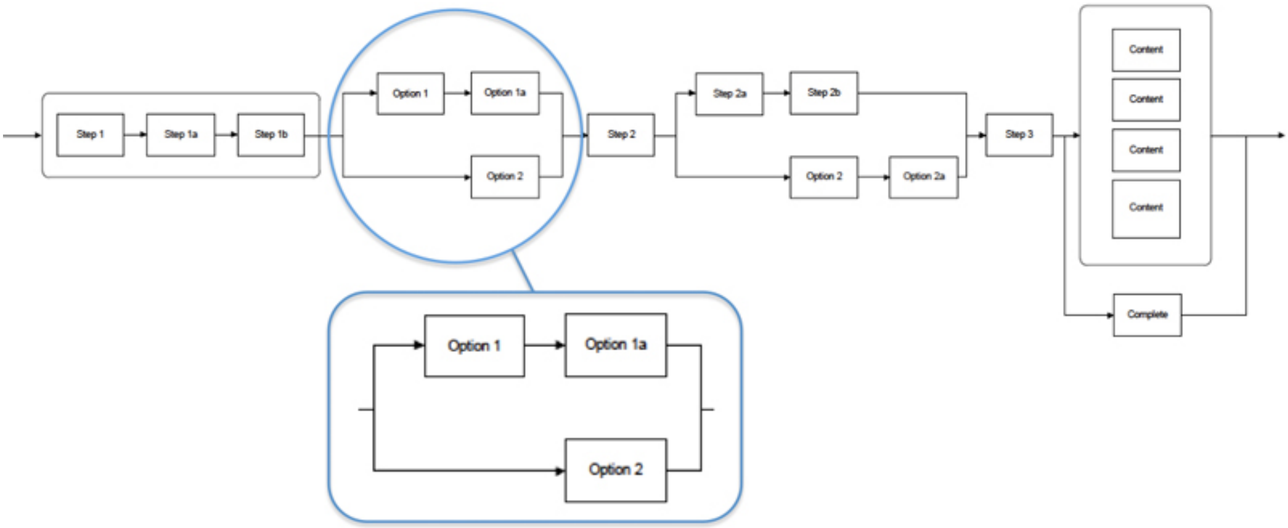
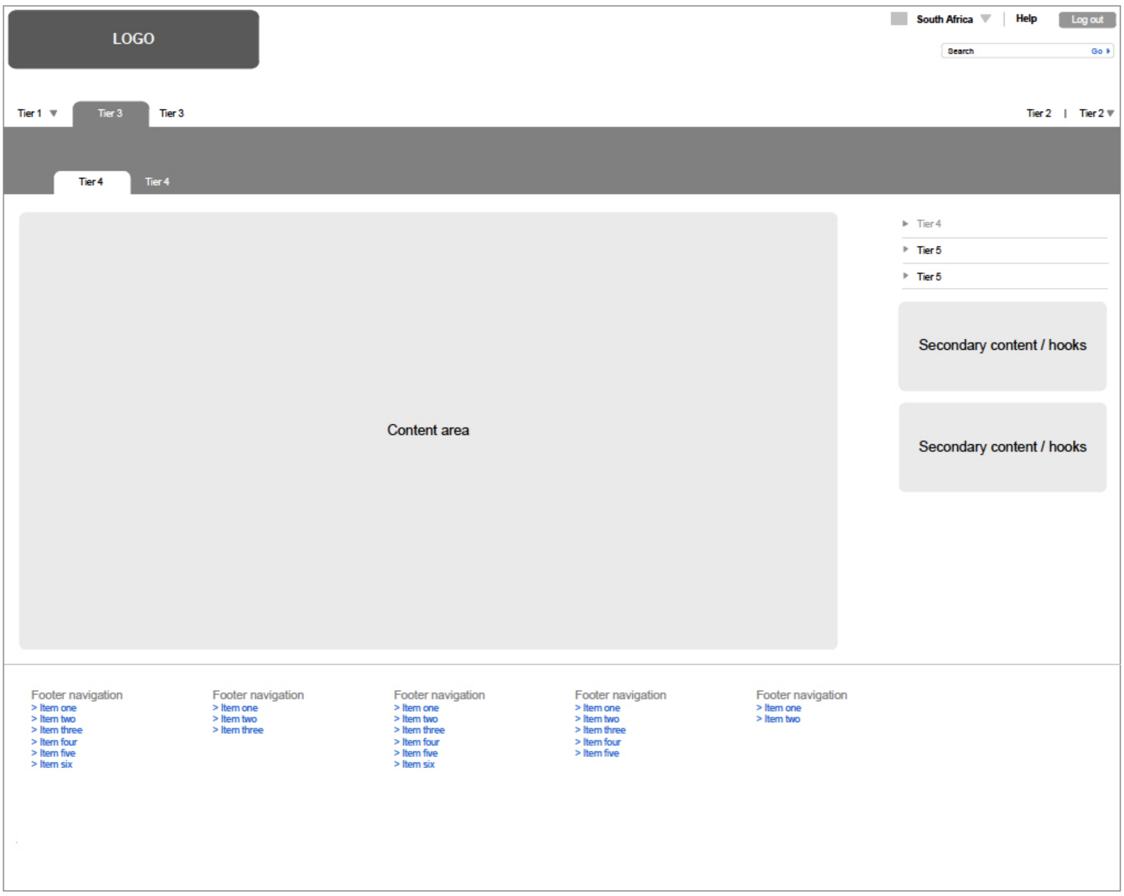


Figure 17: an example of a wireframe where the aforementioned tiers in the sitemap hierarchy are being demonstrated as areas of navigation. (Fenn & Hobbs)



Additionally, when creating the IA for a website the designer will be thinking about how the IA needs to effectively work within the constraints and opportunities provided by the media in which it will be experienced (a desktop browser, a mobile phone browser or a tablet browser for instance). The IA however remains one step removed from the end-product. For example, the information architecture of a website is bounded to the media in as much as a key benefit facilitate the findability of various items of content and functionality in the website through designing carefully labeled categories or a search mechanism. However, the semantic, organisational and structural relationships between content and functionality are in no way necessarily bound to any media. It is an illusion of a product- led approach to (information architecture) design that presents the media (or an outcomes based approach) as the driver behind the information architecture design. Information architecture, first and foremost, is interested in meaning as it exists as structure, which thereafter is tailored for media (although it may not appear this way in practice).

All the above examples are drawn from bounded IA, however cross-channel IA has an easier job of describing the transdisciplinary nature of IA. In their book *Pervasive Information Architecture: Designing Cross-Channel User Experiences* (2011) Resmini and Rosati present five heuristics (place-making, consistency, resilience, reduction and correlation) that specifically argue the way in which pervasive logics for the formation of structures across media can form the basis of experiences that take their meaning, in part, through structures, that in the first instance, are unbounded. For example, they describe Correlation as "...the capability of a pervasive information architecture model to suggest relevant connections among pieces of information, services, and goods to help users achieve explicit goals or stimulate latent needs" (Resmini & Rosati, 2011: 168). Note that there is no mention of channel or media; rather, it is correlations between the "pieces of information, services and goods" (ibid) that ultimately are experienced across channels and media, or independent of any particular channel, that the IA seeks to design and define. Further they describe (Resmini & Rosati, 2011: 183) the way in which these heuristics operate in the context of one another:

…correlation strategies of course impact on other heuristics. Correlation helps reduce the paradox of choice (reduction […] especially when dealing with focus and magnification), supplies alternative and custom navigation paths (resilience), and ultimately facilitates a berry-picking approach (place-making, resilience).

The argument for the transdisciplinary nature of IA is closely coupled with the need for a language of expressing solutions. From an educational perspective this is critical. Information architecture provides a multitude of deliverables that can be applied directly or adapted for the purposes of developing in learners the ability to analyse, synthesise and express solutions in an un-bounded manner, where the solution can be presented, discussed and critiqued as separate to and without the need for it to be inferred through final designed artifacts and products. In this way we can explicitly develop the thinking skills implicit in information architecture design that will assist in solving indeterminate problems.

The transdisciplinary nature of IA is perhaps best argued through exploring the manner in which meaning is created in IA. Meaning making in information architecture is a very recent discourse among both practitioners and academics in the field. The importance of understanding meaning making in IA is overdue given how far we are into the informational age, where the proliferation of indeterminate problems (and their elusive solutions) are increasingly being defined by the large amounts of data that define them.

It is in the act of synthesis, restructuring and solutioning with the end of creating solution-ecosystems, that composition occurs and it is in this act of composition, that new meanings through new structural forms and arrangements of parts (data), are created. These activities, and the associated design, can be found in both bounded and cross-channel IA but are most clearly exhibited in poetic IA. In all instances however it is the distinction between design- solution and design- artifact that provides the opportunity for the application of IA to extend beyond the current view of its application in practice.

It is thus our position that, divorced from the dominant understanding of the bounded, product-led practice of information architecture design that predominates today, that the thinking tools and techniques that characterise IA could be considered to be a critical tool for solving indeterminate design problems within any or across multiple environments. It is this skill, which we hope to develop in our students. Through its user-centered and empathetic approach, a non-prescriptive dealing with cognitive problems (which allows for indeterminacy and its explicit tools for achieving these ends) we believe that IA is transdisciplinary and that the specific manner in which information architects analyse and discover, synthesise, and express their solutions provide:

1. A design method for discussing shifts in meaning (and what this may mean in terms of risk, impact, socialization, etc.) through the tools used and
2. A basis for students to directly engage with what structuring complex solutions involves because it is given form through deliverables that labour to express the underlying structure and meaning in solutions and not just the final artifactual evidence that resides at the product-level.

Ideally, the cognitive abilities and processes that facilitate structured thinking, as employed by information architecture designers, should be understood to form the basis for conceptualising, executing and measuring learning methods for design students.

Conclusion

As described in this paper, the practice of design when considered foremost as a discipline neutral, people-centred, problem-solving practice has many similarities to the fields of transdisciplinary research and information architecture. All three of these fields consider the process of problem solving as deeply embedded within the social realities of people. All three of these practices also recognise that the outcome of a rich exploration of the contexts of the problem would result in vast and unresolved data, which viewed collectively results in a high level of complexity. All of these practices consider the act of identifying and understanding the often illusive and complex problem as a fundamental step in solving the problem. Again, design, TD and IA all recognise that the resolution of found problems, may take various forms and are unique as they are constructed in reference to the particularities of specific problem contexts. This integrated process of identifying solutions through a deeper understanding of problem and their contexts and in return understanding the problems, better, through the embedded knowledge, affordances and limitations of the solution is systemic and iterative. Therefore as problems are often complex with multiple solutions the act of problem resolution is also complex.

In this paper we have termed the site of this integrated and systemic modeling the problem/solution ecology. For the cognitive act of resolving these complexities in such a manner as to account for the multi-realities of the problem such as the perceptions and beliefs of the users and the rationalities of commerce, we have applied a loose adaption of the Principle of the Included Middle. While design, TD and IA may be considered essentially transdisciplinary as they source the context for practice from both disciplinary and social realities, they do diverge in the forms that their solutions finally take due to their own disciplinary logic. While design contains a rich legacy of physical, digital and systems-based solution, in contrast information architecture solutions are usually conceptual, represented in diagrammatic plans that tend to be translated by other design disciplines or developers into the final design solutions with which users interact.

As IA focuses on the cognitive resolution of designs Included Middle through the synthetic composition of meaning and contains within its disciplinary knowledge many explicit tools that help to structure the thinking required for solving the complexity of the problem/solution ecology, we believe, as we have outlined in this paper, that these cognitive tools could provide value to both students and educators who seek, as they must, to grapple with the complex problems of our time.

References and Citations:

Brown, N. 2000. The Representation of Practice. Working Papers in Art and Design 1. Available at http://www.herts.ac.uk/artdes/research/papers/wpades/vol1/brown2full.html (accessed May 14 2010)

Buchanan, R. 1992. Wicked Problems. Design Issues, Vol 8, No2, pp. 5-21

Nicolescu, B. 1984. Towards Transdisciplinary Education and Learning.
Available at B Nicolescu, listserv.metanexus.net (accessed August 13 2012).

Cross, N. 2001. Designerly Ways of Knowing: Design Discipline versus Design Science. Design Issues, Vol. 17, No. 3, pp. 49-55, 2001

Cross, N. 2006. Designerly Ways of Knowing. London: Springer- Verlag

Goldsmiths University of London. MA in Design: Interaction Research.
Available at http://www.gold.ac.uk/pg/ma-design-interaction/ (accessed August 13 2012)

Hunt, J. 2009. TransDesign Q&A.
Available at http://transdesign.parsons.edu/faqs/ (accessed August 13 2012)

Jahn, T, Bergmann, M & Keil, F. Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics* 79 (2012) 1–10

Johnson, N. 2007. Simply Complexity: a Clear Guide to Complexity Theory. Oneworld Books: Oxford

Kazmierczak, E. 2003. Design as Meaning Making: From Making Things to the Design of Thinking. Design Issues. 19(2) 45-59

Kuniavsky, M. 2010. Smart Things: Ubiquitous Computing User Experience Design. Burlington, MA: Morgan Kaufmann

Max-Neef, M. Foundations of transdisciplinarity. *Ecological Economics* 53 (2005) 5–16

Merriam, S. 2009. Qualitative Research: A guide to Design and Implementation. San Fransisco: Jossey- Bass

Norman, D. 1998. The Design of Everyday Things. London: MIT Press

Norman, D. 2011. Living with Complexity. Cambridge (Mass) & London: MIT Press.

Parsons the new School for Design. Transdisciplinary-Design.
Available at http://www.newschool.edu/parsons/mfa-transdisciplinary-design/) (accessed August 13 2012)

Resmini, A & Rosati, L. 2011. Pervasive Information Architecture. Burlington, MA: Morgan Kaufmann

Rittel, H & Webber, M. 1973. Dilemmas in a General Theory of Planning. Policy Sciences. (4) 155-169

Rosenfeld, L & Morville, P. 2007. Information Architecture for the World Wide Web, 3rd Edition. Sebastopol, CA: O'Reilley Media

Russel, B. 2009. Human Knowledge: its Scope and Limits. London & New York: Routledge

Shedroff, N in (ed) Jacobson, Robert E. 1999. Information Design. Cambridge, Mass: MIT Press

Stanford University. Real World Projects. .
Available at http://dschool.stanford.edu/our-point-of-view/#real-world-projects (accessed August 13 2012)

University of Central Lancashire. Transdisciplinary Design.
Available at http://www.uclan.ac.uk/information/courses/ma_transdisciplinary_design.php (accessed August 13 2012)

University of Pretoria. Department of Visual Art: postgraduate programmes
Available at
http://web.up.ac.za/default.asp?ipkCategoryID=9341&sub=1&parentid=1584&subid=1627&ipklookid=9 (accessed August 13 2012).

Van der Merwe, J. 2010. A Natural Death is Announced. Design Issues. 26(3) 6-17

Wickson *et al*. 2006. Transdisciplinary research: characteristics, quandaries and quality. *Futures.* 38 1046-1059.

Wurman, R. S. 1996. Information Architects. Zurich: Graphis Press Corp

www.boxesand arrows.com.
Available at www.boxesand arrows.com (accessed May 17 2010)