

ACES

Design and the Art of Management THEMED ISSUE

THE DENVER BIENNIAL
OF THE AMERICAS
Bruce Mau

DESIGN THINKING
Bauer and Eagen

DANCE AND ORGANIZATIONAL LEARNING
Rowe and Smart

BUILDING DESIGN CAPABILITY
Sung and Chang

INTERACTION DESIGN AND INNOVATION
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DESIGN METHOD AND COLLABORATION
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DESIGN PROCESSES AND TOOLS
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STRATEGIC PLANNING,
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Rubinyi

DESIGNING INNOVATION
INTO ORGANIZATIONS
Costello, Mader and Gatto

THE ARTIST ENTREPRENEUR
Fletcher

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The Aesthesis Project was founded in January 2007 and is a research project investigating art and aesthetics in management and organizational contexts. The project has its roots in the first Art of Management and Organization Conference in London in 2002, with successive conferences held in Paris, Krakow and The Banff Centre, Canada. From those events emerged an international network of academics, writers, artists, consultants and managers, all involved in exploring and experimenting with art in the context of management and organizational research. The Aesthesis Project will be developing extensive research and artistic projects internationally, with academic research fellows and associate creative practitioners, publications and consultancy.

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EDITORIAL

This edition of *Aesthesis* has had a long gestation period, in part due to its visual complexity. The contributors to this issue (except Bruce Mau) were originally convened by Ken Friedman and Laurene Vaughan for an international conference stream on design management, held over four days at the Art of Management and Organization Conference at the Banff Centre Canada in September 2008 (For the next invigorating conference, in Istanbul, see the rear of this issue). Despite the divergence of subject matter and different disciplinary approaches to the subject of design, a genuinely stimulating and international dialogue emerged, and this issue of *Aesthesis* is the product of that dialogue. Not all the research contributors to the conference were able to continue working on their material for this issue, so for their input we thank Rob Austin and Daniel Hjorth of Copenhagen Business School and Gökçe Dervisoglu of Istanbul Bilgi University. As to this issue – enormous thanks are due to Bruce Mau and the Bruce Mau Studio in Toronto and Chicago, to Seth Goldenberg, Andrew Clark, and particularly the wonderful Whitney Geller!

Ken Friedman's art, design, performance, and media work, as well as his academic research and leadership has stretched across many countries as it has industrial sectors and academic disciplines. From the extremities of Fluxus in the 1960s to his current academic role in Australia, it is a pleasure to have his editorial presence in this issue – as it is Laurene Vaughan, whose design leadership and project management is evident in her collaborative paper in this issue. Vaughan is part of a growing sector of design researchers and managers in Australia whose geographic location, far from inducing a sense of isolation, provides the impetus for global networking and international projects.

During the past two years The Aesthesis Project has been centrally concerned with three objectives – first, bringing together creative practitioners (whether artists, managers or consultants) with scholars and researchers, breaking down the institutionalised barriers that keep us apart; second, encouraging and facilitating the visual presentation and interpretation of academic research; and third, in part as a result of the second, encouraging public dissemination of research. It is with these objectives in mind that this diverse group of contributors have been brought together – designers, consultants, academics, design managers, design business managers and design project managers. Our theme is 'design', but the content is relevant to any organization or manager concerned with developing innovation models, product or service development, IT capability and the creative process, design audit and evaluation.

'Design' is still viewed as a 'specialist' discipline, largely associated with 'making things' – and yet, what organization, company or institution does not function 'visually' and do so using design – from their web presence, corporate facilities, market communications, product design and packaging, branding. Who needs convincing that the leaders in global business invest massively in their design – from their strategic brand to new product development and service design innovation. The emphasis of this issue therefore, opening our Papers section with Robert Bauer and Ward Eagen's seminal article, is 'thinking' – using design concepts, processes, tools and models to implement creative and productive change, and this can be done in any organizational context. However, far from being supplementary to extant organizational processes, as Rowe and Smart show with regard to the biotech industry, thinking 'design' can be central to conceptualising organizational processes. Even Robertson's 'models' of design thinking, used largely in a creative agency context, can be implemented in generic way within multiple business contexts.

However, as much as design can become both a mechanism for business or organizational development, the prevailing narrowly instrumentalist and functional conception of 'design' must be challenged – design as the mechanism through which art, culture and creativity can be exploited for corporate profit. Design is both culture and aesthetics as well as industrial innovation and business 'solutions'. Great design creates a new field – a virtual zone between business/industry and culture, where both enter into dialogue and do so in a critical spirit. Culture does not have a monopoly on creativity; industry is not always the source of economic development; business is not the only means of generating wealth. Only in the critical dialogue between art-culture and business-industry, with its conflicts and contradictions, will we be able to ascertain the 'what and how' of developing our economies.

It is the purpose of this issue to hold these two dimensions in tension – the industrial application of design thinking and the broader aesthetic or cultural meaning of design, a meaning that is never wholly appropriated strategically or in fact can be, as it involves aesthetics and cultural values that are always shifting in their role in the experience of designer and consumer alike. We feature Tung-Jung Sung and Pai-Yu Chang's systematic analytical assessment of a design consultancy's resources and capabilities, category by category; their analysis is highly useful in any design audit or context of rigorous organizational evaluation. We also feature Richard Fletcher's reflections on the new 'artist entrepreneur' and their role in the 'new creative economy', and Lucy Kimbell's review of three of the most notable design exhibitions in recent years.

Most of our papers have emerged from the contributor's professional experience, which is true of Bob Robertson and his agency, as well as Kelly Costello, Roger Mader and Jessie Gatto, where we find design as a mechanism through which innovation is conceptualised and implemented within organizational development. Laurene Vaughan, Nifeli Stewart, Michael Dunbar and Jeremy Yuille take us step by step through a University-based

research project, where the design and development of an online digital video prototyping and annotation tool is undertaken reflectively, considering the methodological implications of their steps. Stefan Holmlid similarly stands in the gap between university research and industry, drawing on his experience of both, investigating the new frontier of interaction design. Kati Rubinyi offers what is probably the most unpredictable paper, moving from the framework of web design for urban planning in contemporary California to a visionary architectural project of the early 1960s – Cedric Price's *Fun Palace*.

Bruce Mau, who opens this issue, is one of the great designers and design thinkers of our time. His design practice, research, writing and management draws on the great philosophical and formal traditions of design and art history, but is dynamically future-oriented. Mau articulates the need for design as a political imperative – faced with global climate change and chronic economic instability – the obligation for massive change must be promoted in the way we live our lives, our communication, culture, cities, corporations, social and education systems.

The term 'massive change' became Mau's leitmotif with his 2004 multimedia exhibition at the Vancouver Art Gallery, articulating the means by which design method can address structural problems in areas as diverse as information, transportation, energy, materials, manufacturing, military, health and politics. The resultant book, *Massive Change: Bruce Mau and the Institute Without Boundaries* (Phaidon) is a major contribution to the history of design as a discipline, but more than that, conceptualised design as a premier synthetic, multi-disciplinary and non-partisan means by which the most major human environment-based dilemmas can be addressed.

Bruce Mau's contribution here in *Aesthesis* is his latest project: as Artistic Director of the international cultural event, The Denver Biennial of the Americas, he will demonstrate the centrality of design thinking to cultural politics as well as global wellbeing – our beliefs, values, lifestyles. It will become a platform that design has rarely had.

This issue has been a long journey of discovery – on behalf of the editors of The Aesthesis Project I hope you find it inspiring, instructive and useful.

Jonathan Vickery
issue General Editor

Design Thinking

— Epistemic Plurality in Management and Organization

Robert M. Bauer Ward M. Eagen

So Design Thinking is neither just design, nor thinking: it is both something more and something less than designing and thinking. This paper outlines 'Design Thinking' as a solution oriented generative methodology for creating desired outcomes – and it goes well beyond the making of aesthetically pleasing artifacts and environments. We have outlined a programme of design thinking that is fundamentally multi-epistemic using a Jungian typology of ways of knowing (thinking, feeling, sensing and intuiting), and this contributes to our understanding of how the best in creative problem solving is achieved.

Analytical thinking, a mono-epistemic approach, is shown to be part of, and not the opposite of, design thinking, and although analytical thinking provides the epistemic underpinning of capital, design thinking represents the epistemology of creative labor. We believe that a more significant adoption of a design thinking stance would be beneficial and could ultimately lead to entire organizations becoming design agents.

1. DESIGNING AS CREATIVE PROBLEM SOLVING

Instrumental rationality and analytical thought are effective in optimizing solutions for a defined problem with a defined goal and a defined solution space. Rational decision making has been the major paradigm for economic action even though it has been widely acknowledged that organizations and managers face problems that do not satisfy these conditions. Today there is an heightened awareness of the potential of design thinking to go beyond the critique of analytical thinking by providing a more comprehensive alternative in dealing with managerial and organizational problems. 'Design thinking' is a term that designates how designers go about creating artifacts and environments such as industrial products, buildings, services or graphics. The term is widely established, yet unfortunate as it implies a style of *thinking* thereby de-emphasizing that designing extends far beyond intellectual activity.

Since the 1960s research in design thinking has been conducted, predominantly by researchers of computer-based expert systems and researchers aiming to explain and improve design processes and education. More recently, a third group has become strongly interested in design thinking: the business community, including practitioners, consultants, scholars, educators and media. 'Design thinking' has emerged as a label for an approach for enhancing managerial behaviors and processes by partially modeling managing after designing (e.g. Boland and Collopy 2004). This managing-as-designing approach has been fueled by design firms (most notably IDEO) repositioning themselves as innovation-strategy consultancies, by design schools (such as the Design Institute in Chicago or the Stanford D-School) directly addressing the business community through offering consulting and education, by business schools (most prominently the University of Toronto's Rotman School of Management) promoting design-inspired management education, and by business media (most importantly *Business Week*) spreading the word and shaping the discourse.

In this context, 'design thinking' represents a generic approach to creative problem solving or, less cognitively framed, to creating valuable new arrangements that improve consumer or work experience. It appears that businesses are facing increasing pressure for innovation and growing demand for products and services that offer rich experience beyond technical functionality. If this is true, then it is no surprise that design thinking is gaining currency among business practitioners, consultants and scholars because design thinking seems more suited to the task of creating the new, rich experiential artifacts and environments than singularly analytical methodologies.

This broad based interest suggests that the concept of design thinking is understood as highly general in the sense of being applicable to many different types of problems, an understanding which brings the concept close to where it originated. As early as 1968, Simon noted: 'Everyone designs who devises courses of action aimed at changing the existing situations into preferred ones... Design, so construed, is the core of all professional training; it is the principal mark that distinguishes the professions from the sciences... The natural sciences are concerned with how things are... Design on the other hand is concerned with how things ought to be' (Simon 1969: 111-114). In Simon's view, 'design' is a highly general term, not restricted to the design professions that produce aesthetically pleasing artifacts and environments such as graphic, industrial and interior designers. Specifically, design is contrasted with analysis. Professions design: they explore possible worlds and shape the actual world prescriptively. By contrast, sciences conduct descriptive analysis; they take the world as given explaining how it functions by revealing underlying causal mechanisms (Simon 1969; Gordon 1973). This dichotomy between analysis and design is central to the current discourse about design thinking in management. Design thinking is portrayed as a potential remedy for managerial over-reliance on analytical thinking and carries the hope that the gap between analyzing existing alternatives and creating new ones will be filled.

Simon's apparently sharp distinction between analysis and design is actually, however, of solely heuristic value and does not withstand scrutiny. Fundamentally, it is impossible to fully disentangle prescription and description, action and observation, or invention and discovery (e.g., Heisenberg 1955; Maturana and Varela 1984; Horkheimer 1937; Latour and Woolgar 1979; Bernstein 1983). In Simon's writing his analysis/design dichotomy serves purely as a rhetorical device. He juxtaposes detached, abstract problem solving with interventions into the lived world only to suggest that they are essentially no different. Apparently, Simon sees analysis and design as intellectual activities for solving well-structured and ill-structured problems, respectively. Hence his claim that by and large, analysis, primarily in the form of the standard logic of declarative statements, will also suffice for design: 'It can be shown that the requirements of design can be met fully by a modest adaptation of ordinary declarative logic' (Simon 1969: 115). It is probably fair to say, that Simon's position cannot be separated from his core research interest, namely enabling computers to solve ill-structured problems, for which the applicability of formal logic is a necessary precondition.¹

Simon characterizes ill-structured problems by the absence of given alternative solutions but still assumes a clearly defined solution space. Thus solving ill-structured problems takes on the form of a tree search: given an initial state, a desired end state, and a set of actions that change the initial state, the design task is to search the solution space consisting of all possible combinations of actions for the optimal solution. However, compared to the 'wicked problems' that designers typically face (Buchanan 1992), searching a potentially very large but well-defined solution space is still a 'tame problem'. 'Wicked problems', a technical term coined by Rittel, lack clearly defined solution spaces and desired end states (Rittel and Webber 1973). Alternative solutions differ in degrees of better or worse according to multiple and usually conflicting criteria but are virtually never correct or right. Such problems have no inherent stopping rule to determine when problem solving is complete. Moreover, each 'wicked problem' is essentially novel and unique, and, more often than not, testing is prohibitively expensive. Briefly, a 'wicked problem' is only fully understood through its solution, which must be produced through a one-shot operation.

Simon's 'ill-structured' problems and Rittel's 'wicked problems' differ significantly. Simon defines design as intervening in the lived world but treats design problems as formal problems: getting from an initial to a desired end state is equated to connecting two coordinates in abstract space, a question to be answered by a computer. Conversely, Rittel conceptualizes design problems as fully embedded in the lived world, dynamic, moving targets open to negotiation until designing ends, which often occurs for no other reason than exhaustion of resources. Such problems are managed or dealt with, rather than solved; and they require competent human agents to do so.

Corresponding to these conceptions of problems and problem solving agencies, there are two branches of inquiry into design thinking: artificial intelligence research and research that aims at enhancing human designers' capacities through providing tools (Rittel 1972; Conklin 2006) or, improving design training and education (Lawson 1997, 2004; Eastman 2001; Cross 2006). Both lines of research have made tremendous progress. Computers and robots routinely perform tasks that not so long ago seemed out of a machine's reach (e.g., speech and face recognition; walking rugged, natural territory; or piloting airborne, seaborne or ground mobile vehicles). On the other hand, pioneering empirical studies of how architects design (e.g. Eastman 1970; Lawson 1972, 1979; Akin 1986; Rowe 1987; Darke 1978) has led to a substantial body of empirical research into architecture, engineering and industrial design practice that has significantly improved our understanding of design. Until now neither line of research has reached their ambitious goals. Computers are far from being trusted with complex problems such as urban planning or winning architectural competitions, and design education is incapable of systematically producing outstanding designers (or raising the average to what previously counted as excellent).

The current understanding of design thinking that pervades the ongoing discourse on design thinking in management relies heavily on the epistemology, psychology and practice of architectural, engineering and industrial design. It owes a great debt to Simon's highly general concept of design thinking that laid the foundations for applying design thinking to management. Simon broadened our perspective by moving from well-structured to more ambiguous ill-structured problems. Rittel continued this line of reasoning introducing 'wicked problems' that are even more undetermined, and nominally situating both Simon's well-structured and ill-structured problems as 'tame'. Analytical thinking may be sufficient for solving well-structured problems but as the degree of ambiguity increases, so does the necessity of a more encompassing, general epistemological concept. 'Design thinking' is that concept, involving all epistemic modes that

constitute human experience and despite the term's connotations, it can neither be simply reduced to aesthetic judgment, nor cognitive reasoning.

2. HOW DESIGNERS THINK

Empirical research into the psychology and epistemology of design has been conducted since the early 1970's, initially focused on architectural design and expanding into engineering and industrial design (for excellent surveys see Lawson 1997, 2004 and Cross 2006). Basically, this research has tried to answer two questions: first, how do designers solve problems differently than non-designers; and second, how do experienced or distinguished designers' work differently than novice or average designers, respectively? Methodologically, researchers have primarily relied on variations and combinations of concurrent protocol studies (i.e. taping designers who think aloud while working in a lab or studio to create design solutions) and in-depth interviews (i.e. designers retrospectively describe how they design). Both methods have their limitations. Laboratory studies miss many factors that influence every-day life and work; and thinking aloud strongly intervenes into the processes meant to be observed. Retrospective self-reports are necessarily narratives with a particular perspective. Over time, however, this research has revealed interesting features of design thinking.

Designers tend to explore problems through solution conjectures rather than analyzing the problem and subsequently generating alternative solutions (Lawson 1979; Kolodner and Wills 1996). Designers often shape both the problem framing (Schön 1988; Lloyd and Scott 1995) and possible solutions, aiming for matching problem-solution pairs (Cross and Dorst 1998) rather than searching a given problem's solution space. Designers often work in a playful fashion, physically engaging with representations in the form of drawings, models and prototypes (Lawson 2004; Schrage 2000). They frequently introduce new goals and constraints throughout the design process (Akin 1986) — even when dealing with rather well-defined problems (thereby, treating them as ill-defined problems) (Thomas and Carroll 1979). Designers often reduce complexity early on by committing to particular details (Lawson 1994), or simple formative ideas, abstract principles or 'generators' (Darke 1978), or they explore the problem until they find such a complexity reducing 'first principle' (Cross 2001), rather than start with the general and move towards the specific. Consequently, the design process grows

from attempts to creatively resolve the tensions between two or more such complexity reducing foci or principles (Rowe 1987).² Designers tend to deliberately utilize the tension between what is desired and what is possible, often starting with the desired and working their way back to what is doable.

These insights are illuminating and encouraging, yet are far from amounting to a coherent model of design thinking. In fact, it is still unclear if design thinking is a sufficiently coherent phenomenon to capture in one model and one term only. However, in this paper we will provisionally accept this assumption, which is commonly shared in the current discourse about design thinking. In what follows we outline a conceptualization of design thinking that enables us to examine the potential of design thinking in management. We build on quasi-normative suggestions from the above mentioned key contributors to the current development of design inspired approaches to management, most importantly from IDEO (and the D-School; Kelly 2001) and from the Design Institute at the Illinois Institute of Technology (Owen 1998 a,b).

3. THE THREE MOVEMENTS OF DESIGNING: UNDERSTANDING, DREAMING, BUILDING

Although the products of design may in fact be goods and services, these physical manifestations are only the vehicles of the design agent's central intention, that is, the creation of new, rich experience. All experience is embodied and physically insinuated in the lived world, mediated through the body (Merleau-Ponty 1945). The design process necessarily starts in the grounded, embodied reality of the lived world, is led by imagination into the virtual realm of possibility, only to return to the lived world for actualization. The Design Agent's excursion via imagination traverses a realm where time and space have no limitations, where one can be entirely open to new possibilities that can be quickly and freely explored, such that one returns to the lived world with newfound possibility. Consider Freud's observation that thought is action in rehearsal and that humans are torn between the reality principle and the pleasure principle (Freud 1911). Imagination is the domain of the pleasure principle as every thought (possibility) that can be imagined is realized and yet exists without the real problems of actualization, beyond constraints, limits, and consequences. Although designing aims to change reality, it must pass through the virtual, harvesting the potential of possibility found only in the imagination and return to enrich the embodied experience of the lived world.

We suggest that the design process can generally be understood as three movements, 'Understanding', 'Dreaming', and 'Building', each containing a divergent and a convergent motion (refer to Figure 1). Understanding moves from the lived world to the virtual by Immersing into the target experience from which a Redefinition is abstracted that charts the design agent's intent. Dreaming moves within the virtual by Imagining possible worlds and Opting for the most promising directions for enriching experience. Building moves from the virtual back to the lived world actualizing promises through a progressive series of Prototypes culminating in the Presentation of a new design.³

'All doing is knowing, and all knowing is doing.'

H. Maturana and F. Varela

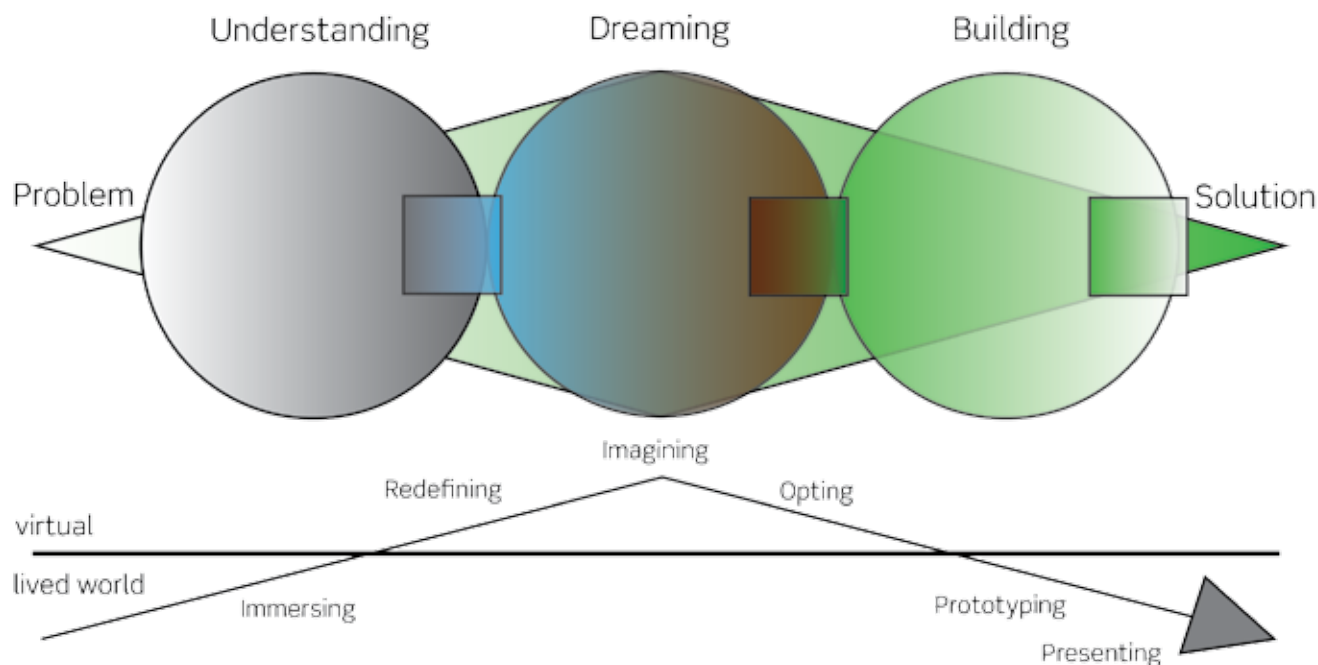


Figure 1: The Three Movements of Designing

First Movement: Understanding (Immersing And Redefining)

Understanding, the movement leading from the lived world to the virtual, is composed of a divergent motion, 'Immersing' - expanding the perspectives of the design agent - and a convergent motion, 'Redefining' - refocusing perspectives. Note that the term 'design agent' can be an individual or a collective, such as a design team or a web based community and may dynamically change with movements and motions. We are using the term to clarify that the designer as the 'genius', 'artist' or 'auteur' is not what we have in mind. Design is mostly a team process, and designers require a diverse set of skills more in the vein of facilitator or midwife than creator.

Immersing: Since all designing is designing of user experience, it is important for designers to initially interrogate the user experience they wish to improve. In order to do so designers study users, employing ethnographic research methods such as observing users in their own environment, conducting in-depth interviews with users, participating in users' practices to gain first-hand experience, and having users study their own practices (Mariampolski 2006). These methods enable designers to put themselves into the users' shoes and see the world through the users' eyes, which when successful, allows designers to understand users better than users understand themselves.

Ethnographic methodology builds on the hermeneutic cycle (Geertz 1973; Bernstein 1983) as an iterative approach to understanding. Reflecting on experience, mostly gained through observing and empathically resonating, leads to preliminary understanding (provisional conjectures), which in turn directs future attention, thereby shaping the experience that is the basis for further reflection, and so on (Glaser and Strauss 1967). Distinguishing the iterative approach to understanding from inferring inductively (from given data) or deductively (from given principles or axioms), Peirce coined the term 'abductive inference' or 'inference to the best explanation' (Peirce 1901), and design theorists have identified abductive reasoning as the 'logic of design' (March 1976; Cross 1982).

Redefining: When designers aim for Immersion by entering the users' lived world and resonating with the users' experience, their search is usually initiated and driven by a specific interest, for example, improving an unsatisfactory product or service or developing a new one for a certain target group, etc. Immersion enables designers to understand users' actual problems or needs, which in turn provides the basis for designing value. Generally, design problems are 'wicked problems' known to be caused by deeper, underlying problems (Rittel and Webber 1973). Building on the first divergent motion (Immersing), the primary goal of the second convergent motion (Redefining) is to focus efforts through uncovering the underlying, deeper problem so that an actionable problem statement can be developed that captures the design agent's intent.

Redefining is ideally grounded in systems thinking. Like competent doctors who understand an infection symptom as the combined result of the germ's 'attack' and the body's 'defense', competent design agents do not think in terms of free-standing products or services but of interventions into systems comprised of products or services and users dealing with it within a community or super-system (interconnecting users and uses of the prospective product or service). Systems thinking requires adequately defining system boundaries, modeling causal loops, and radically contextualizing meaning (Bateson 1972) all of which are cognitive moves that address how the whole and its parts react to each other. In addition, systems thinking is concerned with the timing and sequencing characterizing the evolution and current behaviors of complex systems (Brown and Eisenhardt 1997). Systems thinking is aided by various visualization techniques (e.g., causal maps, flow charts, cognitive maps, semantic webs, matrices, etc; Beckman and Barry 2007) and at times by computer-simulated models (Sterman 2001). Yet in designing human experience, storytelling, 'telling the right story right', remains the manifestation of systems thinking par excellence (Gabriel 2000).

Understanding leads from concrete experience to an abstract description of the problem to be solved. The Redefined problem statement can differ significantly from the initial one in ways that neither the client nor the design agent can anticipate. The problem properly engaged takes on a certain life of its own, however the design agent must resonate with this Redefining as it becomes the statement of intent for the next movement.

Second Movement: Dreaming (Imagining And Opting)

Dreaming remains within the virtual and is composed of a divergent motion, Imagining, expanding the solution space, and a convergent motion, Opting, where decisions are made that ultimately condense an area for actualization.

Imagining: The quest for new ideas through imagining relies on various types of thinking: *analytical* thinking challenges the presuppositions of extant ideas, destabilizing and shifting them; *associative* thinking connects ideas in a spontaneous, stochastic fashion; *day-dreaming* playfully combines the powers of conscious and unconscious information processing; and *dialogical* thinking aloud, e.g., brainstorming, merges and re-combines ideas from different individuals, and ideally resulting in what none of them could have ever imagined on their own.

Design agents use Imagining to generate a large set of alternative solution concepts for the Redefined problem; some rather elaborate and mature, others raw and partial; some concerning the design task in its entirety, others concerning particular aspects; some complementing, others contradicting, and yet others seemingly unrelated to each other. It is commonly understood that deferring judgment enhances Imagining. Not all ideas are equally useful but in Imagining's motion, an idea's value lies in its potential for generating new ideas that forward the action in the realm of the possible, rather than its potential as the basis for action in the actual world.

Opting: Designing requires imagining the world as it *could* be, envisioning how it *should* be, and yet clearly seeing how it *is*, coupled with the ability to know when to adopt which perspective. Opting is the process of centering on the group of ideas that can coherently co-exist and that warrant further development towards actionable concepts, shifting the direction of the designer's focus of attention from the possible towards the actual. Opting is highly evaluative of ideas and relationships between ideas (patterns). Yet one exits the process with many unknowns still remaining to be physically explored through modeling. At the end of Dreaming, design agents Opt for a certain solution space trusting that it can be actualized.

Third Movement: Building (Prototyping And Presenting)

The movements Understanding and Building both develop knowledge through iterative cycles. They can be viewed as mirror images with Understanding spiraling from the lived world to the virtual, and Building spiraling from the virtual back again to the lived world.

Prototyping: Prototyping aims at developing the most promising ideas generated and integrating them into an actual

product or service that enriches experience. To be successful this motion relies on specific goals and a sound understanding of what can and should be tested. Prototyping, sometimes referred to as *rapid Prototyping*, is essentially an iterative approach to knowledge acquisition through multiple cycles of action and reflection (Schön 1983). Prototyping runs counter to Cartesian Dualism in the Western tradition that separates the head from the hand, strategy from implementation, (and white collar from blue collar work). The initial build is used to explore particular ideas and specific relationships and may in fact be quick and dirty. Incrementally building on lessons learned through reflective testing as well as outside feedback, the next-generation prototype is more nuanced in its response to new interrogations. Each iteration refines until the solution satisfies the design problem or is in a satisfactory form that can be adopted by users. Designers think to build and equally, build to think, dynamically interweaving experiential knowing and physical doing.

Prototyping is the physical manifestation and conceptual continuation of Imagining as a way of exploring ideas at low risk and cost. It can be understood as an experiential model of scientific progress through the continuous falsification of hypotheses (Popper 1934). Every prototypical model, physical object, pilot project, computer simulation, etc., instantiates an hypothesis as a validity claim to test. The art of Prototyping lies in the creating of physical experiments designed to maximize insight and mitigate risk: to be successful, it requires quick learning based on very short development cycles. Prototyping facilitates rapid development and effective user feedback, enabling communication between agents that may otherwise lack shared knowledge or a common language (Carlile 2002; Schrage 2000).

Presenting: In the present motion, the client welcomes the new design as the design agent bids farewell. The wrap-up of a design project is more about releasing than resolution: rarely are there design projects or design agents that do not require more time for development. Experienced design agencies understand this and religiously guard against *scope creep* that diminishes the considerable time and budget required to make a rich, professional presentation. A successful presentation is an experience charged with the very energy and hope of the entire design process and communicates the value proposition of the new experience promised.

The three movements we have articulated are not always explicit in any design process. Consider for example an agricultural equipment manufacturer where the design team largely consists of engineers and designers who actually farm, using the company's equipment on a regular basis. Thus the design team is already immersed in the users' world and therefore Immersion is not apparent as a separate step in their design process. Or consider an architect designing a house who, after meeting the client and visiting the site (Immersion), is already quite familiar with the solution space of 'house'. Unless she wants to innovate 'house', she can go right into Building without an explicit Dreaming stage. This does not mean that she does not dream up new possibilities of 'house', but we would expect that this is in fact an ongoing condition of her life as an architect. We maintain that the three movements are fundamentally different and collectively constitute designing, although they may not always be explicit or appear in sequence in the design process.⁴

'Le cœur a ses raisons
que la raison ne connaît
point.'

Blaise Pascal

4. EPISTEMIC PLURALITY

We speak of epistemic plurality if an agent's actions are informed by diverse epistemic modes or ways of knowing. By contrast, a computer is a paradigmatic example of a mono-epistemic device, relying exclusively on the most explicit form of declarative knowledge, namely algorithms (Bauer and Moldoveanu 2008). In the twentieth century, modern cultures placed enormous emphasis on language - natural as well as formal - as the primary basis for human reasoning, understanding human brains as very powerful, complex computers. Polanyi's (1966) seminal criticism of an over-reliance on explicit knowledge as descriptively wrong and prescriptively misleading, gained tremendous currency in the 1980s as a founding piece of the knowledge or competence-based view. However, his dichotomous perspective is still (counter-dependent) on modernist ideals like complete information and full transparency, showing that declarative or explicit knowledge is necessarily complemented by tacit or implicit knowledge and can thus never be complete. As a result, Polanyi's dichotomous view breaks away from mono-epistemic, purely language-based reasoning but does not arrive at a truly pluralistic, multi-epistemic conceptualization of human knowledge and action.

Jungian Epistemic Modes

From the perspective of the Jungian model of psychological base functions, which is an early and still outstanding conceptualization of human knowledge rooted in epistemic plurality, design thinking can be understood as inclusive of analytical thinking but much larger in scope. Jung (1921) distinguishes four elementary psychological functions: thinking, feeling, sensing, and intuiting.

Thinking (Cognition): Thinking systematically relates categories of ideas to each other, linking contents of imagining into conceptual relations that enable humans to create possible worlds for risk-free exploration. Thinking ranges from daydreaming to actively manipulating symbols as tokens for ideas along the grammatical structures of natural or formal languages.

Feeling (Emotion): Feeling is an affective, sentimental function that imparts value to content as the basis of likes and dislikes. In essence, feeling positions, objects and events, including those of the mind, on a continuum from embracing through neutral to rejecting, evaluating them in terms of good or bad, pleasant or unpleasant, acceptable or unacceptable. Emotions can strongly fuel or inhibit action.

Sensing (Perception and Proprioception): Sensation provides an immediate experience of what is: one thinks and feels about things and events, regardless of their physical presence but one senses them as an object or event only within their immediate physical presence. Sensation is conscious perception that has a certainty based on pure physicality. Sensing is intimately tied to aesthetic categories such as exciting/boring, harmonious/disharmonious, beautiful/ugly, etc.

Intuiting (Intuition): Intuition is a gestalt of unconscious perceptions that possess intrinsic certainty and conviction: Spinoza and Bergson thought of intuition in this sense as the most direct and highest form of knowledge (Jung 1921). Through intuition humans access insights and knowledge without awareness of any trace of the process. Intuition comes with a certainty but no rationale for this certainty, although in hindsight, it may be possible to trace the source of the intuitive knowledge as a specific causal chain. Intuition never directly reflects reality but actively, creatively, insightfully, and imaginatively adds meaning by reading into the situation things not immediately apparent through sensory data.

Jung points out that the four epistemic modes are incommensurable: insights and knowledge from one cannot be accurately represented in terms of another. Human knowledge is necessarily fragmented and conflicting in nature, permanently struggling - to give a classic example, our inability to resolve the conflict between beauty, truth, and goodness. On the other hand, without this fundamental difference, that is, if one mode could be fully represented in terms of another, one or more epistemic modes would be redundant and consequently could not compliment the others. The fundamentally different modes of knowing may induce struggle and pain but they also stabilize human experience even in situations when one epistemic mode might fail to cope. In addition, if multiple ways of knowing, despite their in-principle difference, align and join to form a coherent experience, they tend to convey an enormous sense of reality or truth.

We know of the world in multiple and diverse ways and, necessarily, all knowing of the world is epistemically plural. However, this does not mean that one always makes good use of all the potential powers of epistemic plurality. Design thinking is more epistemically plural than analytical thinking: different ways of knowing are employed according to their respective strengths within the various

movements and motions that produce the design solution. By contrast, we consider analytical thinking as a mono-epistemic approach that relies on thinking only, rejecting other epistemic modes, and regardless of how powerful thinking is, removed from embodied experience, it cannot produce experientially rich artifacts and environments.

DESIGNING AS THE EPITOME OF EPISTEMIC PLURALITY

Design thinking oscillates between the lived world and the virtual, and between divergent and convergent modes of information processing. Relying on different combinations of epistemic modes, each of the six motions that jointly constitute designing has its own distinct epistemic profile.

In the process of repositioning itself as a strategic innovation consultancy, IDEO publicized its design process promoting it as a general approach to innovating products and services (Kelley 2001). We will use IDEO's well known redesign of the common grocery shopping cart (ABC 1999) as a publicly available stylized case to illustrate how our conceptualization of design thinking epitomizes epistemic plurality.

Immersing: In the first motion attention is directed toward the lived world, intended to broaden and deepen the design agent's understanding of what the user experiences; it thus requires an openness to experience that leads to diverging trains of thought. However, immersing into the user's world to effectively gather intelligence, the design agent ultimately intends to return with new value propositions (products or services) for the user.

Immersing oscillates between thinking and, on the other hand, sensing and feeling. Observation (watching, listening, touching, smelling) provides sensory information about user experience in context: empathizing in this way allows the design agent to experience as *if* they were the user without losing sight of the 'as if' condition (Vaihinger 1927). Immersing leads from sensing (engaging physically to absorb through the senses all necessary information) and feeling (empathy as emotionally resonating with users) to thinking and intuiting. Gradually, through repeated (hermeneutic) cycles, Immersing brings forward explicit knowledge of what the user needs above and beyond simplistic utility. In addition, true immersing expands the design agent's intuitive understanding; although most information presented in

experience to the body never becomes conscious – the senses process at least one million times more information than the conscious mind (Maturana and Varela 1984) – it still influences directions in the design process because unconsciously absorbed information fuels intuition. As new insights become less frequent and saturation approaches, the instrumentality of Immersing limits diverting and continued research is determined to be no longer efficient or effective, and it is time to Redefine the problem.

In the IDEO shopping cart case, a cross-disciplinary design team was initially presented with an orientation session that outlined the project and revealed a number of statistical facts about shopping carts, for example, a psychologist introduced safety concerns citing accident reports. The team then divided into smaller groups to investigate how people use, make, and maintain shopping carts as well as explore peripheral areas such as bike shops and stroller designs. Research was not academic, but hands on requiring full immersion as the design team went to interview and observe, photograph and sketch, users in their own environment, whether it was a grocery store, maintenance shop, or parking lot.

Virtual	Redefinition Convergent Thinking within Limits Set by Feeling and Sensing	Imagining Divergent Thinking while Intuiting, Feeling, Sensing and Thinking Derailing Trains of Thought	Opting Convergent Thinking aided by Intuiting (and challenged by Feeling)
	Immersing Divergent From Sensing and Feeling to Thinking (and Intuiting)		Prototyping Convergent From Thinking to Sensing Guided by Feeling (Aided by Intuiting)
Lived World			Presenting Divergent Feeling and Designing (Thinking, Feeling, Sensing, Intuiting)

Table 1: Epistemic Profiles of the Six Motions

Redefining: Immersing oscillates between experiencing (sensing or feeling) and reflecting (thinking), and as field research continues the emphasis shifts towards the thinking: designers require dis-embedded knowledge brought from field to studio, workshop, lab or office as reports, images, etc. When saturation approaches, Understanding changes vectors from Immersing to Redefining, which predominantly relies on systems thinking, a particular form of analytical thinking. Redefining is a convergent, complexity reducing motion because thinking establishes patterns, thereby compressing extant elements (e.g., detailed information, particular insights etc.) into a coherent whole (e.g. model, problem statement etc.). Redefining aims for a problem statement that, in Einstein's words, is as simple as possible, but not simpler. This is an active process that imposes order, shaping the parts, reinterpreting, reevaluating, and assembling and recombining them. Redefining is a formative, primarily linguistic process. Written language enhances precise and careful manipulation of symbols. In addition Redefining employs various visualization methods (e.g. diagrams, matrices) that enable experimenting with alternative symbolic arrangements before selecting one.⁵

At the end of the first movement and after various acts of re-evaluation, selection, organization, integration and compression, experiences are articulated as an explicit Redefining of criteria for the successful design solution that also captures the design agent's intent. However, design agents would not take this process of abstraction so far as to erase the problem's conceptual and aesthetic connotations that tie the problem statement back to its source, namely, to the users' experience of the lived world. Redefining as thinking acts within boundaries set by sensing and feeling. Here, knowledge is not meant to be completely separable from the knower: design agents reconnect the abstract problem statement and its meaning to the user in terms of aesthetic and emotional consequences by means of their embodied experience from Immersing.

Returning to the IDEO studio the design team shared their insights into the experiences of a variety of users in the form of stories, quotations, observations, photographs, etc. Interestingly, the team utilized no thinking tools, sharing their knowledge through informal individual presentations and casual group discussion, without producing a coherent problem statement. This appears in stark contrast to the other stages of IDEO's design process, all of which rely on specific technologies. We would argue that IDEO has achieved

mastery of five motions, Redefining being the one that lags behind. We have reason to believe that the team's inability to process the information adequately and generate a coherent problem statement led to difficulties downstream that eventually jeopardized the redesign of the shopping cart (see below).

Imagining: Imagining is divergent thinking, a mental activity that proceeds freely from one idea to the next, quickly generating a large set of different ideas, more often than not, including promising new ones (de Bono 1967). The major challenge in Imagining is breaking loose from the deeply entrenched habits of thought which are not even recognized as choices and so escape scrutiny. Imagining requires awareness of trains of thought while actively attempting to derail them: thinking can be creatively disrupted by all epistemic modes including thinking. Consider for example a brainstorming session where an utterance is subjected to an intellectual operation like thinking through the exact opposite idea's implication, which may lead to another idea; or the idea is received empathically and triggers feelings that lead to another idea; or if the idea is presented as a drawing or material object, another idea is triggered by sensing of the initial idea's physical qualities; or the idea immediately triggers another idea with the knower not knowing how she arrived at her knowing (the defining element of intuition), etc.

Imagining rests on two pillars: the ability to create or seek out environments that provide plentiful stimuli that can potentially disrupt thinking, and a receptive stance that recognizes that humans, in principle, have no control over their next thought (except for a limited capacity for suppressing it; Libet et al 2004). This openness and detachment allows one to simply observe their own thoughts, even those that surprise. As is true with Immersing, the receptive, divergent stance in Imagining is a means to an end. Technically, ideation could continue forever; yet, it is terminated when the rate at which promising ideas are produced drops to the point where Imagining no longer justifies the required resources. Approaching this point of exhaustion, Opting, a convergent evaluative mode, sets in governing the selection and assembly of the ideas that warrant further development.

Brainstorming is IDEO's preferred technology for ideation (Kelley 2001). Most firms consistently fail to produce effective brainstorming in which team creativity tops aggregated individual inventiveness. By contrast, at IDEO brainstorming in cross-functional teams has been developed into a core competence that significantly contributes to IDEO's brand value (Sutton and Hargadon 1996). The physical space is configured around a large table with no defined 'head' and any spatial directionality is a result of the pin-up wall for posting ideas as people dynamically move about. Throughout, brainstorming rules are displayed: "one conversation at a time", "stay focused on topic", "encourage wild ideas", "defer judgment", "build on the ideas of others". The team leader assuming the facilitator role wears a bell which he rings when anyone is seen to be criticizing an idea. All of this gives rise to brainstorming as a dense and dynamic process of cooperative thinking between equals.

Opting: Imagining ideally results in a large set of diverse ideas, a loose collection which from a rational perspective, resembles data points in disarray. Like Understanding, Dreaming is brought to a close through the imposition of order, through complexity reduction accomplished by (analytical) thinking. Redefining and Opting, although motions of convergent thinking, differ: Redefining restructures past experience rich in sensory and emotional content; Opting, on the other, aims at restructuring future options and thus relies on factual knowledge and analytical thinking about the realizability and expected utility of the ideas generated. As rational knowledge about future states of the world is necessarily incomplete, intuition bridges the gaps in the rational assessment of extant ideas' future potential. Note that ideas are not evaluated individually but in context, as configurations of ideas that are established through analytical thinking. Feeling too has its role in Opting: first, Opting requires trust in the future design process and such trusting is an emotional faculty; second, feeling interferes with thinking, suggesting to choose desired possibilities instead of opting for what remains to appear promising after having been subjected to systematic doubt by analytical thinking.

In the redesign of the shopping cart at IDEO Opting is exercised in two clearly separated steps. By voting for the best ideas, the brainstorming team evaluates their ideas, which are displayed on large pin-up walls. Each team member individually evaluates individual ideas by sticking Post-it notes. Subsequently, a group of highly experienced designers, not all of which are part of the actual design team, gathers and interprets the generated ideas and identifies a pattern, namely four need areas (shopping, safety, check-out, and, finding what you are looking for). They refocus the apparently drifting team by splitting it into four groups, each focused on one specific need area to develop that prototype.

Prototyping: In the third movement, designing returns from the virtual to the lived world, oscillating between action and reflection. Prototyping, like Immersing, deals with the tension between embodied experience and abstract concepts, heavily relying on sensing (the physical) and thinking. Jung's conception of sensing captures the entire physicality of humans as sensory-motor systems, including both the senses (seeing, hearing, smelling etc.) and the sensing of one's own body moving in space and time. Epistemologically, Prototyping and Immersing are mirror images: Immersing addresses the sensory system, takes a receptive, diverging stance and operates outside-in, translating from concrete to abstract. By contrast, Prototyping addresses the motor system, takes a formative, converging stance and operates inside-out, translating from abstract to concrete, iteratively refining and integrating multiple ideas into one. The interplay between sensing and thinking in Prototyping is guided by feeling, ensuring that the insights into users' emotional states and dynamics (gained through Immersing) translate into emotional design. Similarly, during Prototyping the background knowledge gained through Immersing increases the likelihood of intuitive solutions to design problems that occur.

IDEO spends an amazing amount of energy on Prototyping with professional staff, workshop and tools that can rapidly produce working prototypes and professional quality finished builds in a variety of materials. Prototypes are explored through sensations as well as understood in cognitive and affective modes and are used to test and explore user experience of the design.

Presenting: In the end, Presenting must convey just how the user's experience will be made richer, which requires a very high and focused level of communication. Designing such experience can be understood as a nested cycle, potentially involving all of the above motions. In addition, feeling is of crucial importance for presenting. Not only does the design agent aspire to create affirmative emotional user experience, it is also necessary for the design agent to cope with their own feelings. Throughout the entire process design agents experience disruptions – shifts from one motion to the next that occur for insufficient reason and are thus inherently violent and potentially frustrating. Letting go of the entire design project is the most pronounced such shift, potentially evoking strong mixed feelings that are characteristic for transitional periods.

IDEO's visualization skills match their professional ability to rapidly produce quality prototypes: their graphic design, finishing of prototypes and event choreographies are outstanding. IDEO's presentation of their shopping cart re-design was masterful in staging and became a landmark in repositioning the firm as a strategic innovation consultancy. On the other hand, their attempt to redesign the common shopping cart failed, as their design – despite winning a design price – was never implemented. We are not in the position to provide a full explanation for this failure. However, when the design team meets for Redefining the problem, one designer reports a significant difference between professional and average shoppers. The latter hold onto their cart almost throughout the entire shopping experience. Professional shoppers, by contrast park their cart and move swiftly between the shelves and the cart that functions as a base station. IDEO's redesigned shopping cart meets the exact needs of professional shoppers. It provides a mere frame for several removable baskets, assuming the cart will serve as a base station for shoppers to use a basket to collect grocery items. The design team knew about the different usages of the shopping cart, but chose to not explicitly redefine their design task and, as a result, ended up redesigning the common shopping cart to serve uncommon shoppers.

Disrupted Cycles in Action

The design process is *arational* in that gaps are sometimes bridged without a logically complete chain of rational justifications. This is not surprising as design is the design of human experience and in our Jungian understanding, experience is fundamentally fragmented resting on four incommensurable ways of knowing. The very nature of human experience, that it appears continuous while resting on a discontinuous structure and process (Varela et al. 1991), is mirrored in the design process and the design team, as the team rather than the individual is often the most appropriate agent to carry out the design process. A design team comprising of members with heterogeneous professional and personal backgrounds reflects the epistemic plurality of designing. In addition the team switches quickly between different governance structures such as market (brainstorming as a market of ideas), clan (the group of 'self-appointed' adults taking over) and hierarchy (the team leader appoints subgroups and orders them to develop specific prototypes). Again, the teams extraordinary competence smoothes the gaps and transitions, but on a fundamental level they necessarily remain mirroring the structure of human experience that is implied in human design, for and by humans.

The design process consists of nested cycles: At the highest level designing moves from the lived world to the virtual and returns. Embedded in this macro cycle, Immersion and Prototyping repeatedly loop between *perception and reflection*, and *action and reflection*, respectively. Finally, each design problem that arises during Prototyping as well as Presenting in its entirety can be treated as a nested micro-cycle. Each motion in designing has a tendency to exhaust itself while teleologically advancing towards the subsequent motion. Yet, no motion has an exact *stopping rule*. Hence, moving on is usually to some extent arbitrary and regularly occurs simply because the design agent must move on, driven by budget and deadline. Finally, *intuition*, one of the four foundational epistemic modes, is inherently discontinuous — offering insights without providing sufficient reasons. At its best intuition can cut right through the design process, providing insights that allow for skipped substantial parts of it — and yet, it is again unclear how much potential gets lost that way.

5. IMPLICATIONS FOR MANAGEMENT

As stated at the outset of this paper, the current interest in design thinking is fueled by the prospective benefits of design thinking applied to management and organization. We shall now explore the managerial and organizational implications of our conception of the part-to-whole relation between analytical and design thinking and, specifically, we will try to answer the question under what conditions one should rely on which epistemic modes.

In the 1960s Simon made it clear that analytical thinking is best suited for evaluating given alternatives and choosing the best one. Hence, analytical thinking is the tool of choice for managers and organizations that face more opportunities than they can seize; they can focus on selecting the most profitable ones, typically the case in markets where demand exceeds supply (e.g. post-war economies), or in businesses where employees provide so much creativity that the corporation can take it for granted and solely focus on selecting the best ideas, or for stock brokers choosing from a well-defined set of buying and selling options. By contrast businesses under pressure to innovate must

adopt a creative approach that generates and seizes new possibilities. Design thinking is the appropriate approach for such businesses engaging actively in the creation of new value propositions,

Analytical thinking is a mono-epistemic approach that relies solely on thinking and operates on well-defined systems of conditions, goals, and solution alternatives or solution spaces. The beauty of analytical thinking lies in its consistency, precision and transparency, yet, it is these very qualities that constitute a closed system, incapable of generating something new that was not implied in the system in the first place. Formally speaking, analytical thinking requires abstraction: the object of analysis is mapped onto abstract categories (symbols or data), which in turn are subjected to systematic scrutiny (rule-based manipulation). This requires commensurability in the sense that the symbols (data) and the body of rules governing their manipulation must be fully consistent, both internally and with each other. In business, money as a universal equivalent provides such commensurability because differences of all sorts experienced in the lived world can be mapped onto one kind of difference, namely more or less (expected) financial value. Hence our assertion that analytical thinking is ideally suited for investors' detached rational decisions and exercise of external control.

By contrast, design thinking is a multi-epistemic approach and essentially discontinuous. It exploits structural incoherence through employing epistemic modes that differ radically in the sense that neither can one be reduced to another, nor is there an encompassing mode capable of integration. In addition, design thinking utilizes dynamic incoherence, running through phases (movements and motions) that connect with each other discontinuously, as more often than not a motion's termination and the next one's commencement occur for insufficient reason. Design thinking draws on the full potential of human experience, including the challenging tensions induced by the necessary incoherence and incompleteness of human experience.

Consequently, design thinking is capable of utilizing tensions such as actual vs. possible, action vs. reflection, attached involvement vs. detached evaluation, divergent learning orientation vs. convergent goal orientation, all of which, like the tension between thinking and feeling, must be dealt with locally and temporarily but cannot be permanently resolved. In turn, design thinking enables creative resolutions of practical design tensions such as different perspectives among designers or between users and designers, or different formative principles ('generators') that guide the designing. Most importantly, design thinking tackles the tension between the known and the unknown, the meaningful and meaningless, which makes it the *via regia* to creating new opportunities, enhancing experience and adding value.

This juxtaposition of analytical with design thinking is intimately tied to a dichotomy foundational to economic theory: capital versus labor. Analytical thinking can be understood as the epistemology of capital, while design thinking provides the epistemic foundations of (creative) labor. Allocating capital to extant investment opportunities is best achieved through analytical thinking, enabling both sophisticated inference (quantitative methods) and a detached stance that acknowledges real world events, however meaningful, affecting or beautiful, solely in terms of their impact on potential investments' expected utility. By contrast, creating new opportunities is best achieved through design thinking, which artfully combines engagement with the unknown, attached participation in the lived world, detached reflection and evaluation and, not the least the will to shape reality.

The current dominance of economic and quantitative approaches in management education has been criticized as functionally ineffective and ethically undesirable (Pfeffer and Fong 2002; Goshal 2005). Our analysis supports such critique because overreliance on analytical thinking is expected to leave managers unprepared for using multiple ways of knowing, thereby limiting their capacities for innovation. This has ethically problematic consequences because managers trained to evaluate extant opportunities rather than to create new ones, are prone to frame economic action as a zero-sum game that necessitates fierce competition for a maximal share of a fixed total amount of existing value. By contrast, managers capable of design thinking can opt for a twofold approach: cooperatively creating new value and, subsequently, appropriating their fair share, thereby ensuring the possibility of further cooperative value creation. Design thinking thus appears to hold a potential for increasing total wealth, balancing cooperation (value creation) and competition (value appropriation), and enhancing job satisfaction as it involves sources of intrinsic motivation such as aesthetic (dis-)pleasure, passion, empathy and the experience of making a difference.

It is important to note that design thinking is not restricted to developing new products or services but that it can potentially inform management in general. Consider the

movement Understanding as an example: If one presumes that all managers or organizational units have internal or external customers, then it is in principle possible for them to delve into their customers experience in a quasi-ethnographic fashion. It is true that business codes frequently permit managers to deploy classic ethnographic methodology for exploring their customers' experience; however, unobtrusive measures can be taken as well: managers can learn to empathize with their customers and to observe and listen as 'professional strangers' (Agar 1980); they can leverage these capabilities by arranging for frequent exposure to the customers' and customers' customers' environments; and they can intentionally expose themselves to situations similar to the ones customers experience. Similarly organizational units can increase customer intimacy and involve those with the most intimate customer knowledge into key decision-making.

On both manager and organizational levels, increased capability for immersion requires both personal development in the form of training and organizational development that alter structures and processes. Equally, the organization as a whole can be understood as immersing itself in customer experience, if individual stances, skills, tools and routines, as well as organizational culture, capabilities and processes amount to an organization flexible enough for shadowing its customer and permeable enough for resonating with their experience. The same is true for all three movements of designing as each can be adopted by individuals, sub units and entire organizations. Design thinking may be most pronounced in independent design agencies and corporate design departments, but when applied to management and organization its ultimate implication is that entire organizations can be understood and designed as design agents.

6. IMPLICATIONS FOR FURTHER RESEARCH

In this paper we have proposed a conceptualization of design thinking as consisting of three movements, each comprised of two motions. We have further established the multi-epistemic nature of design thinking by demonstrating that each of the six motions has its own distinct epistemological profile. Analytical thinking, as a mono-epistemic approach has been shown to be not the opposite of design thinking but rather, a part of it. It provides the epistemic underpinning of capital; design thinking represents the epistemology of (creative) labor. We have pointed out the consequences of

the current over-reliance on analytical thinking in management as problematic and have highlighted the possibility of design thinking inspiring personal and organizational development. We feel that a general understanding and more significant adopting of a design thinking stance would be beneficial and could ultimately lead to entire organizations becoming design agents.

We believe that further research is warranted in all the areas of our argument, including the possible implications we sense as an unfolding on the horizon, but have not as yet had the opportunity to explore. For instance, additional empirical research in how designers think is required to overcome current methodological limitations and narrow the gap between descriptive and prescriptive approaches to design thinking. The concept of *epistemic plurality* requires further investigation to determine if, and how, Jung's pioneering work could be advanced. Particulars of design thinking in organizations (e.g. idea generating techniques) have yet received insufficient research attention and research in personal and organizational development inspired by a more comprehensive understanding of design thinking is still in its infancy. Finally, the proposed concept of design thinking is in principle open to reflecting influence from stakeholders other than the user (customer) but this feature has yet to be explored more deeply. //

NOTES

1. Pointing to optimizing algorithms, search procedures, and special purpose programs for designing motors, balancing assembly lines, selecting investment portfolios, locating warehouses, designing highways, diagnosing and treating diseases, and so forth, Simon maintains: 'Because these computer programs describe complex design processes in complete, painstaking detail, they are open to inspection and analysis, or to trial and simulation... There is no question, since these programs exist, of the design process hiding behind the cloak of 'judgment' or 'experience'. Whatever judgment or experience was used in creating the programs must now be incorporated in them and hence be observable' (Simon 1996: 135). Simon must have been aware of Gödel's proof of the impossibility to solve the Entscheidungsproblem (Gödel 1931; Nagel and Newman 1958), yet makes no mention of the fact that no program can include all of the knowledge necessary for creating that program. One can only guess from the fact that he still upheld his position in the third edition, which appeared almost three decades after his 1968 Compton Lecture 'The Science of Design' that Simon must have considered the practical damage caused by this incompleteness as minor if not negligible.

2. Christopher Alexander is interesting in this contrast between design and analysis. His book *Notes On the Synthesis of Form* (1964) was an

attempt to layout architectural design in a hierarchal structure (decision tree) along the lines of a computer program and was pretty much ignored by architects. On the other hand, his *A Pattern Language: Towns, Buildings, Construction* (1977), which structured a typology of successful building patterns has been hugely influential. One could understand the first as purely analytical thinking and the second as design thinking, using a generative grammar invoked by context.

3. Owen proposes a design process that differs twofold from the three movements presented in this paper (Owen 1998 a, b; Beckman and Barry 2007). First, Owen splits Problem Redefinition into two separate steps: 'frameworks', concerned with understanding the problem and organizing this knowledge in logical form; 'imperatives', specifying the implications of that knowledge for design (e.g., requirements, quality criteria etc.), which ideally leads to an explicit value proposition. Second, Owen does not consider Ideation a separate phase but instead subsumes it under *solution generation*. Although these differences matter, Owen's design process and our three movements build on fundamentally equivalent understanding of design thinking.

4. The vast majority of empirical studies of design thinking uses fairly well-structured problems (Cross 2001) and find that designers leap right into action, simultaneously exploring the problem and the solution through iterative cycles of building and thinking. However, in our view it is unsurprising that designers engage in Building when the problem's solution space is understood.

5. Here, visual elements are symbols, pictograms, boxes, arrows, words, numbers etc., which is different from the more representational sketches used in Imagining and Prototyping.

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