The Role of Design Thinking in Firms and Management Education

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Abstract

We draw on our experiences as university-level educators in design and management, as well as consulting, to argue that management education has isolated design, specifically design thinking, from traditional MBA curricula—to the detriment of both business schools and firms. Notwithstanding the occasional "new product development" marketing course, we question the widespread practice of segregating design thinking solely for use by so-called "creative professionals." The social bases of this isolation include semantic gaps, conceptual blocks, and social barriers between business disciplines. We unpack design thinking in a concrete, tractable manner and offer concrete suggestions for promoting a shift to design thinking within management education, and in firms. We conclude by mentioning the pros and cons of diverse solutions, including an ad hoc approach, management education programs, teaching problem-driven design thinking, firm-specific executive programs, leveraging in-house design resources, and deploying designers as top managers.

Introduction

Business interest in design thinking for managers and how to profit from it has never been greater. Business Week, for example, regularly features a supplement called "IN" (for innovation) where they extol the virtues of design thinking (e.g., Business Week, 12 March, 2007, supplement). A recent issue of Harvard Business Review featured a theme of designing strategy. The word "design" has become near-pervasive. But what exactly is "design thinking?" What role does design thinking have outside the rarefied realm of "creative professionals?" How can entire organizations (rather than solely designers) benefit from design thinking? With limited exceptions, we find that most prominent business education institutions and publications lack an understanding of design thinking and its potential role in firms and management education.

Innovation, design, and fomenting innovative processes inside firms are getting a lot of popular attention, most of it misdirected. Evidence exists that the real ways in which design innovation and design thinking can improve organizations remain ignored or get lost in the noise caused by the attention given to the (admittedly substantial) importance of product-based design and innovation. Among the absent design-thinking dimensions we note in most of the popular and technical literature are multidisciplinary teams, fluency, user-centered research, prototyping, critique, iteration and form-giving.

As noted, interest in design thinking is presently at an all time high. As a result, business schools have recently introduced more courses focusing on creativity skills, design, and modern, fast-cycle product development techniques. Most MBA programs, however, miss the opportunity to talk about deploying design thinking in the entire organization—instead, they focus on the needs of marketing majors (or students following marketing courses). This approach implies that teaching these students to think about new products/services using some of the tools of the designer will benefit the marketing organization. This approach has several obvious drawbacks, the most important among them being the persistent disciplinary isolation of design thinking.

We note one exception to this trend in business schools: the Rotman School of Management at University of Ontario. Roger Martin, the Dean at Rotman is militant about the "great value in the designer's approach to solving problems." (Martin, 2007) He states that "we are on the cusp of a design revolution in business, and as a

result, today's business people don't need to understand designers better, they need to become designers." (Martin, 2007) Martin advocates the (trademarked) terms "integrative thinking" as a process to achieve superior "business design." We applaud Martin's basic thrust, and view it as broadly compatible with our own. We offer some refinements to Martin's approach. We provide concrete definitions of seven design thinking dimensions, specify a model illustrating how these dimensions interact, identify impediments to implementing design thinking in firms and business schools, and suggest multiple tools to address these impediments throughout an organization.

This paper proceeds as follows: after the introduction we briefly discuss existing definitions of design thinking. We then offer an original definition of design thinking by identifying multiple dimensions of design thinking and offering a preliminary model for how these elements (optimally) interact in organizations. We then discuss three important barriers to embedding design thinking principles in organizations, beyond the boundaries of creative professionals' departments: semantic gaps, conceptual blocks and social barriers. We conclude by offering our prescription for embedding design thinking practices in firms and business school curricula, a task that comprises a major challenge for most organizations.

Design thinking defined

In our view, design thinking requires the following elements to be successful: (1) multi-disciplinary teams; (2) fluency; (3) experience-based, user-centered research; (4) prototyping; (5) iteration; (6) critique; and (7) form-giving. We define each dimension below.

Multidisciplinary teams. While there is nothing particularly new about using multidisciplinary teams to tackle innovation, the importance of these teams cannot be overstressed. Multidisciplinary teams are necessary precursors to design thinking--they are part of organizational context, and design thinking may not occur in its absence. Multidisciplinary teams are composed, as the name suggests, of diverse personnel from various functional areas, including, for example, marketing, finance, manufacturing, technical support, and sometimes even customers. Diversity, however, is not the unique defining characteristic of multidisciplinary teams. What is different in our model is that the organization of these teams and their depth of interactions are more extreme than previously conceived. For example, at the Stanford "d.school", where one of the authors teaches, teams are organized around a concept called "radical collaboration." This is considered an essential element for innovative outcomes. These teams have some unusual characteristics, one of the most important being that they are not organized around a single leader. Radical collaboration in this sense means that team leadership is frequently passed back and forth, and team members have an explicit task of "making the leader look good." One analogy that is often used to teach teams this behavior is a jazz ensemble. A jazz group is expected to be comfortable with the notion of passing a solo back and forth among players, within the structure of a song. Stanford's methodology suggests "…radical collaboration creates a culture of innovation at the d.school. And our culture of collaboration means we move quickly beyond obvious ideas…" (Stanford d.school, 2007)

Fluency. Merriam-Webster (2007) defines fluency as "…capable of moving with ease and grace… 2 a: capable of using a language easily and accurately…" Though often overlooked by others, multidisciplinary teams require fluency to function optimally. Fluency, like multidisciplinary teams, is a necessary precursor to design thinking. It is a part of the existing organizational context, without which, design thinking may not take place. We define fluency as the ability to translate effectively between various rarefied technical vocabularies, to move effortlessly between problem solving methodologies, and the ability to value other's outcome expectations. As an example in the realm of problem-solving methodology, consider brainstorming. Fluency is a critical dimension for effective brainstorming. Brainstorming is not possible if teams fail to suspend judgment and generate many ideas, both good and bad. In this case, fluency is the deeply embedded understanding of the requirements of a process coupled with substantial experience in implementing the (brainstorming) process. An analogy to fluency in language would be a strong awareness of the syntax of a language—how things fit together in the writing process. In addition to syntax, vocabulary fluency is also important.

Without mutual vocabulary fluency, multidisciplinary teams run into other critical team dynamics issues; sometimes they fail to function at all. For instance, a technical vocabulary, which is highly efficient at encoding discipline-specific knowledge, becomes a significant barrier to communication in a multidisciplinary team where

many members do not know "the code." Team members often need to be re-trained to speak in plain English, without jargon (or other team members much undergo costly training to comprehend the jargon). For example, certain team members exhibit an over-reliance on reductive or analytical problem solving methods, which often confuses other team members. This creates lopsided solutions and alienates the non-analytic team members. Fluency tends to focus on expanding available problem-solving tools and increasing a team's comfort-level with everyone's various tools. Finally, divergent outcome expectations are often an issue in multidisciplinary team dynamics. Business training conditions team members to expect tangible outcomes in terms of plans, schedules, and/or specific market information. Design training conditions team members to place a high value on process outcomes. Process outcomes that designers expect, such as productive brainstorming sessions, creative synergy between participants, and concentricity of vision, are frequently dismissed as unimportant or unquantifiable by some team members. A dismissive attitude about a valued outcome, from any team member, indicates a lack of respect for and ability to move between disciplines, and is often the undoing of multidisciplinary teams.

One of the organizing principals of Stanford's d.school is that trained designers (often graduate students) function as the "glue" binding multidisciplinary teams together. This is especially important for teams where the outcomes required are not obviously "design" outcomes, but rather a new business process or a service. Designers are often called upon, because of their visual skills and creative mindset, to help teams visualize early ideas, to help with brainstorming and other creative processes, and to work as translators between various vocabulary-specific groups. Under the Stanford d.school standard, designers, or others trained in design thinking, are practiced at fluency and are generally required if a team is going to achieve high-performance innovation.

User-centered research focused on experience. Design thinking begins with focused observation. Ethnographic research tools are employed and users are studied in their home or working environments. Latent needs, discovered through these study techniques, become the basis of the insights that inform the entire design process. It is critical to note that latent needs can only be discovered through a combination of observation and inquiry, and must be observed at the site of the activity or service being designed. Asking users "what they want" or "what they need," in an artificial setting (mall intercepts, web questionnaires, etc.) typically fails to provide the right kind of data for down-stream design activities.

In design thinking, user groups often contain extreme or leading edge users and populations that do not use the product or service but may be potential users since they have similar or parallel needs. This type of user-centered research does not attempt to look at the mainstream markets nor does it expect to generate an "average user" profile. As such it differs from the traditional user research methods of focus groups and surveys and generates data of a different quality: data with more emotional nuance. Developing, analyzing and interpreting a "nuanced dataset" and preserving the insights and innovations therein drives subsequent design thinking activity. Findings from nuanced data are strongly reflected in the final product, service or experience.

Prototyping. Stanford's approach is that "prototyping is thinking." A prototype is any object or simulation that can evoke feedback from the target user group and buy-in from the sponsoring organization. When we talk of prototyping in terms of design thinking, it is important to stress that we are not talking about engineering models or prototypes designed to validate a final idea. We are talking specifically about prototypes that are used to evoke and explore the problem. These prototypes are often crude, no more than paper models, simple spreadsheet simulations, or hand drawn storyboards of a potential new experience. These prototypes are seen and used by target users, refined, and built again and again; each iteration is used to evoke feedback on one aspect of the design. A partial prototype is often made to test one aspect of the product or service; only rarely is a prototype "complete" in this phase. It is critical that prototypes are shared among the multidisciplinary team and used at all levels of the organization to solicit comments and buy-in.

Iteration. Central to design thinking is the notion that iteration is the most efficient method for stimulating high quality design innovation. Iteration implies that the idea of "fail early and fail often" is a goal to be sought, not a pitfall to avoid. In order to encourage iteration, teams often use techniques like brainstorming and rapid prototyping to stimulate new approaches to problems. Teams are encouraged to "start-over, often." Rather than treat iteration as a mere arrow in a diagram, we consider iteration to be an integral process step: deciding how to revise and refine a crude initial design into successively more satisfying prototypes is a critical dimension of design thinking.

Critique. Unless the critique process is embedded in design thinking, the "fail early, fail often" dictum and the iterative process described above will end up in an endless loop. This is why design (and art) since the Renaissance has been taught using the critique process. Designers have become quite comfortable with this approach, but outsiders routinely fear it. The critique process involves selecting discrete moments in an interactive design process for an in-depth dialog about the concepts and design "so far". James Elkins, in his book "Why Art Cannot be Taught" describes one common form of critique this way; "[it is] the ancient art of dialectic: you ask (a question), you think about the reply, you ask again, you rephrase the question, you go on, pushing and inquiring, without changing the subject." (Elkins, 2001, p. 170, emphasis added). This technique is often aggressively applied in design, art, and architecture schools and it is not uncommon for first year students, unaccustomed to the technique, to leave their first few "crits" in tears.

A critique can be, but often is not the same as a milestone review (also known in project management parlance as a phase review, toll gate, project checkpoint, etc.). A good milestone review is a primarily a decision-making event. Facts and figures are weighed to assess the project's progress and its likelihood of success. In contrast, a good critique is primarily an opportunity to vet a concept; to examine, through questioning, paths not taken, alternatives unexplored, and the quality of the design synthesis. Opportunities for improvement and refinement abound when critique is properly executed. Applying milestone-like criteria to a critique risks losing the value of the dialectical process and potentially impairs the transfer of insights from the above-mentioned nuanced dataset of user observations from iteration to iteration.

Our experience teaching design thinking in an MBA program (at SFSU) and at the d.school (Stanford) has shown us that business students are often not at all comfortable with the open ended and subjective approach of critique. Business professors tend not to use critique because they are not trained in this dialectic technique. Our experience has shown that the case study method often employed in business schools, via its Socratic pedagogy, has aspects in common with critique in design thinking and, once students realize this, they become more comfortable with the process and critiques go much more smoothly. Team teaching and/or juried design reviews are particularly effective ways to implement the critique process in an educational setting owing to the multiplicity of perspectives available to the student. Critique is an essential dimension in the design thinking process.

Form-giving. Form-giving is the final phase of the design thinking process. Note that a "final" prototype is very different from the output of form-giving. Prototypes are necessarily incomplete and rough, whereas the result of form-giving is necessarily complete and detailed. Although the innovation process has come far to reach this point, it is common that the final embodiments of the design, (of product, service or experience) often fall far short of the designers' and customer's expectations. Something has been lost. Organizations often fail to capitalize and deliver on design thinking because they skip the final step of form-giving. This is the step where the organization must embed the underlying findings of the original user research (the nuanced dataset) and the many cycles of prototyping and iteration into the object or service. The goal of form-giving is to evoke delight and satisfaction, and to legitimize the underlying innovations discovered in the course of user-centered research. Successful form-giving fulfills the hopes and aspirations of the user--emotional connections to the product or service are constructed and understood by the multi-disciplinary team—the product is ready for users. It is necessary, as they say at Apple, to create "objects of desire;" a dedication to the refinement of the final form is necessary. The famous Mies van der Rohe quote "God is in the details" is nowhere more relevant than for the form-giving dimension of design thinking. (van der Rohe, 1959).

Impediments to embedding design thinking in firms and business schools

Semantic gaps. Different words have different meanings for different people. Semantic gaps refer to differences across people regarding commonly understood meanings or definitions of important terms. Oddly, small differences (that go unrecognized) create worse problems than large differences in perceived meaning, possibly owing to the emergence of an implicit, incorrect sense of understanding that is easier to establish when gaps are small—but design thinking sees small differences as crucially important, including small differences in meaning. Semantic gaps related to design thinking occur when students or managers maintain incorrect (stereotypical) ideas

about design thinking. This may occur in two ways, which often manifest concurrently: (1) the student/manager assumes that he/she knows well the meaning of a particular design thinking dimension, and (2) he/she further assumes that knowing about a technique (right or wrong) equates with expertise in that technique.

Semantic gaps related to understanding design thinking abound in firms and at business schools. We offer an example regarding one of the most popular (and routinely abused) design thinking tools: brainstorming. In business schools, while teaching design thinking in executive MBA programs, we often start the first class meeting of a semester with a simple question like "who here already knows how to brainstorm?" Invariably, about 90% of the people in the class raise their hands. Our response is to press further: "OK, then what are the rules of brainstorming?" Uncertain looks and dead silence are the most typical response. The best we can usually get out of people is "brainstorming means to come up with lots of good ideas." Most students are ignorant of the two most important precepts of brainstorming (suspend judgment and work for a high degree of idea fluency). Students and managers are frequently convinced by previous (minimal) exposure to brainstorming from another class (taught by non-designers) that they not only know what it means to brainstorm, but that mere possession of this knowledge means that they are highly competent at the technique. Even after explaining the rules of brainstorming to students we nearly universally observe students not suspending judgment and openly and (often brutally) criticizing new ideas of their fellow students during exercises. Also, students routinely come up with very few ideas in their early days of brainstorming, underscoring the importance of practice/exercise of design thinking. We have observed many students of business administration grappling with the internalization of productive brainstorming techniques—some students are afraid to put pen to paper if the brainstorming task includes a sketching component, for example. Their prior understanding of brainstorming is incompatible with the actual process of proper brainstorming. Students and managers routinely become self-convinced that they can brainstorm competently because their (generally wrong) internal definition of brainstorming seems sufficient for their purposes. The problem is that improper use of brainstorming (doing something else and labeling it brainstorming) is not particularly productive. Not only do they have the definition wrong, they assume that knowing is the same as having expertise—brainstorming is not a skill deemed worthy of practice. Hayakawa (1964) might observe that they have fallen into a major semantic trap: the word is not the thing, or in this case, knowing the name of a skill is not the same as possessing the skill. Correcting students' and managers' distorted definitions of design thinking precepts is the first step in fomenting design thinking in managers and management education. Eliminating semantic gaps between design professionals (who possess the proper knowledge and skills) and managers is critically important, but remains largely ignored in management education.

Since much work in firms and business school classes occurs today in multidisciplinary teams composed of diverse professionals possessing divergent cognitive maps of what comprises design thinking, the bridging of the semantic gaps assumes even greater importance. Semantic gaps are exceedingly common and pernicious in organizations: understanding and diffusing design thinking techniques into an organization are major challenges. Next, we turn to a discussion of another barrier to implementing design thinking in organizations: conceptual blocks.

Conceptual Blocks. Although it is important to bridge semantic gaps to achieve proper understanding of and ability to implement design thinking, other vexing barriers to implementation exist. In particular, conceptual blocks, a term coined by James Adams in 1974, exert negative effects on the efficacy of design thinking. Adams (1974) identifies several types of conceptual blocks. Although related to semantic gaps, conceptual blocks tend to be more individual-focused than oriented towards building mutual common correct understanding of important terms and techniques (bridging semantic gaps). One of Adams' clearest examples of a block is cultural blocks: people fail to see the possibilities to solve a particular problem owing to prior conditioning (by parents, friends, schools, television, society and other influences). In his book, Conceptual Blockbusting (1974) Adams presents readers with the problem of removing a ping-pong ball stuck in a vertical pipe embedded in a concrete floor without destroying the pipe, the ball, or the floor. Students working in groups often come up with offbeat solutions, but the presence of a perceptual block manifests when someone suggests urinating into the pipe to float the ball to the top of the pipe. Some members of the problem-solving group are appalled at this idea, even though it is one of the most practical solutions available given the constraints of the problem. When someone suggests destroying the pipe to remove the ball, another person typically observes that this is against the rules. So what? The stated goal is to remove the ball, not follow the rules. Arguments often ensue regarding whether this is an appropriate solution (it is). In a work group

free of conceptual blocks, people recognize the value of thinking about problems in a manner that is free from cultural bias. In firms and in business schools, the emphasis is generally on “socially acceptable” solutions, and oddball solutions are filtered out. Once people see a problem, their cultural conditioning takes over and they limit their solution-seeking behavior to conform to convention. When problem-solving in a multidisciplinary team, even one person with conceptual blocks can seriously impede a team.

Social barriers. “Designers eat lunch with designers; accountants eat with accountants.” The physical isolation of designers in organizations and the perceptions of profession-based barriers to interaction are the fault of both designers and non-designers. That is, designers accept and (are resigned to) expect the treatment they receive from non-designers. Isolation and lack of comprehension, particularly of iterative process and process-outcomes render problematic the diffusion of design thinking into entire firms. That business schools also isolate design (in the marketing department typically) reinforces managerial thinking styles prevalent in firms.

Social barriers are particularly insidious with respect to their effects on relations between designers and non-designer top managers. In particular, an economic calculus at the managerial level frequently trumps the (often more relevant to success) design thinking calculus. For example, a manager may embrace a design process up to the point where using two colors instead of three on a product is significantly less costly. Managers at this point typically instantly (and inexplicably) abandon the implications of user-centric data that points to the efficacy of three colors. The resultant decision ostensibly saves money (possibly money is saved in the short term), but may ultimately result in fewer unit sales (and corresponding lower profits) because three colors was the right choice to create the proper user experience. It is not easy to create satisfaction and joy in users, and ignoring or abandoning the message of user-centric data and analysis further impairs the process.

Traditional managers often do not see the difference between process outcomes and final outcomes--this makes designers hesitant to bring important intermediate results and issues to the attention of management at a time when the cost of making large and small changes is miniscule compared to making changes at traditional “milestone” moments. For example, one purpose of prototypes generated in a design thinking process is to create buy-in at the sponsoring organization. As previously described, design thinking prototypes are crude, made from paper and cardboard. Prototypes of a service or experience are often simple handmade storyboards, not produced by a graphics department. Prototypes are intended as the basis for discussion and critique. Managers, however, typically lack an understanding of the importance of rough, partial models—they have been known to react in an ignorant, hostile manner to such prototypes. This response (or the expectation of such a response) engenders confusion and fear in designers. One resulting "social barrier" to overcome in most organizations is that senior management is only brought in for comment at "Phase Reviews" and only shown "finished models." In fact, top managers are missing key opportunities to offer input at stages where the economic efficacy of major changes is high—these moments additionally represent opportunities to interact with and better understand designers and design thinking. Design teams need to overcome their fear of exposing such preliminary work to management, and management must change their expectations of what such prototypes "mean;" i.e. works in progress and not finished proposals—they are intended for criticism.

Finally, unlike, for example, accountants, designers don’t stop being designers at home or at lunch. Their passion for design and especially for design thinking permeates their lives. Many designers enjoy discussing design issues and refinement of design thinking techniques outside of the work environment. Managers routinely ignore or misinterpret this behavioral characteristic of many designers. For non-designer managers, this property of designers represents a resource, an opportunity to spread design thinking into the broader organization, beyond the exclusive realm of so-called “creative professionals.” For the majority of firms this is a missed opportunity. Admittedly, not every designer seeks to change the world of their firm, but managers are missing an opportunity to diffuse design thinking into an organization by socially isolating designers—it is wrong to blindly accept the conventional approach to “creative professionals” that other firms have employed for many years. This section has identified problems with suffusing an organization with design thinking. Next, we briefly discuss ways to address the barriers to bringing design thinking into organizations.

Solutions--Bridging the gap between design thinking in firms and management education

Pedagogical practices that embed design thinking in organizations

Education in the classroom and the firm. At San Francisco State University, in the interest of overcoming social barriers to design thinking in firms, we offer an MBA class for executives in "creativity skills" (a manager-friendly re-labeling of design thinking) called "creativity for managers: a global perspective." This class introduces managers to design thinking (in its diversity throughout the world) and relevant design thinking skills are developed in the managers. We start the class by teaching traditional design tools: brainstorming and sketching, but we quickly move the conversation outside the realm of design into solving more general enterprise-level problems which often lie considerably beyond where design thinking is applied traditionally. Students, after practicing in the "safe" area of product design where they know they are not expected to excel, are challenged by problems that require them to apply design thinking to what are generally regarded as non-design problems, for example, how to profitably enter a new market, or how to re-organize their firm into a more efficient structure.

In addition to attacking social barriers, the executive MBA classroom offers an opportunity to (1) bridge semantic gaps (by talking about them), and (2) break down conceptual blocks among students. In fact, despite its age, we work through the entire Conceptual Blockbusting (Adams, 1974) book as part of the class.[i] Results from this type of class for bringing design thinking into students' firms is limited because the class is typically composed of a "cohort" of executives from many different organizations. A cadre of design thinking-savvy, motivated managers from one firm would be better for that particular firm. Prospects for individuals to bring design thinking to their firm are limited.

Firm-specific executive education programs. To better serve the needs of specific organizations, many prominent business schools have, over the years, introduced firm-specific executive education programs (e.g., Harvard and Stanford). These programs offer custom-tailored classes to fit the articulated needs of executive students who all work at a particular firm. Cohorts consist of managers from one firm, and some firms experience such substantial benefits from this approach that they choose to sponsor multiple managerial cohorts, typically one per year.

The advantages of firm-specific programs over traditional MBA curricula are many, and include customization of content and (critically for design thinking) increased impact of the techniques learned in class upon return to the firm. Firm-specific programs are a powerful tool for helping organizations achieve superior performance. Firm-specific programs, like executive MBA programs, break down semantic gaps and conceptual blocks, but they are also highly effective for social barriers, one of the most challenging of the impediments to design thinking—the downsides to firm-specific programs are cost and diversion of managerial attention. Alas, the number of firm-specific management education programs addressing design thinking issues remains quite small to date. Although custom design thinking-oriented executive programs likely exist, we are presently aware of the University of Toronto's Rotman School offerings, as well as those of Stanford University (through the Plattner Institute of Design) and the Netherlands' Nijenrode Universiteit (though classes are held in Dutch), and San Francisco State University's Executive MBA program. At Stanford, the diversity of client-schools is high: firms embracing design thinking via customized executive education programs include BP and Proctor & Gamble. All the mentioned schools work with firms to develop customized executive education degree (or certificate) programs that incorporate design thinking approaches to business problems throughout the firm. Discussions and projects often address specific issues at the sponsoring firm. Executives return to their firms as part of a team that has (importantly) achieved buy-in and developed design thinking skills that they are ready and motivated to share.

Teaching problem-driven design thinking. One important approach that can enhance the transfer of design thinking skills to students and managers is the used of problem-based learning techniques (PBL, see Dochy, Segers, Van den Bossche and Gijbels, 2003, for an overview of PBL efficacy). Under the PBL pedagogy, students identify problems and use design thinking to understand, apply and internalize important design thinking processes. PBL violates several conventions of traditional pedagogy, among them the notion that the instructor is a somewhat distant supreme being who primarily lectures and then tests for knowledge retention. PBL emphasizes, in contrast, providing students with genuine problem-solving experiences where the problems are identified, discussed and agreed upon jointly by students and the instructor. Under PBL, the instructor becomes an approachable,

knowledgeable mentor, as opposed to the more traditional role of detached dictator. In essence, the PBL experience allows students to design their own learning experiences within the limits set by the instructor. PBL is broadly compatible with important design thinking principles, and enhances iteration, prototyping and critique skills. Combining executive education or firm-specific programs with a PBL-oriented approach to pedagogy creates a powerful tool for learning design thinking in an outside-the-firm classroom setting. PBL helps alleviate semantic gaps, break down conceptual blocks, and within student groups, is surprisingly effective at tearing down social barriers.

We have discussed three approaches to enhancing management education (outside the firm) with design thinking. While all these approaches are efficacious, they also suffer from drawbacks, the most important being the opportunity costs of sending managers back to school—managerial attention span is a precious commodity, and schools are costly. Below, we examine some in-house alternatives to "school," some of which are less costly to firms than externally-based pedagogical initiatives.

Management practices and embedding design thinking in firms

Ad hoc approaches to design thinking. Most recognition and acceptance of design thinking initiatives in firms take an ad hoc form. Systemic approaches remain relatively rare. Top managers often fail to see the added value of design thinking outside the realm of traditional product and graphic design tasks. One low-commitment approach, in-house seminars led by designers, is one way to imbue an organization with design thinking capabilities. For example, one of the authors worked for a time as an employee of a prominent Silicon Valley software house. Computer programmers are notorious for avoiding or ignoring critical user-centric data regarding the quality and nature of user interactions with their software. In a series of in-house seminars led by a variety of experts who routinely employ design thinking, the level of awareness regarding the importance of user needs was raised substantially among software engineers. We have found that one-time seminars or events have minimal impact on practices in firms, but a series of seminars that integrate design thinking across a variety of disciplines (from marketing to coding to typeface design to strategy) can be very effective. The message is that top management (the sponsor of in-house events) buys into design thinking and the seminars (occurring every 2-3 weeks) are not horribly intrusive on people's ability to get their work done. An in-house seminar series is a signal that top management takes design thinking issues seriously and sees value in spreading these practices beyond the design department—under the right conditions, a virtuous cycle of increasing interest and attendance emerges. When engineers know that top management is unambiguously behind an initiative (via a continuing series of seminars) they often embrace design thinking precepts in a willing manner. Ad hoc approaches are particularly cost-effective for dealing with semantic gaps.

A simpler ad hoc method for spreading design thinking in firms exists: bringing designers into meetings that discuss any and all new initiatives, including those that are not traditionally part of designers' worlds. A designer can act as facilitator for brainstorming, and serve as a meeting's visual thinker (e.g., sketching on the whiteboard). This method, while effective for bridging semantic gaps, is limited in its effectiveness at spreading design thinking throughout an organization. Even if design thinking is not installed as the default mode of attacking (non-design) problems, benefits accrue to people from seeing the technique in action—results also generally concretely improve over solutions that fail to utilize design thinking.

Leveraging in-house design resources. It is often a surprise to us that business schools do not leverage their in-house design resources to disseminate design thinking practices throughout their curriculum. By "in-house" resources for business schools we mean engineering and design schools that are part of the same university system as the business school. Of course, different schools inside the modern university often act and feel like completely separate institutions and many of the dysfunctional characteristics of these academic institutions can be used as exemplary case studies of the social barriers and semantic gaps noted in the preceding sections. However, in our experience there have been recent successes in utilizing in-house expertise to leverage design thinking and learning across disciplines, notably at Stanford's d.school.

The d.school, more correctly known as the Hasso Plattner Institute of Design at Stanford, is a multidisciplinary effort that was started by a Design Group faculty member, Professor David Kelley, the founder of

IDEO. His goal was the creation of a new type of "design thinking" Institute. The Product Design faculty, along with faculty from the Management Science and Engineering program, the Business School , Computer Science, the School of Education, and faculty from Anthropology and other social sciences, form the core of the d.school faculty. The contributions of every discipline are valued and equal at the d.school and, as a rule, all classes are co-taught, sometimes by three or more faculty, and never two from the same discipline. However, it is clear from the practice at the d.school that designers are leveraged for their expertise in design process and thinking. As George Kemble (2007), the Executive Director of the d.school has stated,

> We believe having designers in the mix is key to success in multidisciplinary collaboration and critical to uncovering unexplored areas of innovation. Designers provide a methodology that all parties can embrace and a design environment conducive to innovation. In our experience, design thinking is the glue that holds these kinds of communities together and makes them successful.

This leverage is visible at the faculty level: almost every faculty member of the Design Group at Stanford (in the Mechanical Engineering Department) has taught at the d.school. Graduate students from Stanford's highly regarded Joint Program in Design (started in 1963 as an interdisciplinary program between Engineering School and the Art Department) serve as teaching assistants for most of the classes. The d.school has rapidly become an agent of change for other departments and programs at Stanford by explicitly creating opportunities for groups to take advantage of design thinking methodology. Semantic gaps and conceptual blocks are readily addressed by proper leveraging of in-house design resources.

Deploying designers as top managers. Companies noted for their successful innovations often have designers, or design-trained managers, in senior positions. Two companies from different eras come to mind as benchmark examples: Braun (now a division of Gillette), and Apple.

Dieter Rams, a trained architect turned industrial designer, was Braun's Head of Design from 1961-1995. Rams reported directly to the two brothers (sons of the founder, Max Braun) who owned Braun at the time, Artur and Erwin Braun. Design at Braun, lead by Rams, was used to reposition Braun to benefit from the expansion of the post-war consumer electronics market (1951). Rams' influence on the company went well beyond the design department: his "ten principles of good design"☐ at Braun became part of the company's culture. Under his leadership, Braun became a successful global supplier of appliances and personal care products.

It is interesting to note that Rams' brand of design thinking borrowed heavily from the Staatliche Bauhaus (the Bauhaus School, 1919-1933, Germany) that emphasized prototyping and multi-disciplinary teams. Indeed, the Bauhaus manifesto may be one of the first design documents to speak about their strategic importance. Bauhaus founder Walter Groupius wrote that the goal of the Bauhaus was "to create a new guild of craftsmen, without the class distinctions which raise an arrogant barrier between craftsman and artist."☐ (Frampton, 1992, p. 123)

Jonathan Ives, the Senior Vice President of Industrial Design at Apple, is another example of how a designer, raised to the level of a direct report to the CEO (Steve Jobs), can set the bar for an entire company. Apple, more than any other modern company, lives by the design philosophy set forth by Dieter Rams in the 1960s. It was Rams who, as one of his ten principles, said, "good design is consequent to the last detail." (Rams, 1962) At Apple, Jonathan Ives is the man who manages the consequent details. Everything designed by Apple exhibits his exceptional attention to detail. In every endeavor, Ives follows two other Rams dicta: "Good design is as little design as possible…and…back to purity, back to simplicity."☐ Apple's recent sustained financial success is evidence that, in their industry, elevating designers to management is a concretely profitable strategy. The idea of designer as top manager seems compelling. Rams' philosophy is a powerful tool for addressing issues with semantic gaps in particular, and to a lesser extent for conceptual blocks. His approach may also have some incidentally positive effects on social barriers.

Concluding thoughts

For design thinking to permeate an organization requires an environment different from the traditional work or educational environment. We have isolated two organizational-context dimensions necessary for a rich design thinking environment, without which design thinking activities are impossible: multidisciplinary teams and group/individual fluency. Within this organizational context, high performance design and innovation outcomes occur when a multidisciplinary team engages in design thinking process by explicitly working with five dimensions of design thinking action: user centered research, prototyping, iteration, critique, and form-giving. Fig. 1 illustrates the proposed interrelationships of these dimensions.

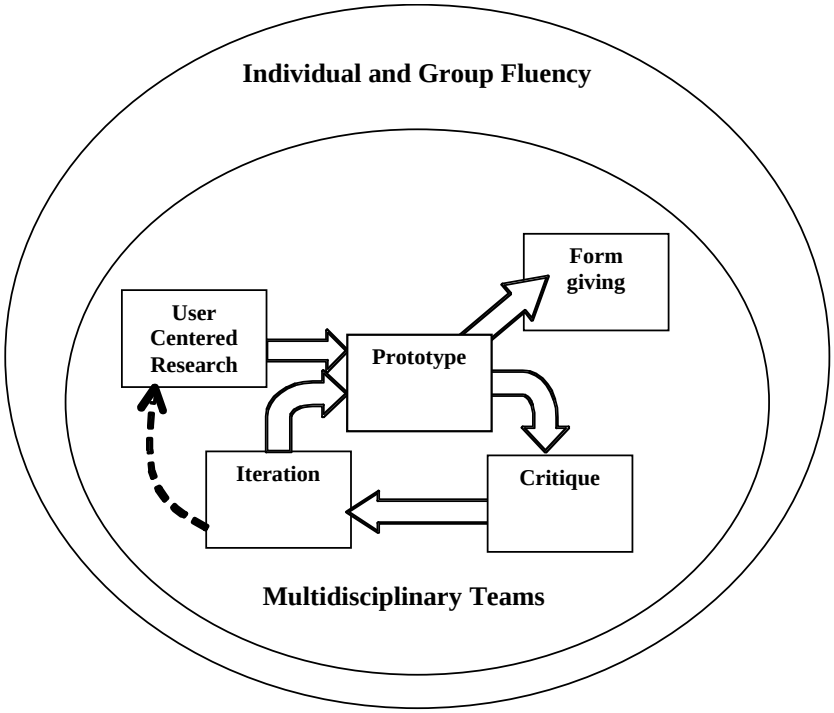

FIG. 1: SEVEN DIMENSIONS OF DESIGN THINKNG

Per Fig. 1, design thinking activities thrive given an organizational context of a multidisciplinary team possessing individual and group fluency skills. The proposed process occurs within this context, and iteration plays a central role. Iteration is identified as a distinct process intentionally; the goal is to prompt the statement “now we will iterate” so that the team is not tempted to accept early problem solutions. Similarly, experienced design thinking teams know when to ask “Is this the last iteration? Should we stop now?” The number of iterations is undetermined, though in our professional experience in highly creative environments, iteration always continues until the allotted

time runs out. Iteration drives the prototype-critique-iterate cycle, but iteration may also sometimes lead back to user-centered research—gaps in knowledge of user requirements must be addressed if present (the dotted arrow in Fig. 1). Fig. 1 also shows form-giving as the culmination of the design thinking process. A subsequent generation of design thinking might start with the results of a previous generation's form-giving as part of its input and proceed to user-centered research and prototyping to begin the next-generational cycle of design thinking.

While Fig. 1 outlines a plausible process, it lacks prescriptive value as to how best to implement design thinking throughout an organization: which solutions for problems with design thinking are most efficacious for particular problems? Table 1 describes our thoughts on the comparative efficacy of our proposed solutions to each design thinking problem arena. Table 1 indicates that conceptual blocks are cost-effectively addressed within a classroom setting, for example, by an MBA program. Development of a problem-based learning orientation to design thinking also effectively addresses conceptual blocks—the structure of the PBL inquiry process explicitly seeks to break through conceptual blocks. For semantic gaps, the best solutions are an ad hoc approach (e.g., a seminar series in a firm) or having a designer as top manager (we prefer both initiatives). Social barriers are best addressed by firm-specific management education, which creates a spirited cadre of design thinkers in one firm to spread the techniques throughout an organization.

TABLE 1: EFFICACY OF SOLUTION AREAS FOR VARIOUS DESIGN THINKING PROBLEMS

		-->Increasing importance of group-level interaction issues---->		
	Solution Type	Conceptual Blocks	Semantic Gaps	Social Barriers
Pedagogy-based solutions: Management development initiatives	Classes/MBA programs	+++	++	+
	Firm-specific management education	++	+	+++
	Problem-based design thinking orientation	+++	+	++
In-firm-based solutions: Human relations initiatives	Ad hoc	+	+++	++
	In-house design thinkers	+	++	+++
	Designer as top manager	++	+++	+

+ = Low efficacy
++ = Medium efficacy
+++ = High efficacy

The drawback to firm-specific executive education initiatives is that they are expensive both monetarily and redirect costly, finite managerial attention from other problems. A less costly but nonetheless efficacious solution to social barrier issues is to use in-house design thinking resources (designers) as facilitators and team members in problem-solving tasks that fall outside the realm of traditional design.

This paper has proposed a preliminary framework for management educators and managers interested in design thinking to explore implementation of design thinking in their organizations. Much work remains to be done in the realm of validating the anecdotally-derived relationships we have proposed herein, but our substantial experience addressing design thinking issues both within business schools and in firms leads us to assert that this is a rich arena for further study. Future research efforts might focus on empirically validating our model by examining innovating firms and tracking the nature of their design thinking processes against their subsequent performance. Also, though we aver a logic of cost-efficiency in mapping solutions to design thinking problems, the actual comparative efficacy of solutions may vary with the idiosyncratic nature of organizations in which implementation of design thinking precepts is attempted.

Our main contributions include a useful set of original definitions that break down design thinking into seven dimensions, two of which are organizational context-related and five of which comprise design thinking activities. The specified dimensions must each have the proper character in organizations wishing to engage in productive design thinking. This may seem like a demanding set of requirements, but we reiterate that design thinking is not easy, even for experienced practitioners. Inculcating an organization with the necessary values, environment, culture and processes is a substantial, intimidating task. To facilitate this task, we have proposed a simple framework within which design thinking might be expected to prosper. Additionally, we have identified types of impediments to design thinking in organizations and examined some possible solutions and their comparative efficacy.

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[i] Adams' book has been revised recently and incorporates more current terms of art and technology—its relevance remains undiminished today.

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