Human-centered Innovation Processes
The Case of Design Thinking in Nascent and Large Firms

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To Daddy

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ABSTRACT

For more than a decade managers, academics, educators and politicians have indicated that innovation is the key to our future. As a result, we find a plethora of innovation initiatives around the world, from university curricula to the mission statements of banks. This push to innovate is a direct result of the recent economic downturn as well as from an ever more competitive, connected and dynamic world. In order to remain relevant in such a world, emphasis is given to generating new ideas that may lead to new products and services. Despite these initiatives, evidence indicates that investment in innovation does not correlate with success. Although the goal of innovation is clear, the processes whereby that goal may be accomplished are varied and not entirely understood. The motivation of this thesis, therefore, is to gain a better understanding of some of those innovation processes.

In recent years, a growing number of firms, organizations and governments have adopted an approach to innovation that is referred to as "Design Thinking". They use the term to describe the process by which a multifunctional team tackles a problem by exploring the underlying needs of the people most affected by that problem—whether that be customers, users, etc.—then, based on these observations, defines the root cause or key elements of the problem and finally attempts to resolve it through an active cycle of ideating, prototyping and testing potential solutions. While the process itself is well defined and understood, its implementation and use by managers in the context of innovation management calls for further exploration. With this objective, I first conducted research within academic literature, followed by an ethnographic study focused on the use of Design Thinking by both large firms and entrepreneurial teams.

The first paper of this dissertation examines the different elements in the Design Thinking process within the context of management research. I find that, although the process as a whole has previously been given little attention in academic research, each of its individual components has been previously researched. The goal of the first conceptual article is thus to establish the common ground among diverse subfields of research in management upon which future research in Design Thinking may build.

The second paper of this dissertation aims to uncover how large firms use Design Thinking as an approach to innovation. Based upon direct observation and interview data we find evidence of links between Design Thinking and Absorptive

Capacity. We therefore propose that Design Thinking may be a helpful tool for firms who wish to innovate by an increase in their Absorptive Capacity.

The third and final paper of this dissertation aims to understand the effects of Design Thinking on the venture creation process. This work is based on ethnographic research conducted at Stanford University wherein twelve teams participated in an accelerator program that uses a Design Thinking approach with the goal of creating and launching new ventures. Building on Dynamic Capabilities literature, this research finds that the teams with greater capability to iterate their venture concept through repeated cycles of attachment and detachment relative to their proposed products or services tend to be more successful.

The result of this research indicates that, while the elements of Design Thinking have been known and practiced piecemeal in management, integrating these into the process of managing innovation, and not just in the innovation process itself, can lead to greater success in the overall goal of increasing innovation output.

RÉSUMÉ

Pendant plus d'une décennie, gestionnaires, académiciens, éducateurs et politiciens ont indiqué que l'innovation est la clé de notre avenir. En conséquence, nous trouvons une pléthore d'initiatives portant sur l'innovation à travers le monde, tant dans les programmes universitaires que dans les chartes de responsabilité des banques. Cette envie d'innover est une conséquence directe de la récente crise économique ainsi que d'un monde de plus en plus compétitif, connecté et dynamique. Afin de demeurer pertinent dans un tel monde, nous accentuons plus notre travail à générer de nouvelles idées qui amèneront de nouveaux produits et services. En dépit de ces initiatives, les données indiquent que des investissements dans l'innovation ne garantissent pas le succès. Bien que l'objectif de l'innovation soit clair, les processus par lesquels ce dernier peut être atteint sont variés et pas entièrement compris. L'objectif de cette thèse est donc d'acquérir une meilleure compréhension de certains de ces processus d'innovation.

Au cours des dernières années, un nombre croissant d'entreprises, d'organisations et gouvernements ont adopté une approche de l'innovation qui est appelé *Design Thinking*. On utilise ce terme pour décrire le processus par lequel une équipe multidisciplinaire aborde un problème en explorant les besoins sous-jacents des personnes les plus touchées par ce problème – cela peut être les consommateurs, utilisateurs, etc. Ensuite, sur la base de ces observations, on définit la cause ou les éléments clés du problème et enfin on tente de le résoudre à travers un cycle de création basé sur l'innovation, les prototypes et de nouvelles solutions qui seront testées. Bien que le processus lui-même soit bien défini et compris, sa mise en œuvre et son utilisation par les gestionnaires dans le cadre du management de l'innovation appelle à une exploration plus poussée. A partir de cet objectif, j'ai effectué premièrement des recherches à travers la littérature académique suivie d'une étude ethnographique portée sur l'utilisation du *Design Thinking* par de grandes entreprises ainsi que des équipes entrepreneuriales.

Le premier article de cette thèse examine les différents éléments du processus de *Design Thinking* dans le contexte de la littérature propre au management. J'ai trouvé que, bien que le processus dans son ensemble a attiré très peu d'attention dans la littérature académique, chacun de ses composants individuels a été précédemment

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étudié. L'ambition du premier article conceptuel est donc d'établir un terrain d'entente entre les divers sous-domaines de la recherche en management sur lesquels la future recherche sur le *Design Thinking* peut être élaborée.

Le deuxième article de cette thèse vise à découvrir comment les entreprises de taille importante utilisent le *Design Thinking* comme une approche de l'innovation. Basés sur des données d'observation et d'entrevue directe, nous trouvons des liens entre le *Design Thinking* et le concept de *Absorptive Capacity*. Nous pensons donc que le *Design Thinking* peut être un outil utile pour les entreprises qui souhaitent innover par une augmentation de leur *Absorptive Capacity*.

Le troisième et dernier article de cette thèse propose de comprendre les effets du *Design Thinking* sur le processus de création d'entreprise. Ce travail est basé sur une recherche ethnographique menée à l'université de Stanford où douze équipes entrepreneuriales ont participé à un programme d'accélération qui utilise l'approche du *Design Thinking* avec comme objectif de créer et lancer de nouvelles entreprises. En construisant la littérature basée sur la théorie de *Dynamic Capabilities*, cette recherche montre que les équipes entrepreneuriales avec une plus grande capacités à adapter leur entreprises par des cycles répétés d'attachement et de détachement par rapport à leur produits ou services proposés ont tendance à avoir plus de succès.

Le résultat de cette recherche indique que, bien que les éléments du *Design Thinking* sont connus et pratiqués au coup par coup dans le management, les intégrer dans le processus de management de l'innovation et non seulement dans le processus d'innovation lui-même, peuvent conduire à une plus grande réussite de l'objectif global d'accroître la production d'innovation.

MOTS CLÉS
Design Thinking, empathie, équipes multifonctionnelles, définition du problème, idées, prototypage, création d'entreprise, équipes d'entrepreneurs, émotion, cognition, Absorptive Capacity, Dynamic Capabilities

ABSTRAKT

Über mehr als ein Jahrzehnt haben Manager, Wissenschaftler und Politiker auf die Bedeutung von Innovation für unsere Zukunft verwiesen. Infolgedessen entstanden weltweit Innovationsinitiativen im Überfluss und der Innovationsbegriff fand Einzug in universitäre Lehrpläne sowie in die Leitbilder zahlreicher Banken. Dieser Wunsch nach mehr Innovation ist eine direkte Folge der letzten Rezession sowie einer zunehmend kompetitiven, vernetzten und dynamischen Weltwirtschaft. Um in dieser Welt nicht an Bedeutung zu verlieren, muss der Fokus auf der Generierung neuer Ideen liegen, die zu neuen Produkten oder Dienstleistungen werden können. Ungeachtet dieser Bemühungen zeigen Studien, dass es keine Korrelation zwischen Investitionen in Innovation und dem Erfolg einer Unternehmung gibt. So klar auch das Ziel dieser Innovationsbestrebungen ist, der Weg dorthin ist es nicht. Die zugrundeliegenden Prozesse sind vielfältig und bisher nicht vollständig erforscht. Das Ziel dieser Arbeit ist es, ein besseres Verständnis dieser Innovationsprozesse zu erlangen.

In den vergangenen Jahren hat eine wachsende Zahl unterschiedlichster Unternehmen, Organisationen und Regierungsorganisationen einen neuen Innovationsansatz zur Anwendung gebracht, den man unter dem Überbegriff „Design Thinking" zusammenfassen kann. Er beschreibt den Problemlösungsprozess multidisziplinärer Teams mit Fokus auf die Bedürfnisse der wesentlich betroffenen Ziel-/Nutzergruppen. Basierend auf den zentralen Erkenntnissen dieser ausführlichen Beobachtungsphase versucht das Team, die Wurzel des Problems beziehungsweise dessen Kernelemente zu identifizieren und festzuhalten. Erst dann können in einem schöpferischen und iterativen Kreislauf von Ideenentwicklung, Prototyping und Testen potenzielle Lösungen entwickelt werden. Auf Basis dieses Forschungsgegenstands wurde zu Beginn die zur Verfügung stehende Forschungsliteratur zusammengetragen, gefolgt von einer ethnographischen Feldstudie in großen Unternehmen sowie neu gegründeten Start-ups. Die erste Veröffentlichung im Rahmen dieser Dissertation untersucht die unterschiedlichen Elemente des Design Thinking Prozesses im Kontext des Forschungsfeldes »Unternehmensführung«. Es konnte festgestellt werden, dass, obwohl dem Prozess als Ganzes bisher nur wenig Aufmerksamkeit zu Teil wurde, seine einzelnen Bestandteile sehr wohl erforscht sind. Ziel des ersten konzeptionellen Artikels ist deshalb die Etablierung einer gemeinsamen Grundlage der vielfältig

miteinander verbundenen Forschungsfelder innerhalb der Unternehmensführung, auf die eine weiterführende Forschung des Design Thinking-Ansatzes aufbauen kann.

Die zweite Veröffentlichung im Rahmen dieser Dissertation versucht zu ergründen, wie große Konzerne Design Thinking als Innovationsansatz nutzen. Aufbauend auf Beobachtungen vor Ort und Interviewdaten lässt sich ein Zusammenhang zwischen Design Thinking und der „Absorptive Capacity" eines Unternehmens beobachten. Die vorliegende Arbeit sieht Design Thinking deshalb als ein geeignetes Hilfsmittel für Unternehmen, die durch eine Steigerung ihrer Absorptive Capacity ihre eigene Innovationsfähigkeit erhöhen wollen.

Die dritte und finale Veröffentlichung dieser Dissertation versucht den Einfluss des Design Thinking Ansatzes auf den Unternehmensgründungsprozess zu verstehen. Sie basiert auf ethnographischen Feldstudien, die im Rahmen eines Accelerator Programms der Stanford University, an dem 12 Teams teilgenommen haben, durchgeführt wurde. Im Rahmen dieses Programms wurde der Design Thinking Ansatz zur Generierung geeigneter Geschäftsideen und der Gründung eines neuen Unternehmens angewandt. Aufbauend auf die Theorie der „Dynamic Capabilities", stellt diese Arbeit dar, dass jene Teams, die über die Fähigkeit verfügen, ihre Geschäftsideen iterativ und losgelöst von ihren ursprünglich vorgeschlagenen Produkten oder Dienstleistungen weiterzuentwickeln, in der Regel die erfolgreicheren waren.

Das Ergebnis dieser Forschungsarbeit deutet darauf hin, dass, während die Elemente des Design Thinking bereits bekannt waren und einzeln Anwendung in der Führung von Unternehmen fanden, die Integration der Teile in ein umfassenderes Verständnis des Innovationsmanagements am vielversprechendsten scheint. Ein solcher Ansatz, der nicht allein den Innovationsprozess an sich betrachtet, kann zu einem nachhaltigerem Erfolg in Bezug auf die Steigerung der Innovationsleistung führen.

SCHLÜSSELWÖRTER

Design Thinking, Empathie, Multifunktions Teams, Problemstellung, Ideation, Prototyping, Venture Creation, Entrepreneurial Teams, Emotion, Kognition, Absorptive Capacity, Dynamic Capabilities

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INTRODUCTION

PAPER 1

The purpose of this article is to present a review of those different streams of research relevant to the context of management literature and that have studied one or more of the core principles and phases of Design Thinking. While the names and order of these phases vary between practicing institutions and organizations, these may be separated in five: team formation, customer empathy generation, problem definition, ideation, and rapid prototyping and testing. Relevant literature to each of these phases is individually analyzed; initially describing their origins in various fields of research, followed by a review of the latest research within a subfield in the context of management research.

Observing Design Thinking not as a whole, but as the sum of the individual phases of an overall process, unveils streams of psychology, team building, knowledge management, organization behavior, new product development, marketing, total quality management, information systems, and management literatures. As the core principle of Design Thinking lies in bringing together and building upon different fields of knowledge, it seems only natural that not any single field of research could properly explain this phenomenon as a whole. Each of these fields of knowledge have in their own realms been widely researched, tested and published. Therefore, this review focuses on the field of management research, where it has been a common practice to borrow and utilize different concepts and theories from other fields, such as psychology and sociology (Whetten et al., 2009).

The emerging literature on Design Thinking is scattered among different fields of study and still at an early stage. It has only recently began to make its way to top management journals. However, our review of the literature suggests two ways to advance the study of Design Thinking. First, I hope that by having demonstrated that the field of management has already (perhaps unknowingly) dedicated a lot of ink to the topic by studying the diverse phases of this phenomenon, academic researchers will no longer shy away from the term. Second, this review might encourage future researchers to explore innovation as whole, acknowledging and understanding the interactions between the diverse subset of fields of research relevant to this complex phenomenon. Future research could adopt a holistic and system perspective, not just on what Design Thinking does but also on how it does it. Each phase has a deep research base, but the

different approaches have not been integrated. This article aims to be a first step in doing so, as for numerous institutions, organizations and governments, Design Thinking as a whole has proven greater than the sum of its parts.

PAPER 2

Literature on Design Thinking has so far been vague and disconnected. Our goal was to develop a better understanding of this phenomenon through exploratory research and our findings lead to three main contributions.

The first contribution lies in shedding light on how and why some firms have implemented a Design Thinking approach to help them in their innovation efforts. We believe this may help understand its relevance for research within management literature and clarify its role within the innovation process for managers. Second, our research shows the central role of Design Thinking in helping firms to recognize, absorb and reconfigure new external knowledge for the purpose of innovating. In doing so, we offer a theoretical grounding for future research on Design Thinking by uncovering its links to Absorptive Capacity literature. Finally, we contribute to the current debate in Absorptive Capacity literature. Our research presents evidence that potentially clarifies one of the central issues regarding the role of Assimilation and Transformation as alternative phases in current Absorptive Capacity models. We propose that within the cyclic learning process of a team, Assimilation is done at an individual level and Transformation at a team level. Additionally, we posit that the concept of innovation has evolved in the past two decades and therefore the technological driven measure of Absorptive Capacity solely based on R&D intensity may no longer be appropriate. Our findings suggest further research on the topic could offer valuable insights to both practice and theory.

PAPER 3

Building on previous literature in the field of venture creation and dynamic capabilities, we conducted an inductive study that addresses the question: How do entrepreneurs develop dynamic capabilities in the process of creating a new venture within the context of an accelerator? We aim to offer some insight into the process of adaptation in affective capabilities by individuals and teams, shedding some light into the genesis and

development of dynamic capabilities in young ventures through some of their underlying micro-foundations. Based on an ethnography work at an accelerator program in Stanford University and the resulting case studies from the ventures that took part, we develop a six-step process model to show how firms can detach from an existing solution and move forward to a better version.

The first contribution is our description of the genesis of dynamic capabilities, both from an entrepreneurial and a psychological perspective. From the entrepreneurial side, it was the entrepreneurial drive, the risk-taking behavior, anxiety, and the exposure to the reality of the market that led two of our cases to engage in various cycles of capability development. This confirms and further details some of the theoretical propositions of Teece (2007) who put forward that organizations need to convert high-levels of anxiety into internal change for reconfiguring their business. In terms of the psychological foundations we are showing how the process from being emotionally attached to an idea to detaching from it, forms a micro foundation of a dynamic capability.

The second contribution of our work lies in our description of the process of forming dynamic capabilities. We expect our pinning down of concepts, themes and aggregate dimensions makes the often "fuzzy" concept of dynamic capabilities describable.

Third, our research aids to the understanding of whether dynamic capabilities are only important in fast changing environments (Barreto, 2010; Di Stefano et al., 2010). Our conclusion is that developing dynamic capabilities is of great importance for entrepreneurial ventures. We acknowledge our research setting is biased, as the goal of an accelerator program is to simulate a fast-changing environment for ventures to learn to adapt quickly and that this accelerator is located in a privileged environment as Silicon Valley. Despite this bias, our sample of the observed ventures pertains to both fast and slow-paced industries. Based on our evidence, this accelerated environment accurately replicates the challenges of the real market for an entrepreneurial venture in any industry. Therefore, at least under this simulated context, we found that the development of dynamic capabilities was of great importance to the survival of the venture.

UNPACKING DESIGN THINKING – A MANAGEMENT RESEARCH PERSPECTIVE

INTRODUCTION

In recent years, Design Thinking has been the focus of attention from both academics and practitioners. Since 2004, there have been at over 4685 articles published in the form of journal, newspaper, magazine or online media articles in which the notion of Design Thinking is addressed. However only 435 of these articles were published in peer-reviewed journals, while the others are in the form of books, business press, practitioner journals, and present descriptive cases on how different organizations have adopted Design Thinking in their innovation processes.

While there has been a growing interest reflected by the number of articles published, and an abundance of conferences and workshops on the subject, it appears that academic research (and practitioners) has yet to develop a common understanding, that would allow examining Design Thinking through different lenses and draw effectively on the work of others.

In this comprehensive review of diverse relevant academic literature, I have attempted to explore the origin of the concept and to examine it through the context of management. This broad and multifaceted review revealed several insights, including the following:

- Scholars do not agree on a definition for Design Thinking. Existing definitions are context dependent or descriptive.

- The literature is developing in silos, according to the phenomena of interest of each respective researcher. These are (a) design science that is concerned with the decision making processes of design professionals; (b) design, engineering and management education that are concerned with learning processes and teaching strategies and (c) innovation and technology management that is concerned with the advancement of our understanding of organizational and managerial phenomena.

- Despite conceptual differences among researchers in different silos (and within the same silo), there are some emerging themes. Notably, (a) there is widespread acknowledgement—implicit and explicit—that Design Thinking is an effective approach to innovation; (b) there is a growing need to generate a collaborative and knowledge sharing culture within and outside an organization; (c) design

and development efforts are increasingly user-centered; and (d) cycles of testing and iterating are shortening across all fields and industries. These emerging themes could serve as important catalysts for a more unified study of Design Thinking.

- In the context of management literature, although generally disregarded by the academic community, all distinct elements and phases that comprise Design Thinking have been independently researched.

My intended contributions in this article are twofold: first, to provide an overview of the literature on Design Thinking that documents its discrepancies and illustrates its origins, and second, to structure the relevant literature for each of the main phases of Design Thinking in the context of management, to bridge the seemingly diverse subfields of study and help put future research on Design Thinking on a more solid conceptual footing.

The review is structured as follows: I begin by briefly reviewing the emergence of Design Thinking. Next, I proceed to the Method section, where I discuss the way this review has been carried out. I then review the overall existing Design Thinking literature by examining it through multiple lenses. I follow by examining the different phases of Design Thinking individually, describing their origins from diverse literatures and use within the management discourse. Finally closing with a discussion on the relevance, implications and possibilities of future research.

METHOD

To detect the origins and development of the discussion on Design Thinking, I applied a multistep process (e.g. Zott, Amit & Massa, 2011) that consists on tracking the appearance of a specific management term in a large number of journals to study its evolution (Abrahamson & Fairchild, 1999). I initially searched for articles published in leading academic and practitioner-oriented management journals during the period January 2004 to December 2013. The initial list of academic journals included the Academy of Management Review (AMR), Journal of Management Studies (JMS), Academy of Management Journal (AMJ), Administrative Science Quarterly (ASQ), MIS Quarterly, Journal of Management (JOM), Management Science (MS), Organization Science (OS), and Strategic Management Journal (SMJ). To these I added three of the

leading practitioner-oriented journals, namely, the Harvard Business Review (HBR), MIT Sloan Management Review (MSM), and the California Management Review (CMR). Focusing on articles that contain the term Design Thinking in the title, keywords or full text, the initial search revealed only 11 articles of which 6 had appeared in CMR, HBR, and MSM.

This relatively small set of articles (especially those published in academic outlets) led me to extend the search, using the EBSCO Business Source Premier database as a starting point (see Certo, Holcomb, & Holmes, 2009; Laplume, Sonpar, & Litz, 2008). This database represents one of the most complete sources on business studies (Zott, Amit & Massa, 2011) and provides access to academic business economics journals and other publications such as Books, Case Studies, Conference Proceedings Collections, and Working Papers. I searched the database for peer-reviewed and non-peer reviewed articles published from January 1, 2004 to December 31, 2013 containing the term Design Thinking in the Title, Abstract or Text. The result of this process, shown in Figure 1, drew a total of 1236 articles, from which 435 articles were peer-reviewed and 7 articles were already present in the initial sample, the overall peer-reviewed sample contained 439 articles. An initial cursory analysis of these articles, performed by reading article titles, journal names, abstracts, and introductions, revealed that not all the articles identified by the search would be useful for the purpose of writing this review. Many of these articles were case studies, summaries of articles published elsewhere, or studies in which the Design Thinking is not really the subject of the analysis. As a result, I eliminated 384 articles, leaving a sample of 55 articles.
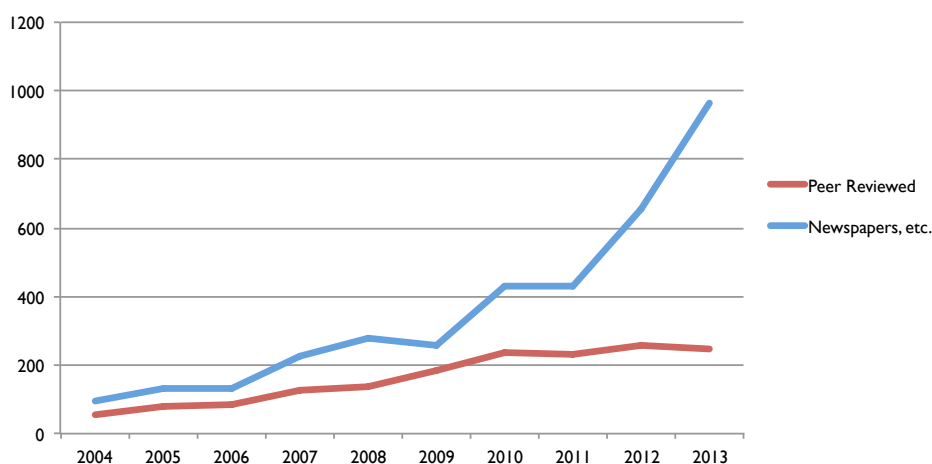
Figure 1 - References to Design Thinking 2004 - 2014

By reading these 55 articles in depth, I became aware of the loose use of the term Design Thinking in existing peer-reviewed literature and that even those articles that belonged to the same field generally failed to build on each other. However, as I highlight below in the Discussion section, the analysis of these publications suggested some more detailed research could be found regarding the individual phases and underlying mechanisms of the Design Thinking processes, such as (1) multifunctional team building, (2) customer or user centered empathic understanding, (3) problem definition, (4) ideation and idea selection and (4) solution prototyping and testing.

Observing Design Thinking not as a whole, but as the sum of the individual phases of an overall process, led me to review adjacent literatures that might be relevant for the study of Design Thinking but do not directly refer to the concept—namely, the streams of psychology, team building, knowledge management, organization behavior, new product development, marketing, total quality management, information systems, and management literatures. The search for literature for these distinct phases and throughout diverse fields of knowledge consisted in two steps; first by searching and reading the highest cited academic peer-reviewed articles within these different fields and second by following the citations made on the those initial articles by leading management journals (i.e. AMJ, AMR, ASQ, JOM, JMS, MS, MIS, OS, SMJ, CMR, HBR and MSM). This process lead to a total of 74 articles of which 21 belong to the leading management journals and focus on one or more of the phases of Design Thinking. I hope that by drawing on these literatures I may help put future research on Design Thinking on a more solid conceptual footing.

ORIGINS AND OVERVIEW

Design Thinking: What it is and What it is not
Peter Rowe, a Harvard University architecture professor, coined the term *design thinking* in 1987 as the title of a book in which he elaborated and developed theory on architectural design. However, it wasn't until 2003 that design thinking began being used to describe the working process followed at the consulting firm IDEO and popularized in the past decade through Stanford University's d.school. The term design thinking in itself is misleading, as put by Rylander (2009): "the term Design Thinking is composed of two ambiguous words that defy straightforward definition." Particularly

conflicting is the word "design", as its use implies that the term is related specifically to design professionals. However, design thinking is used not only by designers, but by people in a wide range of fields. In fact design thinking, as one of its core values, requires the use of multifunctional teams. Therefore, while design thinking draws some of its tools and practices from the field of design, it is not exclusively nor specifically related to this field. As such, Design Thinking has enjoyed a steady rise of interest by firms as part of their innovation efforts and universities as an education approach. These, usually mimicking Stanford's d.school established so called Innovation Labs in firms and implemented similar curricula at universities within their study plans.

However, Design Thinking until recently has not been well received by academia. The term does not give a clear indication of what field of research it should belong to. Design science has in many instances rejected it as a simplification of what professional designers do and have been doing for the past 50 years (Dorst, 2011). Additionally, Design Thinking has been criticized for its poor construction and framing, the ambiguity of term itself and for its lack of a clear definition: the approaches to it adopted by different people have sometimes little to do between each other, other than the term itself (Liedtka, 2014). For these reasons only few articles on academic journals elaborate on the concept, some shying away from the term Design Thinking in favor of other less controversial terms, and with researchers attempting to explain this phenomena drawing almost exclusively from design science.

A recent review of Design Thinking relevant literature by Johansson-Sköldberg and colleagues (2013) found a wide and largely disconnected discourse separated between that of design science, referred to as "designerly thinking", with a long history of academic debate and distinctive epistemological roots, and that of the management science. They find the management discourse to have distinct areas of focus that are often less academically anchored than designerly thinking and generally view Design Thinking superficially (Johansson-Sköldberg et al., 2013). In order to better understand the scope of the available research, I build on the work on Johansson-Sköldberg and colleagues (2013) and classify the different areas in which the term Design Thinking as been used.

Design Thinking discourse			
Designerly Thinking	*Design Thinking*		
Design Theory	*Design Management*	*Engineering and Business Education*	*In Organizational Practice*
Academic construction of the professional designer's practice and their decision making processes	Underlines the relevance of design practices and theory for managers	Concerned with the learning processes and teaching strategies that enhance learning through adductive and inductive reasoning	An approach to observe and understand the needs of an environment to then construct, test and iterate solutions in a collaborative way

Table 1: Design Thinking discourse, adapted from Johansson-Sköldberg et al. (2013)

As shown in the Table 1, the first area, referred to as 'Designerly Thinking' by Johansson-Sköldberg and colleagues (2013), links theory and practice from a design perspective, and is rooted in the academic field of design. Although not always using the term "Design Thinking", design academic theory has been developing and refining the concept of the designer's thinking process for the past 40 years (Buchanan, 1992; N Cross, 2011; Nigel Cross, 2006; Krippendorff, 2004; Lawson, 2006; Rittel & Webber, 1973; Schön, 1983; Simon, 1969). This thought process, Designerly thinking, refers to the particular academic construction of the professional designer's practice (practical skills and competence) and theoretical reflections around how to interpret and characterize this non-verbal competence of the designers (Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013).

The second area in the Table 1 is referred to as Design Thinking, and even if separate, it is sometimes confused with Designerly Thinking. Adding extra confusion, within this second area several groups of focus have also been identified (Johansson-Sköldberg et al., 2013). This perspective has been adopted by the education, business and management communities seeking for strategies to address the complex and open-ended challenges faced by contemporary organizations (Cabello et al., 2014). Despite its recent popularity, Design Thinking within these fields is less mature and thus less coherent, and there is a limited number of empirical studies to draw from (S. D. Carr, Halliday, King, Liedtka, & Lockwood, 2010). I therefore separate the area of Design Thinking into three main sub-areas that have taken different views on Design Thinking: Design Management, Design, Engineering and Business Education and Organizational Practice.

DESIGN MANAGEMENT

The management academic discourse began exploring design management as an academic area in the 1980s using the term Design Thinking to underline the relevance of design to managers (Johansson-Sköldberg et al., 2013). This discourse has drawn mainly on Designerly Thinking nature of design problems and processes and applied these in the context of innovation management (Olson, Cooper & Slater, 1998). Scholars in this field usually view management discourse through a design theory lens (e.g. Liedtka, 2000) and present practical successful cases (e.g. McCullagh, 2010). The focus is generally on how designers and design processes, techniques, and attitudes can enhance firms' processes, leading to a large number of articles of successful case-based descriptions with little or no theoretical basis. This approach, while attractive to practitioners, has resulted counterproductive for its academic development by steering academics away from research that may help understand of the underlying mechanisms of this phenomenon.

ENGINEERING AND BUSINESS EDUCATION

In the field of engineering, design is considered a central activity (Simon, 1996). Therefore, engineering education should instill in future engineers the design of effective solutions that will meet social needs (Sheppard, 2003). *Design Thinking reflects the complex processes of inquiry and learning that designers perform in a systems context, making decisions as they proceed, often working collaboratively on teams in a social process, and "speaking" several languages with each other (and to themselves)* (Dym et al., 2005, p.104). The view is that in order to teach these complex processes, engineering education needs to move beyond the historical "engineering science" model that has remained unchanged since the 1950s (Dym, 2004). The result of which has been the concern that engineering graduates are perceived by industry and academia as being unable to change of focus from the practical to the theoretical (Dutson et al., 1997). To address this challenge, specific attention has been given to the project based, shared language, collaborative, and deductive/inductive problem solving elements of Design Thinking (Dym et al., 2005). Research in this field suggests that this pedagogical model improves retention (Hoit & Ohland, 1998), student satisfaction (Olds & Miller, 2004), diversity (Carrilo, 2002) and student learning (Eris, 2004).

With some links to management research, management education has also conducted research on the use of Design Thinking. This literature, has also studied the effects of project-based learning in which students are encouraged to explore problems broadly,

deeply understand the people involved, and recognize the value in the contributions of others. Roger Martin, Dean of the Rotman School of Management, has been a major proponent of Design Thinking in management education. He views Design Thinking as resulting from the nature of design work: a project-based workflow of "wicked" problems, tackled by a series of ad-hoc teams that collaborate for a specific purpose and then disband onto the next project (Martin, 2005a). These "wicked" problems are described as a "class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (Churchman, 1967). In order to address these wicked problems that are increasingly common in today's dynamic environment, students should be taught to follow a cognitive thought processes that resembles that of a designer, among other characteristics, namely convergent and divergent thinking (Beckman & Barry, 2007; Dunne & Martin, 2006). In a more recent article, Wastell (2014) reaffirms the continuing relevance of the design perspective in management education and practice. Highlighting that Information Systems research provides a valuable repository of design theory and techniques.

IN ORGANIZATIONAL PRACTICE

The third sub-area is the practical approach of Design Thinking that became a methodology not only for designers, but for anyone looking to learn about users, solve problems through collaboration and creativity. This understanding of Design Thinking has been championed first by David Kelley, Professor at Stanford University and co-founder of IDEO, the world largest design consultancy. IDEO's long and renown practical experience has been the object of study of both business (e.g. Brown, 2008) and academic literature (e.g. Hargadon & Sutton, 1997). In 2003 Kelley decided to stop calling the IDEO approach 'design' and labeled it 'Design Thinking': ' "I'm not a words person," Kelley says, "but in my life, it's the most powerful moment that words or labeling ever made. Because then it all made sense. Now I'm an expert at methodology rather than a guy who designs a new chair or car." '(Tischler, 2009). Being Design Thinking an approach towards innovative solutions to a wide range of problems in the organizations, it includes steps and principles needed to perform projects with this methodology (T. Brown, 2008). Additionally, this approach is taught in a number of institutions: among the others, the two most recognized, and commonly known as

'd.schools', are located at Stanford University in the United States and in the Hasso-Plattner Institute (HPI) in Germany. The d.school functions as an institution where students from all fields and organizations collaborate in solving challenges following the Design Thinking approach.

In related research within this thesis (Cabello et al., 2014), we find that the d.school faculty and community, as well as those companies who use design thinking as part of their innovation efforts, draw a clear distinction between the practice of design and design thinking. This community regards Design Thinking as a distinctive way of solving problems following a cyclical process that can be applied to any area in an organization, whether or not it is product-related. To those who share this view, Design Thinking can be applied to a large number of business problems. And because this problem-solving methodology can be uncoupled from the design function, it can be scaled throughout an organization (S. Carr, Halliday, King, Liedtka, & Lockwood, 2010).

Design Thinking cycles through a series of phases, yet as a pre-requisite to this process, team formation is crucial, requiring a careful mix of professional skills or background and different types of individual characters. The process then proceeds as: first, to gain a deeper understanding of the people for which a certain problem is being worked on by means of observation and interviewing ("gaining empathy"). Gaining empathy may be seen the ability to recognize emotions in others. Second, to gather and structure the findings and insights generated to find patters of conduct. Third, only at this point is a wide range of solution concepts verbalized. Building upon these different ideas, a set of possibilities is selected. Fourth, the proposed solution ideas are quickly prototyped through rough sketches or physical objects. This allows the participants to better understand each other's concepts, to present to future users for feedback and reiterate based on new insights.

While the names and order of these phases vary between practicing institutions and organizations, the overall structure of the process remains equal as shown in Figure 2. In the following section, relevant literature to each of these phases is individually analyzed; initially describing their origins in various fields of research, followed by a review of the latest research within a subfield in the context of management research.
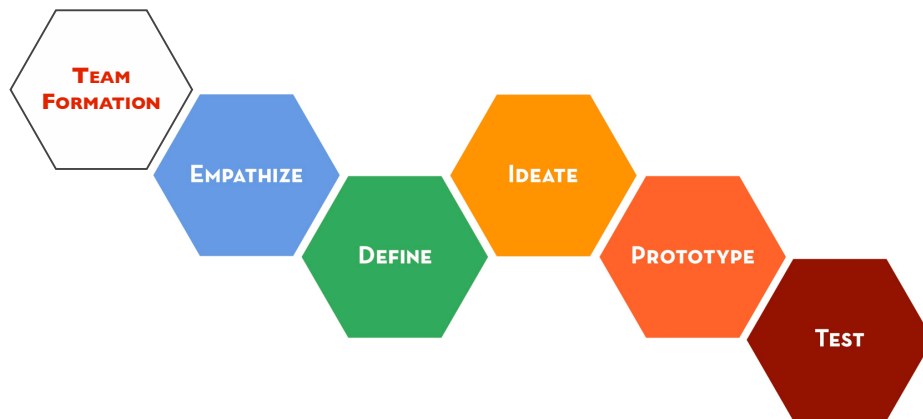
Figure 2 - Stages of Design Thinking, preceded by Team Formation

Design Thinking within the Context of Management Research

The following section presents a review of the relevant literature to each of the above-mentioned phases. Each is individually analyzed; initially describing their origins in various fields of research, followed by a review of the latest research within a subfield in the context of management research. Table 1 summarizes this review of these different streams of literature and their relevance to Design Thinking.

TEAM FORMATION

Organizations have structured their workforce into teams during more than twenty years (Devine, Clayton, Philips, Dunford, & Melner, 1999; Kozlowski & Bell, 2013; Mathieu, Maynard, Rapp, & Gilson, 2008). The underlying assumption is that people can be more productive and motivated when grouped in teams (Jones, 1983; Shepperd, 1993; Weber & Hertel, 2007). As a result, teams are widely recognized as the building blocks of today's organizations. The seminal work by Ancona & Caldwell (1990, 1992a, 1992b) on new product development established the long-term benefits of multifunctional teams, showing that while diversity may slow progress in the short term, it also fosters speed and innovation over the team's full development cycle. However, special attention must be given to the team's external communication strategy, internal conflict resolution facilitation, protection from organizational politics and a reward system for team, rather than functional, outcomes. Ancona & Caldwell conclude, "Over time, teams following a comprehensive strategy enter positive cycles of external activity, internal processes, and performance that enable long-term team success" (1992b, p.634).

In one of the most recent reviews of the team literature, Matheiu et al. (2014) recognize that the vast literature on teams has focused on either *team composition* (e.g.

Mathieu, Maynard, Rapp, & Gilson, 2008) or *team outcomes* (e.g. Bell, Villado, Lukasik, Belau, & Briggs, 2011). Research, although fragmented, determines that team composition affects team effectiveness in terms of creativity and innovation (Hackman, 1982; Mathieu et al., 2014). Team member diversity has been supported by numerous studies showing that while initial negative effects may occur; these can be mediated through the team's access to diverse external resources and growth of internal social ties among members (Han et al., 2014; Ancona & Caldwell, 1990, 1992a, 1992b). Design thinking allows this mediating effect to occur organically throughout the initial phase of gaining empathy with the user. During this phase the team focus is solely on the user, benefiting from access to diverse external resources that may help gain insights into the user and not requiring any particular skill set from an individual team member.

GAINING EMPATHY

Gaining empathy is considered the cornerstone of design thinking and what defines it as a human-centered approach to problem solving. This phase is important not only for the knowledge and insight that is gained from the user, but for the secondary effects on team dynamics that will be covered in the following sections. The contemporary familiarity and common use of the word "empathy" renders it somewhat vague (Gerdes & Segal, 2009). "Empathy" was coined by psychologists Theodor Lipps (1903) and Edward Tichener (1909) as a translation of the German word "einfühlung" that means "to project yourself into what you observe" (Titchener, 1909). Wispe (1986) defines empathy as the process whereby one person tries to understand accurately the subjectivity of another person, without prejudice.

Since the coining of the term, many different fields of psychology have explored the concept of empathy. Hoffman (1984) from the field of developmental psychology considered empathy in the context of the continuum of human development. Batson et al. (1991) in social psychology considered empathy as a mechanism to altruistic behavior, relating empathy to other personal motives, such as not having to view pain or perceiving a sense of reward for helping someone (Batson et al., 1991). Davis (1996) developed a comprehensive, yet individual level, model that includes all major empathy constructs developed prior to the recent neurobiological discoveries related to empathy. In recent years research in the field of social cognitive neuroscience has used brain imaging to identify our bodies' response to observing another person's actions (Decety & Jackson, 2004; Decety & Lamm, 2006; Decety & Moriguchi, 2007), called

mirroring (Iacoboni, 2008) and is considered to be one of the biophysical components that mediate empathy in the brain.

The first reference to empathy found by this author outside the field of cognition and psychology appears under the title User Understanding (Riley, 1985). This work from the La Jolla Institute of Cognitive Science in San Diego, CA. presents a hypotheses and an evaluating framework for how much understanding a user needs in order to skillfully use a computer or a computer program. This work later appeared as a book chapter edited by Norman and Draper (1986) under the title *User Centered System Design*. Consequently the fields of Information Systems, Design or New Product Development have used interchangeable the terms *user-centered*, *customer-centered* or *human-centered* to describe an approach to design or build solutions centered on the understanding of people's underlying needs.

Later on in the late 90s is when firms began to realize traditional market research, such as customer surveys, was not enough for successful product development (Leonard and Rayport 1997; Sanders and Dandavate, 1999) and the term "empathy" in relation to design was introduced (Kouprie & Visser, 2009; Battarbee and Koskinen 2005). Designers were then believed to have a better understanding to customer's sensitivities, to better understand them, their situation and their feelings – to be more empathic (Kouprie & Visser, 2009).

Among the recent studies of empathy, Baron-Cohen & Wheelwright (2004) built on previous psychology theory and empathy measurement instruments to propose the Empathy Quotient tool, which measures on two psychological dimensions, empathizing and systemizing. Empathizing is defined as the drive to identify another's state and to respond with an appropriate emotion, while Systemizing is defined as the drive to analyze a system in terms of its underlying lawful regularities and to construct systems using such lawful regularities (Baron-Cohen & Wheelwright, 2004). Design thinking works under the assumption that traditional educational has pushed too far into the Systemizing dimension and that in order to innovate it is necessary to find a balance between the two dimensions. With the aim to help re-learn that which was lost from the Empathizing dimension, design thinking offers different tools and pushes those who practice to go out and empathize with their users.

In Design Thinking and relative to any other type of collaborative work, it is fundamental for an individual to have the capability of empathizing with others and

understanding their different framework. While this capability has become increasingly relevant, there have been few studies of perspective taking within organizations. Parker & Axtell (2001) address this research gap. They define perspective taking as a process that results from people empathizing with others (the people whose perspective is taken), feeling concern about their misfortunes (e.g., Betancourt, 1990; Davis, 1983), understanding or identifying with their experiences (Egan, 1990), and experiencing pleasure at their achievements (Aron, Aron, Tudor, & Nelson, 1991). Their work investigates the antecedents and consequences of the extent to which employees in an organization empathize and take the perspective of internal suppliers. Their proposition is that perspective taking promotes contextual performance, particularly helping and cooperative behaviors.

In the context of management research, studies have explored the effects of empathy on individuals and its influence on a group or organization. Barsade (2002) expands this view and posits that empathy is followed by an emotional contagion that can influence group behavior, giving the example of a customer service representative who may have high degrees of stress given the constant low-grade effect of listening to customers' problems or negative feedback. This negative contagion has been shown to lead to a burnout in sales environments (Verbeke, 1997) or in healthcare jobs that are in constant contact with sick or depressed people (Omdahl and O'Donnell, 1999). The opposite contagion has also been studied, from customers who are lead to feel dissatisfied from a customer service representative's stress or bad mood (Pugh, 2001).

Building on the previous works of emotion in the workplace such as that of Ashkanasy & Daus (2002) and Pugh (2001), the role of emotions in organizational decision making processes appears to be only recently generating interest. Within organizational research, Müller et al, (2014) consider empathy in relation to corporate philanthropy, exploring the role of employees as drivers for corporate philanthropy. Integrating arguments from theory related to affective events, intergroup emotions and affect infusion, the authors develop a framework in which organization members' collective empathy has an effect on the likelihood, scale, and form of corporate philanthropy. Their work therefore sheds light on the underlying mechanisms in which empathy is aroused in individuals and becomes collective, having an effect on an organization's philanthropy. Further research could build on this work with a focus on empathy towards users and its impact on a team's innovation output.

Other recent research in the field of management has focused on empathy within teams in an organizational setting. Li et al., (2014) extends research on team processes and individual-level behavior to develop a multilevel, dynamic framework that establishes a team altruism construct and identifies its key dimensions. Altruism is motivated by an actors' genuine concern or empathy over another (Batson & Shaw, 1991). This work complements previous research of team egoistic behavior and advances our understanding on internal and external team processes by delineating those that are more altruistic from those that are more egoistic. Of particular interest to Design Thinking research, is their incorporation of the external processes, in which a team engages or collaborates with other teams, organizations or users. Further research could help us better understand the egoistic and altruistic team member's behaviors towards users and increase our understanding of team processes.

PROBLEM DEFINITION

Defining the actual problem determines what will be eventually solved and ultimately the quality of the solution (Baer et al., 2012). In the field of strategy, Mintzberg, Raisinghani, and Theoret (1976) state that diagnosing or formulating the problem may be considered as the most important aspect of strategic decision making. Here too, are multifunctional teams widely recognized as essential for tackling strategic challenges (e.g., Amason, 1996; Bantel and Jackson, 1989; Finkelstein, Hambrick, and Cannella, 2009; Nickerson and Zenger 2004; Schweiger, Sandberg, and Ragan, 1986; Wanous and Youtz, 1986).

In the field of strategy, Baer et al. (2014) recognize the breadth to which problem formulation has been discussed in diverse literatures (e.g., business strategy, organizational behavior, psychology, sociology, and operational management), but find a lack of depth in providing a theoretical approach. They then propose a theory that identifies and gathers the impediments most likely to impact formulation comprehensiveness and describes their interactions to jointly impact problem formulation. Hoping to offer managers with specific guidance to implement a process that may enhance the formulation of complex, ill-structured problems.

Separately, but aligned to the same principle, in the field of group creativity Harvey (2014) underlines the importance of combining the diverse views and expertise of different members of a multifunctional team to form a "creative synthesis". Harvey (2014) based on the dialectical model and a broad review of the literatures of teams,

organizational behavior, cognition, management and decision-making, proposes a synthesis process in which groups focus their collective attention, enact ideas, and build on similarities within their diverse perspectives. The dialectical model views people's social interactions as determined by their individual understanding of the situation they are in, therefore influencing their thoughts, questions, and socially accepted rules of engagement (Bartunek, 1984). Creative synthesis is rooted in a dialectical model that views the constant struggle between conflicting forces as a driver of change and novelty (Harvey, 2014). She proposes that this process is more likely to result in a breakthrough idea.

The value of "creative synthesis" in groups mirrors the way that individual creativity benefits from understanding a problem from different perspectives (Miron-Spektor, Gino, & Argote, 2011), reorganizing knowledge (Cohen & Levital, 1989; Teece, 1998; Zahra & George, 2002; Todorova & Durisin, 2007), and identifying or constructing a novel problem (Zhang & Bartol, 2010). Previous research finds synthesis as a means for a common way of understanding past and future ideas and events (Ford & Ford, 1995), particularly the insights that may have been gathered during the Empathize phase. The mutual understanding that results from this process will help the team to search, propose, and evaluate new ideas (Fleming & Sorenson, 2004). Lichtfield (2008) proposed goal setting as a mechanism for linking brainstorming research to organizational creativity, suggesting that specifying a particular context before idea generation may improve this process. Doing so will guide the next phase of idea generation (Sternberg, 1998), and work as a guiding reference for teams that find themselves heading in a different path than the one that was intended. With this point of reference, the team may view new ideas differently and therefore novel ideas may become acceptable and valued (Harvey, 2014).

Hargadon & Bechky (2006) describe moments of collective creativity as involving "...not only the original question, but also whether there is a better question to be asked." (page 492). Harvey (2014) proposes that the "better question" may open up new possibilities that were unlikely to be considered within the previous interpretation.

IDEATION

Ideation is widely recognized as an essential phase in creativity and organizational innovation models (Litchfield, 2008; George & Zhou, 2007) and critical for an organization's effectiveness (Amabile, 1988; Oldham & Cummings, 1996). At the core of

this phase are small and diverse teams that are able to build on each other's knowledge to generate creative ideas and select the most promising ones (Harvey & Kou, 2014; Litchfield, 2008; Amabile, 1988). However, research has found that both collective idea generation and evaluation are neither straightforward, nor entirely effective (Paulus & Nijstad, 2003; Rietzchel et al., 2006).

The use of brainstorming in design thinking has evolved and improved over the years. Small teams of less than five or six people are the norm. The use of written notes or *brainwriting* is common practice, as it forces team members to frame their ideas in a limited space and ideally in a pictorial form. Having structured and defined the problem in question allows for a better focus on solutions. These are then generally grouped into ideas categories to then prototype a few of them in parallel, this lends time for "incubation," to generate a better understanding of the proposed ideas and connect and build on each other.

With a long history and large research base, brainstorming is the most common ideation tool that enables the generation of shared knowledge, building on individual team member's knowledge and the insights gained from the empathic analysis of the client's needs (Schumpeter, 1934; Kogut & Zander, 1992; Van den Bosch, Volberda, & de Boer, 1999; Ahuja & Katila, 2001; Litchfield, 2008).

Research on brainstorming has generally focused on its effectiveness as a tool for number of ideas generated in interactive brainstorming groups (Sutton & Hargadon, 1996), the reasons for its lack of effectiveness (e.g. Paulus & Dzindolet, 1993) and the strategies to increase its effectiveness (e.g. Paulus & Yang, 2000) and recently the importance of coupling idea generation and idea evaluation (e.g. Rietzchel et al., 2006; Litchfield, 2008; Harvey & Kou, 2014). Designed as a tool to boost idea generation, brainstorming is has been indeed found to be ineffective. However, when regarded as an innovation tool, the focus of past research has been too narrow (Rietzchel et al., 2006). An early study by Hargadon & Sutton (1996) finds important outcomes from brainstorming that are not considered by previous literature or are reported but not labeled as effectiveness outcomes, suggesting that viewed in organizational context, efficiency at idea generation, merits no special status as an effectiveness outcome.

Research on strategies to increase brainstorming efficiency is also plentiful. In their research, Paulus & Yang (2000) found that *brainwriting* (described as a written form of brainstorming in which team members all write their ideas on short notes

before sharing them) is a more effective form of brainstorming, under the condition that team members show a high level of attention to other's ideas and when a period of reflection or "incubation" is allowed for team members to better grasp each other's ideas after the exchange.

Cognitive and emotional research has proposed that for a work context to support creativity, both positive and negative mood states interact to promote creativity (e.g. Kaufmann, 2003; Shwarz & Skurnik, 2003; Clore, Gaspar, & Garvin, 2001). Whereas negative moods and dissatisfaction can promote problem and opportunity identification, positive moods may promote divergent thinking, fluid ideation, among other effects. In an organizational setting George & Zhou (2007) research the role of positive and negative moods in a supportive context and its effect on creativity. They posit that a supervisor may provide such context by providing developmental feedback, displaying interactional justice, and creating a culture of trust.

While traditionally idea generation and idea evaluation have been studied and practiced separately, Harvey & Kou (2013) find that attempting to separate these phases may actually hinder the generation of shared knowledge and building on individual team member's knowledge. Rietzchel, Nijstad and Stroebe (2006) find that idea selection is so ineffective that the process is hardly better than selecting a random sample of ideas. These findings are consistent with those of Simonton (2003), who reported that people are not effective at recognizing their best ideas, and that this does not improve over the course of their careers.

Also within the context of management research Perry-Smith & Shalley (2003), draw from social network theory to propose that organizations interested in being innovative and creative should facilitate the interaction of their employees across and outside of the organizational boundaries. Their work posits that those actors who are not central in the organization and with a large number of connections outside the organization will have the highest creativity at work and therefore diversity, cultural norms and organizational structures influence creativity (Perry-Smith & Shalley, 2003). This research supports Design Thinking practices related not only to teams consistent of actors from different areas within an organization, but also of their close interaction with users outside of it and its influence in the generation of new ideas and their development into innovative solutions.

PROTOTYPING & TESTING

Depending on their content, ideas can also be captured in drawings (Carlile, 2002), working prototypes (Hargadon, 2002; Schrage, 2000), or even performances and role plays (Bartunek et al., 1983; Sawyer, 2004) as physical acts have been found to activate the processes involved in overcoming mental fixedness or the processes involved in forging new connections among distinct ideas and are therefore conductive to creative thinking (Leung et al., 2012). Generally, using prototypes throughout the entire Design Thinking processes allows teams to take a physically active approach to communicating, testing and learning from themselves and from their potential users (D'Ippolito, 2014; Jones and Jordan, 1998, Leonard and Sensiper, 1998). Research has also found that an active engagement of various stakeholders within and outside an organization during prototyping and testing enables an overall efficient prototyping process (Bogers & Horst, 2013).

Prototyping is defined as the processes of a product or service producer to present for testing to a potential user who is potentially unable to accurately articulate his needs. References to prototyping and testing can be found as early as the 1980s in the information systems literature (e.g. Nauman & Jenkins, 1982) and then further popularized in the new product development literature as Set-Based Design and Concurrent Engineering in the 1990s (Sobek et al., 1999). More recently, Carlile (2002) depicts prototypes as "boundary objects", describing them as simple or complex representations (i.e., sketches, assembly drawings, parts, prototype assemblies, mock-ups, and computer simulations) that can be observed and then used across different functional settings, establishing a shared syntax or language for individuals to represent their knowledge, and for that knowledge to be transformed. An early prototype does not signify that a decision has been made, but rather that an idea can continue to develop and therefore helps the development of a new product even when the prototype is incorrect (Thomke, 1998). Prototyping ideas that emerge during group interaction, goes beyond abstract idea elaborating and disadvantage identifying, and can further aid creative synthesis and brings them closer to implementation (Harvey, 2014). Research has found that prototyping translates usability problems into specific product/service changes and will help detect potential usability issues following an active engagement and experimentation (Bogers & Horst, 2013).

Terwiesch & Loch (2004) are among the first researchers to explore the concept of prototyping within the management literature. They posit that prototypes have namely

two advantages: they allow a user to evaluate a previously unknown product/service, and it guides both parties in the search for the ideal product/service specifications. More recently, research conducted by Harrison & Rouse (2012), revealed the interactive nature of feedback in which, through their interaction, users providing feedback and creative teams jointly construct a problem space that provides openings for changing prototypes. This means that although creative teams are constantly required to choose some ideas and abandon others, when the team tests a prototype for feedback they are forced to re-construct and articulate the problem space for feedback providers. In doing so, creative teams revisit old ideas and may see them in new ways. The most surprising finding in the work of Harrison & Rouse (2012) is that the most drastic changes on prototypes occurred when feedback touched on those ideas the creative team had already explored and discarded.

From this perspective prototyping represents an important design practice and, as such, a central element in corporate innovation processes (Bogers and Horst, 2013, Leonard and Rayport, 1997). We may conclude that within the innovation processes, end user involvement is essential to all phases of the problem-solving process, but particularly to prototyping (Bogers & Horst, 2013). The above-mentioned research illustrates how an active participation from the user via interaction with a prototype may result in better understanding of the overall experience and potential parameters.

Closely related to prototyping, in the early 2000s Nambisan (2002) identified three roles customers could take in the new product development process; the customer as a resource for ideation, the customer as a co-creator for enhancing the knowledge required for design and development and the customer as a user for product testing at any stage of the development process and product support through customer communities. The emergence of new information and communications technologies lead Nambisan (2002) to propose the use of virtual customer communities where users could be involved in different roles within an organization's innovation process. Indeed, more than a decade later, we have seen the strong role of these virtual communities through product specific blogs or social platforms such as Twitter and Facebook, where customers share their feedback and experiences, help each other in troubleshooting and present their complaints. These platforms have also recently had an effect on Design Thinking. In 2010, IDEO launched OpenIDEO.com, an open platform on which a diverse community solves challenges for social good. Within the platform, questions are posed,

ideas are shared, concepts are tested and eventually a winning idea, business or concept is picked. Further research must address not only the implications of prototyping and testing, but to also build on the work of Nambisan (2002) and explore new avenues of involvement between organizations and the people they attempt to serve.

LIMITATIONS

The available peer-reviewed literature explicitly on Design Thinking is still recent, with its majority originating in the past decade. Additionally, except for a few cases, these articles have still not made their way to top journals, particularly in the field of management. The rather divergent nature of the available literature makes making sense of it challenging, as the background of this researcher is not specific to the majority of the above mentioned fields. Until today, Design Thinking remains a theoretically underdeveloped and sometimes overloaded concept. This has raised doubts of its usefulness for empirical research and theory building. Future research should attempt to overcome these limitations. Scholars have already developed the independent theoretical foundations of Design Thinking, future effort should be placed in bridging the gaps between these foundations. This may help clarify the concept within its different contexts and aid firms in better understanding their needs and capabilities for continued innovation.

CONCLUSION

The purpose of this article is to present a review of those different streams of research relevant to the context of management literature and that have studied one or more of the core principles and phases of Design Thinking. While the names and order of these phases vary between practicing institutions and organizations, these may be separated in five: team formation, customer empathy generation, problem definition, ideation, and rapid prototyping and testing. Relevant literature to each of these phases is individually analyzed; initially describing their origins in various fields of research, followed by a review of the latest research within a subfield in the context of management research.

Observing Design Thinking not as a whole, but as the sum of the individual phases of an overall process, unveils streams of psychology, team building, knowledge

management, organization behavior, new product development, marketing, total quality management, information systems, and management literatures. As the core principle of Design Thinking lies in bringing together and building upon different fields of knowledge, it seems only natural that not any single field of research could properly explain this phenomenon as a whole. Each of these fields of knowledge have in their own realms been widely researched, tested and published. Therefore, this review focuses on the field of management research, where it has been a common practice to borrow and utilize different concepts and theories from other fields, such as psychology and sociology (Whetten et al., 2009).

The emerging literature on Design Thinking is scattered among different fields of study and still at an early stage. It has only recently began to make its way to top management journals. However, this review of the literature suggests two ways to advance the study of Design Thinking. First, I hope that by having demonstrated that the field of management has already (perhaps unknowingly) dedicated a lot of ink to the topic by studying the diverse phases of this phenomenon, academic researchers will no longer shy away from the term. Second, this review might encourage future researchers to explore innovation as whole, acknowledging and understanding the interactions between the diverse subset of fields of research relevant to this complex phenomenon. Future research could adopt a holistic and system perspective, not just on what Design Thinking does but also on how it does it. Each phase has a deep research base, but the different approaches have not been integrated. This article aims to be a first step in doing so, as for numerous institutions, organizations and governments, Design Thinking as a whole has proven greater than the sum of its parts.

Table 1 - The Design Thinking phases and their relevant and most recent studies in the context of management research

Team Formation	Empathize	Define	Ideate	Prototype & Testing
Han et al.	Li, Kirkman & Porter	Harvey	Harvey & Kou	Harrison & Rouse
2014	2014	2014	2013	2014
Journal of Organizational Behavior	Academy of Management Review	Academy of Management	Administrative Science Quarterly	Academy of Management Journal
The results of an empirical study shows that the interaction of team-bridging social capital with team-bonding social capital was positively and significantly related to team creativity. Knowledge variety and knowledge disparity had a joint effect on team-bridging social capital, and knowledge separation was negatively related to team-bonding social capital. Moreover, team social capital mediated the effects of knowledge diversity on team creativity.	This conceptual article extends research on team processes and individual-level behavior to develop a multilevel, dynamic framework that establishes the team altruism construct and identifies its key dimensions. This work aims to complement existing understanding of team egoistic behavior and advances research on team processes by delineating those that are more altruistic from those that are more egoistic.	Theoretical paper proposing that the process of creative synthesis improves the chance that each of a group's ideas is a breakthrough. Then elaborating the process facilitators of creative synthesis and the implications of the dialectical model for understanding extraordinary group creativity. Creative synthesis provides an alternative way for groups to combine their cognitive, social, and environmental resources into extraordinary output.	An inductive qualitative process analysis of four U.S. healthcare policy groups tasked with producing creative output. Results show that evaluation does not impede groups' creativity. They develop a conceptualization of evaluation as a generative process that shapes and guides collective creativity.	Through an inductive study of feedback meetings in creative projects, this article seeks to clarify how much traditional prescriptions for feedback apply during creative projects that rely on nonlinear and ambiguous work patterns. The main findings are that creative and feedback givers co-construct problem spaces and that certain types of feedback prompt creators to return to old ideas. Based on this, the authors propose a processes model that describes the influences of creative projects over time.
Mathieu, et al.	Mueller, Pfarrer & Little	Baer, et al.	Litchfield	Bogers & Horst
2014	2014	2012	2008	2013
Journal of Management	Academy of Management Review	Strategic Management Journal	Academy of Management	Journal of Product Innovation Management
Categorizes team composition models into four types and highlight theory and research associated with each one, offering an integrative framework that represents members' attributes, overlays temporal considerations, and integrates membership dynamics. Providing a research agenda for both research and practice.	This article explores the role of employees as drivers for corporate philanthropy, as they have been recently recognized to be more empathic in nature. This article integrated arguments from affective events theory, intergroup emotions theory, and affect infusion theory, to develop a framework in which organization members' collective empathy in response to the needs of unknown others infuses executives' decisions, thereby affecting the likelihood, scale, and form of corporate philanthropy.	This conceptual article establishes the microfoundations of strategic problem formulation by developing a theory that predicts a core set of impediments to formulation that arise when complex, ill-structured problems are addressed by heterogeneous teams.	This theoretical paper is based on the literature on brainstorming, developing a goal-based view of intervention in idea generation. A goal-based view provides new insight into the conduct and evaluation of brainstorming research that improves its relevance to management, and it suggests a broader agenda for defining expectations for creative ideas and tailoring interventions to match these definitions.	This article explores how collaborative prototyping across functional, hierarchical, and organizational boundaries can improve the overall prototyping process. It suggests the existence of two levels of prototyping: the managerial vs. the designer level; on this latter, collaborative prototyping transforms the act of prototyping from an activity belonging exclusively to the domain of design engineers to an activity integral to NPD, with internal and external participants.
Nakata & Im	Bardase	Grant & Berry	George & Zhou	Terwiesch & Loch
2010	2002	2011	2007	2004
Product Innovation Management	Administrative Science Quarterly	Academy of Management	Academy of Management Journal	Management Science
Empirial study surveing 206 NPD teams in U.S. high-tech companies. Results show that cross-functional integration improved new product performance and that both internal and external factors contribute and codetermine cross-functional integration.	This article explores the transfer of moods and its influence within work groups through a laboratory study of managerial decision making using multiple, convergent measures of mood, individual attitudes, behavior, and group-level dynamics. Findings show a significant influence of emotional contagion on individual-level attitudes and group processes. Particularly with positive emotional contagion group members experiencing improved cooperation, decreased conflict, and increased perceived task performance.	The research draws on motivated information processing theory and proposes that the relationship between intrinsic motivation and creativity is enhanced by other-focused psychological processes. Perspective taking, as generated by pro-social motivation, encourages employees to develop ideas that are useful as well as novel.	This article develops a dual-tuning perspective concerning how positive and negative moods interact to influence creativity in supportive contexts. The results of this empirical study found that when supervisors provided a supportive context for creativity and positive mood was high, negative mood had a strong, positive relation to creativity, with creativity being the highest when the context was supportive and both positive and negative moods were high. The authors explore three ways in which supervisors can provide a supportive context: providing developmental feedback, displaying interactional justice, and being trustworthy.	This article explores the growing importance of customer need elicitation for product customization. As a first step in this new field of research, this article develops an economic model that aims to answer the questions: how many prototypes should be built, who should pay for them, and how the prototypes should be priced relative to their costs.
Perretti and Negro	Parker & Axtell	Kavadias & Sommer	Perry-Smith & Shalley	Carlile
2006	2001	2009	2003	2002
Academy of Management	The Academy of Management Journal	Management Science	Academy of Management Review	Organization Science
Empirical study on the film industry. Results show the negative effects of teams conformed by members of different status and by the insertion of new members into an existing team, or teams into an organization, without consideration to the existing structure.	This conceptual study investigates the antecedents and consequences of the extent to which frontline employees take the perspective of their internal suppliers. The authors then propose that perspective taking will promote contextual performance, particularly helping and cooperative	This research proposed that nominal groups perform better in specialized problems, even when the factors that affect the solution quality exhibit complex interactions (problem complexity). In cross-functional problems, the brainstorming group exploits the competence diversity of its participants to attain better solutions.	Conceptual article explores the association between the context of social relationships and individual creativity, high-lighting the importance of both static and dynamic social network concepts and describing an individual's creative life cycle in terms of network position. The authors argue that weaker ties are	This research connects product development literatures focused both boundary objects and prototyping as means of driving innovation and adds value to both by specifying different categories of boundary objects in new product development and the critical characteristics that

Team Formation	Empathize	Define	Ideate	Prototype & Testing
	behaviors. They define perspective taking as a result of developing empathy for others and and experiencing pleasure at their achievements.	However, their advantage vanishes for extremely complex problems.	generally but not always beneficial for creativity, propose the network positions that facilitate and constrain creative work, and describe three moderators.	are essential in establishing effective boundary processes.
Ancona & Caldwell	Varca	Lichtfield	Paulus & Yang	Nambisan
1992	2009	2008	2000	2002
Administrative Science Quarterly	Journal of Services Marketing	Academy of Management	Org. Behavior and Human Decision Processes	Academy of Management
This qualitative research on new product development teams shows that the type of external communication teams engage in, not just the amount, determines performance. Over time, teams following a comprehensive strategy enter positive cycles of external activity, internal processes, and performance that enable long-term team success.	An empirical study on 226 surveyed front line employees finding that those employees who spent more time engaged in empathic behavior or saw empathic behavior as critical to service quality also reported significantly higher role conflict.	This theoretical paper is based on the large body of literature on brainstorming as a prototype, developing a goal-based view of intervention in idea generation. A goal-based view provides new insight into the conduct and evaluation of brainstorming research that improves its relevance to management, and it suggests a broader agenda for defining expectations for creative ideas and tailoring interventions to match these definitions.	This empirical study proposes conditions under which idea sharing in groups can be productive: carefully processing the ideas exchanged and reflection on after the exchange process. Suggesting that, under the right conditions, the idea exchange process in groups may be an important means for enhancing creativity and innovation in organizations.	This theoretical paper examines the design of virtual customer environments, focusing on interaction pattern, knowledge creation, customer motivation, and virtual customer community-new product development team integration. Offering propositions that relate specific virtual customer environment design elements to successful customer value creation, and thereby to new product development success.
Ancona & Caldwell	Williams	Bartunek	Sutton & Hargadon	Naumann & Jenkins
1992	1998	1984	1996	1982
Organization Science	Journal Of Business & Industrial Marketing	Administrative Science Quarterly	Administrative Science Quarterly	MIS Quarterly
This research finds that in order to garner the positive process effects of diversity organizations must at the team level, training and facilitation in negotiation and conflict resolution may be necessary and at the organization level, protect the team from external political pressures and rewarded for team, rather than functional, outcomes. Finally, diverse teams may need to be evaluated differently than homogeneous teams.	This survey study of 51 organizations shows that to maximize a selling organization's capability for developing and maintaining effective customer relationships, each of these sales force management activities should be examined and configured to make a positive impact on the practice of sales force customer-oriented behaviors.	This qualitative empirical paper proposes that major changes in interpretive schemes occur through dialectical processes in which old and new ways of understanding interact, resulting in a synthesis. Finding that environmental forces are likely to initiate the change, but the way the environment is interpreted by organizational members affects the type of change that takes place.	Through an empirical qualitative study of a product design firm this study finds important consequences which are not considered by previous literature on brainstorming or are reported but not labeled as effectiveness outcomes. This study suggests that when brainstorming sessions are viewed in organizational context, efficiency at idea generation may deserve no special status as an effectiveness outcome.	The authors review published references to prototyping and related concepts, and synthesize a process model for IS in which resource requirements are enumerated and discussed. The article includes an analysis of the economics of prototyping, and a brief discussion of several examples.

Alan Cabello Llamas

ENHANCING ABSORPTIVE CAPACITIES - THE CASE OF DESIGN THINKING

written with Giada Baldessarelli and Christopher Tucci

INTRODUCTION

Despite the increasing adoption of Design Thinking as means to innovate (Brown & Katz, 2011), the phenomenon still lacks a theoretical basis within the management literature and the few studies that aim at doing so are mainly anecdotal (Carr et al., 2010; Liedtka, 2014). While over hundreds of articles on the topic have been published between 2000 and the 2009 (Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013), the majority of them are in the form of books, business press and practitioner or design-focused journals. Despite the growing interest, several academic researchers have criticized Design Thinking for its poor construction and framing, the ambiguity of term itself and for its lack of a clear definition. This has created a stark divide between supporters and non-supporters. Given its controversial nature but the growing number of organizations and even governments (e.g., Singapore) that have adopted Design Thinking practices in recent years, this research is motivated by the need for an objective evaluation and understanding of the phenomenon. Accordingly, advancing the research on this growing yet poorly understood phenomenon, our research aims to understand the underlying mechanisms of Design Thinking as it is utilized by organizations as an innovation methodology, collect knowledge about users and their surrounding contexts, and integrate it with organizational knowledge in the innovation process.

Even if the term was first coined by Peter Rowe in 1987, Design Thinking has increasingly been considered a 'hot topic' in corporations and business schools only since the early 2000s. It is recognized among practitioners as a strategic methodology for innovation that draws from the professional designer's work process. Within the growing number of organizations that are adopting it, a wide variety of professionals apply "designers' principles, approaches, methods, and tools to problem solving" to foster innovation (Brown, 2008). This approach involves different organizational roles, well beyond people formally trained in "design," and is based on the empathic understanding of users and their contexts (Brown, 2008). Therefore, with Design Thinking, organizations acquire knowledge about the interaction between users, products, and their surrounding environment.

They then internalize and integrate this knowledge with their existing knowledge, tackling so-called "wicked problems" (or opportunities to generate innovations).

To explore the mechanisms underlying this phenomenon, an extensive ethnographic study was conducted at the two locations of the "d.school" (formally known as the Hasso-Plattner Institute of Design), the most recognized institution where Design Thinking is taught and practiced in collaboration with numerous organizations. We started this study with an exploratory research question: "How does Design Thinking support innovation?" As our research advanced, we found interesting parallels between the knowledge flow that occurs during Design Thinking projects and the stages proposed by scholars for developing Absorptive Capacity. We therefore propose that Design Thinking allows and requires the recognition, absorption and application of knowledge from outside organizational boundaries.

First introduced by Cohen and Levinthal (1989), the construct of Absorptive Capacity posits the importance for innovation of the organizational ability to go outside the boundaries looking for external technological knowledge, internalize it and successfully exploit it. Similarly, Design Thinking seeks this external knowledge, not only in the form of technology but also about consumers and their surrounding environment and contexts, fostering innovation through its assimilation, transformation and utilization. While Absorptive Capacity was originally measured by R&D intensity, we propose that since the late 1980s the nature of R&D has evolved. Just as these authors foresaw in their seminal work, yet never considered in their measure, current innovation efforts fall across different intermeshed organizational functions (Cohen and Levinthal, 1990, p.134).

The contribution of this article is to give the reader a better understanding of the underlying processes of Design Thinking by explaining its links with Absorptive Capacity. We propose Design Thinking as a means to foster innovation by enabling the development and enhancement of the organizational ability to recognize, assimilate, and apply information, thereby advancing the development of theory in an area that has so far been dominated by practitioner case-based descriptions on how different organizations have adopted Design Thinking in their innovation processes.

The paper is structured as follows: section 2 introduces Design Thinking followed by section 3 that describes the research setting and the methodology used for the analysis. Section 4 describes our model linking Absorptive Capacity with Design Thinking by showing how it supports innovation by assimilating, transforming and applying external knowledge. In our final section we discuss potential implications and future research.

WHAT IS DESIGN THINKING?

In the past decade, within the context of organizations' innovation strategy, Design Thinking has been used in various firms, non-profits, NGOs and governmental departments as a practical approach for multifunctional innovation teams to better understand their organization's users and solve problems through collaboration and creativity (Martin?). These contemporary organizations are all seeking strategies to address their own complex and open-ended challenges. Design Thinking guides multifunctional teams to follow the professional designer's work process, building on diversity of paradigms, ideas and solutions of different individuals within a team.

Prof. David Kelley from Stanford University and co-founder of IDEO, the world largest design consultancy, introduced the current understanding of the term Design Thinking. IDEO's long and renown experience has been the object of study of both business (e.g. Brown, 2008) and academic literature (e.g. Hargadon & Sutton, 1997). The name Design Thinking was first introduced by Kelley, who in 2003 decided to stop calling the IDEO approach 'design': " 'I'm not a words person,' Kelley says, 'but in my life, it's the most powerful moment that words or labeling ever made. Because then it all made sense. Now I'm an expert at methodology rather than a guy who designs a new chair or car.' " (Tischler, 2009).

This methodology therefore offers a set of steps and principles to foster innovative solutions to a wide range of problems in an organization (Brown, 2008). The approach requires 5 steps that can be summarized as follows. First, empathize, whereby the team understands the problem by plunging themselves into it – observing and talking to the people they're trying to help, working with them, interviewing experts. Second, define - whereby the team gathers their findings and looks for patterns to better define the actual problem being solved. Third, ideate –

brainstorm solutions to those problems identified at stage two. Fourth and fifth, prototyping and testing – create quick mock-ups of different solutions to try out against the problem, take these back to the potential user for them to test and experience and then reiterate based on this feedback. Hence, in democratizing the professional designer's work process, Design Thinking can be applied to a large number of organizational problems. Consequently this methodology can be uncoupled from the design function and scaled throughout an organization (Carr et al., 2010).

We began our exploratory research with the open question - "How does Design Thinking support innovation?" Our preliminary findings suggested that, supported by Design Thinking, organizations are generally able to acquire and transform knowledge to produce human-centered solutions.

METHOD AND DATA COLLECTION

RESEARCH DESIGN

Adopting an exploratory approach, we started our research with the generic question "How does Design Thinking support innovation?" and we decided to conduct an extensive ethnographic study to collect "rich, detailed and evocative data" staying open to inputs from the field (Edmondson & Mcmanus, 2007). Due to the lack of systematic research and the pure anecdotal results of previous academic studies on Design Thinking, an explorative inductive study is well suited for such poorly understood phenomena (Edmondson & Mcmanus, 2007). Because Design Thinking is a growing innovation strategy pursued by organizations in different ways and often in combination with other innovation methodologies, following Corley & Gioia (2004) recommendation, we needed to identify a context where Design Thinking was clearly practiced and distinguishable from other innovation strategies. We therefore focused on the ecosystem composed by the d.school and the organizations that currently or in the past collaborated with it. In order to assure the broad understanding of the phenomenon and to reduce the bias coming from specific geographic settings (e.g. the Silicon Valley), we chose to initiate this research focusing on the two locations of the most recognized institution where Design Thinking is taught and practiced in collaboration with organizations: the Hasso-Plattner Institute of Design, called d.school.

One of the authors spent six months (March - September 2013) at Stanford University's d.school as Visiting Researcher and the following six months at Potsdam University's d.school as a participant in to their Basic Track program (October 2013 - February 2014). The first few weeks at each location were spent gaining familiarity with the faculty and staff, while the following months were spent attending sessions following a participant observation approach and establishing connections with different organizations that participate in this ecosystem and regularly practice Design Thinking.

The d.school focuses on creating learning experiences from which participants develop creative solutions to organizational problems. Through projects in a wide range of domains, the d.school encourages companies to discover people's needs, to collaborate with colleagues from other fields, and to build on each other's knowledge. Companies collaborate with the d.school through a fellowship program for leading executives, by proposing challenges to be tackled by teams of graduate students, or by the participation of their managers in a number of workshops and programs.

Stanford d.school. Co-Founded in 2005 by Prof. David Kelley, the d.school is located at the center of Stanford University's campus. The subjects of the courses offered vary widely, from introductory D.Thinking Bootcamp to entrepreneurial accelerator programs. Courses are offered to both students and executives. In the latter case, they are set up in teams with people coming from other companies and offered an intensive course on the principles and methodology of Design Thinking. Recent collaborators include: Facebook, Procter & Gamble, Kaiser Permanente, Google, Henry Ford Learning Institute, Timbuk2, WalMart and JetBlue Airlines (d.school Fact Sheet, 2012).

Potsdam d.school. Following the model of Stanford's d.school, Hasso Plattner brought the d.school to Germany in 2007. Here, courses follow a different model, offering a two-semester Design Thinking program to graduates. The two-semester program is divided into a Basic Track and an Advanced Track, where participants work in different teams to a series of real-world projects developed in partnership with an external company or organization. At the Potsdam d.school courses called the Professional Track, are also offered to managers and executives, where they are set up in teams with people from other companies and introduced to the principles

and methodology of Design Thinking. Recent collaborators include: Deustche Bahn, DHL, Siemens, Bosch, SAP, SwissCom and DekaBank, Deutsche Post, Lufthansa(http://www.hpi.uni-potsdam.de/d_school/partner/bisherige_partner.html seen on 27/03/2014).

To assure construct validity, we collected data through different sources (Yin, 2003): (1) participant observation, (2) semi-structured interviews, (3) informal discussions, (4) written material. The evidence guiding our descriptions of and inferences on Absorptive Capacity through Design Thinking have been identified through observation and interaction with participant teams at the d.school, interviews with experts and executives of companies that apply Design Thinking, and finally material collected during and after the time spent at the d.school. As Glaser and Strauss (1967) suggest, it is the submersion in empirical reality that allows the development of a testable, relevant, and valid theory. We used an iterative process to develop inferences. So, we relied on participant observation and interviews as main data sources to understand how teams perform and experience Design Thinking, not only how it is viewed through the eyes of its main proponents or through explicit phrasing of it through interviews. We present each of the four different sources of data with further detail.

1. Participant Observation: One of the authors observed and participated both in Design Thinking sessions and projects. In the sessions, coaches introduced topics through interactive activities, in which teams were encouraged to seek help from others. Teams continuously presented their progress through acting, sketching or building with available material, post-it notes and rolling whiteboards. The visible and vocal nature of all activities offered to the authors the opportunity to observe how individuals and teams tackled different projects; each session was carefully observed and recorded through notes, but also pictures and videos when possible. After each session the field material has been organized and transcribed in order not to loose any detail. One of the authors participated with five different teams for distinct projects, developing different solutions to a wide set of challenges. In some cases these challenges were proposed by different organizations and in others these were taken as practical learning projects. Each team was comprised of at least

5 people (including the researcher), working together at least twice a week. Participation by the researcher included helping to conduct customer interviews, gather market research, brainstorming and preparing presentations. Each team developed numerous designs, working prototypes and models for their projects.

2. Semi structured interviews with Design Thinking experts and executives: Initial interviews were directed to members of the d.school directly involved in the work process, while subsequent interviews were further focused to key experts and executives. This order was followed in order to not loose the opportunity to ask the most relevant questions to the leading experts, particularly when a promising theme arose such as Absorptive Capacity. In general, interviewees are leading Design Thinking experts from different locations: the United States, Germany, Scotland, Finland, Singapore and Switzerland. These experts are either executives directing a Design Thinking initiative within a company or the directors or coaches within the d.school. Interviews were structured with the underlying knowledge flow theme, although this concept was rarely mentioned given the diverse background of most interviewees.

3. Informal discussions: Informal conversations took place with participants, executives, coaches and staff, ranging from brief exchanges while waiting for public transport to multiple long talks over lunch. The content of these discussions varied widely: executives and participants sharing the insights on their work or coaches planning and preparing for a new program at the d.school or abroad. Some of these later lead to repeated, more in depth, conversation.

4. Written Material: To complement the observation and interviews, additional secondary data were collected. Published case based material from different companies and organizations was collected online or through people working in this field. Where available, online information in the form of publications and literature on the d.school and their projects was collected. Most teams participating in sessions at the d.school are required to present progress reports and to document their projects' results. More than 400 documents reporting activities or results were duly collected, classified and analyzed. Team communications and document sharing are made through online platforms (i.e. Box, GoogleDocs, Basecamp, etc.), allowing all participants to share their work with each other,

participate actively in each other's projects and helped these researchers keep track and better understand each team's progress.

Participant Observation	Stanford d.school	7 months	3 projects 1 industry
	Potsdam d.school	8 months	3 projects 2 industry
Semi Structured Interviews	Professors & Coaches	Stanford, Potsdam, National University of Singapore, Hochschule Munchen, University of Technology Sydney	10 interviews
	Practicing Executives	SAP, IDEO, Intuit, Panasonic, Logitech, Swisscom, PostFinance, Fidelity Investments, CapitalOne, The Customer Experience Company	17 interviews
Informal Conversations	100x		
Written Material	400x Articles		

Table 1 – Overall Data Collection

DATA ANALYSIS

Such as in Glaser and Strauss (1967) and Miles and Huberman (1994), a set of iterations usually began with a hunch inspired by the data or literature, followed by a compilation of evidence from all data sources in order to confirm if this hunch could be grounded. All data was then analyzed in order to use, leave or modify each inference. Those retained inferences were then summarized visually showing how strongly it could be grounded in accordance to the data. When a promising theme such as Absorptive Capacity arose, we read and summarized the pertinent literature and, focusing our data collection, did preliminary analyses to decide if it was worth pursuing. Specifically, the interest in Absorptive Capacity emerged when we noticed the critical importance of the assimilation of knowledge within teams and the rapid learning curve that teams undergo in their projects. Consequently, we focused on the knowledge flow that Design Thinking allows starting from internal previous knowledge and additional external sources. We then followed the Miles and Huberman (1994) recommendations for qualitative data analysis, by reducing and organizing the data into tables and charts that were displayed for the researchers to better make sense of the data and at times to share with other researchers for their insights and recommendations. This further allowed us to concentrate our subsequent interviews and observation on knowledge.

UNIT OF ANALYSIS: TEAM

While the construct of Absorptive Capacity proposed by Cohen and Levinthal (1990) works at the organizational level of analysis, organizations are composed by individuals and knowledge is first developed at the individual level (March, 1991; Nonaka, 1994). Cohen and Levinthal (1990) remind that "an organization's absorptive capacity will depend on the absorptive capacities of its individual members. To this extent, the development of an organization's absorptive capacity will build on prior investment in the development of its constituent, individual absorptive capacities" (Cohen & Levinthal, 1990, pg. 131). Recent literature supports this claim describing the role of organizational learning as a collective sensemaking process that follows an identifiable progression of cognitive activities, beginning from the individual level, taken later to the group (or team) level and finally to the organizational level (Sanchez, 2005).

Additionally, in the innovation literature for the past decade the team has risen as the predominant level of analysis (e.g. Brown & Eisenhardt, 1995; Gibson & Gibbs, 2006). Hargadon and Becky (2006) show how in complex contexts, individuals do not possess all the needed knowledge to develop innovation. Rather, innovation comes often from groups of people that collaborate and ideate together: "Francis Jehl, one of Thomas Edison's longtime assistants, once explained that, "Edison is in reality a collective noun and means the work of many men" (Hargadon & Bechky, 2006). The team, bringing in different kinds of specialized knowledge, builds on its members' background and expertise to reach a common goal (Kozlowski & Ilgen, 2006). It therefore has become the unit of analysis to understand the micro-foundations of the knowledge creation and application towards innovation and it is the level of analysis that we focus on for our research.

DATA RELIABILITY

Construct validity is established using multiple sources of evidence, the creation of a chain of evidences, and by having key informants review interview transcripts (Yin, 2003). In order to reduce any type of bias, data were collected from different sources and locations. Each course session and interaction with teams was recorded with the objective to capture with as much detail the voices, actions, intentions and appearances of the environment under study. These records were taken in the form of notes, pictures, recordings or videos detailing what the researchers heard and saw, which were then transcribed and classified.

Ethnographic and secondary data is complemented with semi-structured interviews with key subjects. The reason for conducting interviews is that they provide a flexible means to access information that one might not obtain via other sources (Robson, 2002). The Miles and Huberman (1994) method for analysis of interviews was employed. This data has been interpreted according to previous literature and data gathering and then following Yin (2003) using it to then triangulate the interview data. These sources enabled a triangulation of findings to then build stronger interpretations. Again following Yin (2003), an ethnographic protocol was developed to ensure that data collection was replicable to maintain a chain of evidence. This replication logic fosters the emergence of testable theory that is free of researcher bias (Eisenhardt, 1989). All gathered data were reviewed by both researchers and when possible by colleagues external to our research. When possible, field notes were revised with different participants in order to assure completeness and reliability. Interviews were transcribed promptly and sent to the interviewees for revision and appraisal.

THE APPROACH OF DESIGN THINKING TOWARD THE CREATION AND ENHANCEMENT OF ABSORPTIVE CAPACITIES

In contexts of rapid technological changes, firms are often unable to cope with market changes relying only on their current knowledge basis or quickly renewing it internally. Thus they often look outside their boundaries for external sources of information (Cohen & Levinthal, 1990; Laursen & Salter, 2006; Volberda, Foss, & Lyles, 2010). The ability to recognize the value of external knowledge, integrate it and apply it, called Absorptive Capacity, was introduced for the first time by Cohen and Levinthal in their seminal paper of 1989 to explain why organizations often invest in basic R&D: "firms may conduct basic research less for particular results than to be able to identify and exploit potentially useful scientific and technological knowledge generated by universities or government laboratories". According to the scholars, Absorptive Capacity leads firms to gain first-mover advantage in the exploitation of new external knowledge because they develop the needed sensitivity to recognize and understand emerging trends or opportunities in the market (Cohen & Levinthal, 1990).

Starting from the seminal paper of Cohen and Levinthal (1989), the interest within the community of management and innovation scholars for Absorptive Capacities grew extensively during the past two decades. However, it has been noticed that the directions taken by the research are highly dispersed and not consistent. According to Lane, Koka, & Pathak (2006): "it is unclear what this large stream of papers has collectively accomplished". We therefore started from this fragmented literature and focused on building on the seminal and revised dimensions of Absorptive Capacity.

PROCEDURAL NATURE OF ABSORPTIVE CAPACITIES

Some scholars adopted a knowledge-flow perspective and analyzed the development and enhancement of absorptive capacities as the process of knowledge flow that goes from outside to inside the organization. This process has been first decomposed by Zahra and George (2002) that introduced two sub-sets of Absorptive Capacities: Potential Absorptive Capacities as the external knowledge that a firm could acquire and utilize (PACAP), and Realized Absorptive Capacities as the external knowledge that a firm has acquired and utilized (RACAP). The authors investigated these components and proposed to split the two identified sub-sets (PACAP and RACAP) into the following organizational capabilities: knowledge acquisition, assimilation, transformation, and exploitation. Starting with this conceptual model and going through a critical review of the literature on Absorptive Capacities, Lane and colleagues (2006) proposed a review of the construct. Going back to the original definition of Cohen and Levinthal, but introducing a process perspective, Lane and colleagues (2006) describe Absorptive Capacity as "a firm's ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, and (3) using the assimilated knowledge to create new knowledge and commercial outputs through exploitative learning" (Lane et al., 2006). A year later, Todorova and Durisin (2007) revised the Absorptive Capacities construct, building on the paper by Zahra and George (2002) and introduced a reconceptualization. They suggest that the paper (1) does not give enough emphasis to the recognition of the value of external knowledge as first component of the construct, (2) considers social integration only as a determinant

for RACAP and (3) fails to integrate a component of dynamicity in the model. Accordingly, the reconceptualization proposed by Todorova and Durisin (2007) aims at overcoming these limitations by eliminating the distinction between the two sub-sets of Absorptive Capacities, reintroducing the recognition of the value of knowledge as the first explicit step as proposed by Cohen and Levinthal (1990), and introducing social integration capabilities as necessary investment for all components of the model. Finally, according to cognitive science of learning, they see assimilation and transformation as two alternative processes that firms follow based on the existing organizational cognitive schemas and their ability to internalize knowledge through them.

Despite the differences proposed by the scholars, they all agree that developing Absorptive Capacity is a process that requires external sources of knowledge and prior internal knowledge to happen. In line with this, Design Thinking, being a methodology composed by a set of steps and principles that allow going from the empathic understanding of users to the development of solutions, relies on the knowledge generated by the observation and interaction with users as a form of stimuli, and on the prior knowledge of a multifunctional team. Through a process similar to Absorptive Capacity, Design Thinking seeks external knowledge to foster innovation through its assimilation, transformation and utilization.

COLLABORATIVE NATURE OF ABSORPTIVE CAPACITIES

Extending the first definition of Absorptive Capacity, Lane and Lubatkin (1998) proposed that, in order for explicit and tacit knowledge to be recognized and assimilated, a collaborative and interactive process is necessary: knowledge transfer occurs through social integration of the parties involved in the process. On the one hand, the mere exposure to external knowledge is not enough: to develop effective Absorptive Capacity towards innovation "intensity of the effort is critical" (Cohen & Levinthal, 1990). On the other hand, the relative characteristics of the involved parties play a significant role to make effective the process: the learning ability depends upon the characteristics of the knowledge base of all the involved parties (Lane & Lubatkin, 1998). Thus diversity of knowledge possessed by the members is required to benefit from the learning process, because it allows cross-fertilization effects and generation of new stimuli. But to enable integration and effective knowledge exchange between the involved parties, they should hold

different specialized knowledge, but share the same basic knowledge (Cohen & Levinthal, 1989, 1990; Lane & Lubatkin, 1998), have a common language, and similar cognitive structures (Ahuja & Katila, 2001).

Design Thinking allows the development of social integration through two mechanisms. First, it is a user-center approach that combines and builds on the observations of users and their contexts of use: with it the team members share the same knowledge about users. Second, putting together members coming from different disciplines and with different backgrounds and creating a cross-functional interface, it enhances the "knowledge exchange across disciplinary and hierarchical boundaries" (Jansen, Van den Bosch, & Volberda, 2005). Therefore, Design Thinking offers a common language and a shared cognitive structure for the team to build on each other's knowledge and integrate the knowledge coming from users' observation.

"It allows to share the creative process and the creative methods through different disciplines. […] It allows firms to implement a creative working routine in their daily lives and therefore a problem solving orientation." (Associate, National University of Singapore).

"A new way of engaging with different parts of the organization and asking the tough questions and figuring out what is the real need of the organization" (Innovation Executive, SAP)

Design Thinking requires deep collaboration among members of the group during all the phases of the project and is aimed at creating new knowledge coming from both the recombination of the participants' previous knowledge and the generation of new knowledge. As such we propose Design Thinking as a tool that allows organizations to integrate different backgrounds and to recognize, assimilate and apply external knowledge.

THE MODEL

Noticing the similarities between the process that leads to the development and enhancement of Absorptive Capacity, we deeply explored the procedural and collaborative nature of Design Thinking through participant observations and interviews. Afterwards, we compiled our evidences following the Absorptive Capacity process.

RECOGNIZE THE VALUE

The first component of the revised model of Absorptive Capacities proposed by Todorova and Durisin (2007) is the recognition of the potential value of external knowledge. We argue for its importance because, in order to innovate, organizations must first recognize the need to do so and take concrete actions in that direction, tapping into external information to renew their internal knowledge base (Cohen & Levinthal, 1989, 1990). The realization of managers of the need to look outside the organization to acquire complementary knowledge is therefore a necessary antecedent to Absorptive Capacity. Lane et al. (2006) describe this first step as recognizing and understanding potentially value of new knowledge from outside the firm through exploratory learning. Zahra and George (2002) state that the breadth and the depth of knowledge exposure may influence the extension of the search zone for new opportunities. Organizations therefore partner with the d.school to extend the possible spectrum of search, seeking to adopt Design Thinking as (a) a way to obtain new stimuli, (b) integrate new competences in their innovation process to leverage their internal knowledge and (c) gather new external insights about their customers.

Organizations that have used and/or implemented Design Thinking into their organizations generally choose to do so in one of the following ways: (1) collaborating with the d.school by handing over a project to a team of students; (2) through executive education programs at the d.school; (3) implementing a Design Thinking project-based approach for dedicated innovation teams or within so-called "Innovation Labs" inside the company, frequently partnering with the d.school to assist them in doing so.

Generally, as a first contact, organizations have with the d.school is with student projects. Organizations contact the d.school with an idea or problem they would like to be developed in one of its programs.

"First of all, we didn't know at all if we would achieve any result and this was in the beginning for me the challenge: shifting 20 people from Switzerland to Berlin, working on a design challenge for three days, having coaches from HPI, it was not so normal for us." (Innovation Director, PostFinance)

The organization and faculty then meet in order to determine the scope of the project and frame it according to the organizations expectations. These projects can be developed within different programs; these vary either by subject or time span. At Stanford, projects are generally oriented by a specific subject (e.g. sustainability,

consumer psychology, healthcare) and last between ten weeks to a year. Potsdam follows an open approach regarding the subject and projects last between three to six weeks. Student teams are generally conformed by no more than five people from diverse backgrounds and are often unfamiliar with the organization and its routines. This is seen not as a disadvantage but as an opportunity for the organization to gain an entirely new perspective: relying on the people outside the organization to perform a project allows the extension of the breadth and the depth of the search zone (Zahra and George, 2002). Organizations can count on different viewpoints and different experiences and cognition, that allow to 'think out of the box' and reduce the risk of failure coming from organizational stickiness to the internal knowledge base and old rigid capabilities (Gavetti & Levinthal, 2000).

Executive education programs are another possibility for organizations to learn of Design Thinking by engaging with the d.school. Here executives participate in intensive workshops were they are teamed up with people coming from other organizations and with different backgrounds. These teams are then given a deep dive into Design Thinking principles and tools through interactive activities and exercises. Learning by doing is the core concept and as such, participants will rarely spend more than a moment sitting down or passively assimilating concepts; as pointed out in Cohen and Levinthal (1990), important elements of the learning process are developed through many practice trails. Indeed, the executive education programs aim for executives to return to their organization and teach their experience to their colleagues.

Finally, the third way to partner with the d.school is building a space for innovation inside the organization. They require not only a physical space, but also an organizational structure to support it and keep it active. Involved employees come from different departments of the organization and work together towards common goals.

"It is important to generate a temporary and physical space (a protected area) that allows the creation of a network as radical as possible." (U. Weinberg, Potsdam d.school)

"There are a lot of different lines of business that come to the lab requesting help on projects, especially when an executive sees there's a customer experience that's cross to different lines the business but they can't allocate their own resources. So they bring it to the lab that is the connector piece. [...] The lab hired a lot of outside people on purpose to bring in a different way of working." (Design Thinking Director, CapitalOne)

These spaces have been developed in different formats by different organizations, with specific geographic and organizational cultures taken into account. However, in general Innovation Labs allow organizations to provide a protected space where employees are free to collaborate with others, develop, prototype and test ideas without reward or punishment, but simply for the intrinsic personal motivation to work on one's own ideas.

TEAM BUILDING

Having recognized the value of external knowledge and as an antecedent to acquiring such knowledge following a Design Thinking approach, organizations must first assemble a team with the purpose to do so.

Engaging with the d.school either through a Design Thinking project or its executive education programs, teams are formed with individuals from different backgrounds, different previous experience and usually various organizations:

"The multifunctional team makes, I think, the main difference. [...] You can start building on weak ties that you already have among the departments or even to external partners of your network." (Program Director, Postdam d.school)

The constitution of multifunctional teams aims at fostering the acquisition and integration of different knowledge in two ways. First having porous boundaries, i.e. opening up to external information coming from clients, and integrating different specialized knowledge allow the firm to scan more broadly in search of innovative solutions for the client needs (Volberda, Foss, & Lyles, 2010). Second, multifunctional teams put together genre experiences that have a positive effect on innovation performance, enabling cross-fertilization effects and generation of new stimuli (Ahuja & Katila, 2001; Taylor & Greve, 2006).

"Once we put together people from Marketing & Analytics, a Brand representative, a designer, a DT coach and one other person from Legal & Ethics. That was the working team. Then the first thing that we do when we're kicking off a project is align people to the customer: we take people away from looking at each others and thinking about how their own opinions are different from the ones of the others, and instead focus on what the customer thinks. We're directing everybody's view towards the one of the customer." (Design Thinking Director, CapitalOne)

ACQUIRE

The second component of the Todorova and Durisin (2007) model is knowledge acquisition where organizations actively gather and acquire information from outside. The effort of the organization toward the acquisition of new knowledge is characterized by three attributes: intensity, speed and direction (Zahra & George,

2002). The acquisition process benefits from high intensity and speed and the number of different search directions taken into consideration is positively related to the knowledge exposure (Ahuja & Katila, 2001; Zahra & George, 2002). With respect to that, Design Thinking supports this intense effort.

"I chose to adopt Design Thinking, because of three things. First, for speed: you know, it's one way to achieve speed; second, it kind of leans very clearly to the customer, and third is the multidisciplinarity. I think these three things are really keys to innovate and they are kind of embodied in the Design Thinking processes and for us that worked." (VP Innovation & Product Development, Panasonic)

Within the Design Thinking process, acquisition of new knowledge is done at the *Empathize* stage, in which organizations are placed in profound contact with their clients in order to internalize and deeply understand their explicit and tacit needs.

Empathize

Design Thinking has a strong user-centered focus and empathy is the foundation of the user-centered design process (d.school Stanford, 2010). Team participants of a project need not only to ask, but to observe users and their common and uncommon behaviors, engage expectedly and unexpectedly with users and immerse themselves into the experience, in order to see the environment through the eyes of the user. A user-centered approach is required to fully understand the people behind a challenge. First, only through intense participation and sharing, does the learning process allow to understand and integrate of both explicit and tacit knowledge (Ahuja & Katila, 2001; Van den Bosch, Volberda, & de Boer, 1999). Second, both team participants and users may often grow use to current conditions. Therefore they both fail to realize the potential for new solutions, as user's cannot accurately verbalize their underlying needs (Leonard & Rayport, 1997). This step of the Design Thinking approach allows organizations to reduce the risk to be caught in the expressed needs of the users (Tushman & Anderson, 1986; Van den Bosch et al., 1999) and not being able to understand their tacit needs (Leonard & Rayport, 1997).

"The idea used to be that the customer has his system and we [SAP] have a list of functionalities, and the customer used to tell us what they want in terms of the new release. It was just a very incremental innovation. With DT the processes of looking at it are more holistic, we ask the tough questions, the why questions. […] We had a lot of great success, because having these strategic conversations with our customers brought a lot of new opportunities for SAP." (Chief Design Officer, SAP)

"By considering human factors, you're exploring what people really want and then we try to come up with a new business or a new technology to make this work, but only once we actually know what people really want." (D. Kelley, d.school+IDEO)

The challenges that teams are presented are meant to rarely resemble any previous experience team members may have had. Therefore, in order to build empathy for the particular users who are directly impacted by a challenge, the team must put itself in other people shoes. This helps the team truly understand what is of importance to the user and what is not. The following example illustrates the importance of generating empathy and how this approach yields insights that focus-groups, interviews, and other such methods cannot (Beckman & Barry, 2007):

> "Consider the student team sent to study customers shopping for meat. The students situated themselves on the floor near the meat counter in as unobtrusive a location as possible, and observed that customers at the left end of the meat counter just grabbed a package of meat, tossed it in the cart and left, while customers at the right end of the counter deliberated longer, fussing with the packages of meat before choosing one. The students found that the cheaper meats were on the left end, and the more expensive meats on the right end, although all were packaged the same way. Further, they observed that the "fussing" generally entailed picking up a package of meat, squeezing it, replacing it, picking up another package and squeezing it, and ultimately, in most cases, choosing the first package and placing it in the shopping cart. With this discovery, the students proceeded to speak with some of the shoppers in an attempt to determine what the shoppers thought they were doing as they picked up and squeezed the packages of meat. A few conversations made clear that the customers really didn't know what they were doing, and couldn't explain what they learned by squeezing the packages of meat, but that in some way they were seeking more information about the quality of the meat itself. Had the students started with interviews, it is unlikely people would have described their shopping behaviors accurately, as they were unclear themselves about what they were doing. The students' observations, and the behavior patterns they identified, led to their ability to unearth some of the users' interests and concerns about buying meat. (p. 32)"

As argued by Leonard and Rayport (1997), watching what people do and how they interact with their environment gives clues about what they think and feel, and about their needs. In particular, from the observation of users, the team can yield knowledge on: the triggers of use for a product or service, its interaction with the user's environment, its possible customization by the user, its intangible attributes and unarticulated user needs (Leonard & Rayport, 1997).

Key elements that compose the empathic phase are engaging with other people and personal experience. One of the observed team that was given the challenge to 'redesign the public toilet experience', mapped out all the public toilets in an area and set out to observe by whom they were used, what were the habits of people going in and out of a public toilet and the state of the facility during a certain period of time. This allowed the team to interpret intangible factors of that experience in order to uncover insights. These insights lead further ahead to diverse innovative solutions. A common phrase used by the faculty was: "The better the insights, the

better the solutions". Yet the process of learning to recognize those insights is far from straightforward, as users generate filters for information from certain experiences that they may deem trivial or unattractive (such as a public toilet experience). Engaging directly with the people under observation reveals the way they think and the values they hold, which at times are even not obvious to the people who hold them. As engagement is often unexpected, the surprise factor often leads to unanticipated insights. The stories that people tell and the things that people say they do — even if they are different from what they actually do — are strong indicators of their deeply held beliefs about the way the world is (d.school Bootleg, 2010). As one may assume, most people were not particularly comfortable answering questions of their recent public toilet experiences. Yet, others took it as an opportunity to vent their frustrations on the inadequacy of public facilities and their preferred use of other facilities such as department stores, for example. This led the team to explore those unofficial public facilities and the thoughts and actions behind the users and the facility managers.

Other than engaging directly with people, personal experience is a powerful source of insights and understanding. Teams often find or recreate these experiences to immerse themselves and better understand the situation that users are in, and for which they are working. A team that was given the challenge to improve a city's "lost and found experience" set out to loose their wallets on the public transport. One team member would simply "forget" his wallet as he stood up to get off, while another observed from the opposite side. They would usually immediately be called out by another passenger and handed over the forgotten wallet. They realized that an important factor in this exchange was the reaction to having the wallet returned, if the team member just took the wallet and left, the returnee would look somehow disappointed. Yet if the team member reacted positively and thanked him, the returnee would appear to be even happier than the person to whom the wallet was returned. This exchange was dubbed 'the magic moment' by the team working on the challenge and it was the basis to a wide set of concepts.

ASSIMILATE AND TRANSFORM

After knowledge is acquired, organizations assimilate the information or transform it. Following the studies done on cognitive science, Todorova and Durisin (2007) posit that knowledge can be directly assimilated when the preexisting cognitive

structure fits with the information to be integrated, while it requires accommodation through transformation when new information cannot be integrated in the actual structures. Accordingly, they proposed two alternative processes. Knowledge assimilation takes place when the new knowledge already fits the cognitive schemas in the organization; in this case, the internalization happens directly. Vice versa knowledge transformation is required when new knowledge cannot be assimilated, and therefore the cognitive schemas should be adapted.

After the observation of the users, the members of the team build on each other's knowledge to come up with new ideas. In order to do that effectively, they need to integrate their different knowledge. But integrating knowledge is an activity that requires considerable effort because, if explicit knowledge can be transferred with low effort, transferring tacit knowledge is costly and slow (Grant & Baden-Fuller, 2004). According to Nonaka (1994) tacit knowledge involves both know-how and mental models. Know-how refers to the skills that are applied in specific contexts to find specific solutions to problems (Nonaka, 1994), while mental models are the cognitive schemata and knowledge structures that individuals use 'to describe, explain, and predict events in their environment' (Mathieu & Heffner, 2000). Sharing tacit knowledge within a multifunctional team is everything but easy. Know-how is difficult to transfer from one person to another, especially when their backgrounds are different and the competence overlap is little; also, different mental models of the team members do not always converge as they should in order to guarantee high team performances (Mathieu & Heffner, 2000). Therefore, to coordinate the effort of the members, and integrate their tacit and explicit knowledge efficiently and effectively, they should share the same mental models or have compatible mental models (Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1994) that 'allow team members to draw on their own well-structured knowledge as a basis for selecting actions that are consistent and coordinated with those of their teammates' (Mathieu & Heffner, 2000).

In this sense, Design Thinking allows collaboration among team members that overcomes difficulties in their tacit knowledge transferring and differences in their mental models: initially focusing on the user needs, the team members interpret and transform the knowledge they gained from the users and later combine it with

their personal knowledge and background and with the knowledge of the other team members. Empathizing with the user and deeply understanding its needs enable cohesion, development of convergent mental models (Mathieu & Heffner, 2000), and sharing of tacit know-how (Nonaka, 1994). This shared base of knowledge about the user forms a base that allows the team members to build over, while facilitating personal connections to be formed.

"It's not how knowledge gets shared; it's how they build on each other's ideas. If […] you get a philosopher and a doctor, and get them to build on each other's ideas, you will obtain something that's never happened before. […] Human-centered design is so human that these people are willing to do, to go out and understand the user. […] We have is a methodology that allows these radical collaboration, that allows these people from different disciplines to work together. […] But you have to keep bringing up the user. Especially when you have a conflict you take it back to the user and say: "What do you think?" There's a higher authority than either the philosopher or the doctor and it's called the user." (D. Kelley, d.school+IDEO)

Throughout our research we observed the assimilation and transformation at the team level of both explicit and tacit knowledge through the following steps: Define, Ideate, Prototype and Testing. Whereas the processes of assimilation and transformation are carried out continuously during the entire process and constitute the learning cycle of the team. We further describe Design Thinking stages of Define, Prototype & Testing.

Define

The observation and empathy stages inevitably lead to large amount of ethnographic information; therefore careful analysis and synthesis of the generated information are essential solution to user's needs. But information is context-specific and therefore not easily understandable and transformable by every team member in the same way (Zahra & George, 2002). Additionally, relying on a team that involves people with different backgrounds and mental models could lead to low cohesion and social categorization among the members (Dahlin, Weingart, & Hinds, 2005).

To be sure that team work is effective, the Define phase is guided toward the definition of the team's so called *Point of View* that allows the team to focus and overcome difficulties in the integration between members' past experiences and backgrounds. The goal is to develop a deep understanding of the users and their environment, based on this, to identify contradictions or discrepancies between the

user's stated or perceived thoughts and the observed actions or emotions. The team's Point of View (POV), is therefore the outcome of this analysis focused on the specific users, insights and needs uncovered during the Empathize phase and should be expressed in the form of an actionable problem statement (d.school Bootleg, 2010). This step is critical because it explicitly expresses the problem being addressed.

"I think the most important and hardest part to do is the Define step, so form a POV." (Chief Customer Experience Officer, Fidelity Investments)

The POV provides focus and frames the problem acting as a reference to evaluate competing ideas. It should also fuel the following brainstorming sessions through "how might we" statements that help the team to generate and test ideas in parallel. Based on this, the POV is later revisited and reformulated as the process moves forward. Most importantly, the POV serves as guidance during the rest of the process, by capturing the core values and inspiration of the team's work.

Ideate

The focus on the POV allows the team to make full use of its various background and explore as many ideas as they may come up with, minimizing the difficulties coming from different past experiences or different cognition schemas. Focusing on the POV assures the transition from problems and observations to solutions for the users. This transition, called Ideation phase, allows going from a situation where the knowledge is assimilated to the generation of problem-solving idea through the transformation and recombination of this knowledge.

Idea generation is widely acknowledged as an important stage in models of creativity and innovation inside organizations (Glynn, 1996; Litchfield, 2008; Shalley, Zhou, & Oldham, 2004; West, 2002) that needs to be addressed in order to develop reasonable ideas. Brainstorming, in its various forms, is among most common tools for Ideation in Design Thinking.

Brainstorming, introduced by Osborn's (1957) as an essential tool for increasing creativity, has received extensive attention among academic scholars (see for instance Camacho & Paulus, 1995, Hargadon & Sutton, 1997, Smith, 1998, Nijstad & de Dreu, 2002, Rietzschel, Nijstad, & Stroebe, 2006). Within Design Thinking Brainstorming is widely used for ideas generation and sharing: the goal is to explore a wide solutions' space developing both a large quantity of ideas and diversity among those ideas. The knowledge of team's members is recombined in

order to create new ideas and concepts starting from client's needs and the different backgrounds and knowledge of the team's members.

"At some point it turns into knowledge. Before being knowledge it's a bunch of half-baked ideas that you have to synthesis into knowledge. Let's look at the IDEO group, right. They go out and observe and they put it in, through brainstormers; it ends up on these big boards with lots of post-it notes and then they kind of organize them and stuff and then somehow the ideas come up. Well, it's all knowledge, but the sharp point is when they synthesis this knowledge into the idea that they're going to champ, that they're going to work on." (D. Kelley, d.school+IDEO)

Thus, the brainstorming sessions fulfill two purposes. First, they allow the team to interpret and analyze both the explicit knowledge and enter in contact with tacit know-how of each member:

"Inevitably, there are differences of perspectives that are coming: in the actual content of the project I have found that to only be a positive thing. [...] Everybody brings a different perspective to the room. So that's all healthy stuff" (Design Thinking Director, CapitalOne)

Second, they enable the recombination of the knowledge into new synthesis (Ahuja & Katila, 2001; Kogut & Zander, 1992; Van den Bosch et al., 1999). Brainstorming can therefore be considered as a tool to enable the generation of shared knowledge built on previous knowledge of the group's members and information gained from the empathic analysis of the client's needs.

A variation of brainstorming that is commonly used by companies such as Procter & Gamble, Google, Facebook and IDEO is "How Might We…?" (Berger, 2012). Tim Brown, IDEO's CEO, observes that within the phrase, each of the words plays a role in encouraging ideation. "The 'how' part assumes there are solutions out there, 'Might' says we can put ideas out there that might work or might not - either way, it's OK. And the 'we' part says we're going to do it together and build on each other's ideas" (Brown quoted in Berger, 2012; p.2). After teams have formulated their POV, they are asked to break that larger question into smaller pieces looking for aspects of the statement to complete the sentence, "How might we…?" Within the team each member draws or writes on post-it notes in silence and then posts them on a board, after the predetermined time is over, each team member shares them. These post-its can then be categorized or built on each other and finally voted on by each member. Basadur and Gelade (2006), who have conducted research on this tool, posit that when people try to ideate, they often talk about the challenges they're facing by using language that can inhibit creativity instead of encouraging it.

Since ideation exercises should go beyond obvious solutions and harness the collective perspectives and strengths of the team in order to uncover unexpected areas of exploration, it is recommended that the members express also the most obvious solutions in order for the team to drive beyond them. All these ideas must at some point prove their utility if they are to become successful, but novel or slightly wilder ideas may require longer gestation periods to establish their potential usefulness (Litchfield, 2008). The need to allow time for incubation of ideas is supported by cognitive research on creativity (Ward, Smith, & Finke, 1999). Given that many people may have difficulty clearly expressing novel ideas at first (Nunamaker et al., 1995; Straus, 1996), these incubation periods may help them to expand on their initially conceptions and to refine their ideas (Paulus & Yang, 2000). Prompting team members to build on other's ideas, to refine and/or expand these contributions may support incubation, especially when combined with positive feedback and recognition (Litchfield, 2008; Sutton & Hargadon, 1996).

Prototyping and Testing

After the Ideation phase, the team selects a number of good ideas that will be further developed and, eventually, implemented (Nijstad & de Dreu, 2002). Thus, for creativity to become innovation, divergent idea generation must be followed by convergent idea selection (Rietzschel et al., 2006). This is a complex task and mechanisms to facilitate it often function poorly (Goldenberg, Lehmann, & Mazursky, 2001; March, 1991; Rietzschel et al., 2006). However, similarly as defining a POV, teams are encouraged to defer judgment and build on each other's ideas. Prototyping is often used not only as a means to test well-developed ideas, but also as a means to explain and build a coherent convergence of different ideas into a solution that is innovative and solves user needs.

This tool has been researched in the fields of design (e.g. Dow, Fortuna, & Schwartz, 2012), engineering (e.g. Dolan & Matthews, 1993) and management (e.g. Nambisan, 2002), and recognized a powerful means to facilitate knowledge exploitation and integration. Prototyping allows constant iteration, deemed necessary to assure learning and knowledge exchange (Dow et al., 2009; Lynn & Akgün, 2003; Schrage, 2000; Schon, 1995). Prototypes may be described as physical expressions of the team's thoughts and 'facilitate a process of transforming current knowledge (knowledge that is localized, embedded, and invested in practice) so that new

knowledge can be created to resolve the negative consequences identified' (Carlile, 2002). In this sense, prototypes help a team exploit the tacit know-how of each member, to transform that knowledge, and to integrate knowledge of different members into tangible outputs. Although it is commonly thought that prototyping refers to a physical object, it can take any form: a board of post-it notes, a skit or role-play, a space, interface, storyboard.

"We had C-level people and we came to the point of saying: "We need some types of prototype to show things". But when you talk about processes and business models you can't build something: so, we used Lego. We had paper and Lego and they started to build solar panels and houses, and put little engines made with Lego and they connect it with wires and everything." (Innovation Officer, Swisscom)

Creating tangible alternatives in parallel enables people to effectively discover unseen constraints and opportunities, enumerate alternative solutions, and obtain feedbacks (Leonard & Rayport, 1997). Early prototypes are aimed to be quick and rough in order to test multiple ideas at one time and learn quickly experiencing and interacting with them. Moreover, developing those boundary objects allows starting a conversation with users or with other stakeholders interested in the project.

"With these prototypes we were able of having a strategic discussion with the board of directors of [the company] to explain and show them how we could use this data for providing new services to our customers. [...] It was enough for having this strategic discussion and saying that if we don't believe that this is a strategic opportunity, we don't work more on this topic. But everyone agreed that there were opportunities and we could go deeper into this topic from a strategic point of view." (Innovation Director, PostFinance)

Therefore, these objects constitute a shared language that contains the knowledge of the team, and may be usable by others for testing. The prototype may help the team in the process of further developing ideas, selecting the best ones, explaining it to the rest of the team or to other stakeholders. In testing a prototype, the team allows the user to interact with the prototype and potentially generate further empathy to refine or improve solutions.

Prototyping therefore works in two forms. First, as an internal tool for the team to develop, understand and select ideas; second, as an external tool to present the results to other people interested and gather knowledge in the form user feedback, observing the user's interaction with the prototype and further refining the concept based on this knowledge.

Testing has been widely recognized in theory and in practice as the natural complement to prototyping and an effective tool 'to detect product flaws early in

the development cycle and to minimize costly redesign and rework' (Nambisan, 2002). Also, this tool generates new knowledge that drives next iterations and refinements of the prototypes. Testing is indeed an opportunity to acquire new knowledge: since user needs are drawn from the observation of their habits and engagement with products or services, the observation of their interaction with the prototypes yields insights and teaches more about the unexpressed user needs. In this sense, testing feeds the feedback loop that generates new knowledge and leads to the development of a validated solution that satisfies the requirements and specifications emerged during the process (Veryzer, 1998).

One observed team, which was given the challenge to understand the effects of mobile communication on social interactions, prototyped and tested their concept of projecting a flow of different colors on the wall next to a cafeteria table based on the use of mobile devices from people on the table. Without users noticing they were being observed, whenever a person within a group having lunch at that table would touch their mobile device, the color flow would change to red. The users quickly caught on with the meaning of the changing colors and after playing with this functionality for a short while, they continued with their conversation. A few more minutes into the conversation one person pulled out their mobile device and as the color changed, they immediately put their mobile device back in their pocket appearing to feel embarrassed. The team approached the users to ask about their lunch experience, being met with curiosity and interest, these conversations lead to a great deal of insights that helped the team refine and re-build their prototype for further testing.

EXPLOIT

The path from concept to market is a long one even after the prototypes have been tested and the team came up with an innovative solution. Organizational decisions about resource allocation and further development are dependent on managerial support and innovation champions need to enter in action to push further till the solution's commercialization. The success of an idea is greatly improved if its champion has the will and skill to engage in the influence tactics necessary to gain its acceptance by others, accessing informal networks, framing the idea in a compelling manner, and managing the ambiguity of the process (Lawrence, Mauws, Dyck, & Kleysen, 2005). The higher in the organizational structure an idea goes, the

better chances it has of being integrated if someone in the upper management who has the authority to ensure that collective action is enforced, promotes it. Power relationships inside the organization therefore influence the exploitation of new knowledge via resource allocation processes (Noda & Bower, 2007). Todorova and Durisin (2007) added this concept of power relationship to their model. They posit that it enables a better development of Absorptive Capacity and interacts with cognitive processes, learning, and capabilities in the organization (Cohen et al., 1996; Contu & Willmott, 2003; Dosi, Levinthal, & Marengo, 2003). They consider power relationships to improve the understanding of why only some new knowledge is used in organizations and why some are better able to exploit external knowledge (Coopey & Burgoyne, 2000; Hill & Rothaermel, 2003; Lawrence, Mauws, Dyck, & Kleysen, 2005). Although our research finds that team dynamics during the process allow for better social integration of the participants and that the active hands-on approach of empathizing and prototype testing lead to enhanced idea framing and communication. The scope of Design Thinking does not cover the firm's exploitation capabilities, which is in fact one of its main critiques.

"I think the biggest problem is how to come from the final prototype into a way of implementing these things. That's our biggest challenge. All the projects we did at Stanford and St. Gallen, I would say none of them was realized in the same way that the final prototype was built. [...] all the experts come in and there are so many boards, like the product development board, the marketing board, IT infrastructure board, that have questions and finally there is nothing left from the original idea." (Innovation Officer, Swisscom)

DISCUSSION

Our findings suggest that the procedural and collaborative nature of the approach and the dependence on different sources of internal and external knowledge make Design Thinking an innovation methodology that enables the development of Absorptive Capacity. We found out that teams following the steps of this approach assimilate and transform explicit and tacit knowledge through the following steps: Empathize, Define, Ideate, Prototype and Testing. Thus, Design Thinking' steps, resembling the model proposed by scholars as process to build Absorptive Capacity, allow the recognition of the value of external knowledge, its acquisition, assimilation and transformation.

Even if the procedural nature of Absorptive Capacity has been implicit since the first management studies, the first and probably best known paper that studies

Absorptive Capacity from a process perspective is the one written by Zahra and George in 2002. They explore Absorptive Capacity as a set of organizational processes used by organizations to manage and transform knowledge. Starting from a critical review of the paper written by Zahra and George (2002), Todorova and Durisin (2007) pointed out that the paper had some weaknesses coming from the fact that they "do not build systematically enough on Cohen and Levinthal's original contribution" (Todorova & Durisin, 2007, pg. 774). First, Zahra and George's process did not focus enough on the recognition of the value of external knowledge as first and essential step to build Absorptive Capacity. Second, social integration is not important as tool only in later steps of transformation and exploitation. Finally, even if Zahra and George (2002) start their paper stating that Absorptive Capacity can be consider as a dynamic capability, the dynamicity of the model is not clearly described. Therefore, trying to overcome these weaknesses and going back to the seminal work of Cohen and Levinthal, Todorova and Durisin (2007) proposed a revisited model. This re-introduces the phase of recognition of the value of external information as the first phase, includes assimilation and transformation as alternative phases to develop Absorptive Capacity and not sequential, includes social integration as essential mechanism during all the process and finally involves an iterative loop necessary to show the dynamic nature of the construct. During our research we found out that the development of Absorptive Capacity follows a similar model.

First, the recognition of the importance of external information is the first step that leads organizations to undertake Design Thinking projects that have a clear focus on users and customers.

"We put together Marketing & Analytics, Brand Representative, a design person, then we have a DT coach and one other person that is from Legal & Ethics. So that's that working team. The first thing that we do when we're kicking off a project is align people to the customer." (Design Thinking Director, Capital One)

Second, social integration mechanisms appeared to be important as well for organizations: the development of social relationships among team members enables trust and effective collaboration to find and develop solutions during all the process.

"That was a very interesting side effect from the people who worked for these 5 months very intensely together. Somehow you build up, maybe it's too much if you talk about friendship, but you have very intense periods and so you build somehow a lot of trust with these people.

[…] maybe talking about silos is too much, but you have some walls between the different departments and I'm convinced that it helps you break down these walls here." (Innovation Director, PostFinance)

So, to effectively integrate and exploit knowledge, organizations need also to have a culture that allows this virtuous loop of knowledge management. Design Thinking requires multiple iterations of its steps, because during the project each prototype tested will require additional brainstorming to fix problems or weaknesses and after the project the created knowledge base enters in the organizational memory and it is used for future projects enabling a virtuous loop of knowledge creation and transformation (Hargadon & Sutton, 1999).

"I think it allows a certain informal culture, it allows a certain open flow of communication. … Design Thinking could help create a culture of open communication and sharing, sharing knowledge." (Associate, National University of Singapore)

"At IDEO the big deal is, helping other people is more important than doing your own work. One of the things in that study [Hargadon & Sutton, 1996] was that when you receive an all-IDEO e-mail goes out, the kind of 'can you help me?' or 'doesn't anybody know how to glue?', it is because somebody is really desperate. You know that some day you might need to send an all-IDEO e-mail as well, so you want to answer that question if you know the answer because you want somebody else to answer your question." (D. Kelley, IDEO+Stanford d.School)

Organizations that successful implement Design Thinking projects, do not only succeed in mastering Design Thinking as a methodology, but they also manage to create the organizational change needed. Thus, the collaborative culture developed through Design Thinking enables knowledge flow among team members, but also with other people and with clients. Change management literature is vast, and far beyond the scope of this study, yet it is important to recognize the observed beneficial effects of adopting such a culture within an organization. A quick search uncovered that these effects have been previously, and in most cases individually, studied by management literature (e.g. Li & Porter, 2014; Mueller et al., 2013; Cross & Cummings, 2004; Regans & McEvily, 2003; Hansen, 2002; Hansen, 1999). Through the development of social integration mechanisms, teams learn the value of interacting with their users or potential users, of approaching other within the organization for different views, to trust each other's area of expertise and building upon each other's views. This enables relationships to be formed across organizational boundaries that allow for future collaboration. Finally, teams develop a sense of ownership and pride for their project that generates interest and engagement by other members of the organization.

Despite the observed similarities between Design Thinking and the Absorptive Capacity model proposed by Todorova and Durisin (2007), we found out also a significant difference with the model proposed by Todorova and Durisin (2007): building Absorptive Capacity through Design thinking requires both assimilation and transformation. In this sense, they are not anymore alternative. Todorova and Durisin (2007) consider assimilation as occurring when organizations already have at their disposal the knowledge structures necessary to internalize the information coming from outside. Vice versa, "firms transform their knowledge structures when knowledge cannot be assimilated. Transformation represents an alternative process to assimilation" (Todorova & Durisin, 2007, pg. 778). According to the behavior we noticed within this research and especially during the participant observation of teams, the phases of assimilation and transformation are not alternative as proposed by Todorova and Durisin (2007), but are both present during the process. Each team member assimilates the information about the user needs and interprets them through their cognitive schemata and knowledge structures. Afterwards, working with the other members to identify a solution to user needs, individuals transform their knowledge by integrating their own with their team member's into innovative solutions to customer needs. We suggest therefore that knowledge needs to be transformed when multifunctional teams work together; thus, this operation does not occur only when knowledge cannot be assimilated through current knowledge structures. Additionally, due to the interactive and collaborative nature of Design Thinking approach, these processes of assimilation and transformation are carried out back and forth continuously during the entire process and contribute to constitute the learning cycle of the team.
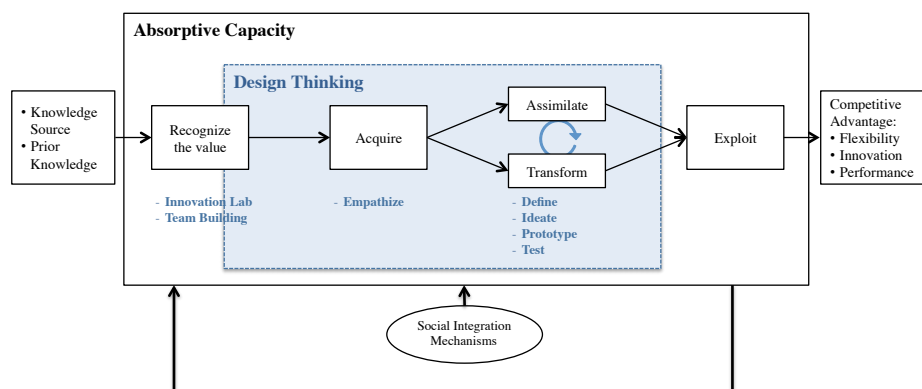

Figure 1 - The link between Absorptive Capacity and Design Thinking

Even if our findings show the potentialities of Design Thinking as tool for innovation, it must not be considered a substitute of internal R&D or marketing. Design Thinking can and should be coupled with existing organizational processes.

"Like [German Automotive firm], I think that for most of their work they use very traditional R&D processes and market research processes and that's perfectly fine. Then a small part of the company might use DT to come up with something completely new, like what happens if gasoline runs out or if users don't buy their car anymore. They use DT for these very open ended wicked kind of problems. I like this notion of wicked problems that is sometimes used: wicked problems are not supposed to be solvable, but with DT you can take chunks out of it and solve it in parts. But sometimes you have we discuss projects with companies, and then some guy in R&D says: "We have the perfect way of solving this". We let them solve this. It's much better if they already have a routine for solving this within the company that has worked before, it's not really wicked problem, it's not really something that DT is more useful than their established routine development processes. So when they come with a traditional engineering problem, or that they need these two products combined or it's just about the technical issues, in that case all the engineering processes they have are much better than DT. " (Director - Strascheg Center for Entrepreneurship)

"So what I've seen is that the kind of research and insights and frameworks we come up with for understanding our customers are really different than our traditional marketing and brand groups come up with. So we've gotten a lot of demand from those teams saying: "Can we use your stuff?" Like: "Oh, that's so interesting, you've come up with 5 different personas, maybe that should be the personas for all of CapitalOne customers". And I am like: "No! You shouldn't! Hold your horses for a second. I only did ten interviews! This was not thorough market research, nor should it be thorough market research". So I'm kind of against this concept of our empathy and our insights becoming the repository of market research for the company. That doesn't mean that it's not relevant for other projects." (Design Thinking Director, CapitalOne)

In 1990, Cohen and Levinthal acknowledge the emerging relevance of cross functional collaboration for innovation: "*It has become generally accepted that complementary functions within the organization ought to be tightly intermeshed, recognizing that some amount of redundancy in expertise may be desirable to create what can be called cross-function absorptive capacities" (Cohen and Levinthal, 1990, p.134)*. Nevertheless they, and the majority of the subsequent research, chose to measure the construct solely on R&D intensity, defined as R&D expenditure divided by sales. More than twenty years later, relevant literature in that field has identified different R&D generations. Authors in this field describe the first of these as involving linear and isolated flows of knowledge, then as adapting to basic routines of project management, followed by business development groups to coordinate different functions, leading to R&D as integrative activity, learning from and with customers, moving away from a product focus to a total concept focus, where activities are conducted in parallel by cross-functional teams (e.g. Nobelius, 2004; Niosi, 1999). This generational shift from a technological push R&D to the

contemporary concept of innovation (i.e. customer-centered, open innovation, etc.), has therefore highlighted the importance of, what were known as complementary functions such as marketing and design, within the organization.

This presents two important consequences to our research; the first is the relevance of Design Thinking to the R&D function and therefore to the Absorptive Capacity construct. The second is the place occupied by Design Thinking within the innovation efforts of an organization. Through our research we observed a clear distinction between the objectives and expectations of a Design Thinking project, versus those embedded within the organization through existing processes such as marketing, engineering or IT. However, considering the diversity of industries and cultures in our sample, each organization approached Design Thinking in its own style and placed this function within the organizational matrix in its own way. For instance, the German software company SAP, who's founder and chairman Hasso Platner is one of the main proponents of Design Thinking, has attempted for almost a decade different strategies to implement Design Thinking within the organization, enjoying multiple successes and challenges all of which they have learned valuable lessons for their next iterations.

FUTURE RESEARCH

Our findings showed how Design Thinking helps organizations to build and enhance Absorptive Capacity. Despite that, our results are limited to the d.school and the organizations that collaborate with it, so supplementary research is needed to uncover other areas of research and prove or disprove some of our findings.

First, it could explore better the relation between Design Thinking and Absorptive Capacity. Further research is needed to understand the underpinnings of the Absorptive Capacity process and its link to Design Thinking. These could analyze how social integration mechanisms work during the different phases of the Design Thinking projects. Additionally, given the current debate, future studies could seek to better understand through empirical work how the processes of assimilation and transformation occur within Design Thinking teams.

Second, additional and systematic research is needed to understand better the impact of Design Thinking on innovation since during this study, discerning views on Design Thinking as an approach for radical or incremental innovation were a recurring and contradictory theme. While Design thinking is widely regarded as a

methodology towards innovation (Brown, 2008), its role in fostering radical versus incremental innovation is not clear. Similarly, literature has suggested there to be a conflicting proposition between Absorptive Capacity and Innovation discourse (Lane et al., 2006).

"I'm convinced we came out with new ideas, new services, that we wouldn't have been able to develop in the usual way we use to work before using DT. One thing is that DT is successful if you also have the possibility to make major changes. Sometimes, especially if your products or services are very close to your core business, it's very hard to make fundamental changes or it's very expensive, but you have to have the possibilities to make really changes within your company. If you have only to improve slightly existing products, then maybe it's not so useful. But if you really look for innovation, for something completely new, where you're also able to develop new things, then DT helps you a lot, especially in the phase of generating the idea and making the idea feasible and very concrete." (Innovation Manager - PostFinance)

"Within the process you use creativity to come up with something, you have this aha moment and come up with something brand new, but it's rarely brand new. I wouldn't define it as radical; it might be a new product or something completely new for the company. Sometimes it's very unorthodox combinations of something that hasn't been there yet, but I wouldn't say it's radical. I would say it's very incremental, very focused on developing additional products for your portfolio, additional services for your portfolio, but you won't develop a product that will take your company in a completely different direction." (Program Director - Strascheg Center for Entrepreneurship)

Radical innovations have been defined as to "embody a new technology that results in a new market infrastructure [...] and do not address a recognized demand but instead create a demand previously unrecognized by the consumer" (Garcia & Calantone, 2002). Radical innovation is therefore classified into to two dimensions: proximity to new technology and distance from existing markets (Abernathy & Clark, 1985; Benner & Tushman, 2003). This suggests radical innovation requires new knowledge or the departure from existing one and that "the organization [is required] to move into uncharted territory, where reliance on experience, current knowledge assets and loyal customers is not an advantage" (O'Connor, 2008). In Cohen and Levinthal's (1990) definition of Absorptive Capacity "a firm's ability to recognize the value of new, external information, assimilate it and apply it to commercial ends", they consider that this capability as "largely a function of the firm's level of prior related knowledge". Whereas literature on radical innovation suggests that 'prior related knowledge' may no longer be 'related' (Le Masson et al, 2013). Research to clarify these conflicting propositions between the Innovation and Absorptive Capacity literature has so far been limited (e.g. Lane et al., 2006; Van Den Bosch et al., 1999). Similarly, we find Design Thinking to be in conflict with these two dimensions of radical innovation. First, Design Thinking heavily depends

on the knowledge of multifunctional teams already existing inside the organization. The seminal works of Hargadon & Sutton (1996) on Technology Brokering at IDEO and Henderson & Clark (1999) on Architectural Innovation suggested this recombination of 'prior related knowledge' as a form of competitive advantage to a firm, but if the recombination of these may generate radical innovation is unclear. Future exploratory research could better understand the results of following a Design Thinking approach and further clarify its underlying mechanisms. Second, being a human-centered approach that starts from the understanding of user's needs, a question as old as the automobile arises, assumedly described by Henry Ford as: "If I had asked people what they wanted, they would have said faster horses". Our research showed a disparity between "how far from their existing markets" some firms were willing to go in conducting their acquisition of knowledge during the Empathize phase. This suggests further research is necessary to understand how far should a firm go from its core competency's to *…develop a product that will take your company in a completely different direction."*

Third, being Design Thinking an approach that starts with the deep understanding of customers, future research could study this phenomenon from an open innovation viewpoint. Indeed, during the past decades, the importance of external knowledge has been emphasized not only in the literature on Absorptive Capacity: management scholars adopting also other lens showed how focusing on external information is essential for organizations. In particular, among the vast management literature, in the last decade scholars focus more and more on open innovation as strategy that bringing ideas and inputs into the organizational boundaries allow companies to innovate. Indeed, increasing costs of technology development and decreasing products life cycle are fostering more and more the adoption of open innovation strategies, enabling firms to be efficient and effective in creating and capturing value (Chesbrough, 2003b; Laursen & Salter, 2006). Organizations therefore recognize the importance to go outside and look for external knowledge (Cohen & Levinthal, 1989, 1990), to avoid missing opportunities that fall out their current businesses (Chesbrough, 2003a). In this sense, Design Thinking could enter in the large stream of literature on open innovation as tool to develop innovation capabilities integrating stimuli coming from outside the organization. Indeed, if open innovation and Absorptive Capacity

have been clearly defined as complementary (Spithoven, Clarysse, & Knockaert, 2011), literature on Design Thinking for the extent of our knowledge has not analyzed deeply Design Thinking as related to open innovation phenomenon. Future research on this topic could therefore go in this direction. Especially Design Thinking could enter in the disclosure about user-center innovation initiated by Von Hippel in 1986 with his paper "Lead users: a source of novel product concepts" (von Hippel, 1986).

CONCLUSIONS & LIMITATIONS

This article explores how large firms use Design Thinking as an approach to innovation. Based upon direct observation and interview data we found evidence of links between Design Thinking and Absorptive Capacity. This work is not without limitations.

The main theoretical contribution of this work lies in advancing the conceptual understanding of Absorptive Capacity by presenting evidence that may lead to further research on how it occurs and how to measure this construct of innovation. Additionally, we hope it may encourage future researchers to explore the approach to innovation called Design Thinking as a whole.

As a contribution to practice, this research presents an illustration on the different industries and approaches to apply Design Thinking, as for the limitations of doing so. Along the course of this research, this was a frequent question from managers who have heard about Design Thinking, but are unsure of how this could fit within their organizational structure and current innovation efforts.

The selection of firms was narrowed to those who has implemented and commonly used Design Thinking within their innovation efforts. While this selection is appropriate for the phenomenon under study, it is in itself self serving as it is the job of the interviewed managers to educate and promote within their organizations this approach to innovation. Although all interviewees talked about the hurdles and challenges in using Design Thinking, they were all still convinced of the value of this approach to creating an innovative organization. It is indeed easier to come across organizations and managers willing to share their insights on a successful rather than a failed initiative. Further research could address this limitation by understanding the cases in which Design Thinking failed to either be implemented or produce the desired results.

Another limitation lies in the relative lack of depth into specific cases described throughout this article. While a participant observation approach was followed on a number of projects, this participation ended at the conceptual stage and further insights into their implementation is still lacking. Similarly, regarding examples provided through interviews, understanding of these cases is limited to the interviewees' description. It is worth noting that although existing research (e.g. Hargadon & Sutton, 1996; Ravasi & Stigliani, 2012) has conducted more in depth analysis of specific Design Thinking projects which would address this limitation, this research has first strayed away from using the "uncomfortable" Design Thinking term and second, has focused only on a specific aspect of the process.

The scope of this research in itself shows the potential generizability of its findings. We have studied large organizations from the United States and Europe, in industries spanning from banking and consulting to retail and software. The challenges faced by these organizations covered everything from business model reconfigurations, to exploring new solutions for existing customers and new customers for existing solutions. We conclude that the generizability of design thinking lies not in where it is applied, but rather on why and how it is applied. A Design Thinking project should aim at resolving problems that center around people, not solutions in the form of existing products and services. A Design Thinking challenge should be framed as an open exploration of an activity or experience, not as a marketing research question. A Design Thinking culture should allow for learning by sharing knowledge across internal and external organizational boundaries, not as en elite and secretive group that lies above the rest.

We conclude that Design Thinking is not a substitute for existing technological and marketing research processes, it is rather a complementary tool to explore their impact. Not this, nor any other innovation methodology, is a silver bullet for innovation. Design Thinking in itself will not necessarily increase an organization's innovation output. Design Thinking will however help an organization, and more importantly the organization's employees, to learn more about its customers and their needs. This understanding may lead to both a sense of meaning for an innovation effort and the team spirit necessary to push it forward.

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Table 2: Relevant Quotes from interviews

ACAP Dimensions	d.Thinking Steps	Expert Interviews
Recognize the value	*Team building*	"We have a task that requires a certain amount of time to be completed and we need a very specific group of people for that, not coming from the same structure." (U. Weinberg, Potsam d.School)
		"Companies are more or less used to having maximum 2 or 3 people in the team. But I think the major difference in the results comes from opening up the boundaries. So companies start to integrate people from other departments or even from the outside (for example, a couple of d.school students and also former project partners). For example, Airbus started to open up to other external partners in terms of being better able to forecast trends in the materials and stuff like that. The multifunction team makes, I think, the main difference. [...] You can start building on weak ties that you already have among the departments or even to external partners of your network." (Program Director, Potsdam d.School)
		"When you design a car, you need really every single department who is involved in the design in that group because the complexity of the is astonishingly high. If you create a car that has not the right quality, is not reparable, is difficult to produce, has not a good design, is not fuel efficient, the result is going to be negative." (Associate, National University of Singapore)
		"They must form themselves, that's part of the education process. We give them a lot introduction to the importance of diversity on the team, especially cognitive diversity versus gender and ethnicity and discipline, and we give them instructions on how to form a team. They form a team themselves and they bid to become a team. They have to give us a one page explanation of why they're going to be a great team. And the reason I still do that is because I still believe, I don't have a research validation, that the single most important variable of the high performance team is ownership. It's your team, you volunteered to be on this team, you helped shape the team, that's number one variable." (L. Leifer, Stanford Center for Design Research)
		"Having a multidisciplinary team that talks to each other throughout the entire process makes the communication more efficient and the ability for the team to be able to quickly test out ideas, have better conversations that cut across the different disciplines so far and so forth." (Chief Design Officer, SAP)
		"We put together Marketing & Analytics, Brand Representative, a design person, then we have a DT coach and one other person that is from Legal & Ethics. So that's that working team. The first thing that we do when we're kicking off a project is align people to the customer, so you take people away from looking at each other and thinking about how my opinion is different than your opinion and say: "What does the customer think?" We're directing everybody's view towards that customer. So we do that in any kick off of the project and we also intentionally kick projects off in a way that is not business as usual. [...] we have to physically be at the same place at the same time, and we dedicate a full day and we can't take any meetings from outside and you close your computers. So we have a dedicated room and a dedicated space and just automatically create the atmosphere, the assets, the activities, the people in the room as different as business as usual. I find that to be really bonding. The second thing that we do is to make sure that everyone has some sort of background in DT." (Design Thinking Director, CapitalOne)
		"One way we achieve this is with this outside-in perspective, because we put students on clients' teams and they have not worked for these companies before." (Program Director - Strascheg Center for Entrepreneurship)
		"The two practices that we do differently are getting people to talk to and see customers more often and to put more cross-functional teams together. So we want to get someone from legal, marketing, design, technology, product onto a team from the beginning and get them to collaborate right from the beginning. [...] So if you get to the right people and you get them, you bring them and they understand early and you don't ask a yes/no question. You bring them in to the problem. I've learned actually that some of better Design Thinkers are lawyers." (Chief Customer Experience Officer, Fidelity Investments)

		"For the project that we did for Business2, we said that we were not going to run the project from the Central Design Team only: we were going to be leading it, but we were going to bring other designers and other people on. So we actually went specifically to payroll, to marketing, to quick product and brought some people together. Unfortunately due to resourcing constraints, we were able to only get designers and researchers. But we were not able to get PM and Product Development engineers, because of we were asking for an intact team for six weeks full time and that's the hardest thing you can ask for." (Design Research Strategy Director, Intuit)
		"you have limited resources within the company and initially you have one or two experts for a specific issue. So for example, going back to the Alpiq-Swisscom meeting again, from our side we needed someone knowing the energy market, someone knowing big data, big data analytics, we needed someone doing machine to machine communication, connectivity and all the smart meters. The choice of the right people is more triggered by the topics" (Innovation Officer, Swisscom)
		"at the beginning you recruit people and you realize very fast if some of them don't fit in the environment or in the way of working. I think that working together in these design challenges is one of the best things you can use to figure out how people work: how they behave under pressure, how they behave in the group, what ideas they bring and so on. It's a very interesting experience." (Innovation Director, PostFinance)
		"Basically I went to different departments, to the heads, and I said: "I need two or three people from your department for the next 5 months", and they said: "Ok, what kind of people?". I said: "Ok, who has a knowledge that is above average and the willingness to do something different and he or she has to be highly motivated". That was everything that I said to them, so I recruited in a very un-normal way. Then we made this test, and the test was only for bringing the teams together, nobody will know about the results except Bernard and me." (Innovation Director, PostFinance)
		"This means that you have people coming into the situation and you have cultural differences that depends on where they came from, which is interesting, gender differences, education backgrounds, marketing versus engineering, and those are all going to preload people with ways of seeing stuff." (M. Barry, Point Forward Consulting)
		"Within our innovation unit we have people from all parts of the company, sales, marketing, development, etc." (VP Innovation & Product Development, Panasonic)
Acquire	*Empathize*	"You always have to take into consideration the organizational culture. Everything is described by the organization culture, where they came from, what are their traditions and stuff like that. [...] We really have to figure out the specific needs and the specific targets also of the people starting to implement that within the company." (Program Director, Potsdam d.School)
		"We look at new ways of innovating, not necessarily from a technological point of view, but more from a kind of meeting-needs point of view, an observations point of view to be able to understand what we need to do." (VP Innovation & Product Development, Panasonic)
		"We always start with fresh research. [...] you always go out and do this deep ethnographic research which is always up to date, right on the pulse of what's happening at that moment. I see a lot of the companies we work for, breaking some of the thinking patterns that they had before about how to understand customers, how to get ideas for new products, new services. ... I have a lot of follow up emails from the companies and sometimes two years later they built on the ethnographic researches made by the students when they were out doing a really deep dive into either a new target group that the company wanted to tackle, or a new technology that they have invented and they don't know what to do about it" (Program Director - Strascheg Center for Entrepreneurship)

"I love having the client with us, because they know a lot that we don't. We can't just assume that we're going to have only fresh eyes, which is what we come with, but at the same time there's a lot of things that they know that we don't know yet. Having them working along side us helps things to come up. It helps. At the very end, we present recommendations or how they're going to move forward, and when you have your client right besides you, who lived it from day one with you, you can see that they started to learn themselves. Personally, the projects that I've lead have lead to more things being real than a lot of other colleagues because they refuse to work with the client, because they don't want the client there. I actually like it when the client's there, because I think it leads to real stuff. People gain confidence with it because they're like: "We've spent six months working on this, we learned this much. We now have a good instinct that it's something to pursue as a business". (Design Lead, IDEO)

"The idea used to be that you (customer) have your system and we have a list of functionality that you want to tell us in term of the new release. It was just kind of a very incremental innovation. With DT the processes of looking at it are more holistically, asking the tough questions, asking the why questions. [...] We had a lot of great success, because it also brought a lot of new opportunities for SAP by having a lot more strategic conversations with our customers. [...] for SAP it was really good to go directly out to our customers and have those success stories directly with them and have them rave about the process that we were working on to help to get the credibility to drive that inside." (Chief Design Officer, SAP)

"We – IDEO – are going into these things and we are able to come up with new ideas easily because people come up with technological ideas, but not human-centered and we inherently come up with new and different ideas, I'm not saying they're better, they're just different. By putting human factors, i.e. DT in human-centered design, you're exploring what people really want and then trying to come up with a business and a technology to make this work but only once you know what people really want. So it's just not that this is any better, it's undeserved because most companies are coming through this way (technology) or from this way (business), while designers are the ones coming from this way (human-centered) and that's what's make DT sing if you ask me. The results are new to the world ideas because it's a different methodology." (D. Kelley, Stanford d.School+IDEO)

"The point was using a more focused approach in defining what you would like to know and getting closer to the user. When I started here, people were really focused on the technical aspects of solutions. [...] I gave you the example of the Platform, based on cloud approach, which was developed eight years ago, but that no one was buying it. The solution was great from a state-of-the-art point of view and they could have it somewhere implemented as a cloud solution. The problem was that, at that time, they built something not really needed for the market. I recognized this problem in almost all the workshops we had and what I was trying to say to people was that we had to find first the needs and the market and then build on the needs and go from there to find something the customers really need. We work with this basic idea doing workshops internally. [...] we really invite to the board meetings sales persons, who are out there and talking to customers every day, or even we bring in customers and ask them what they think would be better. From time to time we also bring in the users that utilize our IT systems or workstations to really get a better experience and better feeling of what is needed. This helps a lot." (Innovation Officer, Swisscom)

Define	"This process puts a lot of attention on observation, deep research and also prototyping. It's an iterative process, that forces us, not to think linearly, but always think very close to the problem and the people, because we are doing something for other people that requires you do it better and better over and over again." (Ulrich Weinberg, Potsdam d.School)
	"I think that considering the consumer differently within the whole strategic discourse became for me the most important part of Design Thinking. So it's not about you have to understand what your customer wants already, what he can explicitly tell you, it is more about trying to create the future preferences for him." (Program Director, Potsdam d.School)
	"I think the most important and hardest part to do is the Define step, so form a POV. " (Chief Customer Experience Officer, Fidelity Investments)

"The story is that two young fishes are swimming along minding their business when an older fish who's swimming the other way says: "Morning boys! How's the water?" [...] The two fishes swim by for a little bit and one looks at the other and goes: "What the hell is water?". The most obvious point of the fish story is that the most important realities are the hardest to see. Fishes swim in the water and depend on it, but they can't see it. So I pose the question: how do you see the water you're in? Because effectively that is what all Design Thinking depends on [...] you can go up to other fishes or other creatures around you, and see how they see it, how they perceive this environment they are in. That connects to the concept of emotion. You can experiment in the water, you can disclose it in some way: bubbles, churn, that's kind of an interesting approach. And all these are tools at getting to this notion of water. You can keep pushing; you can chase older fishes and ask like to an expert in the field. Another thing may be stop swimming; if you think about it, that's all you're doing, so changing your day is a way to get to this thing called water." (M. Barry, Point Forward Consulting)

"In our work we have to step back and say: "What is putting this together? What are the assumptions and the inferences I'm making from those assumptions about how it looks and what are the alternatives that could be playing out?" [...] This is all sort of helping them not just to go out and see the world, but to see it with fresh eyes, to start seeing in a different way. That's the starting point for the POV we talked about. [...] the empathy is giving you a sense to understand that emic knowledge, the internal knowledge of how they make sense, while the POV is the outsider view, the etic perspective which allows you to begin to say: "It could be different". " (M. Barry, Point Forward Consulting)

"At some point it turns into knowledge. Before being knowledge it's a bunch of half-baked ideas that you have to synthesis into knowledge. Let's look at the IDEO group, right. They go out and observe and they put it in, through brainstormers; it ends up on these big boards with lots of post-it notes and then they kind of organize them and stuff and then somehow the ideas come up. Well, it's all knowledge, but the sharp point is when they synthesis this knowledge into the idea that they're going to champ, that they're going to work on." (D. Kelley, Stanford d.School+IDEO)

Assimilate and Transform	Ideate	"We establish milestones in the course that force people to think like an engineer, think like a designer, think like a strategic planner, think like a manufacturing guy, always with a human in the middle. We get these projects and in the first week we ask the team to build a full-scale model of the user and update it during the year." (L. Leifer, Stanford Center for Design Research)
		"Some of our best sessions have been co-design sessions, what we call co-design, we brought in our institutional clients, given them markers and have them help drawing and prototyping, that's where I think we're really having the most success." (Chief Customer Experience Officer, Fidelity Investments)
		"It's about getting out from where you are, you will not find the solutions where you are sitting, but getting out, could be out of your organization, inside the broader organization or could be outside." (VP Innovation & Product Development, Panasonic)
		"We've also established a team of almost 20 user-centered design consultants and they're working in different projects for established products. They look at our portfolio for one segment, for example our banking customers, and try to re-design the portfolio and products." (Innovation Officer, Swisscom)
		"The people worked from different areas within PostFinance: people from marketing, people from sales, people from IT, people from finance, basically every department we have, except HR, worked on the design challenge. Then all of a sudden you develop new talents from some people you didn't know that they had. One guy we realized he could draw incredibly, even he was not an IT guy but used this program for making the mockups in an incredible way and very easy. It looked like he'd never done anything else before. You also see the talents from a lot of people in this process." (Innovation Director, PostFinance)
		"That's great and that is traditionally the kind of creative piece of DT: the brainstorming in which you want to understand people so that you can come up with lots of new ideas, create value, etc. [...] It's about creating that narrative of a new space and environment and you create new experiences within that environment and the team has to share that. [...] Just coming up with a whole bunch of ideas is not very effective, it really isn't. What it is good is that we're kind of creating a new shared frame. " (M. Barry, Point Forward Consulting)

	"Inevitably, there are differenced of perspectives that are coming: in the actual content of the project I have found that to only be a positive thing. So the Dev that comes in is going to say: "Oh well, that's really interesting and the thing that just figured out is really relevant to this new technology that I was reading about last night in bed". None of us in the rest of the team is going to realize that. The designer is always going to say something completely different. And so on, like: "Oh! Maybe I come from an industrial design background, I haven't even worked with digital products before but I find that this thing that I've created in the past is really relevant experience wise or tactile wise to this thing we're trying to create". And then the business and tech person obviously comes with a really different perspective too, and they're like: "Oh, maybe I know these five different competitors, one of them is a startup, let's actually go visit the startup". Everybody brings a different perspective to the room. So that's all healthy stuff, the conflict that I've seen actually happen is less about that and much more about the culture of how they thing stuff should get done. So I think part of what we're trying to teach is this bias towards action, hacker, maker mentality: break the rules, don't ask for permission, ask for forgiveness, and obviously don't jeopardize the kind of financial information..." (Design Thinking Director, CapitalOne)
Prototype	"Students worked on that with experts from Lufthansa, Bundespolizei, Airport owners and security experts. They worked for 12 weeks and they came up with a prototype, a little trolley which speeds up the process of checking in by a factor of 10 times or so." (U. Weinberg, Potsdam d.School)
	"We had some very engineering centered companies that went into smaller and less complex products and specially services. But they still have their version of prototyping and testing in their mind. During DT, they build this notion of rapid prototyping, of very crude prototyping, even the prototypes in two hours. It's very new to them and they don't feel very comfortable with taking something out in this very raw form. So for some of the companies that were very traditionally engineering, this is sometimes something new. Build something in two hours, take it out to the customers and get early feedback, to not waist time doing something that they really don't need." (Program Director - Strascheg Center for Entrepreneurship)
	"It's also iterative. [...] It is better if I do a crummy one (draws a smaller "frog jump" starting where the long one started), I show it to a bunch of people, then I do another one (another jump), then I do another one (another jump). [...] that iterative thing really appeals to them. It's like experimentation rather than planning. If you look at most companies it's a planning exercise until about here (end of long jump) and then they execute. And in here (small jumps), it's doing, doing, doing and the planning happens until about here, right before they launch. [...] To me the prototyping culture is the purpose of it. The big deal in companies that have to get to prototyping culture is that the senior management is willing to see the early prototypes. [...] in a culture that's a culture of prototyping, the boss saw the crummy ones made out of cardboard, not painted and all the stuff and had his input, his or her input. So it's the fidelity of the prototypes that's really important, it's not the prototyping exactly. It's the increased fidelity." (D. Kelley, Stanford d.School+IDEO)
	"It's amazing because I've had in the past three weeks workshops with a big powerhouse in Switzerland, Alpiq Schweiz; we had C-level people and we came to the point of saying: "We need some type of prototype to show things". But when you talk about processes and business models you can't build something: so, we used Lego. We had paper and Lego and they started to build solar panels and houses, and put little engines made with Lego and they connect it with wires and everything. It just helped to get people working and focusing on something, but also have fun." (Innovation Officer, Swisscom)
	"With these prototypes we were able of having a strategic discussion with the board of directors of PostFinance to explain to them and show them cases how and in which way we could use this data for providing new services to our customers, basically on the mockups and what ever we developed. It was enough for having this strategic discussion and saying that if we don't believe that this is a strategic opportunity, we don't work more on this topic and we will make a shift. But everyone agreed that there were opportunities and we could go deeper into this topic from a strategic point of view." (Innovation Director, PostFinance)
Test	"I think the biggest problem is how to come from the final prototype into a way of implementing these things. That's our biggest challenge. All the projects we did at Stanford and St. Gallen, I would say none of them was realized in the same way that the final prototype was built. [...] all the experts come in and there are so many boards, like the product development board, the marketing board, IT infrastructure board, that have questions and finally there is nothing left from the original idea." (Innovation Officer, Swisscom)

"What we also did besides working on this design challenge, we had also a challenging board with the different people from all PostFinance, even people from the board of directors. They were part of this process: we showed them the first results and got their feedback." (Innovation Director, PostFinance)

"Well, to me when you start just doing design for design sake without the intent and the insights behind it, your POV is actually not strong when it goes into market. So, we've just revamped our Accounting Software and it looks beautiful, but guess what? It looks at beautiful as any of our competitors who have the same Illustrator tools. (Design Research Strategy Director, Intuit)

Exploit

DESIGNING DYNAMIC CAPABILITIES – THE CASE OF NEW VENTURE CREATION

written with Andreas von Vangerow

INTRODUCTION

A new venture may be broadly defined as a firm that is in the initial stages of launching their first product or services to market, establishing a customer base and defining the organizational processes and procedures with which they will govern their venture (Klotz et al., 2014). New venture creation has been recognized and promoted as essential to economic growth within the current globalized and dynamic environment (Harris, 2011). Yet while governments and universities encourage new ventures to introduce innovative products and services and generate employment opportunities, entrepreneurial teams face increasing difficulties on the one side by a fast passed growth in technological sophistication that makes the process of creating a new venture more complex and uncertain than ever, and on the other side by investors who in the current economic setting seek to mitigate risk as much as possible (Klotz et al., 2014). These difficulties faced by new ventures are known as liabilities of newness (Stinchcombe, 1965). Venture accelerator programs, that are intense entrepreneurial programs, seek to address these liabilities and, as the name suggests, accelerate new venture development, by facilitating the learning of necessary operational or managerial capabilities and providing the environment to build the required legitimacy with potential customers, employees or other stakeholders (Hallen et al., 2014; Gavetti & Rivkin, 2007).

Accelerators are programs that aim to accelerate early venture gestation by providing cohorts of new ventures with education and mentorship connections during intensive programs that usually last three months (Hallen et al., 2014). The first accelerator program –Y Combinator, was founded in 2005 and as of 2013 there were an estimated 300 accelerators across five continents (Miller & Bound, 2011; Stross, 2012). Accelerators are either privately funded by investors or venture capital firms, while some utilize public grants and others are university affiliated (Miller & Bound, 2011). The setting for this research is within a Stanford University accelerator program called Launchpad. By focusing

on this particular setting, we overcome the challenge of studying the process by which a venture is created (Vesper, 1989), rather than take a retrospective approach to study venture creation after the fact (Katz & Gartner, 1988). Our goal is therefore to build on the research related to those sub-processes involved in the venture creation processes within the context of an accelerator. Specifically focusing on what strategic management literature deems as essential to the success of a new venture and its founders' potential to create value from their innovations: dynamic capability development (Zahra et al., 2006).

Both venture creation and strategic management are dynamic processes concerned with firm behavior and its performance (Ireland et al., 2001). Dynamic capabilities are at the center stage of research in the field of strategic management (Di Stefano, Peteraf, & Verona, 2014). The current high pace of change is forcing firms to adapt rapidly in response to the changes and new potential opportunities in their environment (Barreto, 2010; Di Stefano, Peteraf, & Verona, 2010; Zahra, Sapienza, & Davidsson, 2006). Dynamic capabilities are thus defined as "the capacity (a) to sense and shape opportunities and threats, (b) to seize opportunities, and (c) to maintain competitiveness through enhancing, combining, protecting, and when necessary, reconfiguring the business enterprise's intangible and tangible assets" (Teece, 2007, p. 1319). However, the majority of research on dynamic capabilities has explored these processes in large incumbent firms, leading to calls for further research on the "genesis of dynamic capabilities" (Zahra et al., 2006). Thus, there is a need for more research focused on the process whereby these capabilities are developed as a new venture is created and developed. We aim to building on the extant literature using the notion of dynamic entrepreneurial capabilities proposed by Corner & Wu (2011) to explore dynamic capabilities in the venture creation process. Dynamic entrepreneurial capabilities are defined as the capacities that entrepreneurs use to identify, collect, integrate and potentially reconfigure the necessary resources in the venture creation processes (Corner & Wu, 2011). This approach is consistent with recent research that addresses a more granular view of dynamic capabilities, its underlying processes called micro-foundations (Barney, Ketchen, & Wright, 2011; Felin & Foss, 2005; Foss, 2011; Teece, 2007).

These micro-foundations are described as a firm's collection of distinct skills, processes, procedures, structures, rules, and disciplines with which it responds to its environment (Teece, 2007). Researchers hope that by investigating closely how managers and entrepreneurs assemble resources they will uncover the genesis of dynamic capabilities (Barney et al., 2011; Felin & Foss, 2005; Foss, 2011; Teece, 2007). Especially promising are the psychological roots of organizational decision making and learning (Barney et al., 2011). However, Hodgkinson & Healey (2011), propose that the extant literature on the psychology of strategic management has emphasized the behavioral and cognitive aspects of strategy formulation and implementation while mostly disregarding the emotional and affective ones. This has lead strategic management literature to portray management as a series of rational and dispassionate activities, while in practice firms continue to vest their efforts to foster creativity and nurture a closer relationship with its customers. Therefore, the biases and inertial forces that undermine Teece's (2007) sensing, seizing, and transforming capabilities have both emotional and cognitive roots. Based on this insight, the tools and processes that are commonly thought of as a necessary component of dynamic capabilities and which enable cognitive effortful reasoning and judgment are in practice insufficient to ensure the long-term adaptability of the firm.

Building on this work, we conducted an inductive study that addresses the question: How do entrepreneurial teams develop dynamic capabilities in the process of creating a new venture within the context of an accelerator? We aim to offer some insight into the process of adaptation in affective capabilities by individuals and teams, shedding some light into the genesis and development of dynamic capabilities in young ventures through some of their underlying micro-foundations. Based on an ethnography work at an accelerator program in Stanford University and the resulting case studies from the ventures that took part, we develop a six-step process model to show how firms can emotionally detach from an existing solution and move forward to a potentially better version. We show that those firms that are able to deliberately switch between emotional and analytical modes of operation have a higher likelihood of success.

THEORETICAL BACKGROUND

VENTURE CREATION

The process by which a new venture is created has been an object of study for more than two decades, however the majority of these initial studies have been mainly conceptual (Liao et al., 2005). As early as Gartner's (1985) model, research on the topic has described the processes by which founders progress as a series, of mostly linear, stages. Further research explored venture creation from the perspective of the activities engaged in and completed by founders. The work of Reynolds & Miller (1992) posits that the probability of success to establish a business is related to the increase of business activities during the firm's "gestation" period, but that available models failed to capture the numerous combinations of sequences involved in the venture creation process.

More recently, empirical research fails to support previously proposed linear models (Liao & Welsch, 2008) and conveys the venture creation processes as a iterative and unorganized (Rasmussen et al., 2011). While the notion of a series of phases is still supported, each of these involves an iterative sub-development process in which previous phases are revisited and at times re-evaluated (Vahora et al., 2004). Scholars have agreed that the venture creation process is iterative and constituted by various interacting subprocesses that converge and transform to form a new venture (Davidsson, & Wiklund, 2001). Research in this field has called for further exploration on how these subprocesses contribute to new venture creation (Lichtenstein et al., 2006) and dynamic capability development has been suggested as a crucial sub-process in venture creation (Corner & Wu, 2011).

THE ORIGINS OF DYNAMIC CAPABILITIES

The rise of the concept of dynamic capabilities originated at the same time as the rise of the Internet. The first phase of the development of the concept of dynamic capabilities was concerned with acknowledging the need for constant change in the revolutionizing business landscape (cp. Afuah & Tucci, 2003). Accordingly, Teece et al. (1997, p. 516), originally defined dynamic capabilities as *"the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments."* An inevitable discussion followed to which extent dynamic capabilities are linked to firm performance directly (Teece

et al., 1997) or indirectly (Eisenhardt & Martin, 2000). Not surprisingly, researchers were also questioning whether dynamic capabilities are really only needed in a fast changing environment or not (Barreto, 2010; Di Stefano, Peteraf, & Verona, 2010). Helfat et al. (2007) synthesize the debate by stating that having dynamic capabilities in place enables the firm to reach evolutionary fitness in relation to its environment.

*MICRO-FOUNDATIONS OF DYNAMIC CAPABILITIES*

The 2007 article of David Teece marked the second evolution of research on dynamic capabilities. Now researchers started to look at the micro-foundations of dynamic capabilities to tackle the questions of how firms can actually manage to change constantly. In his work, Teece (2007) defines the micro-foundations of dynamic capabilities as follows: "dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and when necessary, reconfiguring the business enterprise's intangible and tangible assets" (Teece, 2007, p. 1319). His focus on the identification and exploitation of opportunities shows the closeness of his work to the theories of entrepreneurship (Baron & Ensley, 2006; Gruber, MacMillan, & Thompson, 2008; Schumpeter, 1934; Shane, 2000) and makes a natural link to entrepreneurs as the agents of change.

Regarding dynamic capabilities in new ventures, Zahra et al. (2006) conceptually postulate that young firms are more likely to use improvisation and trial and error learning instead of experimentation for building dynamic capabilities in comparison to older firms. However, they do not see a difference between the two for the case of imitation. Corner & Wu (2011) identify problem identification and the open sharing of technological features as micro-foundation of dynamic capabilities in new ventures based on a qualitative study. Besides these first papers, research on dynamic capabilities has dealt almost exclusively with established companies and research on the entrepreneurial micro foundations of dynamic capabilities is still scarce (Foss, 2011; Hoskisson, Covin, Volberda, & Johnson, 2011; Teece, 2012; Zahra et al., 2006). Examining how entrepreneurs dynamically configure resources early in their ventures, could potentially offer

insights into the genesis of dynamic capabilities (Barney et al., 2011; Maritan & Peteraf, 2011).

PEOPLE AND DYNAMIC CAPABILITIES

A third important area of research originating out of the micro-foundations of dynamic capabilities concerns the psychological roots of organizational decision making and learning (Barney et al., 2011; Foss, 2011; Garbuio, King, & Lovallo, 2011). This stream of research is interested how people in firms with their emotions influence the building of dynamic capabilities. The research on dynamic capabilities has come to the point to look at who actually has to change.

In this respect, Hodgkinson & Healey (2011), criticize that the extant literature on the psychology of strategic management has emphasized the behavioral and cognitive aspects of strategy formulation and implementation while mostly disregarding the emotional and affective ones. Further, they pose that the left-brain/right-brain cognitive science underpinning Teece's (2007) model, which characterizes intuition and heuristic processes as primitive sources of bias, must be reevaluated as mounting evidence from the field of social neuroscience is showing that less deliberate forms of cognition are key to optimal functioning. Affect and emotion which have been typically portrayed as a disturbance to the reflective system, are now considered integral to cognition, learning, reasoning, decision making and action (LeDoux, 2000). Hodgkinson & Healey (2011), introduce the distinction between affective and analytical processes based on the works of Bernheim and Rangel (2004) that view the brain as operating in either a 'cold' or a 'hot' cognitive mode, and of Loewenstein and Small (2007) who termed this dichotomy either 'emotional' or 'deliberative' systems.
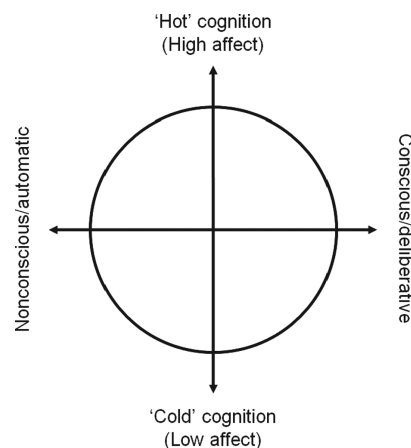
Figure 3: The core concepts of strategic cognition (Hodgkinson & Healey 2011, p. 1503)

Hodgkisnon & Healey (2011) directly apply the insights of their model of strategic cognition (Figure 3) to Teece's (2007) framework of dynamic capabilities. Within sensing, firms that are able to include the hot mode of cognition into their process are less likely to follow cognitive blind spots and suffer from strategic inertia. In addition, firms that allow room for intuition will be able to sense opportunities and threats more effectively. In the seizing phase, firms that nurture emotional commitments to new opportunities but also give room to salient negative affectivity will be better at seizing those opportunities and be less likely to follow overly-risky escalations of commitment (Hodgkinson & Healey, 2011). The preceding propositions are also supported by the work of Garbuio, King and Lovallo (2011) that draw from behavioral research examining the underpinnings of managerial or entrepreneurial decision making on how to invest scarce resources. For the reconfiguring phase, firms are considered to be more successful if they can manage their members' identity-based affective reaction to change (Hodgkinson & Healey, 2011).

Therefore the biases and inertial forces that undermine Teece's (2007) sensing, seizing, and transforming capabilities have both emotional and cognitive roots. Based on this insight, the tools and processes that are commonly thought of as necessary components of dynamic capabilities and which enable cognitive effortful reasoning and judgment, may be in practice insufficient to ensure the long-term adaptability of the firm. Therefore signaling the need for further research and the proposition of tools and practices that by augmenting the cognitive and affective capabilities of individuals and teams may enhance sensing, seizing and transforming capabilities. This should be especially beneficial for the understanding and aiding of entrepreneurial teams where the emotional attachment to a solution and the influence of the founder identity on the firm influences sensing and seizing opportunities even more (Fauchart & Gruber, 2011), and research on the micro-foundations of dynamic capabilities is more limited (Zahra et al., 2006).

Building on these streams of literature, the present article aims to explore how entrepreneurial teams develop dynamic capabilities in the process of creating a new venture within the context of an accelerator.

METHODOLOGY

To answer the above research questions we choose an exploratory, qualitative research design. Such a research design is recommended to investigate phenomena that are poorly understood and where it is difficult to distinguish between the phenomena and its context (Strauss & Corbin, 1998; Yin, 1984). This should be especially true for studying dynamic capabilities (e.g.(Danneels, 2011)), where case studies may be "illuminating" (Teece, 2012). We conducted an ethnography to study the emergent process of dynamic capability formation in new ventures. The ethnography is part of a larger research project that aims to understand capability development and innovation processes. Ethnographies are well suited to study how longitudinal processes unfold over time and how the motivation and emotions of the actors involved and the cues of everyday life shape the gestalt of a newly created firm (O'Reilly, 2009). We then use case studies of new ventures as a unit of analysis, aiming to identify and compare patterns of capabilities.

Research Design & Setting

The ethnography was conducted at the Hasso Plattner Institute of Design at Stanford University, also known as the "*d.school*". Stanford University, as the academic center of Silicon Valley, is prominent for its output of innovation and successful startups. It brought forward numerous successful tech-companies such as Google, Hewlett-Packard, Yahoo, Cisco and Sun Micro Systems as well as well-known companies in other sectors such as Gap and Nike. The d.school was founded in 2004, focused on creating transformative learning experiences, in which faculty and students from the fields of engineering, medicine, business, law, the humanities, sciences and education, come together and produce creative solutions to challenges varying greatly in field and scope (d.school, 2014).

Within the setting of the courses offered at the d.school, lies *Launchpad*. Offered since 2010 by Prof. Bob Sutton, Michael Dearing and Perry Klebahn, to graduate student teams who wish to launch a product or service business. In a time frame of ten weeks, teams work on imagining, prototyping, testing and iterating, building, pricing, marketing, distributing and selling their products or services (d.school, 2013). By studying the early stages of venture creation, we avoid sampling based on outcomes and gained a better understanding of these early

stages which have until now received little attention (Zimmerman & Zeitz, 2002; Zott & Huy, 2007). Using case studies of entrepreneurial ventures at the d.school as our unit of analysis also enables us to identify and compare patterns of capabilities of newly created firms (Eisenhardt, 1989; Yin, 1984).

Teams of graduate students apply as a group with a predetermined product or service idea. During the three months before the start of the program, teams must meet with one of the teaching staff at least once in order to receive feedback or to better focus the team's business idea. Teams must then submit an official application for acceptance into the course. Acceptance rate is under 10% and each team and idea is treated as a real start-up, as every team is required to legally incorporate by the second week of the course. In total 12 teams, 3 lecturers and one teaching assistant participated in the course in 2013. The 12 teams consisted of 25 graduate students from the Engineering, Design, Law, Business, Psychology and Education departments.

Data Collection

Our research was based at Stanford University, where one of the authors conducted this study of the Launchpad program from March to September 2013, followed by additional interviews and data collection well into April 2014. This ethnographic study was conducted participating as a member of one of the teams. A participant observer approach allowed for a better engaging with the environment, building rapport and generating deeper insights with the team observed, the other teams and the entire program. This allowed the researcher to deeply immerse himself into the research setting and to experience and uncover the emotions and affect of the actors and to observe the formation of capabilities.

Following Eisenhardt's (1989) recommendation for a theoretical sampling approach, and based on the data analysis discussed in the following section, out of the 12 teams we decided to study four of them in greater detail where the phenomenon of interest was "transparently observable". We varied team selection based on the following criteria: First, the founders of Altura and Pawprint had a business background while the members of Alexo and Edunautics had a technical one. Second, Alexo and Altura were developing a product versus Edunautics and Pawprint who were developing a product-service

combination. Third, the teams where differing according to their initial attachment to their idea. Altura and Edunautics were highly enthusiastic at the beginning and were personally connected to their idea while Pawprint and Alexo had a more functional approach based on market research. Focusing on these four cases allowed the researchers to balance having to cope with large amounts of information and generating theory and to reach a satisfactory level of theoretical saturation. Particularly, all further evidence in the remaining teams confirmed the proposed micro-foundations in the generation of dynamic capabilities. Additionally, we did not find evidence that could produce new micro-foundations or contradicted our theoretical claims.

Research has shown the importance of a number of factors that may allow a new venture to acquire resources such as location, financing, social capital, competence of the founding team, and the reputation of affiliated firms and institutions (Eisenhardt & Schoonhoven, 1990; Florin, Lubatkin, & Schulze, 2003; Higgins & Gulati, 2003; Schoonhoven, Eisenhardt, & Lyman, 1990; Stuart, Hoang, & Hybels, 1999)). Given this research was conducted within Silicon Valley, location and access to financing holds equal for all teams. Additionally all teams are formed by individuals that have been admitted into equally reputed and respected Stanford graduate programs, and hold access to the university's network and resources. This selection therefore controls for aspects of human and social capital that may be source of heterogeneity in entrepreneurial ventures (Zott & Huy, 2007). This sampling approach allows us to look at variances within teams while keeping other factors constant in order to develop mid-range theories (Gartner, 1985).

In order to reduce type of bias, data was collected from different sources. These sources include participant observations, interviews, student assignments, lecture material, business plans, startups' websites, presentations, press announcement, financials, sketches, drawings, prototypes, videos, and recordings. Additionally we had access to the feedback of angel investors and venture capitalist. This feedback was especially valuable as it was neither self-reported by the team members nor biased by the participating observer. After the initial data collection, we regularly monitored the various venture's websites, collected information from social media and business press (if available). These

sources enabled to triangulate our findings to then build stronger interpretations (Jick, 1979; Yin, 1984). A rigorous case-study protocol was followed and all material was organized in an NVivo case study database to ensure the reliability of our research (Gibbert, Ruigrok, & Wicki, 2008; Miles & Huberman, 1994; Yin, 1984). The broad sources of data can be classified into six general categories.

1. *Launchpad sessions*

One researcher observed and participated in all 20 Launchpad sessions in which participants worked on their business idea. These took place 2 times per week during a total of 10 weeks. Each session was carefully observed and recorded through notes, pictures and videos. Permission to photograph or record any material was explicitly requested during the session to those students involved. These field notes were immediately organized and transcribed after each session in order to not lose any details. These transcripts were then revised with different class participants in order to assure completeness and reliability.

2. *Materials about the startups*

To complement the observed and interview material, additional data was collected. As part of the course a total of 21 assignments were required of every team. These included topics such as product ideation, consumer understanding, market segmentation, pricing, etc. that teams had to work on after session hours. All class communications and assignment delivery were to be made through Basecamp. Basecamp is an online platform that allowed all students to share their work with each other, participate actively in each other's business and helped us to keep track and collect further data of each team's progress. Weekly Essentials Sheets were also scanned and uploaded, providing an important longitudinal measure for this research. In the essential sheet, the teams were asked to reflect on the most important why questions pertinent to their ventures. Where available, online information in the form of publications and literature on each startup was collected up to a year after the end of the course.

3. *External Feedback*

Feedback is essential to the development of the ventures and the team's capabilities. As such, numerous venture capitalists, business angels, Launchpad alumni, experts, potential customers and members of the press are invited as guests to several of the program's sessions. Additionally, attendants to the Beta

Trade Show, which is held half-way through the program, are asked to fill in a Jury Feedback form. This information was duly recorded and presents an important piece of this research as it is neither biased by the researcher nor the participants. The reaction, or lack of, to this feedback by each of the teams presents evidence to their dynamic capabilities development.

4. *Participant observation of entrepreneurial project*

The author took a participant observer role in one of the teams, Alexo, met with team members during class sessions, attended group meetings at least twice a week or whenever the team met and was given access to sketches, reports and designs. Team Alexo was comprised of 3 electrical engineering graduate students who developed a bracelet with an alarm for women to activate in moments of distress. Participation with the team consisted of helping to conduct customer interviews, gather market research and prepare presentations. This team developed several designs, working prototypes and models for their product.

5. *Informal discussions*

The researcher had hundreds of informal conversations with students, alumni, administrative staff, lecturers, professors and affiliated researchers, ranging from brief exchanges while walking to the Caltrain to multiple long talks over lunch. Stanford is such an environment that one can simply say hello to a stranger and stir up a conversation. Informal conversations were held with several professors, d.school staff and visiting executives participating in d.school courses.

6. *Entrepreneurial team interviews*

One researcher conducted thirteen semi-structured retrospective interviews with the teams or individual participants, which were in most cases recorded and then transcribed. The purpose was to understand from each team how their project unfolded, the role each member played, the final product/service designs, how these were chosen, how each team generated and explored alternative solutions throughout the process, and information on interpersonal and political issues that arose during this process. They were asked to describe (and sometimes draw) the model by which their business operated. They were also inquired on their favorite and least favorite moment of the program and their most rewarding and most defeating moment. Finally, they were asked what they would change about the program and how might they make it better.

Data Analysis

For the data analysis the two authors initially analyzed the data independently, in order to ensure the validity and the reliability of findings and to contribute fresh insights with regard to the relation to the theoretical background of the study. We started by capturing all interviews, participant observation and secondary data into an NVivo database. Next, we developed an detailed account of the setting of our ethnographic study that allowed us to really immerse us into the research context (O'Reilly, 2009). Each researcher first coded all our data sources individually. This generated an initial list of codes that we than compared and reduced to first order concepts, overarching themes, and aggregate dimensions as reported in **Table 2** (Miles & Huberman, 1994; Strauss & Corbin, 1998). We constantly compared our findings to the literature and vice versa. Comparing classifications given to the data and discussing any differences to reach an agreement added further to the reliability of our coding (Gibbert et al., 2008). We reached an inter-coder reliability of 94%. The coding was followed by the development of single case write-ups for all of the four case studies before we proceeded to cross-case comparison (Miles & Huberman, 1994). Writing down the case studies and performing the cross-case comparison especially helped us to identify the relationships between our constructs.

Table 3 presents short descriptions of each of the four cases and the relevant data collection. The four entrepreneurial venture cases consisted of two business student teams and two engineering student teams, allowing for variance in the background of the students. These four "extreme" cases are selected based on evidence of one business and one engineering team showing an initial "cold cognitive" mode, while the other business and engineering team showed a "hot cognitive" mode. Additionally, all the products and services developed by the teams were targeting different markets. The four ventures are: ***Alexo***, offering esthetically appealing jewelry that allows women to repel an aggressor and notify authorities with the push of a button; ***Altura***, making a coffee brewer that delivers all the benefits and none of the drawbacks of French press and filtered coffee makers; ***Edunautics***, developing mobile technology and analytics that allow students to notify anonymously and in real-time when they've lost track of a course's content, to then help teachers understand where additional attention

is needed, and **Pawprint**, inventing a dog collar that allows owners to monitor and track their pets' movement and health real time through their mobile devices.

Concepts	Themes	Aggregate Dimensions	Dynamic Capabilities
Team excitement Team motivation Team Self-Description Team strength User motivation User background *Reflection* *Implementing feedback*	Crystallization team identity User motivation identification	Separating team identity from user motivation	Sensing
User experience Desire User need User personalities Unique selling proposition Making use-cases *Reflection* *Implementing feedback*	Discern between what user says and does Recognize user thoughts and feelings	Developing deep empathy for user need	
Pinpointing user problem Design requirements Functionality requirements User interface Competitor awareness Market segmentation *Reflection* *Implementing feedback*	Problem identification and understanding Solution evolution	Separating problem from solution	Seizing
Targeted buyer group Sales channel First Sale Team strengths awareness Rapid prototyping Testing Seek outside help Hiring Motivate new hires Delegation Bootstrapping *Reflection* *Implementing feedback*	Awareness & solving of team needs Interaction with externals	Pragmatic realization & testing	
Envision product/service family Product/service architecture Remain open to user desires Keep team spirit *Reflection* *Implementing feedback*	Expanding scope Evolving vision	Long-term vision building	Reconfiguring
Facing reality Anxiety Endurance Risk Taking Prioritization Pivoting Renewal *Reflection* *Implementing feedback*	Implementing new vision Adapting team focus	New vision implementing	

Table 2 - Coding Process

Cases and Data Collection						
Case	*Business Description*	*Project Participant*	*Informal Discussions*	*Interviews*	*External Feedback*	*Additional Material*
Alexo	*Produces esthetically appealing jewelry that allows women to repel an aggressor and notify authorities with the push of a button.*	Yes	High	0	Yes	High
Altura	*Produces a coffee brewer that delivers all the benefits and none of the drawbacks of French press and filtered coffee makers.*	No	High	2	Yes	Medium
Edunautics	*Develops mobile technology and analytics that allow students to notify anonymously and in real-time when they've lost track of a course's content, to later help teachers understand where additional attention is needed.*	No	Medium	1	Yes	Medium
Pawprint	*Produces a dog collar that allows owners to monitor and track their pets' movement and health real time through their mobile devices.*	No	Low	2	Yes	Medium

Table 3 - Cases and Relevant Data Collection

LAUNCHPAD – THE ACCELERATOR

Launchpad is an intense startup accelerator program offered at the d.school to Stanford graduate students that applies principles of design thinking to help launch a business. We define design thinking[1] as a human centered problem-solving process that combines and builds on the observations, knowledge and creativity of multifunctional teams, (Brown, 2008; Cooper, Junginger, & Lockwood, 2009; Rowe, 1987). The term human-centered was first used in early studies on the interaction between people and computers (Norman & Draper, 1986). This work built on the extensive research on human empathy in the field of psychology and cognition, in which empathy is defined as the unprejudiced process whereby one person tries to understand accurately the subjectivity of another person (Wispé, 1986). Design thinking builds on these concepts, to offer "...a set of principles that can be applied by diverse people to a wide range of problems" (Brown, 2008), such as those faced by early stage founders of entrepreneurial ventures.

The program is facilitated and coached by Michael Dearing, Perry Klebahn, and Andrew Humphries. The objective of the program, in the words of one of the instructors is: *"...to have each team's startup running by the end of the quarter, or having understood why this will not work at all"*. Teams in Launchpad develop software, physical goods / devices or services. This wide diversity of projects is aimed at enriching discussions, analyzing differences and recognizing patterns.

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[1] Peter Rowe, a Harvard University architecture professor, coined the term design thinking in 1987 as a title of a book in which he elaborated and developed theory on architectural design (Rowe, 1987). However, it wasn't until 2003 that design thinking began being used to describe the working process followed at the consulting firm IDEO and popularized in the past decade through Stanford University's d.school, formally known as the Hasso Platner Institute of Design. Given its name and some of its tools, design thinking is frequently and mistakenly thought of as referring to the field of design or professional designers. However, the d.school community and those companies who use design thinking as part of their innovation efforts have a clear distinction between the practice of design and design thinking. To this community, it is regarded as a distinctive way of solving problems following a cyclical process that can be applied to any area in an organization, whether or not it is product-related (Cabello et al., 2014). This process is described as follows: first, to gain a deeper understanding of the people for which a certain problem is being worked on by means of observation and interviewing, this is described as gaining empathy. Second, to gather and structure the findings and insights generated to find patters of conduct. Third, only until this point are a wide range of solution concepts verbalized and building upon these different ideas is a set of possibilities selected. Forth, in parallel to the previous step and further, the proposed solution ideas are quickly prototyped through rough sketches or physical objects. This allows the participants to better understand each other's concepts, to present to future users for feedback and reiterate based on new insights.

Within its syllabus Launchpad is described as being at the intersection of design thinking and going-to-market, further on stating:

"You will work hard on both sides of your brain. You will experience the joy of success and the passing pain of failure on the road to launching your product or service. Some products will succeed in generating lots of revenue and usage; others will not. The outcome isn't important and you cannot control it so don't get attached to it. You can control your effort, your attitude, and your acceptance of the principles of design thinking. This course is about the struggle and the process, not the outcome" (Launchpad 4 - Syllabus, 2013, p.1).

A total of nineteen sessions took place two times per week during the course of ten weeks. Sessions focus on giving direction and feedback, while ninety percent of the workload is expected to occur after class. Given the high workload, participants procure a lower course load than usual or take Launchpad as their only course during the quarter. In order to better grasp the requirements and expectations of the course, all participants are asked to sign the following pledge:

"We will not miss class even once; We will not complain about the workload; We will launch our product / service in the market; We will participate actively in class and outside class; We will think with our hands through rapid prototyping; We will use both sides of our brains (creative and analytical); We will approach every activity with an open mind and a beginner's mind; We will help design and iterate Launchpad this quarter and in the future" (Launchpad 4 - Syllabus, 2013, p.2).

In order to prepare for each session, participants are required to previously complete a series of assignments numbered from 00 to 19. Table 4 presents the topic and description of each of the twenty assignments and the topic and description of sessions they lead to.

Week	Assignments		Sessions	
Week 1	00. Essentials	Keep a weekly record of lessons and relevant changes to their business in the Essentials Notebook	1. Statement of Purpose	Initial 2 minute pitch by each team in which all participants gave four votes each to evaluate pitches in terms of the idea, the team and likelihood of personal investment. First Essentials Sheet is completed by each team and given feedback by everyone in the program.
	1. Statement of Purpose	Prepare a two minute pitch that presents the team, the idea and why someone should invest.		
	2. Cooking up a Reduction	Prepare a 180 character description of the essential value of the business.	2. Cooking up a Reduction	Invited guests are asked to prototype and explain each team's idea based on the 180 character description, teams learn from observing.
Week 2	3. Functional Prototype	Build a full-scale functional prototype demonstrating critical functions and to survive thorough testing.	3. Functional Prototype 1 & Forms of Organization	First prototypes are presented, teams are asked questions by the group and given feedback.
	4a. Forms of Organization	Establish what legal form of organization the company will take.		
	4. User Testing	Perform both qualitative and quantitative user-testing research and present in visual form.	4. User Testing	Teams present prototypes and get feedback from invited potential users. Teams' research is presented and group gives feedback.
Week 3	5. Functional Prototype 2	Build improved prototype 2 and analyze progress and lessons learned against prototype 1.	5. Functional Prototype 2	Invited group of well known business angels with each $50k to invest. Teams pitch, present prototypes and answer questions.
	6. Right Brain Marketing	Design a "mood board" that captures the visual, verbal and brand identity for your venture.	6. Right Brain Marketing	Professional designers review team's mood boards and give input on the value of the brand and of the look and feel of the product.
Week 4	7a. Straight Forward Q&A	Participants leave a straightforward question that a user, funder, or interested party would ask.	7. Communication & Online Community	Feedback is given on online user testing. Participants are each given one of the straightforward questions from Assignment 7a and are asked to pitch considering this question, while the group identifies what may be perceived as beliefs, emotions, physical actions or key words that are conveyed during the pitch.
	7b. - Fears and Goals	Participants are asked to reflect on their inner hopes and fears concerning their ventures.		
	7c. Internet as User Group	Students are asked to design an experiment to test online user interaction and gather feedback.		
	8. Pricing	Deliver a pricing strategy based on the Doulan & Gourville HBR article on the topic.	8. Pricing & Making Stuff	Essentials sheet weekly progress is evaluated. Strategies on pricing models and mechanisms are reviewed.
Week 5	9. Left Brain Marketing	Calculate the fixed and variable costs for production and the break-even and lifetime value scenarios.	9. Selling 1	Teams are provided with material to make lemonade and compete to sell the most lemonade around campus within 2 hours.
	10a. Beta Test Prototype	Full scale, functional **AND** visually appealing prototype (though lacking final features and finish).	10. Beta Trade Show	The teams set up in the atrium of the d.school with many different styles and colors, presenting and making sales or pre-sales of their products/services. Roughly 100 people attended the Beta Trade show.
	10b. Website & Stand	Create a trade-show booth and a website that allows newbies to understand your product.		

Table 4a - List of Launchpad Assignments and Sessions

Week	Assignments		Sessions	
Week 6	11. Debrief - Trade Show	Seriously repositioning of activities and venture based on jury feedback and trade show results.	11. Debrief	Each team got feedback from two others, with which teams' *Why* questions (Essentials) were updated and voted on by participants.
	12. The Path to Production	With a "Looks Like"/"Works Like" axis, teams note progress and map iterative path to production.	12. Processes	Exercise illustrating that the creative process might create certain magic, but processes are necessary to repeat results efficiently.
Week 7	13a. Building Teams	Write a job description for the first two hires.	13. Selling 2	Review on different types of story telling that may help teams find the best story when asking for money, touching on the most important questions an investor may have.
	13b. Interview Questions	Write five key questions candidates should be asked in an interview.		
	14. Pitching	Understand different pitch types and design a modular pitch that may adapt to different audiences.		
	15. Selling with a Team	Considering three employees, design sales strategy with two quantifiable objectives and a list of tasks.	14. Employing	Exercise is focused on hiring the right people, convincing them to join your team and asking the right questions to do so.
Week 8	16. Managing employees	Based on Assignment 15, three teams are allocated other participants to achieve sales strategy in 5 days.	15. Teams	Based on Assignment 16 results are shown, evaluating if employees were motivated, well utilized and given clear instructions.
	17. Financials	Put together a basic six months Balance Sheet and Income Statement estimates	16. Entrepreneurial Finance	Presentation by Michael on Entrepreneurial Finance, where the basics of accounting are explained with simple examples.
	18a. Ask Introductions	Choose two types of people the team would like to pitch two and explain why.		
Week 9	18b. Pitches	Based on Assignment 18a, prepare three pitches, one for each introduction and one for a TV anchor.	17. Presenting	Diane Blare, an NBC anchor, coaches teams pitch in two rounds, a practice with her feedback and a second with Q&A by guest investors
	19. What's Next	Is team continuing and three critical steps to overcome, or shutting down and three lessons.	18. Final	Teams present Assignment 19, with eight teams expressing their full commitment to continue their ventures.
Week 10	20. Confidence Curve	Indicate your level of confidence throughout each activity in program with a curve.	19. Synthesis, & Debrief	Facilitators elicit feedback on activities, improvements and participants confidence.

Table 4b - List of Launchpad Assignments and Sessions

Of particular importance and pertaining to Assignment 00, participants are all handed out a notebook in which each page contains a format with the questions *"What?"*, *"Why?"*, *"Who?"*, *"How?"*, *"Why This Team?"* and *"What/Where [this week]?"*. Individually, participants are asked to set aside time at least once a week to fill in their own personal thoughts about their company in this notebook. Later, once per week each team had to commence a session by, in their groups, filling the same format (called the Essentials Sheet) based on a consensus of what the different team members had written on their notebooks. The purpose of this exercise is to help participants identify and document the events that are likely to change their thinking around their company (e.g. customer interactions, insights on suppliers or manufacturing and lessons from prototyping). This assignment was designed to help participants avoid improving appearances or creating falsely favorable impressions, at the expense of working on activities that push the company forward (e.g. prototyping, developing, pricing, etc.). *"It's even more important, though, that you're having an out-loud dialogue with yourself and your co-founders about the foundational beliefs you're building your company on"* (Launchpad 4 - Assignment 00, 2013, p.2). The weekly Essentials Sheet permitted to document rigorously and continuously the development of each team over the course of the program.

All sessions began with a short physical warm-up exercise facilitated by Andrew, a trained standup performer, in which all participants and guests interact in a different way each session. This allows setting the tone for the rest of each session and allows for participants to get to know each other better. Pitches, progress presentations and feedback from teaching staff, but especially from other teams, happened regularly. Teams were encouraged to seek help from others, but especially from each other in the class. Another team would frequently review internal team brainstorming sessions in order to gather a different perspective.

THE VENTURES

ALEXO

Produces esthetically appealing jewelry that allows women to repel an aggressor and notify authorities with the push of a button.

Team conformed by two graduates and one undergraduate Stanford students in the field of Electrical Engineering, second year PhDs and a third year bachelor respectively. All team members were USA born, with two having an Indian origin. Two members

were male and one was female. All three team members had high GPA scores (3.8-4), had some form of industry experience, had won multiple achievement and scholarship awards for their academic performance and formed part of one or more social clubs.

Initially the team's description of their offer was: "A bracelet that would offer immediate easy access to trigger a signal for help in a moment of crisis." Their two initial reasons for tackling this venture were that current products are not easy to access and that new technology could increase safety. The team was motivated by the possibilities offered by new developments in technology that could allow creating such a device in a very small scale, the unappealing devices in offer at that moment (the female participant carried a small pepper spray on her key chain) and the attention of the media to recent sexual abuse cases. Their initial target users were very broadly described as women feeling vulnerable, the elderly and anyone in need of help during a crisis.

Midway through the program, the team would begin to describe of their vision as: "Products which empower women to protect themselves" and began to consider producing a jewelry line that could attach a circuit module containing the siren and Bluetooth technology to connect to the user's phone. They would describe their motivation for continuing to tackle this venture as "We believe that all women should feel safe." and began to describe their target users as young women who were active and social and also parents and friends who wanted to protect their loved ones. During the Beta Trade show, the team achieved their first pre-order by presenting their product through a poster and website which showed their initial aesthetic prototype.

At the end of the program their main motivation was to ensure that all women felt safe in any situation and their vision was then described as providing women with peace of mind in various situations. Their offering was two styles of bracelets, described as the "Sporty Line" and the "Fashion Line", and had expanded their efforts in supporting awareness and education to the general public on sexual assault seeking to partner with women's organizations and universities.

The two male members of the team focused on electronics and mechanics of the device, while the third had her main focus on user testing, interviewing and contacting possibly interested organizations or associations. However, despite it being described as one of their value propositions and a recurring comment in user interviews, the main focus of the team was on the technological development, and, considerably less on the aesthetic aspects. The team's strong focus on the technological aspects was also noticeable on the

financial model and projection of the business with only a single line referring to "Advertising" as an operational cost.

After the course, the team went on to take summer jobs while continuing to work on Alexo on the side. This eventually led to the abandoning of the venture.

ALTURA

Produces a coffee brewer that delivers all the benefits and none of the drawbacks of French press and filtered coffee makers.

Team conformed by two graduate students from the Stanford Business School. Both were at the moment going through the last year of their MBAs, they each had a couple years of previous work experience at renowned companies with a mix of analytical and commercial roles. Both team members were male and USA born. The following quote from one of the instructors best describes the energy of the team: "We wish we could pack you passion and fearlessness into the candidates that did not get into Launchpad this year. Thank you for that - it is a pleasure to be around."

Initially the team's description of their offer was a coffee maker that would brew everyone's perfect cup of coffee. Their initial motivation for tackling this venture was that current products required certain tradeoffs. "French Press coffee makers leave a residue, while filter coffee often leads to under-extracted coffee." Their initial target users were very broadly described as coffee lovers. The team partnered with an industrial design studio in Oakland to help them design and produce initial prototypes.

Midway through the program, the team would begin to describe of their vision as "an easy way to brew an amazing cup of coffee, delivering the cleanliness of pour-over with the controlled extraction of a French press." Their visible and expressed love for coffee and the continued belief that it could be relatively easy to produce an amazing cup of coffee was their main motivation for continuing to tackle this venture. However, they began to focus on their target users towards a more specific crowd of coffee lovers, who like gadgets and appreciate a beautiful design. Their prototyping and testing efforts had lead them to an appealing and functional coffee maker, which was still to be iterated on, but had already achieved some level of success during the Beta Trade show by selling 7 units.

At the end of the program their main motivation was towards the experience of making coffee and its impact on how a person starts the day. Their offering was simply great

coffee but their target user was by then focused on what they described as "foodies", "coffee nerds", gift givers and "people who appreciate the process as much as the end product".

One of the team members decided to continue pursuing the venture at the end of the course, while the other decided to go back to his home town and continue working on his own entrepreneurial venture. The team member that remained would then participate in other Stanford venture events to continue gathering feedback and support, this eventually lead a few months later to a successful crowd funded campaign on Kickstarter.com in which the goal was exceeded by 400%, raising almost 200.000 dollars.

EDUNAUTICS

Develops mobile technology and analytics that allow students to notify anonymously and in real-time when they've lost track of a course's content, to later help teachers understand where additional attention is needed.

The Edunautics team is composed by three graduate students from the field of Aerospace, Aeronautical and Astronautical Engineering at Stanford University. One team member was Australian, another from South East Asian origins and the third from the USA. All three team members had previous professional experience in leading companies, high GPAs, participated in diverse student groups and could code in different computer languages.

Initially the team's description of their offer was: "Tool to make the classroom a more comfortable and engaging environment." Their initial reason for tackling this venture was that in their view lectures were often ineffective given that students do not ask questions and teachers do not know when students are lost. The team was motivated by the possibilities offered through widely accessible mobile devices and the recurring frustration throughout their own lectures. Therefore, their initial target users were students and professors.

Midway through the program, the team would begin to describe of their vision as: "A way for students to anonymously convey their confusion during class and a means to address this confusion after class." They had by then developed a simple sliding bar app which students could tap when they felt confused during a lecture. This would produce a set of statistics that, matched with the lecture's schedule, could inform the teacher of

what specific topic had caused greater issues. After some testing and later interviewing students and a few professors their motivation for continuing to tackle this venture was focused on helping students voice their confusion and "not feel helpless during class." Their target users were now college students from classes of 50 students or more, but they had recognized that teachers would likely be the buyers. At the Beta Trade Show, the team presented their product and managed to sell one subscription to their service.

At the end of the program their main motivation was to ensure that students would openly communicate issues during lectures and that any confusion would be addressed during class instead of after it. They had improved the data visualization for the teachers and were focusing on all types of students and teachers in medium to large sized classes.

All team members had engaged in both testing and development during the course of the program. Testing has been done both at Stanford and other colleges with positive feedback. Development had advanced both at the app and data visualization level in regards to the functionality and usability. However, turning testers into buyers was proving difficult and the overall business model was still not clear.

At the end of the course the team had declared being motivated to continue pursuing the venture, this however was not the team's highest priority and the effort was abandoned.

PAWPRINT

Produces a dog collar that allows owners to monitor and track their pets' movement and health real time through their mobile devices.

Team conformed by four first year graduate Stanford students, one in the field of Electrical Engineering, and the other three pursuing an MBA from the Graduate School of Business. All four team members did their undergraduate degrees in engineering at renown USA universities graduating with honors and distinctions. Three team members were USA born and male, and the fourth was of Rumanian origin and female. All three team members had high GPA scores, had won multiple achievement and scholarship awards for their academic performance, formed part of one or more social clubs and all but the Electrical Engineer had at least two years of industry experience. Two team members focused on the engineering activities, one focused on the user experience and overall design and another focused on the operational aspects required.

Initially the team's description of their offer was viewed as the: "Nike of dog collars", a smart dog collar that could track pet activity and changes in the pet's health. Their two initial motivations for tackling this venture were that people worry about their pets when they are not around and that pet owners want to track the pet's exercise and health. Their initial target users were very broadly described as new pet owners, the owners of older or problematic pets and pet owners who care a lot about fitness. The product was initially called Pawler and was later changed to Pawprint. Their initial efforts were mainly focused on the aesthetic aspects of the venture and on determining the most important features using Google AdWords A/B testing. This allowed them to focus technical development efforts on the main functionalities and present a working prototype in the following weeks.

Midway through the program, the team would begin to describe of their venture as creating technology and user experience that allows for a deeper bond between a dog and its owner. This was to be achieved through a module in the dog's collar that would contain sensors that would in turn communicate via mobile or desktop with the owner through a dashboard displaying key metrics that described the pet's current and previous status. They believed that their user's were looking to create a deeper bond with their pets and began to describe their target user as a 23-35 year-old young professional who was a technology enthusiast and cared so much for their pets that would sleep in bed with them. At this time the electrical engineer member of the team decided to take his own way due to a misalignment of this member's perceived role in the team and a disconnected view of the future direction of the venture. During the Beta Trade show, the team brought along several dogs that wore the Pawpring collar and achieved 11 pre-orders of their product.

At the end of the program their main motivation was expressed as: pets giving their owners a lot of joy, despite owners spending a significant amount of time away from them. Their offering was expressed along the lines of an experience that allowed owners to have a better relationship and feel more connected to their pets and their target user was described as a pet owner and tech savvy working professional who shops in boutiques.

All team members expressed their commitment to continue working full time on their venture ambitions for the coming months to try to integrate it with other existing

products on the market. The team eventually pivoted and successfully launched a venture to the market within another domain.

DESIGNING MICRO-FOUNDATIONS OF DYNAMIC CAPABILITIES

The main emerging themes from our data were four micro-processes of dynamic capabilities. These are process in which the teams and the environment – generally speaking – become more differentiated from each other. The four micro-processes can be mapped to Teece's (2007) framework. The first two processes, "*Separating team identity from user motivation*" and "*Developing deep empathy for user needs*", correspond to Sensing in Teece's (2007) framework. Process three and four, *"Separating problem from solution"* and *"Pragmatically testing and realizing"*, belong to Seizing in Teece's (2007) work. The Reconfiguration aspect is depicted as the ability to stay hungry through having an ambitious *"Long Term Vision"* and as the ability to successfully implement the "New Vision". The six processes for all four ventures are analyzed below and summarized in Table5.

SENSING: SEPARATING TEAM IDENTITY FROM USER MOTIVATION

The first process is called Separating team identity from user motivation. It entails a stepping back of the team members to understand their own role within the ventures, their own desires in relation to the product idea, and a mapping of their different technical skills. This entails becoming aware of one's own positive affect to the product idea and being able to purposefully step back from it, or to put it in other words, the team identity becomes crystallized. This enables the team member's to realize whether the potential target user of the product have similar motivations, background and desires then the team members or whether they are different. This is a necessary prerequisite in sensing an opportunity in the market. Become aware of one's own desires and being able to separate them from the motivation of the target user also works as a safeguard against cognitive blind spots and strategic inertia (Hodgkinson & Healey, 2011).

Alexo began their venture with a clear identity as *"Engineers who can build tech"*. One of the team members carried a small pepper spray on her keychain and they were very dedicated in identifying the user motivation in engaging with various women and women groups. The team was quick to separate their own views and needs from those

of the different users. Engaging with users shed light on the different perspectives between women on appearance, perceived vulnerability, identity, etc. The team carefully reflected and attempted to build on these diverse perspectives and motivations.

Altura started with a simple purpose statement of *"adventurous coffee drinkers"* to describe both the potential users and the team members. Separating the team identity from the user motivation allowed them to zoom-in onto their potential users by engaging with them in various coffee shops. This subsequently evolved to an identification of sub-types of users and a clear description of the technical skills of the team needed such as marketing and distribution experience.

Pawprint presented itself as a means to keeping track of a pet while its owner is away at work, describing the target user as *"Busy pet owners"*. Describing the target users as busy pet owners was in fact an abstraction from their own needs as busy Stanford students with a heavy workload and a high career focus. The team further identified itself clearly as having an *"Alignment of expertise …", specifically having knowledge on "hardware, user experience, manufacturing, and data".*

Edunautics struggled the most in separating the team identity from their potential user's motivation. They could not successfully disentangle their own experience as students in classrooms and how it might differ from other students. The team stated being very passionate about the idea given that lectures where often ineffective given that students didn't ask questions and that teachers don't know when the students are lost. *"As students, we've all been in the situation where you're lost in class but everyone else seems to get it, so you don't want to be the one to raise your hand to ask a question."*

Sensing: Developing Empathy for User Needs

The second process within the sensing phase is developing empathy for the needs of the users. The previous phase of separating the team identity from the user motivation is necessary to pass to the second stage. Only when someone is aware of one's own desire can someone show empathy for the needs of someone else. Generating empathy is at the core of design science methodology and design thinking (Beckman & Barry, 2007; Thomke, 2003). It entails the two important steps of discerning between what the user says and what the user does, and recognizing the thoughts and feelings of the user. Only an emotional connection to the deep and often hidden needs of the users enable a venture to sense a real opportunity in the market. This incorporation of the emotional

sides of our brain helps the developers to get the proper intuition about needed product functionalities (Hodgkinson & Healey, 2011).

Altura's passion for coffee allowed it to quickly engage with other coffee lovers and identify different needs among them *"Current options require users to make trade-offs"*. The difficulty for the team was not in empathizing with the user, but on identifying which of these trade-offs were the most important to users. *"In my head it was like this product is going to be everything to everyone and it's going to have these ten features…"* Having initially sought to be all things to all users, the team was forced to dig deeper into their user needs and reflect on different insights, realizing that for example: *"The average premium coffee drinker is a bit intimidated by the "chemistry set" approach of many at-home premium brewers."*

Pawprint initial focus was clearly oriented to the new markets and areas of opportunity in mobile devices and the internet of things. They stated their first user need as *"Ways to monitor the health and the fitness of their dog"*. Engaging with a vast amount of dog owners allowed them to detect and later highlight the emotional factor of pet owners wanting to connect with their pets, viewing *"dogs as part of family"* and people who show *"Deep care for their pets"* and *"Sleep in bed with them"*. This development allowed gathering numerous insights on pet owner's activities and needs, like for example users were not interested in just having information about their pets, they want suggestions on how to better care for them. These observations were collected for later prototyping and testing.

Alexo engaged in numerous conversations with women who could potentially use their product and quickly iterated their pitch from a technological one to one focused on empowering women, *"We believe that all women should feel safe"*, and target user was always referred to as *"women in vulnerable situations"*. These statements remained practically static during the remainder of the program. While this portrayal of their user's needs may very well be accurate, the team gives little or no insights about the specific needs of women in different situations of assault. This is certainly a very difficult topic and it is may prove difficult to generate empathy, particularly for the male members of the team. Yet having decided to go for this market niche, being able to successfully explore it and empathize with the difficult situations that women might be facing was essential.

In the case of Edunautics, the team was not able to put aside their own experience as students and furthermore could not depart from stating their user need in only the functional terms of *"Teachers and students in medium to large sized classes"*. While initial observations and engagement with students and teachers lead the team to insights on teachers' reactions that questioned the use of mobile devices in class or that stated a higher focus by university professors on research, the team decided to focus their attention only on students. Further on, despite teachers stated as being one of their target users, these were not again significantly addressed.

SEIZING: SEPARATING PROBLEM FROM SOLUTION

Problem solving has traditionally followed an often-unquestioned sequence of problem identification, idea generation and selection (Fryer, 2012). It is certainly a human trait to think in terms of tangible solutions early on and to become emotionally attached to them. However, this carries the risk to escalate commitment to the wrong solutions that do not match the actual problems of the users (Hodgkinson & Healey, 2011). Some research has however identified these problem solving stages to be actually quite iterative (Lubart, 2001) and this iteration as an important part of the innovation process (Hülsheger, Anderson, & Salgado, 2009). Being able to realize one's own attachment to a solution, such as for example a prototype, and to be able to let it go if testing proves unsuccessful is a critical capability for innovation (Beckman & Barry, 2007). Other research has highlighted the benefits of reflecting on a problem from varied perspectives (Miron-Spektor, Gino, & Argote, 2011) to then identify novel problems (Zhang & Bartol, 2010). More recently, Harvey (2014) highlights the effectiveness of developing a synthesized understanding of a problem at hand for a group to foster creativity.

Altura quickly understood that from a myriad of drawbacks two were essential *("A French press with the benefit of a paper filter"*). However, it was not until the end of the program that the team realized the value of their solution was not in simply offering a new type of coffee brewer, but in offering an overall experience that could replace a user's need to visit a local coffee shop each morning. Aiming then their offering to *"...people who appreciate the process as much as the end product"*.

Pawprint also showed some slight difficulties and followed a similar pattern. While the solution at hand was a dog monitoring collar, the problem shifted from that of busy people left their dogs alone (*"A smart dog collar that monitors pet activity and health"*),

to people that wanted to create a better bond with their pet ("*A way to create a better bond with your pet"*), to an ecosystem that could integrate different products and services for people who wanted be better connected to the pets needs and finally to the realization that this problem was that of only a few. This lead the team to the conclusion that they must reconfigure their vision and efforts towards other opportunities.

Alexo gathered and reflected on numerous insights that made it clear that although this was a situation on the minds of many people, it was a particularly difficult topic that most would try not to think about or decided to avoid. Alexo was successful at grasping this separation, moving from a solution focus by saying that they wanted to build *"An on-person security bracelet that can be activated in moments of crisis"*, quickly shifting to *"Providing women peace of mind through beautifully designed products"* and finally evolving onto supporting or creating an awareness campaign.

Edunautics showed a medium level of success with this dimension. The team initially started with the solution focus of quantifying confused students in a class, but then moving to an abstract problem statement *"Helping students who feel helpless in class"*. Although the team discovered various pain points for both students and teachers, they showed difficulties to integrate these various views or to focus efforts on any other than their own personal pain points.

SEIZING: PRAGMATIC REALIZATION AND TESTING

In order to push a product or service to market it is necessary to be able to realize the initial idea pragmatically and test it. This is especially true for entrepreneurial ventures that are generally lacking resources and need to rely on bootstrapping to a large degree. But being able to realize pragmatically means again being able to quickly let go of certain non-essential features of the product that an entrepreneur may feel attached to and to accept failure.

Alexo is the most noteworthy case in this dimension. The team excelled at building prototypes. A total of 5 different functional *"works-like"* prototypes were built and tested, as well as 4 conceptual *"looks-like"* prototypes. However the disconnect between the team's gathered insights and their pragmatic focus is evident throughout the program. The team's focus was therefore not necessarily centered on helping women, but more interested in building what they viewed as a solution. Not being aware of their own technical focus, subsequently let them to jump too quickly into prototyping without really considering the observed user needs.

Altura was highly successful in rapid prototyping, testing, selling and iterating. Moving rapidly from their all-encompassing solution to specific value proposition led to various rounds of prototyping and testing. Realizing that potential users would not necessarily try the coffee produced by their brewer before buying their product, gave the team a strong focus on the physical design of the product. During the Tradeshow the team was successful in selling a few dozen pre-orders of their product. In this experience Altura learned the impact of the physical design of their product to the preparation process, which turned their attention to the experience of preparing coffee rather than the coffee itself. The team was also successful in building relationships and partnerships with different external stakeholders, which allowed them to quickly iterate and test their different models and offer.

Pawprint approached user testing in a different, yet equally successful manner. The team could quickly test and iterate the physical form of their device by 3D printing *"look-like"* versions of their products. The technological development was initially developed and tested in a slightly larger form with an external power source, later improved to hold its own power source and to execute a proof-of-concept on a real dog, subsequently reduced in to its real form size. The different functionalities resulting from Pawprint's engaging with potential users were A/B tested. Meaning that through placing Google AdWords leading to online mock websites offering different functionalities, the team could test what functions lead to higher traffic, views and clicks. These results where then adapted into their offering. The content and display of different analytics related to a pet's health and activity were also tested in this and personal form, leading to their development of an algorithm to generate useful recommendation.

Edunautics initially outsourced the production of their prototype and faced difficulties in bringing it back to an in-house development. Having finally achieved to do so thanks to one of the team members, their speed of realization and testing was quick but had fallen behind. The team was however successful in contacting and scheduling testing sessions with classes in different schools and universities in different parts of the country.

RECONFIGURATION: LONG-TERM VISION BUILDING

Having a long-term, inspiring vision in place provides the constant *"fuel"* to a venture to engage in cycles of rapid iteration. It helps the venture to always be connected to the hot

mode of their operation. It also serves as a reference point to the founders to whom they can compare the business status and identity of their enterprise. This in turns helps if the venture needs to renew its current form in response to a major threat in the environment (Hodgkinson & Healey, 2011). Beside the *"hot-factors"* related to the identity, having a long-term vision in place also enables the ventures to build on and nurture their co-specialized assets (Teece, 2007). This can be in the form of an overarching product architecture where the individual products benefit from the overall design and appeal, production facilities and brand image. Another example are complementing services to the core product which are enabling a seamless and unique user experience. Knowledge management systems that nurture *"Transactive memory systems"* in the organization are greatly beneficial in exploiting the possibilities of co-specialized assets (Argote & Ren, 2012).

Alexo remained true to the principles of their technical focus. They had a vision of expanding their product family from the initial bracelet to an entire line of jewelry and to partner with woman organizations. Despite their intentions, they never actually implemented those partnerships and they also did not create or blueprint a service suit complementing the bracelet. One of the teachers, Perry Klebahn, was pointing them to this weakness but they did not succeed in implementing this feedback.

"The advise we have going forward is to give your team license to take a broader look at the need you are solving for. You have focused to date and made the product you set out to. The experience around that physical product is now the next step. How do women engage with your brand and how does it become a part of their life (their sense of confidence) - this is a bigger product/service then your physical product and this is where this company must go to 'own' the customer. You are not just building a device - that is not as sustainable a business as a devcie with a thoughtful service round it."

Jake, the founder of Altura, had a vision in mind of how to expand the scope of its current product. This vision helped Jake to stay motivated to continue with his venture despite the frequent frustrations that he encountered in the path to commercialization.

"Duo, the vision is basically and I touched on this in Launchpad, I want to help people brew great coffee at home and that involves more than just the brewer, and that involved more than just the brewer. It's the drink, the grinder, the coffee storage; it's a whole portfolio of products that we'd be able to launch. Right now we're developing the parent brand to Duo. So Duo for me would be the Civic and now we're developing the Honda brand and then all the other products would live under that brand."

Similar to Alexo, Edunautics failed in envisioning the expansion of the product beyond the simple button that indicates confusion. They mentioned it a few times, but they never got down to envisioning a design blueprint, if only in their minds. It was again the

teacher Perry Klebahn who was pointing them to the weakness, without Edunautics implementing the feedback.

Pawprint successfully moved their initial focus of on the dog collar to the concept of creating a deep bond with the pet. They were creating an intuitive user interface where pet owner could see statistics of their pet and where additional service offers like booking a dog-walker could be integrated. Later on, keeping their team spirit, was one of the main reason why they repositioned their venture in face of the strong competitors in the dog collar market.

RECONFIGURING: NEW VISION IMPLEMENTING

Teece (2007) identifies reconfiguration as an essential factor of his dynamic capabilities model. Managers, or in this case entrepreneurs, must depart from established routines and deal with heightened anxiety in order to combine and reconfigure their available assets to meet customer needs. New or "less well-resourced" (Teece, 2007) ventures are perceived as more flexible in its routines and more capable in dealing with heightened anxiety. In this face it is thus essential to get the speed and the drive to implement the new vision and to embark onto a new cycle of capability development. The high-speed that the Launchpad program requires from the participants is forcing the ventures to be strong in this phase.

Altura faced a single reconfiguration cycles. Having focused their target market and understood the core needs of their users, Altura recognized the that the value of his product did not lie solely on great coffee, but on an experience of making coffee that could substitute the daily morning stop at a coffee shop. This shift from product to experience not only impacted the design of the physical product, but also the future vision of a product/service family.

"I want to help people brew great coffee at home and that involves more than just the brewer. It's the drink, the grinder, the coffee storage, it's a whole portfolio of products that we'd be able to launch."

Alexo faced two main and distinct reconfiguration cycles. The first represented a shift from a technological solution to a fashionable accessory. The second was the evolution from a fashionable accessory to an educational and awareness movement. However, a purely technical approach to these challenges proved insufficient to tackle them and the team was adamant to acquire external help or enlarge the team. While moderately successful in implementing the first reconfiguration cycle, the team appeared to loose

motivation to implement the second cycle as it required more attention on areas outside their technical capabilities.

Pawprint had the fastest iteration, going through four reconfiguration cycles. Their initial proposition of a collar that could keep track of a dog's activity when the owner's were away, rapidly moved onto establishing a deeper connection with a pet by monitoring his state and condition over time. This lead the team to a third configuration cycle where they explored integrating their product into a network of other intelligent pet products on the market which could lead to data analytics based services for pets. Having closely analyzed the needs of their customers, competition and the size of the market, the team announced at the end of the program that they would pivot entirely. Therefore running through a fourth reconfiguration cycle, in which they successfully launched a new product focused on the digital photo book market.

Edunautics was unsuccessful in completing a reconfiguration cycle. Their vision successfully shifted from a mobile application that could allow students voice their concerns from a lecture anonymously to a system that could help students better engage with their teachers to improve learning. However, the team's main difficulty lied in detaching themselves from the product and gaining the necessary empathy for the teacher, in order to offer a holistic solution.

Dynamic capability	Micro-foundations	Altura			Alexo		
		Development	Quote	Success	Development	Quote	Success
Sensing	Separating team identity from user motivation n	From same identity as coffee lovers to user subtypes and differentiated team-skills	Initial: *"Adventurous coffee drinkers"* Subsequent: *"Scrappy team"* *"Marketing & distribution experience"*	High	Only Functional team identity but got down to differentiated user types	*"Engineers who can build tech"* and : *"Women in vulnerable situations"*	*High*
	Developing deep empathy for user needs	From abstract assumption to expression of feelings and desires	Initial: *"Current options require users to make trade-offs"* Subsequent: *"Intimated by chemistry approach of existing brewers"*	High	Not able to show real empathy for users. Stayed with unchanged normative statement.	Static: *"We believe that all women should feel safe"*	*None*
Seizing	Separating problem from solution	From improving the French press to great coffee experience	Initial *"A French press with the benefit of a paper filter"* to Subsequent: *"People who appreciate the process as much as the product"*	Med-ium	From pure solution thinking to problem identification	Initial: *"An on-person security bracelet that can be activated in a moment of crisis"* Subsequent: *"Providing women peace of mind through beautifully designed products"*	*High*
	Pragmatic realization and testing	From wishes to clear requirements	Initial: *"Combining the best features of a French press and pour-over"* Subsequent: *"Beautifully designed, easy to clean. Delightful to use, integrated coffee brewer"* Great trade-show performance	High	Sophisticated and rapid engineering and prototyping skills. Failure to conduct real user testing.	Data shows they built multiple designs for looks-like and works-like prototypes but failed with really testing it with the users	*Low*
Recon-figuring	Long-term vision building	From single product to product architecture	Initial: Duo coffee brewer alone Subsequent: *"So Duo for me would be the Civic and now we're developing the Honda brand."*	High	Technical vision but failure to develop service suit around it.	Idea to develop a line of jewelry consisting of a *"Sporty Line"* and a *"Fashion Line"*. Failure to envision a service line around it that actually helps women when being in danger	Low
	New vision implementing	Shift from product to experience	Completed one reconfiguration cycle. Successfully raised $200k	High	Shift from tech to fashion. Failure in developing further.	Move from technical vision to jewelry. Failed to move away from functional focus. Venture abandoned	Low

Table 5a – The Six Processes of Building Dynamic Capabilities

Dynamic capability	Micro-foundations	Pawprint			Edunautics		
		Development	Quote	Success	Development	Quote	Success
Sensing	Separating team identity from user motivation	From own experience to differentiated user types and team skills	Initial: *"Busy pet owners" Passion with the product"* Subsequent: *"Hardware, user experience, manufacturing, data"*	High	Missing abstraction between team and user identity	From *"We have been lost as students" to "Teachers and students"* and *"We want to pass the next exercise"*	None
	Developing deep empathy for user needs	From outcome focus to identifying the underlying emotional need	Initial: *"Ways to monitor the health and fitness of their dog"* Subsequent: *"Deep care for their pets. Sleep in bed with them"*	High	Failure to connect to the needs of teachers	Static *"Teachers and students in medium to large sized classes"*	None
Seizing	Separating problem from solution	From solution focus to problem identification	Initial: *"A smart dog collar that monitors pet activity and health"* Subsequent: *"A way to create a better bond with your pet"* Focus on ecosystem	Medium to High	From solution focus to problem identification	Initial: *"An app that allows students to indicate their comprehension of lecture material"* Subsequent: *"A way for students to indicate that they see a problem in the lecture"*	Medium
	Pragmatic realization and testing	Flexible iterating between user need, prototype, website, and testing.	Initial: *"Electronic device with software"* Subsequent:	High	Technical prototyping and testing difficult. Some good classroom testing sessions.	Unsuccessful outsourcing of prototype building. Later some good testing and prototypes. Too slow overall.	Low-Medium
Reconfiguring	Long-term vision building	Vision of product service architecture. Strong Team spirit	Vision of user experience where additional services could be sold. Focus on keeping their spirit going to enable pivoting.	High	Failure to envision overall product-service architecture.	Focus on the button alone. Failure to envision additional services despite teacher feedback.	None
	New vision implementing	Successfully moved through four cycles	From focus on a dog color to pivoting to produce photo books.	High	Did not complete even one cycle	Unsuccessful. Venture abandoned.	None

Table 5b – The Six Processes of Building Dynamic Capabilities

DISCUSSION & CONCLUSION

Based on our findings, we developed the model presented below (**Figure**). It aims to illustrate how a firm forms affect and therefore attachment to an existing solution, may it be a product, service or way of doing business, and within a dynamic environment may either develop the dynamic capability to renew its offered solution or fail as a cause of its non-action. To achieve the full cycle and generate a new solution would represents Teece's (2007) reconfiguration, defined as the: "Continuous alignment and realignment of specific tangible and intangible assets." Therefore going through his entire framework of sensing, seizing and reconfiguring would signal the generation of dynamic capability.
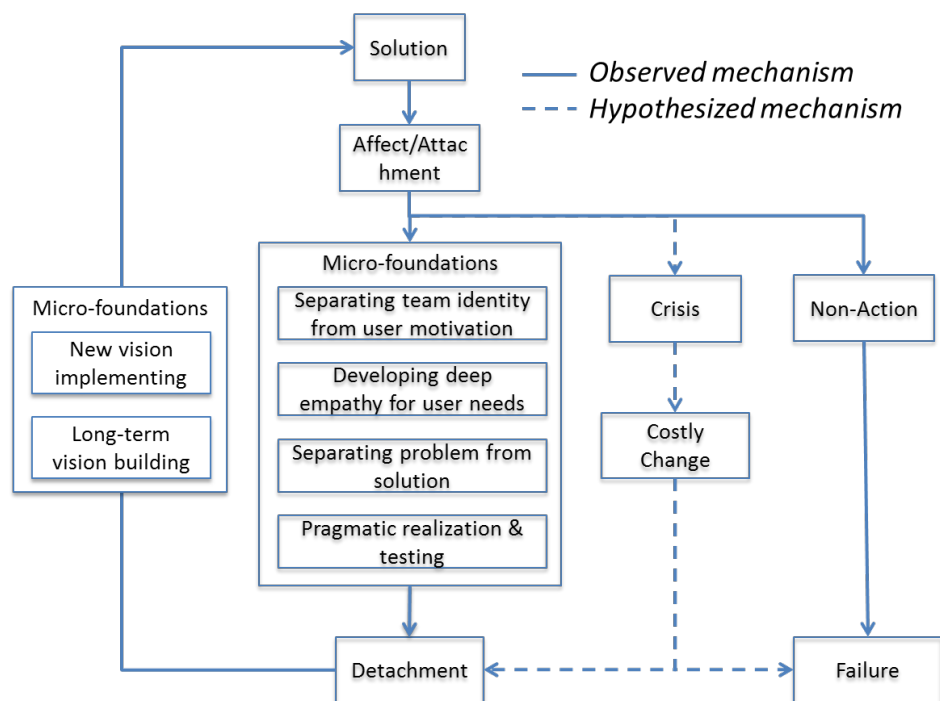

Figure 3: Designing Dynamic Capabilities Framework

This cycle was continuously observed throughout the duration of Launchpad and those teams who showed to have developed the necessary capabilities to continue to do so appear to, have so far, had more success in launching their ventures. One of our propositions and calls for discussion is that large firms may enquire costly change at moments of crisis in order to survive through the process of detachment and generation of new solutions. This could be in form of an expensive acquisition of another company of the firm fails to develop an important capability on its own. Non-action can also lead to failure in small and large-firms like the failure of Alexo and Edunautics in our sample, or the Case

of Polaroid which failed to adapt to digital imaging. (Tripsas & Gavetti, 2000). Given their recent popularity within large firms, further research into the role and impact of so-called "Innovation Labs" and corporate venture capital may help shed light on their possible development of dynamic capabilities (Chesbrough, 2002).

Our first contribution sheds light on the genesis of dynamic capabilities, both from an entrepreneurial and a psychological perspective. From the entrepreneurial site, it was the entrepreneurial drive, the risk-taking behavior, anxiety, and the exposure to the reality of the market that led Altura and Pawprint to engage in various cycles of capability development. This confirms and further details some of the theoretical propositions of Teece (2007) who put forward that organizations need to convert high-levels of anxiety into internal change for reconfiguring their business. In terms of the psychological foundations we are showing how the process from being emotionally attached to an idea to detaching forms a micro foundation of a dynamic capability. By relating it to the process of crystallization of the identity of the team and to the identification of the user motivation we are further adding a detailed level of analysis to Hodgkinson & Healey's work (2011). In terms of the discussion on how individual level factors shape the formation of dynamic capabilities, our research rather runs counter some of the propositions by Felin & Foss (2005) as we find great importance of team level factors such as team spirit or team identity.

The second and most important contribution of our model lies in our description of the process of forming dynamic capabilities. Our detailed pinning down of concepts, themes and aggregate dimensions makes the often "fuzzy" concept of dynamic capabilities describable. We are thus offering an illuminating case study (Teece, 2012) that shows that the concept of dynamic capabilities is of use to explain firm performance opposite to what its critics (Arend & Bromiley, 2009) claim. Within the sensing phase we show how the emotional interplay between the selection of the opportunity (cp. Gruber et al., 2008; Shane, 2000), the crystallization of the team identity (cp. Fauchart & Gruber, 2011) and the development of empathy for the user (Beckman & Barry, 2007) enables a venture to get a real understanding of the market need. Within Seizing, we show how ventures can explore their market niche by flexibly iterating between problem identification, solution drafting, and market testing. This gives a more detailed and nuanced account to what Teece (Teece,

2007) has generally described as selecting enterprise structures, designs, and procedures. In the reconfiguration phase, we are again adding further depth to the work of Hodgkinson & Healey (2011) who point to the importance of the frequent redefinition of social identities. We are adding how this process is triggered and influenced by the long-term vision and implemented through rapid iterations. This also adds further to the conceptual work of Augier & Teece (2008, 2009) who emphasized the role of goals for designing dynamic capabilities.

Thirdly, our research aids to the understanding of whether dynamic capabilities are only important in fast changing environments (Barreto, 2010; Di Stefano et al., 2010) and whether they are related to firm performance directly (Teece et al., 1997) or indirectly (Eisenhardt & Martin, 2000). Related to the first question, we can conclude that dynamic capabilities are at least of more importance in fast changing environments. The beauty and the value of the Launchpad program lies in creating a fast-changing environment in which ventures need to adapt quickly when they want to avoid failure. The idea being that ventures who are successful in this program will be more resistant to the stormy wind of the "real market". In terms of the relation of dynamic capabilities to firm performance our answer is a more qualified "it depends". Sales and profit generated are not the perfect measures to assess the success of a young venture. Within the first one or two rounds of iteration, the link to performance can't be seen yet, but during the later cycles, Altura and Pawprint showed success in term of first sales and capital raised.

LIMITATIONS AND FUTURE RESEARCH

We have followed the startups intensively during the Launchpad program and tracked their developed afterwards. Nevertheless, this is still a limited timeframe and we can only assume the long-term success of the ventures. In addition, the Launchpad program at Stanford, in the heart of the Silicon Valley, has qualities of a "talking pig" (Siggelkow, 2007, p. 20). Both the pressure to be innovative and the support given to the ventures are extraordinarily high. On the one hand, this could pose difficulties to the generalization of the findings to other parts of the world. On the other hand, start-up accelerator programs at Stanford and the eco-system in Silicon Valley serve as the role-model for numerous

similar accelerator programs and industrial regions. The mimicking of even the name *"Silicon Valley"* by other regions such, as Israel's *"Silicon Wadi"* are a case in point (Bresnahan, Gambardella, & Saxenian, 2001; de Fontenay & Carmel, 2004). Additionally, one could argue that most ventures are not coming out of start-up accelerator programs at universities. We believe though, that start-up accelerators simulate normal market forces and thus comparison to other ventures can be made at least to some degree. In addition, the role and impact of start-up accelerators and venture incubators has recently gained momentum within research as in practice (McAdam & McAdam, 2008), which we believe increases generalization of our findings even in the conservative case.

As all qualitative research, this paper aims at generating theory, not at testing it. Future research should validate our predictions on a larger sample. Future research could also examine how different types of founder identities shape the formation of dynamic capabilities. The link between "hot" or "cold" cognitive states of entrepreneurs and that of founders' identities as Darwinists, communitarians, or missionaries (Fauchart & Gruber, 2011) may as well be an area of future research. Another interesting aspect would be how different team dynamics and team compositions influence capability development. Finally, and following on previous calls (Zahra et al., 2006), further research is needed on how building dynamic capabilities differs between entrepreneurial teams and large firms. Can large firms incorporate the team spirit and motivation of entrepreneurial ventures into their operations? How can deep empathy for the user need be transferred between different people and functions, like marketing and R&D? How can a firm identify be shaped in response to the needs of the users? We hope that these questions can pave the way for further research and that the insights generated through our study are stimulating for fellow researchers.

All ventures underwent a selection process in order to participate in the program at an early stage of development, however one may argue that certain ventures held the initial advantage of proposing a product that already met their markets' expectations, in which case they did not need to detach and reconfigure their solutions. Our observations indicate that although some teams did in fact initiate with a solution closer to the needs of their market. We argue however that although an intelligent dog collar may be indeed an ideal solution for a certain market, the venture needs nevertheless to sense, seize, and

reconfigure their solution in terms of the appropriate functionality, product design, interface, pricing strategy, marketing channels, packaging, complementary products and services, etc. While a single product or service new venture may perhaps be the simplest form of a firm, it still represents a high number of key elements to which the founding team must determine an appropriate solution and quickly reconfigure if need be. Each of these solutions could very well be the difference between the eventual success or failure of the venture.

CONCLUSION

The term Design Thinking has been increasingly used in recent years by a growing number of firms, organizations and governments as an approach to innovation. They use the term to describe the process by which a multifunctional team tackles a problem by exploring the underlying needs of the people most affected by that problem—whether that be customers, users, etc.—then, based on these observations, defines the root cause or key elements of the problem and finally attempts to resolve it through an active cycle of ideating, prototyping and testing potential solutions. This thesis aimed at better understanding its implementation and use by managers in the context of innovation management. With this objective, I first conducted research within academic literature, followed by an ethnographic study focused on the use of Design Thinking by both large firms and entrepreneurial teams.

This dissertation is divided into three papers; in first paper of this dissertation I examined the different elements in the Design Thinking process within the context of management research. I found that, although the process as a whole has previously been given little attention in academic research, each of its individual components has been previously researched. The second paper of this dissertation explored how large firms use Design Thinking as an approach to innovation. Based upon direct observation and interview data we found evidence of links between Design Thinking and Absorptive Capacity. The final paper described the effects of Design Thinking on the venture creation process. This work was based on ethnographic research conducted at Stanford University wherein twelve teams participated in an accelerator program that uses a Design Thinking approach with the goal of creating and launching new ventures.

CONTRIBUTIONS

The first goal and contribution of this work was to offer an overview of what Design Thinking is in theory and in practice and the potential outcomes of its use for organizations and entrepreneurs. In doing so, I consider this dissertation represents contributions for both theory and practice.

Within the context of management literature this work has three main contributions to theory; the first by having shown and integrated the previous relevant research which might encourage future researchers to explore this innovation process as whole, the second lies in advancing the conceptual understanding of Absorptive Capacity by presenting evidence that may lead to further research on how it occurs and how to measure this construct of innovation, the third contribution answers numerous calls for research for a description of the genesis of Dynamic Capabilities and a better understanding of its micro foundations at both a cognitive and an emotional level.

This work also advances our understanding on the practical applications and limitations of Design Thinking from which we present three main contributions.

Throughout the past two years of this research I have met multiple Design Thinking managers and practitioners that have shown great interest in understanding the underlying mechanisms behind the process. They practice Design Thinking as an auto mechanic might learn how to fix a car; they know what to do but not why. Therefore, the first contribution to practice from this research is to present an introduction to the engineering behind their technical knowledge and in a way justifies their efforts. The second contribution to practice is the illustration on the different industries and approaches to apply Design Thinking as for the limitations of doing so. This was again a frequent question from managers who have heard about Design Thinking, but are unsure of how this could fit within their organizational structure and current innovation efforts. Finally, this research contributes to entrepreneurs or entrepreneurial teams in their venture creation process. Throughout our interviews, all teams acknowledged that their biggest take aways from this program were to continuously go out and empathize with their potential customers and to distill their insights from doing so to iterate their product or service. In our observations we find that those entrepreneurial teams that were the most successful were the ones who could decouple the passion for their venture, from the form and function of their product or service.

GENERALIZABILITY

The scope of this research in itself shows the potential generizability of its findings. We have studied large and nascent firms from the United States and Europe, in industries spanning from banking and consulting to retail and software. The challenges faced by these organizations covered everything from business model reconfigurations, to redefining NGOs missions, from exploring new solutions for existing customers and new customers for existing solutions, to improving the future of college education. We conclude that the generizability of design thinking lies not in where it is applied, but rather on why and how it is applied. A Design Thinking project should aim at resolving problems that center around people, not solutions in the form of existing products and services. A Design Thinking challenge should be framed as an open exploration of an activity or experience, not as a marketing research question. A Design Thinking culture should allow for learning by sharing knowledge across internal and external organizational boundaries, not as en elite and secretive group that lies above the rest.

Design Thinking is not a substitute for existing technological and marketing research processes, it is rather a complementary tool to explore their impact. Not this, nor any other innovation methodology, is a silver bullet for innovation. Design Thinking in itself will not necessarily increase an organization's innovation output. Design Thinking will however help an organization, and more importantly the organization's employees, to learn more about its customers and their needs. This understanding may lead to both a sense of meaning for an innovation effort and the team spirit necessary to push it forward.

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