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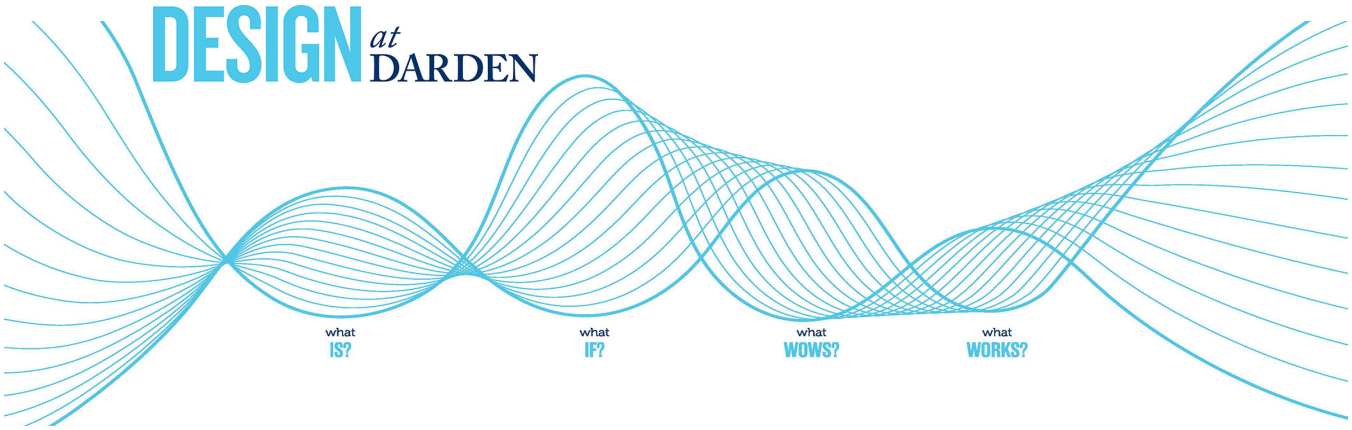
EXPLORING THE IMPACT OF DESIGN THINKING IN ACTION



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EXPLORING THE IMPACT OF DESIGN THINKING IN ACTION

ABSTRACT

Design thinking is a methodology of growing interest to both management scholars and organizations, yet little rigorous research on its efficacy in practice has been conducted, though anecdotal reports of success are numerous. This article reports on a case-based exploratory study aimed at identifying the elements actually practiced under the rubric of "design thinking" and assessing its value for enhancing organizational innovation performance. It does this by examining design thinking methodologies in action in 22 organizations that span industry sectors (both business and social) and organizational types (large corporations, start-ups, government agencies and NGOs). It first identifies the key elements of practice actually utilized by these organizations under the rubric of "design thinking" or "human-centered design" and then explores a set of findings concerning the enabling mechanisms these create that relate to innovation processes in the organizations studied. It then explores how these enabling process mechanisms facilitate improvements in organizational innovation performance related to the quality of choices available, reduced investment risk, enhanced likelihood of successful implementation, increased organizational adaptability and the creation of local capabilities. In conclusion, this initial study demonstrates that, when looked at as an end-to-end system for problem solving, design thinking offers an integrating process and toolkit that incorporates both creative and analytic approaches to problem solving, and that has the potential to significantly improve innovation outcomes.

EXPLORING THE IMPACT OF DESIGN THINKING IN ACTION

Design Thinking is currently enjoying unprecedented attention from practitioners and attracting increased attention from business scholars for its potential to foster innovation across a broad spectrum of organizations and issues. Defined by Gruber, DeLeon, George and Thompson (2015) as a "human-centered approach to innovation that puts the observation and discovery of often highly nuanced, even tacit, human needs right at the forefront of the innovation process," Design Thinking (DT) includes a series of iterative activities: an initial exploratory set of activities focused on data gathering to identify user needs, design criteria and problem definition, followed by the generation of ideas, which are then prototyped and tested. DT is often contrasted with alternative innovation strategies such as technology-driven and designer-led innovation (Verganti, 2008). Rigorous academic research in scholarly management journals on the impact of the methodology on organizational outcomes remains scant, though anecdotal data is plentiful concerning its ability to improve outcomes when innovation is the goal (Brown, 2009; Kelley & Littman, 2005; Liedtka & Ogilvy, 2011; Martin, 2009). Most of the prominent business-consulting firms, including McKinsey, Accenture, PWC, IBM and Deloitte have acquired design consultancies, evidence of its increasing influence on practice.

In both scholarly and practitioner –focused accounts, DT's value has, with a few exceptions, been framed in terms of enhancements to the quality of the solutions produced. This paper seeks to both broaden and deepen the conversation about DT's constituent elements and their impact by more systematically examining its use in-depth and in action. In it, we share the results of exploratory research that examined a diverse set of innovation projects in 22 organizations spanning a variety of sectors, utilizing a methodology characterized as "Design Thinking" by the organizations using it. In doing so, we identify the key elements that comprise it in practice, and detail a set of enabling mechanisms through which we observed it improving innovation processes. We then formulate a set of propositions concerning how these process enhancements potentially impact organizational innovation outcomes, with the goal of assessing the extent to which the set of tools and practices grouped together under the label "Design Thinking" seem likely to offer long-term value.

This paper contributes to the literature by first, reviewing a detailed set of cases, across a diverse set of organizations and contexts, that employ an array of approaches, all labeled "Design Thinking," that aim at solving a varying set of problems. Previous research has focused more narrowly on single case studies or involved a small number of firms, often centered on a single methodology, like IDEO's (Calgren, Elmquist and Rauth, 2016). We describe in-depth the actual practice behaviors observed and detail the methodologies used and the challenges they sought to solve. Secondly, the paper systematically traces the way in which these elements worked together to produce enabling mechanisms that facilitated innovation processes in the organizations studied, synthesizing related research of relevance from other areas as it does so. Finally, it uses the data gathered to develop a set of hypotheses on innovation impact that is considerably broader than has been described in the literature to-date.

TRACING DESIGN THINKING'S ORIGINS

The approach referred to as "Design Thinking," also called "human-centered design" or "user-centered design," though not prominent in the management literature until recently, despite Simon's (1969) often quoted assertion that all successful managers were designers, has multiple antecedents in related fields such as architecture, service design (Kimball, 2014), participatory design (Bjogvinsson, Ehn and Hillgren, 2012) and product design (Luchs, Swan, and Creusen, 2016). It has for decades been a focus of scholarly attention in design-related academic journals like *Design Issues*. In the architectural field, design dates back at least to the Egyptian pyramids, design theorists assert (Bazjanac, 1974). In its earliest conception, design was primarily concerned with aesthetics and principles such as order, symmetry, and harmony. During the twentieth century, in tandem with advances in scientific fields like mathematics and physics, design theory took on a more analytical orientation, emphasizing structured problem-solving processes that sought the "best" solution to a stated problem. Writing in the late nineteen forties, Rittel, a prominent planning theorist, first called attention to the inability of these linear problem-solving approaches to succeed under conditions of uncertainty and complexity (Rittel and Webber, 1973). Adopting the nomenclature of "wicked problems" to describe a class of problems that were ill-structured and did not lend themselves to the accurate a priori assessment of the relationship between cause and effect, Rittel advocated an alternative view of design: a process of argumentation, in which the designer continually refined both the definition of the

problem and its solution, which were testable only through experimentation rather than analysis. It is this view of the design process that underlies "Design Thinking" as practiced today, with its emphasis on the centrality of learning and experimentation, the reframing of problem definitions and the search for emergent opportunities (Beckman and Barry, 2007). Consistent with this new view, Schon (1982) emphasized the critical role of reflection in action, describing design as a reflexive "shaping process" in which the situation "talks back." He termed each iteration a "local experiment which contributes to the global experiment of reframing the problem." Design, he argued, succeeded under conditions of complexity and uncertainty by creating virtual worlds that acted as learning laboratories:

> "Virtual worlds are contexts for experiment within which practitioners can suspend or control some of the everyday impediments to rigorous reflection-in-action. They are representative worlds of practice in the double sense of "practice". And practice in the construction, maintenance, and use of virtual worlds develops the capacity for reflection-in-action which we call artistry." (p.162)

This focus on hypothesis generation and testing as core to design necessitated a different type of hypothesis and mode of reasoning (termed "abduction," borrowed from philosopher C.S. Pierce (1955) than traditional science, March (1976) asserted: "Science investigates extant forms. Design initiates novel forms…A speculative design cannot be determined logically, because the mode of reasoning involved is essentially abductive". Abduction, which moves from observations to hypothesize the best explanation, has as its goal the identification of a plausible explanation and has, itself, independent of the design literature, become a focus of scholarly attention in management as a valuable alternative approach to reasoning (Ketokivi and Mantere, 2010; Shepherd and Sutcliffe, 2011).

Another distinguishing characteristic, prominent design theorists argued, was design's movement between the particular and the abstract, and the emergent and opportunistic nature of the design process. Buchanan (1992), in arguing that there could be no "science" of design explained:

> "Designers conceive their subject matter on two levels: general and particular. On a general level, a designer forms an idea or a working hypothesis about the nature of products or the nature of the human made in the world…But such philosophies do not and cannot constitute sciences of design in the sense of the natural, social, or humanistic science. The reason for this is simple: design is fundamentally concerned

> with the particular, *and there is no science of the particular*…Out of the specific possibilities of a concrete situation, the designer must conceive a design." (P.15-16)

Buchanan situated design as occurring at the intersection of one particular set of constraints, possibilities and contingencies. Thus, a need to mediate between divergent forces is also central to the design process, as Findeli (1990) notes:

> "The discipline of design has got to be considered as paradoxical in essence and an attempt to eliminate one pole to the benefit of the other inevitably distorts its fundamental nature. (The goal becomes) to perceive this dualism as a dialectic, to transform this antagonism into a constructive dynamic (p. 32-33)."

Thus, the invention of new forms requires – and design seeks to manage - an ever present set of tensions like those between familiarity and novelty (Liedtka and Mintzberg, 2006), intuition and rationality (Calabretta, Gemser, and Wijnberg, 2016) and exploration and exploitation (March, 1991). Innovation is itself inherently a dialectical process (Bledow, Frese, Anderson, Erez and Farr, 2009..

These qualities of being hypothesis-driven, abductive, dialectical and focused on the particular, form the theoretical foundation of Design Thinking. To these theories of the design process, DT, as described in the literature today, incorporates three additions. The first is the emphasis on being user-driven; DT's focus on the particular is human-centered (to a degree that its predecessors in design theory were not) with the development of empathy considered critical to successful use of the method (Patnaik and Mortensen, 2009). The second addition is an emphasis on the inclusion of a more heterogeneous set of voices in the design process, with an attendant preference for co-creation and designing *with* rather than *for*. The third is the addition of a specific set of tools and activities, drawn from primarily from graphic, service, participatory and product design, rather than architectural fields. Whereas design theory offered management practice a new lens on problem solving at a largely metaphorical level, Design Thinking accompanies this theory with a toolkit that facilitates its operationalization in practice. These tools include a variety of ethnographic research techniques like observation and interviewing, journey mapping, job-to-be-done; ideation tools like brainstorming and concept development techniques; visualization tools like mind mapping and storyboarding for prototyping; and methods for the design of experiments to test the portfolio of solutions developed. Yet, taken individually, few of these tools are new. Elements seen as foundational to the approach, like ethnographic research, brainstorming techniques, prototyping, and heterogeneous teams, have been in use for decades. The hypothesis-testing dimension echoes themes similar to a body of currently popular methodologies like Lean Start-Up and

Agile Development. Thus, not surprisingly, DT has been dismissed as "old wine in new bottles" and as a passing fad, leaving a set of critical questions that remain to be answered: (1) What is actually practiced under the rubric of Design Thinking versus descriptions in the literature? (2) What are its impacts on organizational efficacy and how are they achieved? and (3) Is "Design Thinking" a valid and unique concept that offers something beyond the individual benefits of its already well-recognized tools and activities, one that is likely to be sustainable in organizations long-term? This paper offers a set of preliminary findings that address each of these issues.

GROUNDING DESIGN THINKING IN BROADER THEORETICAL PERSPECTIVES

Design Thinking's relative lack of attention in the scholarly literature (Gruber et al, 2015) has been attributed, not only to its newness in management circles, but also to its dismissal as merely a set of practical tools lacking any theoretical grounding and therefore not of interest to scholars. Yet, we see its theoretical premises and hypothesized utility traceable to a variety of existing management theories and literatures. DT's efficacy as a problem solving process, for instance, can be situated in the management literature focused on responses to accelerating environmental uncertainty and complexity, as it is often invoked as superior to traditional methodologies when existing data is inadequate for decision making purposes and the ability to make predictions is suspect, tying it to work on other well-accepted concepts like effectuation in the entrepreneurship literature (Saravathy, 2001) and to complex adaptive systems theory (Axelrod and Cohen, 1999; Miller and Page, 2007), where conditions are seen as too novel or chaotic to permit accurate prediction and control. This has led to the search for new management innovations, which Birkinshaw, Hamel and Mol (2008) define as "the invention and implementation of a management practice, process, structure or technique that is new to the state of the art and is intended to further organizational goals" (2008). This search accounts for the heightened interest in new approaches like Lean Start-Up (Womack, Jones and Roos, 2009), Agile Development (Cockburn, 2006), and Open Innovation (Chesbrough, 2006), in addition to DT. These methodologies all share an underlying retreat from what Eisenhardt and Tabrizi (1995) refer to as "compression" approaches to increasing innovation speed and success, to favor more open and experiential processes better suited to uncertain and complex environments, based on experimentation, iteration and broadening networks of contributors. Within this perspective, the DT methodology can be situated as one particular set of organizational routines

(Feldman and Pentland, 2003) aimed at providing a new *social*, rather than physical, technology to facilitate innovation (Nelson and Winters, 1982; Pezeshki, 2014). In writing about routines, Cohen (2007) traces their evolution from Dewey's focus on their 3 foundational components: emotion, action and cognition, insisting that cognition has been privileged by scholars and calling for more attention to both emotion and action, both central to design thinking processes. Eisenhardt and Martin (2000) argue that while routines in less turbulent markets are detailed, analytic and stable with predictable outcomes, as velocity in markets intensifies, they become more simple and experiential, and their outcomes more unpredictable. These routines, taken together, create critical dynamic capabilities for achieving growth and innovation (Barreto, 2010; Teece, Pisano and Shuen, 1997). The particular dynamic capabilities stressed relating to innovation are sensing and seizing opportunity and reconfiguring resources. Dong, Garbuio and Lovallo (2016) found that the key cognitive acts underpinning generative sensing were framing and abduction, both central to DT processes.

Related to routines and dynamic capabilities, another literature has focused on the notion of practice, which makes primary the role of knowing *in action*. Orlikowski (2002) grounds innovation competence in a collective set of "the everyday practices of organizational members, "which include activities leading to sharing identity, interacting face to face, aligning efforts, supporting participation and learning by doing." Like Orlikowski suggests, our study grounds the study of DT in the concrete practices of the individuals performing it. Because it consists of a diverse bundle of tools and activities, DT can be most effectively grounded in various management literatures at the level of particular practices, rather than the abstract bundle. Accordingly, we will return to the relevant literatures as they relate to our research findings on specific practices later in this article. We now turn to our study. After first describing our methodological approach, we assess what, in practice, organizations are actually implementing under the rubric of "Design Thinking" and the kinds of impact on innovation processes that we observed these activities generating.

METHODOLOGY

Data Sources and Analysis

Due to the relatively recent implementation of DT as a widespread innovation practice, and the subsequently limited volume of non-anecdotal empirical studies, we opted to use a qualitative

case-based methodology, believing this exploratory approach to be best suited to the emergent nature of the subject (Eisenhardt & Graebner, 2007). This study utilized purposive sampling (Ritchie, Lewis, Nichols and Ormston, 2013), a non-probability sampling technique that selects respondents based on a specific set of attributes that will contribute to the study underway. Because we wanted to understand the use and impact of DT more broadly, we looked for (1) a cross-section of different types of organizations (e.g., large corporations, start-ups, NGOs, government agencies) and geographies; (2) different sectors of the economy (e.g., government, health care, business products and services, education); (3) a diversity of issues addressed by projects studied (e.g., service improvement, revenue growth, post-merger integration, etc.); and (4) projects of sufficient duration to allow assessment of impact. The authors reached out to an extensive network of personal and university contacts, and worked with the Design Management Institute (an industry association of professionals interested in the intersection of business and design) to solicit examples of organizations who had been working with DT for several years and had a number of completed projects in implementation. Interviews were conducted with the resulting 32 organizations nominated for study to assess suitability for the study; 22 were selected for inclusion in the study, based on the criteria discussed above. All 22 accepted our invitation to be part of the study. The level of analysis was the project, and the innovation team conducting it.

The study relied on a variety of data sources. Most prominent were semi-structured interviews with innovation team members and other key stakeholders involved in the project. The initial interviews lasted an average of 90 minutes, with a span of between 1 and 3 hours, using a semi-structured interview guide, with a minimum of 2 researchers present. Each interview focused on the selection and exploration of one particular project that we studied in-depth. We asked each interviewee to detail their thoughts and activities from inception of the project to its completion. Where possible, concrete evidence of outcomes was obtained. For each project, we spoke with a minimum of three people involved and conducted at least 5 interviews in total for each, with a range from 5 to 10, with some key individuals interviewed multiple times to elaborate key points. Interviews were tape recorded and transcribed, yielding over 3000 transcript pages. Table 1 contains a listing of the 22 organizations studied, (in the order of study) along with their project challenges and the number of interviewees and interviews conducted.

INSERT TABLE 1

During the analysis stage, the study followed an iterative process typical of grounded research (Eisenhardt, 1989). To begin, our search was open ended. Each member of the research team reviewed each interview transcript independently for themes and patterns in the data, after which the team met to explore the similarities and differences. Detailed case studies (between 5000-9000 words) were written on all 22 projects. These were shared with the interviewees to ensure accuracy, and permission was obtained to identify all organizations by name. After some iteration, individual themes from each case were sorted into larger themes, with representative quotes collected from across the interviews, as cross-case analysis was begun. This process was repeated until theoretical saturation was reached. This analysis identified patterns that were significant across cases, regardless of industry, organizational type, or project challenge.

OBSERVED ELEMENTS OF DESIGN THINKING

Our first set of findings aimed to assess the validity of "Design Thinking" as a construct: was it comprised of a consistent set of practices across the organization studied? In this section we describe the key sets of practices that emerged as most prominent, along with the enabling mechanisms we observed them creating that facilitated innovation processes. The five practices we observed were: (1) the development of a deep empathic understanding of user needs and context; (2) the formation of heterogeneous teams; (3) dialogue-based conversations; (4) the generation of multiple solutions winnowed through experimentation; and (5) the use of a structured and facilitated process. Figure 1 summarizes our data structure and lays out our findings on the relationship between these practices and the innovation process. Appendix 1 contains examples of the specific evidence we observed of the five practices at work.

INSERT FIGURE 1

Practice: Development of a deep empathic understanding of user's needs and context

Not surprisingly, and consistent with other research that specifies key elements of DT practice using smaller samples (Calgren et al, 2016a), the aim to develop a deepened understanding of the stakeholder's context - particularly the user who was being designed for - was present in virtually all of the projects we studied. Evidence of this was provided by activities indicating a focus on developing empathy for those being studied, the use of ethnographic tools, and the subsequent use of the insights derived from this research to reframe problem definitions and generate solutions. The tools observed included, but were not limited to, ethnographic

observation and interviewing, journey mapping, mirroring, analysis of the user's "job to be done" and the creation of personas to illustrate different categories of users and their needs. In order to understand user problems more deeply, innovation team members sought a first-hand and empathetic connection, whenever possible, with users (Leonard and Rayport, 1997). Rather than relying solely on quantitative data such as surveys and market analyses, achieving "customer focus" meant being deeply interested in the details of users' lives as people, as team members searched for new and deeper insights. This pursuit of insights into unmet needs preceded the pursuit of solutions, with only two exceptions in the 22 projects studied. This development of a deep empathic understanding impacted the innovation process in multiple ways: providing user-driven criteria for ideation, encouraging reframing of the problem, helping to align team members' perspectives and build emotional engagement, and enhancing their ability to alter course and "pivot."

There were many memorable instances in the study of this deep immersion in users' lives and its impact on the perspectives of interviewees, their framing of the problem, and how these, in turn, affected organizational innovation processes. At The Kingwood Trust, for instance, whose project aimed at engaging the voices of autistic adults and their caregivers and families in the design of their daily activities, a doctoral student from the Royal College of the Arts described her own personal experience as she strove to develop a deeper understanding of Pete, one of the non-verbal autistic adult residents. The first time she observed Pete at his home, she saw him involved in a series of seemingly destructive acts—like picking at a leather sofa and creating indents in a wall by rubbing against it. She focused on documenting Pete's behavior and defined the problem as how to design solutions to prevent such destruction. On her second visit to Pete's house, however, she elected to mirror his behavior as well as observe it and discovered, for herself, the sensory enjoyment his activities provided. Unable to ask Pete directly what he liked about doing these things, she experienced them herself and commented: "Instead of a ruined sofa I now perceived Pete's sofa as an object wrapped in fabric that is fun to pick. Pressing my ear against the wall and feeling the vibrations of the music above, I felt a slight tickle in my ear . . . So instead of a damaged wall, I perceived it as a pleasant and relaxing experience." This change in perspective not only led to the development of an empathic understanding of Pete's challenges, it led to the reframing of the project definition itself, leading the team to appreciate and to design for Kingwood residents' strengths and pleasures, rather than

merely for their disabilities, developing a "Triad of Strengths" (rather than merely impairments) framework to guide the team.

Interviewees reported that DT's focus on paying deep attention to actual human experience was particularly valuable where especially complex social issues were faced. One team member, a partner from ThinkPlace consultancy, working on the New Zealand government's "Family 100" project, aimed at better understanding the needs of poor families, explained the prominent role of meaning (Verganti, 2008):

> "These complex systems are usually understood from a quantitative perspective, and what this fails to provide is meaning. We then end up with policies and other interventions that don't make sense for people and produces a big gap between the intent of the policy and what actually happens. This is actually no wonder if the design of such social complex systems has not been preceded by sense-making of the human experience in the system. What we are doing with work like Family 100 is starting to shine a light on the fact that there is a deep and reliable practice for uncovering the complexity of human experience, modeling exploratory stage happenings and then having the ability to use that in design and decision-making about the future. Without this sense-making and modeling of the human experience, policy makers and designers are making decisions in the dark, quite literally."

In our research, we saw the specific effects of these human-centered research activities influencing the innovation process in multiple ways.

Providing user-driven criteria for ideation. The first, and perhaps most obvious impact, was that the use of design's ethnographic tools developed user-driven design criteria as input to ideation. It solicited new - and particularly valuable - data for idea generation that helped innovators gather deeper insights into needs that translated into higher quality solutions more likely to receive user acceptance. For example, in a case from the US Health & Human Services Agency (HHS), a tournament-style idea crowdsourcing program called "Ignite" reached out to all 80,000 HHS employees with an invitation and support (in the form of training, time, mentoring and other resources) to pursue innovation opportunities using DT and Lean methodologies. One respondent, a young quality officer at an Apache Indian reservation hospital in Whiteriver, Arizona, stepped forward with an idea to reduce the wait time in the hospital's emergency room (sometimes as long as 6 hours). Her initial idea, arrived at by benchmarking Johns Hopkins Medical Center in Baltimore, was to install an electronic kiosk for check-in. But as she and her teammates gathered data from patients, they quickly realized that hospital patients, many of whom were elderly Apache speakers, were not comfortable using computers: solutions that

worked in urban Baltimore would not work in Whiteriver, Arizona. They adjusted their design criteria in line with this learning.

Often, such ethnographic data gathering triggered a shift in perspective on the part of those designing from that of "experts" to that of users, combatting a well-known cognitive bias - the "egocentric empathy gap," in which decision makers consistently overestimate the similarity between what they value and what others value (**(**Van Boven, Dunning & Loewenstein, 2000). At Children's Health Systems of Texas, their project aimed at enhancing the wellness of at-risk Dallas children. Its project leader described her role as working to shift the mindset of clinical staff from one of emotional distance and evaluation (patients weren't using the system correctly) to one of empathy – to move them from a "place of judgment to a place of possibilities" as she described it, and built appreciation for patients' challenges, and for the logic their choices had for them.

Encouraging reframing of the problem. A second innovation impact we observed was that these deeper user insights encouraged teams to reframe the problem and solve a more promising one. Reframing was a critical first step in the ability to identify a better set of choices. DT did this by "holding" teams in the problem space: the structured processes used to implement DT insisted that they do this exploration *before* ideation. By insisting that decision-makers postpone the search for solutions and explore the problem more deeply, new understandings from the exploratory research set the stage for reframing. Redefining the challenge or problem itself has been demonstrated to be an essential element in creating higher quality decisions; there is a rich literature on the importance of problem formulation and framing to the quality of decisions (Baer, Dirks, and Nickerson, 2013). Dorst (2015) has argued that problem framing is one of the key design practices that make the method more likely to yield better solutions than conventional approaches to problem-solving.

The advantages of dwelling in the problem space were evident in our study, as it often led to changing the boundaries of the question innovation teams were asking, as we saw in The Kingwood Trust case. In another instance at Children's Health, in attempting to reduce inappropriate emergency room usage, hospital leaders quickly implemented a solution that seemed sound: place clinics throughout the community. However, after these clinics failed to impact ER usage, they elected to use DT and conducted ethnographic research into the lives of patients and their families. This led to a reframing of the design challenge to seek community-

centered wellness options, rather than hospital-centered, to reduce inappropriate emergency room usage. This was proven valid during subsequent testing in an experiment focused on asthma patients: inappropriate ER usage decreased approximately 50% during the testing period. Similarly, as the US Transportation Safety Administration (TSA) explored the problem of ensuring security at busy airports, their initial focus was on enforcing regulations. After their exploratory research, they recognized that security at checkpoints was likely to be better improved by ensuring that "innocent" travelers remained calm in order to make *malevolent* intent more visible to TSA workers. This reframed focus then became a critical element of their design of solutions, and highlighted, for example, the importance of training their staff in calming passengers. We observed additional examples of reframing at work:

- At IBM, improving trade shows evolved into understanding how human beings communicate and learn.

- At Suncorp, a focus on problems of post-merger integration shifted to creating engagement and alignment around the new strategy.

- At 3M, how to talk to customers' designers morphed into re-imagining the kinds of future-focused conversations salespeople needed to have and how to empower these.

- At SAP, designers and strategists joined forces to take two seemingly distinct problems related to the arrival of Web 2.0 and blend them into one powerful challenge.

-At Toyota, the design of a new knowledge database for customer service reps became the re-design of a larger system of interactions and relationships for it to reside in.

- At The Good Kitchen, "fixing" the menu evolved to understanding the alienation of both the elderly and the food service staff. To solve both groups' frustrations.

Aligning team members' perspectives. In a third impact we observed, this immersion in the stakeholders' perspectives also facilitated the alignment of team members' perspectives and allowed the prioritization of information that decision-makers worked with. Decision-makers in our study often complained of too much data, rather than too little, but felt that what they had was not of the right kind. By translating shared insights into design criteria, they specified and agreed on what data to pay attention to. This aligned teams around what "jobs" solutions needed to accomplish, and avoided premature debates about alternative solutions. This explicit creation of design criteria flowing out of the exploration stage allowed innovation teams in our study to develop a shared frame of reference about what was important *before* they entered the ideation

process. For instance, at Monash University Medical Centre in Melbourne, Australia, clinicians in the Mental Health Service had long been concerned about the increasing frequency of patient relapse (usually in the form of drug overdoses and suicide attempts), but were unable to align on a preferred solution and the situation persisted, despite numerous task forces assigned to address it. When the Service committed to doing patient-centered research on what one doctor called "the demand side" of the equation (versus the care delivery "supply side"), and traced the experiences of specific patients as they interacted with Mental Health, it changed their criteria for solutions. One patient, Tom, became emblematic of the problem. Tom's experience included 3 in person visits with different clinicians, 13 case managers and 18 hand-offs, resulting in a total of 70 different interactions during the interval between his initial visit and his relapse. What was missing for improving patient outcomes, the clinicians realized together, was not interactions with staff but instead a more personal sense of *care* for Tom's long-term problems. This then became the prime criteria for designing the new clinic, whose design proceeded smoothly with this consensus reached, and which has achieved substantial success: pre- and post-intervention comparisons quantify a 60% decrease in patients' overall "representation rate".

Enhancing the ability to alter course and "pivot." This development of user-centered criteria also facilitated the ability to quickly pivot (in the jargon of Lean Start-Up) - to move to alternative solutions when initial experiments failed. It did this by investing in understanding core user needs rather than investigating specific solutions. At TSA, for instance, when the initial concept to build a new website was derailed by an unanticipated change in agency website guidelines, the research already completed could be re-purposed immediately into the design of an app, slowing rapid pivoting valuable in achieving innovation in an uncertain environment.

Building emotional engagement. A final effect of the empathy developed for users was to build key stakeholders' emotional engagement around the need to improve their experience. Monash's Director of Psychology recounted the impact that immersion in Tom's journey had on the staff:

> "We can think all kinds of things about how we believe the system is working, but then seeing the reality of how it was really working, it was shocking to see how far from our intentions reality had come. Patients needed someone to be present for them. Despite a flurry of activity, nothing was changing for them. We needed to *feel* their blockages and struggles."

This focus on developing deep understanding did not only relate to end users like customers, patients or students. At 3M, understanding the needs of their own salesforce to help customers envisage new futures made possible by 3M's cutting edge new products was the focus. In Holstebro, Denmark's Good Kitchen project, understanding the perspective of kitchen workers, not just the elderly recipients who ate the meals, led to fundamental changes in process. "Good food has to come from the heart," the kitchen manager explained at the project's conclusion. Yet, this same manager had advised the innovation team at the start of the project *not* to talk with kitchen workers as she saw them as "irrelevant" to the project's initial goal: fixing the menu. A set of solutions that connected the two groups, like the inclusion of a note from staff with meals, became visible as a way to create meaning for both the workers and the elderly they served.

Practice: The formation of heterogeneous teams

Looking across the projects studied, another widely observed practice was the use of heterogeneous teams. Such attention to diversity has been observed in other research (Calgren et al, 2016a). These positives associated with heterogeneity are not surprising. Such teams are well recognized as providing the potential for producing more creative solutions (Rodan and Galunic, 2004). Diversity brings new data and perspectives, whether from customers, internal colleagues or external networks, into the process that are capable of producing novel insights and solutions, often by inducing reformulation of the initial problem. A range of enhancements to the innovation process we observed were traceable to this diversity: it allowed the building of alignment across differences; the expanded repertoire of teams led to higher order solutions and frequently built local capabilities to solve new problems; it broadened the teams' access to networks and resources; and it enhanced members' willingness to co-create.

Building alignment across differences. Pluralism represents a double-edged sword, for rich possibilities for innovation come accompanied by challenges in translation from theory to action. It is well recognized in the team literature that difference also drives team disagreement and dysfunction (Brown and Eisenhardt, 1995; Lovelace, Shapiro, and Weingart, 2001; Pelled, Eisenhardt and Xin, 1999). Success, these researchers suggest, came through achieving alignment via *concrete* tasks, and speed was associated with iteration and testing. We observed this in action: a key benefit to the innovation process was DT's provision of a mechanism that allowed teams to surmount these well-recognized pitfalls and achieve alignment across their

differences through an emphasis on tangibility and visualization, the use of prototypes, and rapid cycles of iteration and experimentation, fostering shared understanding and alignment across difference. In the Gateway Academy project, for instance, focused on reducing the dropout rate of at risk teenagers, the leader of the innovation team described the unanticipated benefits of an early scoping exercise:

> "Scoping for me was just this really rich conversation—it was a real breakthrough for us. We really wrestled with issues and came together as a group. It was supposed to take an hour or two and it took us across two days. But we needed those two days and that conversation was an important one for the organization. It also became, for me, part of an ethnographic interviewing process: I was learning how my *teammates* viewed the problem, what they were frustrated with, what they thought the most common challenges to students were. And that's where our new team kind of jelled—we became a leadership team."

This is consistent with the evolution of scholars' understanding of the phenomena of learning, as theorists have moved beyond early views of learning as information processing to a view that knowledge is a social phenomenon that is both personal and context-specific. The challenging nature of the learning required in the kind of high uncertainty environments that characterize innovation requires moving beyond what Kuhn and Jackson (2008) called the "casual exchange of information"; it requires significant knowledge development. Carlile (2004) argued that the domain boundaries diverse teams face are both interpretive (as team members accord personal meaning to information and events), and political (as different interests clash and impede knowledge sharing) and that innovation occurs at the intersection of these boundaries and requires the creation of a common lexicon, shared meanings, and common interests. DT tools for critical team tasks (like insight identification) appeared, in our research, to help team's meet Carlile's requirements. The human-centered lens brought a lexicon with it and emphasis on the user provided the common interest. Working in-depth with user stories led to shared meanings.

Expanding repertoire of teams. The question as to what form of heterogeneity best facilitates innovation team composition remains unresolved in the literature (Reiter-Palmon et al, 2012), though job-related functional heterogeneity has been demonstrated to be especially effective (Hulsheger, Anderson and Salgado, 2009). That is what we observed in our research, as diversity of roles and job-related functional background and experiences, rather demographic characteristics, was interviewees' dominant consideration in team formation. Team composition

was carefully managed with forethought given to the requisite variety of repertoires needing representation in the innovation conversation.

Members from outside the sponsoring organization were seen as particularly critical. In the Community Transportation Association of America (CTAA) project, for instance, aimed at addressing the transportation challenges faced by low-income workers, CTAA's request for proposals required that local teams assemble a cross-section of relevant area officials and business people, specifying the kinds of local entities whose involvement was required. CTAA leaders described how long experience working with local communities led them to insist on diverse teams at each location: their history told them that expanded repertoire would lead to higher order solutions. These groups of people, many of whom had never met, would educate each other and produce more systemic solutions, they explained - as when, for example, representatives from transport companies worked with employment counselors. This broadening of the team repertoire expanded the solution space teams worked within, allowing them to move beyond solutions that individuals brought into the room to help them envisage a broader set of possibilities. Similarly, in our study, officials at the US Food and Drug Administration (FDA) used DT to facilitate conversations across diverse stakeholder groups at conferences, despite the challenge of working with upwards of 200 attendees. They carefully architected small teams that had representation from manufacturers, regulators, health care delivery and patient advocacy organizations; again, leading to both novel solutions and creating enduring relationships.

Building local capabilities to solve new problems. These diverse teams formed bonds that encouraged them to continue to work together, after the particular project in question had ended, building local capabilities to solve future problems. As one CTAA local team member described it: "The growth of the relationships is bountiful…the partners continue collaborating in every possible opportunity."

Broadening access to networks and resources and ***Enhancing willingness to co-create.*** Hargadon and Sutton (1997) assert that knowledge results from a kind of brokering activity in which ideas are synthesized and re-combined in a process facilitated through social networks. Related to this, another positive effect we observed of combining heterogeneous team with other design methods was the broadening of access to larger, more diverse networks, with an attendant pooling of resources and an enhanced enthusiasm for co-creating with what Kaplan (2012) calls

"uncommon partners." At Children's Health, their early recognition of the critical role of families and non-medical contributors to wellness led them to work explicitly to find community partners like local churches to co-design a wellness ecosystem whose boundaries (and whose resources) stretched far beyond that of the Medical Center. The partners that Children's worked with - social service agencies, pastors, housing inspectors, the local YMCA - brought new and different resources to the challenges faced by poor children in Dallas. Combined, they created a whole that was larger than the sum of its parts. The Children's President for Population Health described the dawning realization of what they could accomplish together and the enthusiasm this built for co-creation when a community-wide group gathered to address asthma:

> "We had no clue how we related to each other. So we put together the asthma equation, a visual model for asthma, and the factors that were affecting these families and kids. When we put this together, people were stunned. We were all working on the same thing—but from different parts of the elephant. But none of us had ever looked at the whole elephant."

These benefits accrued from the *interaction* of the practices that we have discussed thus far, and were produced within the particular context of the structure set by the DT approach and the kinds of dialogue-based conversations it encouraged, as the next practice we observed explores.

Practice: Dialogue-based conversations that focused on problem definition first and allowed for the emergence of new solutions

Understanding *how* team members interacted with each other in real time to leverage their exploratory research and diverse perspectives was also of interest in our study. Conversation is the building block through which innovation teams operate (Stigliani and Ravasi, 2012). But such conversations often "jump to solutions" when decision-makers fail to invest time and resources in understanding of the problem (Baer et al, 2013), and move too rapidly to a focus on easily identified alternative answers. Indeed, in our research several projects had a history of previous failed attempts (as with Children's Health failed local clinics) and teams caught in non-productive arguments that gridlocked progress (as with Monash Medical Centre's Mental Health Service). The successful design-oriented conversations we observed were perhaps most vividly illustrated by what they were *not*: accepting of obvious and conventional problem definitions, debate-oriented, or focused primarily on the evaluation of a set of already identified solutions visible at the start of the process. Instead, they first explored the problem definition itself as a

hypothesis, sought to understand rather than to argue with the differing perspectives of others in an inquiry-focused conversation, and looked for solutions to emerge *during* the process. We observed this to have five particular outcomes that facilitated innovation processes: encouraging a focus on surfacing tacit assumptions, fostering team alignment and learning, allowing for emergent solutions, building engagement and trust and, in the process, creating a kind of "social technology" for having better conversations.

Without such an inquiry focus, heterogeneity becomes a double-edged sword as diverse teams experience greater conflict. Without the benefit of a structured methodology encouraging inquiry, they will likely resort to debate, with advocates for competing ideas each marshalling their own evidence of support while doing negligible listening. As Senge (1990) argues, participants in such solution-focused debates have little chance of achieving higher order solutions unless they move on the "ladder of inquiry" to a different level, requiring a different kind of conversation. Researchers have repeatedly documented the inability of analytically focused debates to achieve satisfactory resolution in change-oriented conversations (Ford, 1999) and the superiority of dialogue over debate when the goal is generative learning has been much discussed (Bohm, 1996; Isaacs, 2008; Senge, 1990).

Isaacs (2008) defines dialogue as "sustained collective inquiry into the processes, assumptions, and certainties" with the aim of raising consciousness of the tacit and underlying premises underlying beliefs. Tsoukas (2009), a leading proponent of such a dialogical approach to the creation of knowledge, argues that knowledge is created through direct social interaction and requires the collaborative emergence of joint frames and conversations that allow for novelty and coherence, in which progress emerges incrementally. Dialogue is central to innovation because knowledge is created through direct social interaction and conversation management: "Face to face dialogues make it possible for new organizational knowledge to emerge," he concludes.

Focusing on surfacing tacit assumptions. We observed this emphasis on surfacing assumptions to be key to DT's contribution. "Thinking together," as Pyrko, Dorfler and Eden (2016) describe it, requires mutual engagement around a shared problem in a conversation that is shaped but not controlled, and in which the willingness to share tacit knowledge is critical. Such sharing shifts frames of reference and makes team alignment and collective learning possible. An FDA official,

working on a project aimed at engaging a diverse array of stakeholders to establish standards for emergency respiratory devices, commented: “It is easy at the FDA to see standards as being what matters, but in the meetings it became clear that the standards didn’t incorporate real-life experiences. We began to see a new reality: this particular standard is useful, but it’s not comprehensive enough to really guide us or it doesn’t provide the solution that we need.”

Fostering alignment. Another project in our study, at Suncorp, a large Australian financial services firm, aimed at integrating two successful, but culturally divergent, organizations, post-merger. In it, DT methods were used to facilitate a dialogue-based strategic conversation that built alignment on new strategy and vision using the tools of metaphor, and storytelling.

Face-to-face conversation played an essential role in all of the cases in our research. At the FDA, innovation leaders refused to provide a conference call-in number so that colleagues in the same building could not dial-in but had to physically come together. Luigi Ferrara, director of George Brown College’s Institute without Borders (IwB), who partnered with County Kerry to revitalize Ireland’s beautiful but economically-ravaged Iveragh Peninsula, talked about why their approach incorporated multiple intensive week-long conversations involving community and business leaders, government officials and students: “Face to face works so much better!... The most sophisticated tool is not necessarily mechanical or digital: some of the most sophisticated technologies are social. So face-to-face is a super powerful technology… Get all the knowledge in the room.” Orlikowski (2002) confirms this in her research: face to face conversations facilitated behaviors essential to innovation success: sharing information, gaining trust and building special relationships.

Allowing emergent solutions. Such real time conversation allows solutions to emerge *during* the process. Emergence is a critical element in organizational adaptation in complex social systems (Colander & Kupers, 2014; Uhl-Bien and Arena, 2017). Most of the final concepts of interest at the conclusion of the County Kerry process were not recognized as options at its start; instead, new insights along the way sparked by the conversation as it unfolded brought them to light.

Thus, in our research, we observed the use of DT approaches, in particular treating the problem definition as a hypothesis needing further exploration, the surfacing of assumptions in dialogue-based conversations focused on inquiry rather than advocacy, and a collaborative

search for joint frames, created an exploration space that allowed stakeholders with differing perspectives to find emergent higher order solutions by leveraging their differences. It offered a set of collaborative conversation tools capable of accomplishing what many team-learning theorists suggest: supporting the emergence of shared vision, goals and meaning, aligning members' current and prospective perspectives by focusing on shared stakeholder insights and the design criteria they suggested, and building social networks that facilitated information exchange. Tangible artifacts that emerge from the use of design tools like visualization and prototyping have been demonstrated to provide important support for conversational practices aimed at prospective sense making (Stigliani and Ravasi, 2012). Practices like turn taking and non-evaluative listening, though certainly not introduced by DT, are embedded in its protocols.

Creating a "social technology". Taken individually, again, the specific elements of DT that we observed to facilitate dialogue - a shared focus on users, turn taking during conversations, the use of visualization - are not new or unique. However, integrated as a more comprehensive process, they provide what researchers have lamented the absence of: a more comprehensive processes and structured mechanisms to direct team interactions (Baer et al, 2013). Thus, when utilized as an integrated set of processes and tools, DT appeared in our research to provide what Pezeshki (2014) has termed a "social technology" for better conversations, by shaping the conversation, embedding the dialogic approach, allowing new possibilities to emerge, and steering early conversations away from debates that polarized and impeded learning and trust building.

Building engagement and trust. This social technology, in turn, allowed for the building of engagement and trust. As Monash's medical staff leader commented:

> "Language is about the creation of shared meaning. This is achieved through conversations that establish trust, and that lead to commitment. Systems matter more than software. Design tools work on the conversation, and embody the nature of the commitments that bind us. The ethical transformation of people and their commitment to work with each other that underpins DT is based on people listening before they act, not a set of inflexible requirements. In essence, complexity demands loosely coupled systems rather than evidence of compliance. To enable and support this, a conversation space based on trust must be opened up."

In our research, such *thinking* together benefited by *acting* together – our next subject.

Practice: Creation of multiple solutions made tangible through prototyping that were then winnowed through real world interaction and experimentation

Another set of widely observed practices in our study, much discussed in the literature (von Hippel and Tyre, 1995) related to the creation and testing of solutions in action in a very tangible way that fostered knowing in action. We observed three key components of this: (1) an emphasis on generating a portfolio of possible solutions, rather than a single "true" one; (2) treating these solutions as hypotheses to be tested in action through iteration and feedback from outsiders; and (3) the creation of low fidelity prototypes to support this testing. Again, the combination of individual elements described thus far gains power in their interaction - the effectiveness of dialogue is enhanced by the tangibility the experimental elements provide. As dialogue and risk minimizing practices like prototyping and experimentation combine, they create the "virtual worlds" that Schon (1982) argued were essential for learning. This approach produced four observable enhancements to innovation: it reduced both the investment in and the visibility of failures, mitigated against a well-recognized set of decision biases, allowed champions to emerge during the process, and encouraged a learning mindset and action orientation.

Our findings here are consistent with Dougherty's (1992) finding that successful teams ground activities in actual use. Put the product in user's hands, she advised, and build a common and comprehensive dialogue based on action from these particulars, not abstract goals. Orlikowski (2002) is another proponent, reviewing a long tradition in knowledge management around the power of "knowing in action." Prototypes, Okhuysen and Bechky (2009) found, were essential for teams' ability to coordinate, align and create shared meaning. More recent research demonstrates however, that like other aspects of DT's success, prototyping alone was insufficient - it was the generation of multiple prototypes and the interaction of prototyping and iteration as teams actually worked to change and refine them, which led to successful innovation outcomes (Seidel and O'Mahony, 2014).

Reduced visibility of failures. Innovators in our study expected success to take multiple iterations of prototyping, testing and refining. They also expected it to involve failure as well. At The Kingwood Trust, for example, innovators expected some of their prototypes to be actually destroyed by the autistic adults they were designing for. It was a way of giving feedback, they explained, for users who lacked the ability to communicate verbally. The goal was also to learn

in low visibility contexts. Again, learning in action as quickly and cheaply as possible rather than a priori analysis was seen as key to success. Team members' preference was to make the kind of multiple "small bets" that Eisenhardt and Tabrizi (1995) find in their research, and that have appeared prominently in currently popular methods like Lean Start-Up and Agile software development.

Examples of small bets that reduced investment and the likelihood of visible failure were plentiful in the projects we examined. Children's Health selected patients with just one disease - asthma - to test its new business model. When IBM decided to reimagine the standard trade show and arrived at a series of new concepts, they piloted them at one small trade show; not because IBM lacked the financial resources to do more, but because they wanted a simple, low visibility test to learn quickly from. The team at HHS Whiteriver Hospital project aimed at reducing emergency room wait times abandoned their electronic kiosk idea as they learned more about actual patient needs. They then pivoted to a paper approach, but learned quickly through the HHS network that such an approach would be considered "pre-screening" by non-medical staff and would not be legal. The team's third iteration, based on new patient entrant flows, hit the mark: prototypes in experimental use halved wait times and when fully operational are expected to save the hospital millions of dollars per year.

Mitigating decision biases. Training in the design and execution of experiments also resulted in the reduction of cognitive biases. For decades, cognitive scientists have explored well-recognized flaws in decision makers' hypothesis-testing abilities, including over-optimism, inability to see disconfirming data, attachment to early solutions, and a preference for the easily imagined (Kahneman, 2011). "Disinterested dialogue" has been demonstrated to be an essential factor to improving decision-making (Garbuio, Lovallo, and Sibony, 2015). In our research, DT's structured tools offered guidance that improved teams' ability to surface their own unexamined assumptions and see disconfirming data, as the HHS kiosk case illustrated.

Innovators also distrusted their ability to predict success and believed that multiple answers were possible. As one interviewee explained, "We're not going to go out and have one perfected prototype, because we don't even know what that would look like." This approach is supported by research that suggests that people are more open to selecting creative solutions when they are offered multiple alternatives, rather than a single one (Mueller, Melwani & Goncalo, 2012).

Attracting champions. Emergence of multiple solutions also allowed champions to emerge for specific ideas as they developed. Dublin's project, in which public administrators used DT to engage citizens, spawned numerous ideas. Any idea's viability was contingent upon its ability to attract enough volunteers interested in carrying that idea through to fruition. It was the relative enthusiasm of the key stakeholders who would need to do the work of implementation that carried the day, rather than city administrators deciding which ones to implement. "At the end of the day, it's not about our team owning the ideas," one of the sponsors of the initiative noted, "it's about the ideas being owned by the people who have been involved and shown interest in revitalizing their own community."

Encouraging a learning mindset and action orientation. In working with County Kerry, Luigi Ferraro of IwB talked about the action orientation that resulted from DT's emphasis on testing:

> "It forces your thinking. It is easy to stay safely in the debate space and never have your hypothesis interact with reality to get feedback about whether or not it is true. This is what makes everything slow down. It's what paralyzes bureaucracies. You can debate forever. This is where design gets interesting. You have to translate your sentiment into an embodiment that others can see. A fundamental part of design is making things sharable in the world. That forces collaboration because you have to agree on an output… You can say we want to be the world's best city, but that is really empty until you confront the design challenge: operationalizing the value. So what is the best city? All of a sudden a bunch of qualities come out, and those qualities need to be shared."

At SAP, a team composed of strategists and designers worked together to deal with a classic strategy conundrum; how to make the competitive imperative and changes in strategy necessitated by Web 2.0 feel real to managers who would need to implement them. One ex-McKinsey consultant on the team talked about why he had become a believer in the power of making abstract ideas more tangible: "Once I saw that even a rough prototype was really changing the conversations we were having with people, it became very easy to get behind that. You have to see it to believe it. It's far more concrete and open than the traditional 'I'm going to walk you through my PowerPoint' approach. Once I started experiencing that, there was no going back."

In our study, the MasAgro case took this notion of making changes feel real rather than abstract to a new level. An NGO focused on teaching modern and sustainable methods to farmers throughout the developing world, MasAgro faced a critical problem: getting subsistence farmers, whose entire livelihood depended upon the success of their crops, to try new ideas. So MasAgro

recruited local thought leaders among the farmers to plant rows of crops, using old and new methods, side by side. The famers could witness for themselves the performance of the new seeds. This ability to make abstract ideas feel real to those who had not created them was echoed by a Monash physician as he talked about the value of small experiments they called learning launches: "I am more and more convinced that the value of prototypes and learning launches is that they make concepts tangible and create a conversation space for engagement." Again, it is the combination of elements – prototyping and iterative experimentation practiced together – that appeared critical.

Practice: The use of a structured and facilitated process

A final set of observations from our research, one not widely discussed in the design-related literature thus far, related to the presence and impact of a structured facilitated process that helped non-designers feel comfortable trying a new methodology. In our study this took the form of the specification of stages and steps, and specific tool kits, usually developed and facilitated by a set of outside design experts from schools, consulting firms or internal design groups, and frequently accompanied by templates or other project management aids. Though its structured processes have been argued by some scholars to be a negative element of DT (Dong, Garbuio and Lovello, 2016), we observed structure to produce multiple visible enhancements to the innovation process in the cross-section of projects we studied: they increased psychological safety, helped to manage cognitive complexity, allowed for the involvement of key stakeholders not on the core design team, and improved both innovators' confidence and solution quality through expert coaching.

Increased psychological safety. A well-recognized challenge in innovation is discomfort with ambiguity and uncertainty, and a lack of "creative confidence" (Kelley and Kelley, 2013), at the individual level. In the 22 organizations studied, we saw a variety of methodologies in place traceable either to innovation consultancies (e.g., Business Innovation Factory, Peer Insight, IDEO, etc.) or Universities (e.g., Stanford Design School, UVA Darden Business School, The IwB, Parsons Paris), that were important to the success of the projects. The importance of having a structured process in place was expressed by a senior member of the medical staff at Monash:

> "Some people have the view of DT that if you get a whole bunch of people in a room with Post-It notes, something magical happens. And afterward, you don't quite know how you did it. Instead, you have to make it clear that there's a rigorous methodology in place that people can learn. We want to be *leading* edge, not bleeding edge. You need a very structured methodology that lets you safely work through the elements."

The head of Design Strategy at Intuit also explained her decision to provide structure:

> "Anytime you're trying to change people's behavior, you need to start them off with a lot of structure so they don't have to think. A lot of what we do is habit, and it's hard to change those habits. So by having very clear guard rails, we help people to change their habits. And then once they've done it 20 or 30 times, *then* they can start to play jazz as opposed to learning how to play scales."

Orlikowski (2002) finds such common models, tools and methodological structure essential to innovation teams' ability to coordinate and align. Such processes also increase psychological safety. Research by psychologists Dweck (2006) and Higgins (2006) suggests that many decision-makers make choices driven primarily by a fear of mistakes and possess a mindset that prefers inaction to action when choice risks failure. In the face of such a conditioned response - which Higgins calls a "prevention" focus and Dweck terms a "fixed" mindset - significant psychological safety must be provided for individuals to choose action over inaction. Mueller et al (2012) note a similar "bias against creativity" which they trace in their experiments to a desire to reduce uncertainty. Edmondson (1999) found substantial empirical support for a relationship between team psychological safety and learning behavior. In our study, practices like Toyota's creation of a "sandbox" sought to introduce an element of play to lighten the perceived seriousness of finding and testing solutions.

Managing cognitive complexity. One approach taken by the methodologies in use that we observed that increased team members' tolerance for the inevitable uncertainty in the innovation process was a careful layering of the cognitive complexity of the tasks involved. This imposed structure helped non-designers avoid being overwhelmed by the complexity and "messiness" of their project work. It did this by leading them through layers of complexity in stages, often using physical props like the ubiquitous Post-It note, and highly structured tools like mind mapping. In idea generation, it moved them from data gathering into insight identification, then to the creation of design criteria that informed ideation. In testing, it began with these ideated concepts, explicitly surfaced the solutions underlying them, and then translated these into prototypes for

the design and execution of experiments. Thus, the building blocks of the innovation process were clearly delineated in a progressive way which, while some design theorists and practitioners disparage as artificially linear, non-designers in our study clearly found reassuring, and that increased their willingness to persevere through challenging moments in their project work.

INSERT FIGURE 2

Figure 2 details the layering of complexity, the staging of the outputs of the process, and their iterative cycles. Individuals or teams began by gathering data using ethnographic tools - an activity, though intimidating at first, that was eventually seen as both engaging and enlightening for participants and that engendered enthusiasm and persistence to keep them going them through the search for insights. Simple approaches we observed, like writing a single data point on a Post-It note (as individuals) and then the combining and clustering these as a team to develop common themes, made the search for insights feel more playful and less intimating. These kinds of routinized processes have been seen as essential to organizational capability building (Zollo and Winter, 2002).

Involving key stakeholders. DT processes also facilitated the involvement of other key stakeholders who were not part of the core team, but who could still contribute. Though these stakeholders were often unwilling to commit the time and attention to the full range of innovation activities the core team performed, carefully orchestrated intermittent engagement (for instance, in insight generation or brain storming) built a sense of ownership even among those at the periphery of a project, that would later prove critical for obtaining their buy-in.

Improving confidence and quality through coaching. The availability of coaching and facilitation was also frequently built into the structured process we observed. These both built confidence (especially among novices to the method) and increased the quality of output. In many projects, either a consulting firm (as with Children's Health, TSA, MeYouHealth, Suncorp, IBM, Toyota), an academic partner (with County Kerry, The Kingwood Trust, Dublin) or internal design experts (Intuit, 3M, FDA, HHS, SAP) were available to support non-designers as they applied the DT methodology to their projects. Importantly, these supporting individuals did not do the work for the team; they did the work *with* them. Finding the right kind of person for this role was about attitude as well as design talent. "One of our learnings was that not all

design thinkers we chose were effective at getting others to do DT," the leader of Design Strategy at Intuit explained. "There were some who wanted to be the brilliant person who comes down from the mountain with the solution. They weren't actually useful to helping us scale." Her colleague agreed: "If you have a bunch of people who know this stuff and don't want to give it away, you can't scale it. So you have to be as much a facilitator of this as a tactician…"

Activities like face-to-face interaction with customers, deep immersion in their perspectives, hypothesis-driven thinking with its emphasis on prototyping and the design and execution of experiments, are not common activities for non-designers, in either for-profit or social sectors. In order to engage a broader group of employees in innovation, organizations in our study used DT's structured approach to enhance non-designers' creative confidence, as well as the quality of their output. The Ignite Program at HHS again provided a case in point. Reflecting on her experience, the quality control manager who led it described her initial fears when she received the blanket email to join Ignite sent to all employees:

> "Not being in Washington, not part of a tech environment or an innovative environment, it was intimidating. We're babies, and others were so much more sophisticated, more educated…It was scary. But if that e-mail hadn't come to me, I would have never known that I had the ability to make this happen, that I could step outside our little agency."

How the Practices Work Together

Looking across the five practices, they flow initially in one direction, but then iterate back to earlier elements depending upon what occurs during testing, as Figure 3 shows. The process begins with the formation of heterogeneous team that seek deep user understanding and who then work within a dialogue-based process in which insights, design criteria and then ideas are created. These ideas then move into testing and the results of that determine the kind of feedback response necessary. Underlying the entire process is an infrastructure of support and facilitation.

INSERT FIGURE 3

DESIGN THINKING'S IMPACT ON INNOVATION OUTCOMES

Rigorous assessment of the impact of DT on organizational outcomes was beyond the scope of what our methodology permitted. This relates not only to our qualitative methodology, but also to a set of challenging issues surrounding the measurement of outcomes. We do believe,

however, that sufficient data exists to hypothesize, for further testing, set of impacts on outcomes, based on the improvements in innovation processes that we observed. Two of these outcomes - improving solution quality and reducing innovation risk - are already well-recognized in the literature. The other three - increasing implementation success, organizational adaptability and the formation of local networks - are less so. In this section, we build on our findings to hypothesize how the five DT elements identified and their corresponding enabling mechanisms worked together to effect, not just innovation processes, but these specific outcomes, tracing in detail their linkage (summarized in Figure 4) and offer a set of propositions for further testing.

INSERT FIGURE 4

P1: Design Thinking improves organizational innovation outcomes by producing higher quality solutions

Our research suggests that, consistent with conventional wisdom, DT improves organizational innovation performance by improving the quality of the ideas generated, when quality is defined as increasing the value created for stakeholders. This outcome improvement is the result of a combination of mechanisms that we have already reviewed. Postponing ideation and encouraging innovators to explore the definition of the problem more fully before moving into solution generation results in improved reframing of the problem in ways that are more likely to be productive; ideation based on user-driven design criteria increases the likelihood any solution will actually meet user needs; leveraging diversity of perspectives produces higher order solutions that emerge during collective learning that are likely to be more differentiated in the market place. In addition, the emphasis on broad stakeholder engagement and co-creation allows teams to expand their repertoire and find solutions that lay outside of the expertise of individuals.

This is the proposition for which measurable outcomes are most easily demonstrated. We have already talked about outcomes at Children's Health and HHS. There were many more in our study, such as increases in the number of meals ordered and customers served by The Good Kitchen, increased "hot leads" from IBM's new trade show design, decreased call-wait time at Toyota's Call Center, the percentage of employees at Suncorp who understood the new integrated strategy and found it compelling, or improved measures of customer satisfaction like Net Promoter Score at Intuit or employee satisfaction at Toyota.

The remaining impacts we hypothesize - conveying many of the most significant effects we observed - will be more challenging for both practitioners and academics to capture rigorously using quantitative measures.

P2: Design Thinking improves innovation outcomes by reducing the risk/visibility of failure

Another clear and expected effect is that design's toolkit helps innovators better manage the inevitable risks of undertaking innovation. Some of these benefits accrue from the creation of improved solutions talked about in proposition 1: starting with better hypotheses obviously reduces failure risk. DT also contributes to risk reduction through early emphasis on real world feedback and testing. Its ability to improve hypothesis-testing skills and minimize common decision-making errors is critical. We hypothesize that DT's hypothesis-driven approach can mitigate the impact of these biases with its stipulation that innovators develop multiple concepts, create prototypes, surface unarticulated assumptions, and actively seek disconfirming data, all behaviors which have already been demonstrated empirically to improve decision-making through bias reduction (Liedtka, 2014). DT also offers risk reduction benefits of a different nature: beyond just testing the quality of the ideas, it builds trust and ownership among implementers, reducing risk by increasing the likelihood of successful implementation.

P3: Design Thinking improves outcomes by improving the likelihood of implementation

A third, and less explored, outcome of design thinking relates to implementation success. There is a voluminous literature on the failure of innovators to achieve implementation of their ideas (Anderson, Potocnik and Zhou, 2014). Ultimately, innovation requires that a set of human beings act in new ways in order to implement new solutions. In the absence of successfully encouraging and achieving different choices - actual behavioral change - as part of implementation, investment in creative idea generation and rigorous testing provide little impact. We propose that DT's human-centered focus, when it engages a broader set of stakeholders, including implementers, in the process, also encourages change readiness. Though a review of the change literature is clearly beyond the scope of this paper, some dominant themes around how to successfully facilitate change are well-established and consistent with our observations of the ways in which DT's use aids them. Van de Ven and Sun (2011) note that people initiate change efforts when "their action thresholds are triggered by significant opportunities, problems

or threats" causing them to recognize a need for change, and argue that direct personal experiences (like ethnographic research) are more likely to trigger thresholds than are "exhortations" about the need for change. Similarly, Shin, Picken and Dess (2007) looking at change in relation to learning, argue that achieving both requires surmounting both fear of failure and investment in the status quo and creating a sense of purpose, sharing internal knowledge and gathering external knowledge - all key DT activities.

Another long-standing change theory, attributed to Beckhard, argues that critical elements for successful change involve creating dissatisfaction with the status quo, clarifying the new future, specifying pathways to get there, and reducing the personal loss associated with making the change (Cady, Jacobs, Koller and Spalding, 2014). DT encourages all of these change facilitators: exploration of the problem during initial ethnographic research builds alignment and deepens dissatisfaction with the status quo. The methodology also works to build greater clarity around what the new future looks like. Prototyping and co-creation insist that innovators flesh out salient details of the envisioned future.

DT's emphasis on the particular also provides clear pathways to the future. We observed that the emphasis on the means as well as the ends—resources and training needed, timelines, measures to paying attention - made the nature of the change seem more possible. For instance, in County Kerry, the IwB not facilitated the Kerry community's search for potential solutions; they generated detailed timelines for the different specific activities that needed to be accomplished along the way. In Dallas, Children's Health utilized design not just to create a new business model, but to design metrics to measure wellness, as well.. At Monash, learning launches built trust and ownership that combatted loss. Seeing the crops planted side by side helped farmers to see the new future and reduced their fears in accepting MasAgro's advice. As the team leader at Children's Health noted:

> "People feel threatened by work they imagine will disrupt their jobs. You have to help them to see themselves in the future . . . use their stories, their insight, and their expertise so that they hear their voice reflected in the future state. You co-create so that they feel like they helped build this new model. There's an old adage that 'change is painful when done to you but powerful when done by you. If you can just tap into that, you're golden."

Though more challenging to measure than earlier propositions, we hypothesize that this impact on change readiness may be one of the most significant for organizations employing the design approach.

P4: Design Thinking impacts innovation outcomes by improving adaptability

Earlier, we discussed the way in which the shift from a view of organizations as mechanistic to one that views them as complex social systems might increase the value delivered by human-centered design. Focusing on innovation as a social process ties it to human emotions and the complex ways people converse and solutions emerge; it replaces the notion of a single objectively "optimal" solution selected from alternatives identified in advance with a more adaptable portfolio of solutions. This increases adaptability as, in complex social systems, it is almost impossible to "optimize" in the usual sense – decision-makers lack both the alignment around objectives and the data to assess cause and effect. Broadened networks connections also increase adaptability. Access to a powerful network is a key reason why HHS' Ignite program accelerates innovation - the Whiteriver team was able to pivot from their paper-based concept without doing actual experimentation because DC staff connected them with Medicare experts who already knew that screening entrance to the ER by non-medical personnel was illegal.

The less organizations control their environment, the more they operate in complex adaptive systems, we hypothesize, the more valuable DT's tool kit will be. An FDA official explained:

> "When the FDA controls all aspects of the process, then maybe you don't have to bring in other stakeholders. But in many cases, a government agency is at the crossroads of an issue. We don't have complete control over it."

This is true not just for government agencies. Increasingly, it is the collaboration with and coordination of network that allows for adaptability - and DT, in our study, demonstrated its ability to bring members of an ecosystem into productive conversation with each other.

Another key feature in many of our stories was the avoidance of top-down standardization in favor of customized solutions and processes. Standardization may seem efficient in the short run, but in a complex world, adaptability favors solutions that attend to local conditions. It also favors emphasis on identifying design criteria - the qualities of desired solutions in general - rather than on the specific solutions. Design criteria have more inherent resilience; that is, they are useful in telling you how to pivot when an initial solution fails. Diversity, in both team repertoire and solution optionality, plays an increasingly critical role here, too. Simple, stable systems favor homogeneity and usually see diversity of as a nuisance. In complex social systems, heterogeneity is more valuable because it increases the range of both current information and the breadth of solutions generated (Colander & Kupers, 2014; Miller and Page, 2007).

P5: Design Thinking impacts innovation outcomes by the creation of local capability sets

That local, rather than global, decisions are likely to be most successful in complex social system is well established in the literature. Research suggests that, though the larger system is itself complex and difficult to predict, its subunits are less so and tend to operate on "replicator dynamics". Thus, simple central guidelines—established globally but applied locally—are the most promising methods for bringing order and accomplishing change, theorists assert (Colander and Kupers, 2014). Creating create adaptive spaces that encourage self-organization, which must be enabled rather than managed, Uhl-Bien and Arena (2017) argue. One view of DT is to see it as a collection of "simple rules" (Sull and Eisenhardt, 2015) that allows leaders to coordinate and encourage innovation in complex social systems, while maintaining coherence and the ability to share learning. Throughout our discussions of DT's impact – producing better solutions, minimizing risk, increasing the likelihood of implementation and fostering adaptability - the advantage of local is a common theme, whether in the form of local intelligence on a problem or solution, or on the formation of local networks capable of coordination and joint action. DT, we hypothesize, offers the opportunity to bring local voices into the innovation conversation to identify and solve their own problems, in a rigorous and coherent way that fosters information sharing across units. In doing this, it addresses a longstanding challenge around the tension between centralization and decentralization. DT may begin to get at the best of both worlds. CTAA used DT as their mechanism for standardization and centralized control - but they focused on controlling the quality of the process, not the prescription of local outcomes, by combining DT with the formation of diverse local teams who shared their learning with other local teams. MasAgro went a step further towards a powerful resolution of the central/local tension. Because of its global operations, MasAgro was able to reach across its enormous cache of knowledge of world-wide farming best practices to create a broad menu of choices, and then work with local leaders to select ones most appropriate to local topography and traditions.

CONCLUSION

As we review Figure 4, the robust tangle of links (in the form of arrows) between the impacts on innovation processes produced by DT's key elements and innovation outcomes illustrates its connectivity. The five practices highlighted do not directly affect innovation outcomes –each one operates through a variety of process mechanisms. It is these process mechanisms, individually

and in different combinations, which produce better innovation outcomes. Hence, the seemingly mad tangle of connections evident in Figure 4 results, as one traces the relationships between individual process mechanisms and outcomes, as well as interaction between the outcomes themselves. Though the linkage between DT practices and the mechanisms through which they impact innovation processes is relatively straight-forward, the interactions between these enabling process mechanisms and ultimate innovation outcomes are complex and multi-directional. The richness of these interactions is another key finding from our study: they suggest that the power of DT lies less with individual elements and their corresponding tools and stages considered in isolation, and more in the gestalt of them taken together, and coordinated in an end-to-end process.

Research Implications and Limitations

There are obviously limitations to our exploratory study. We have endeavored to paint a holistic picture of design thinking's constituent elements and outcomes and how they interact, so of necessity have sacrificed depth in particular areas to allow for breadth across the overall picture. Opportunities for additional research that could shed greater depth of knowledge on specific topics like the development of empathy or variation across the different methodologies employed, are plentiful. They exist at every level of analysis - individual (e.g., further exploration of topics like growth mindset and the impact of creative confidence), team (e.g., what comprises requisite variety, how to assess and support a team's emotional journeys through the process), organizational (e.g., stages of maturity in the development of DT capabilities, the measurement of outcomes), and ecosystem levels (e.g., selecting partners, the collaboration/competition tension).

Another significant limitation lies with the nature of our sample as well as the challenges of measuring the kinds of outcomes that we hypothesize. Of the five impacts we suggest, only the quality of solutions lends itself readily to measurement, and even that has been the subject of some contention (Dennis, Minas and Bhagwatwar, 2013). None of the other factors - reduced risk, likelihood of implementation, creation of local capability sets and enhanced adaptation - render themselves easily to quantitative measurement.

Another limitation relates to the fact that most (but not all) of the initiatives nominated for study and selected were seen as successful within the organizations that sponsored them. It

would be useful to include more cases of failure to assess whether the same practices leading to success could lead to failure in other contexts. Our research paints a decidedly rosy picture of DT done well: we studied projects which were carefully conceived and in which DT was implemented conscientiously, in which non-designers received training and support from experts in the methodology. Certainly, poorly conceived and poorly implemented attempts are more the norm and could be profitably studied. We have also not discussed challenges to implementation, some of which have already examined by other scholars (Calgren et al, 2016).

There are certainly potential negatives to the methodology, even done well, that we have not explored: DT could be used as a sophisticated tool for manipulation, for instance, or as an excuse for end-running corporate policies and procedures (in a sense, everything becomes an "experiment" that deserves to see the light of day). We hope that subsequent researchers will address these omissions.

The study of design thinking and its effects is in its infancy and opportunities for continued research are plentiful. We look forward to future studies.

Table I
RESEARCH SITES

Organization	Industry	Description of Project	# of Interviews/ (individuals)
United Cerebral Palsy	Charitable foundation	Expanding mission from donor charity to incubating useful products.	6 (4)
Gateway Academy	Education	Keeping disadvantaged students in high school and beginning college.	8 (3)
Kingwood Trust	Health care/Autism	Creating environment where autistic adults live meaningful and independent lives.	6 (3)
Children's Health System of Texas	Health care	Initially, reduce inappropriate emergency room use; morphed to community wellness focus.	5 (4)
U.S. Health and Human Services	National government	Ignite invites employees at all levels to pursue innovation opportunities they see.	10 (6)
Monash Medical Centre	Health care	Myriad projects – addressing length of patient stay, quality of experience in out-patient mental health clinic, etc.	10 (5)
MasAgro Mexico	Agriculture	Increasing agricultural yields sustainably by working with farmers.	5 (3)
New Zealand Transport Ministry	National government	Reversing trend of marginalized youth failing to qualify for driving licenses.	8 (6(
IBM	Technology	Making trade shows a two way learning conversation between customers and sales team.	10 (5)
3M	Materials science	Helping customers to envision new products utilizing new materials.	5 (3)
Suncorp	Financial services	Merging two large financial service organizations with widely differing cultures.	10 (6)
City of Dublin	Local government	Engaging local citizens to create and lead new initiatives for revitalizing depressed urban areas.	
SAP	Software	Helping managers to envision what Web 2.0 would mean for needs of and interactions with customers.	5 (3)
Good Kitchen	Local government	Redesigning meals on wheels program for the elderly.	5 (3)
Toyota	Automobile	Reducing wait time at customer care center.	5 (3)
Intuit	Software	Embedding "Design for Delight" in core organizational values and practices.	5 (4)
MeYouHealth	Health care	Designing a new value proposition for a start-up in the wellness space.	5 (3)
FIDJI France	Financial services	Developing a deeper understanding of customers' expectations of the financial services industry.	6 (4)
Food and Drug Administration	National government	Engaging a diverse array of government and manufacturers to establish standards	7 (4)
Community Transportation Association (CTAA)	NGO	Helping low wage employees obtain transport to work.	6 (4)
Transportation Security Administration (TSA)	National government	Work more effectively with the traveling public.	8 (6)
Kerry, Ireland	Local community	Revitalize a stagnating economy.	10 (8)

Figure 1
DESIGN THINKING PRACTICES

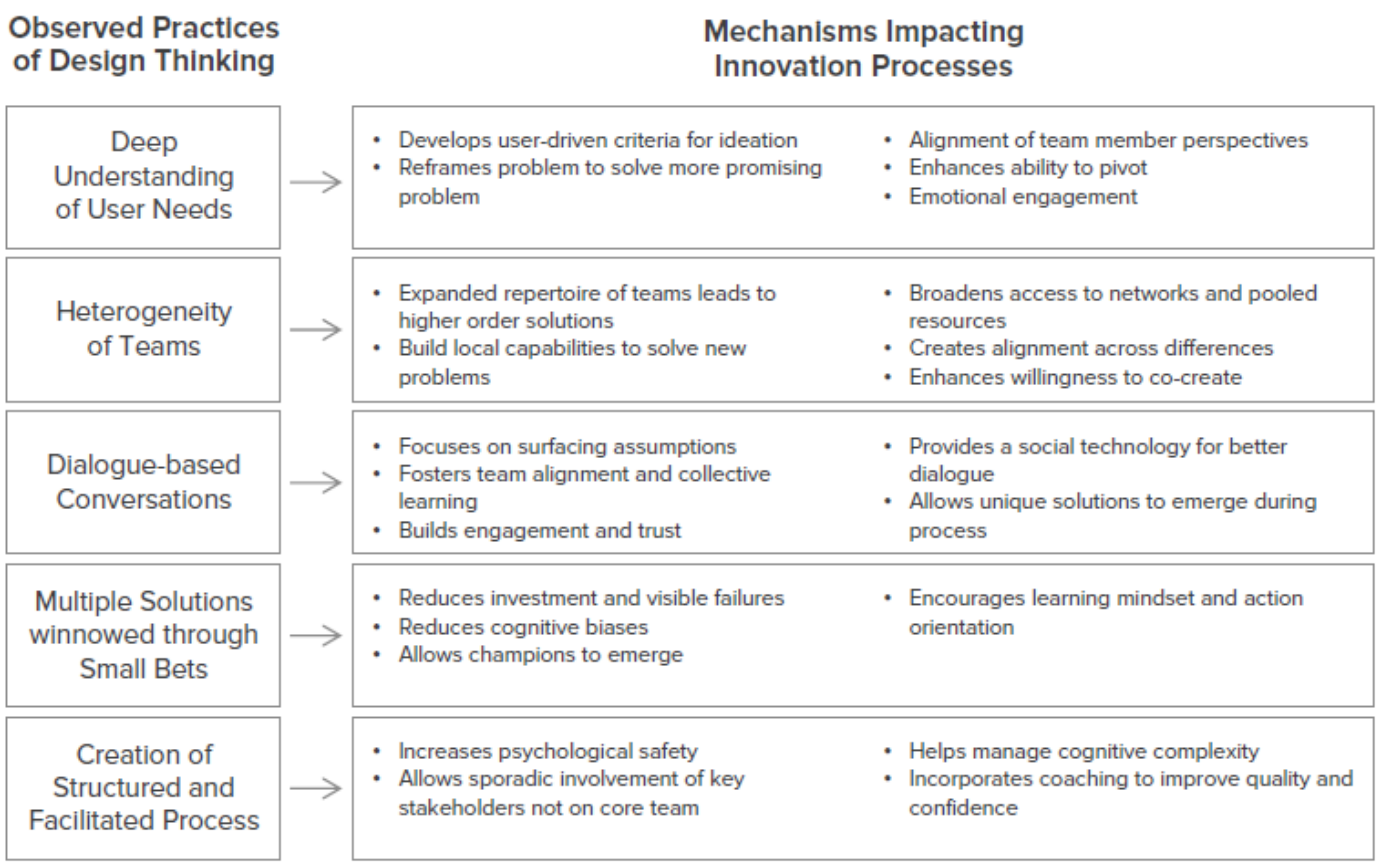
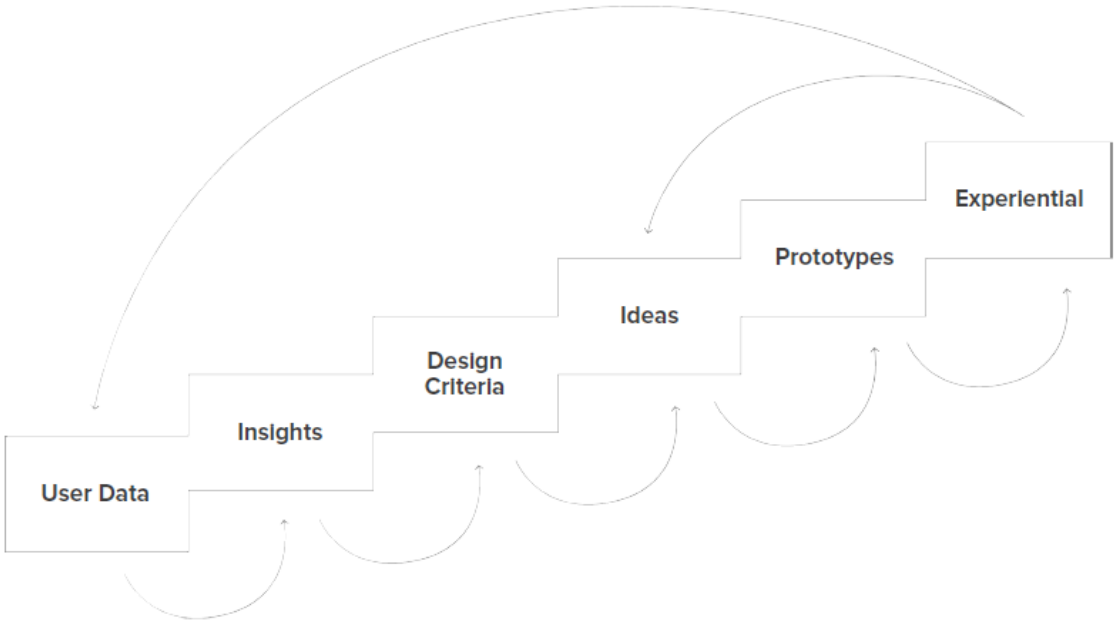


Figure 2
BUILDING BLOCKS OF THE DESIGN THINKING PROCESS



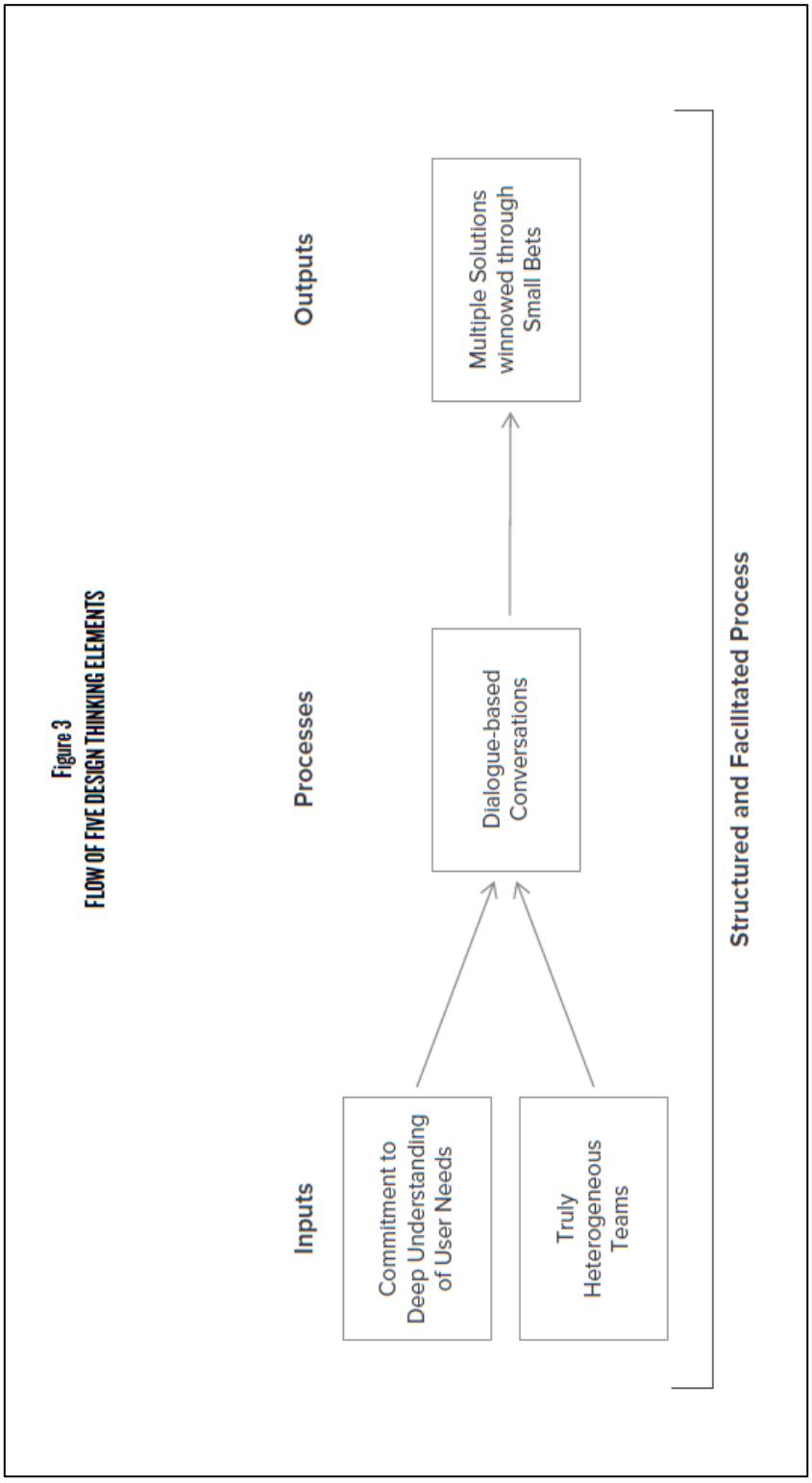
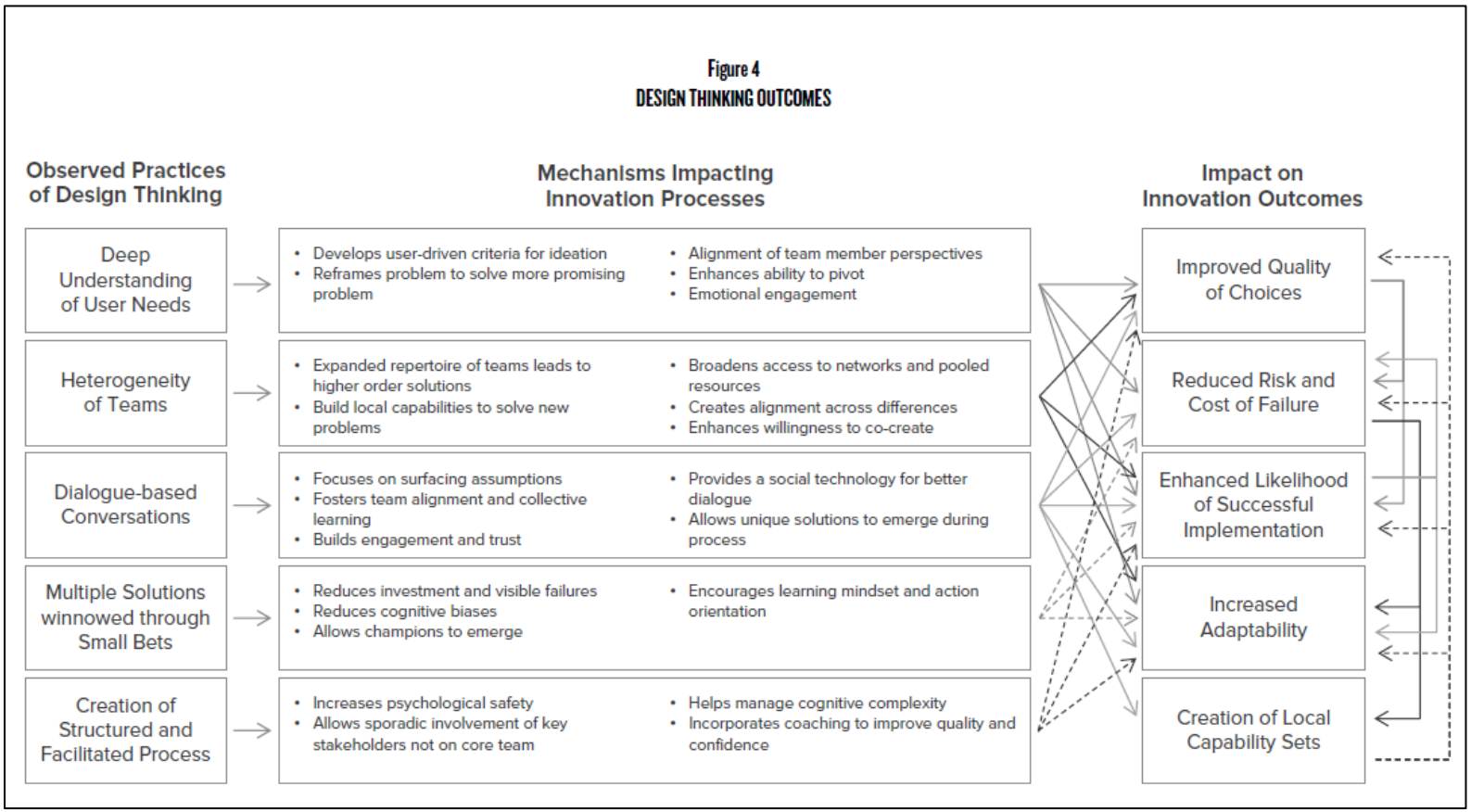


Figure 3
FLOW OF FIVE DESIGN THINKING ELEMENTS
Inputs
Processes
Outputs
Commitment to Deep Understanding of User Needs
Truly Heterogeneous Teams
Dialogue-based Conversations
Multiple Solutions winnowed through Small Bets
Structured and Facilitated Process

Figure 4
DESIGN THINKING OUTCOMES



Appendix 1

Examples of Case Support for Key Practices

Case	Deep Immersion	Heterogeneous teams	Dialogue-based	Experimentation/ small bets	Structure
United Cerebral Palsy (UCP)	Empathy exercises to start, disabled team members describe their experiences	Inclusion of engineers, design students, disabled people	Small group workshop, face to face, using user input to create emergent solutions	Prototyping multiple solutions with feedback from outsider juries	Used Stanford Design School approach, facilitated and coached
Gateway Academy	Multiple interviews with students and faculty, journey mapping, personas	Administrators, guidance counselors, outside educators	Small groups working face to face, based on user input to create emergent solutions	Prototypes of multiple solutions, assumptions surfaced and feedback from educators and students	Darden School D4G approach, in conjunction with online course and coaching
The Kingwood Trust	Extensive ethnographic observation and interviewing	Caregivers, design students, families, adults with autism	Interactive "Make do" workshops with staff and patients	prototyping, use of formal feedback forms for iteration and assessment of solutions	Royal College of Art, London working with BEING consultants
Children's Health System of Texas	Extensive interviewing, Job-to-be-done, journey mapping focused on patient and family	Clinicians, designers, community organizations, families	Face to face workshops with clinicians and diverse community members to seek emergent solutions	Initial focus only on asthma patients; 2 phase process focusing first on incremental than business model change	Business Innovation Factory consultants and methodology
U.S. Health and Human Services (HHS)	Ethnographic interviewing, observation of emergency room users and staff	Employees at local levels, working with federal HQ experts and their users	Emergent solutions, working with larger networks to devise and test	Focus on assumption testing, prototyping and iteration of solutions	Boot Camp orientation featuring DT and lean; coaching by HHS mentors
Monash University Medical Centre	Journey mapping of patient experience, interviews and observation with staff	Clinicians, staff, administrators and patients	Intensive face to face "sprints", focus on problem exploration, developing shared frames	"learning launches" emphasized; multiple solutions refined through iteration and phased testing and feedback	Darden School D4G approach with online course and coaching

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