THE VALUE OF DESIGN RESEARCH

TOWARDS AN INTEGRATIVE DESIGN THINKING MODEL

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ABSTRACT

Over the past 15 years design thinking has surfaced as a powerful creative problem-solving approach for innovation. It provides a mechanism to address the increasing need of organisations to collaborate across boundaries (Meinel and Leifer, 2011, p. xiii), and to move from a functional system-centred approach to a user-centred approach (Lande, 2012, p. 30). Stanford University and the renowned design consultancy IDEO have been at the forefront of the development of design thinking models. Professionals from various fields of knowledge, mostly inspired by Stanford and IDEO, have also conceived models of design thinking. These and other similar approaches present different disciplinary standpoints. Some have preconceptions on the nature of the solution of problems to be addressed. Whatever the model, the information available to learn about them is fragmented. Trying to navigate these models seems confusing. With an increasing demand for design thinking knowledge, a common understanding is imperative; common definitions and toolboxes are needed, as well as simplification (Dorst, 2011, p. 521). This paper presents a preliminary account and literature review of a wider research project that aims to combine and synthesise various successful existing methods into an integrative design thinking model. This model will present a unified set of terms, processes, techniques, methods, principles and behaviours, and will be represented in an understandable, simple way. It is to be used within business, industrial, and academic contexts. The aim is to enable the effective practice of design thinking within and across disciplinary boundaries, and to improve the practice of design thinking.

Keywords: Design thinking model, design thinking method, innovation, Stanford, IDEO.

1 INTRODUCTION

Organisations face complex and ambiguous challenges as globalisation, technology and society advance. Competition is stronger than a couple of decades ago and it is increasingly difficult to compete in new ways. Since the 90s, Porter (1990, p. 73) has argued that a nation's competitiveness depends on its capacity to innovate. For at least the past 15 years, design thinking has been widely adopted as a suitable approach to face these challenges, and is increasingly seen as a major strategy to address innovation from a human-centred standpoint.

Nonetheless, various issues hinder the understanding and dissemination of the practice of design thinking. First, there is a lack of common understanding on

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what design thinking is and what it entails. Second, several design thinking methods have emerged from the fields of design, business and engineering which, even though sharing a common conception, present considerable differences. For example, they have different preconceptions on the nature of the solution to a problem –product, service, communication, strategy or else–. The third issue is that public information available to understand, learn and practice design thinking is fragmented or insufficient. Although there are books, manuals, digital guides and course materials, these are scattered in different media and often present only parts of a whole method. Other valuable documents, although in the public domain, are not widely available. The information available appears as an array of dispersed tools, techniques, principles and stories.

Buchanan (1992, pp. 15, 21) anticipated early on that design thinking was heading towards being a liberal art: a part of the general knowledge every professional should master. Therefore, a common understanding is imperative; common definitions and toolboxes are needed, as well as simplification (Dorst, 2011, p. 521).

This paper presents a preliminary account and literature review of a wider research project that aims to combine and synthesise various successful existing methods into an *integrative design thinking model.* This model will present a unified set of terms, processes, techniques, methods, principles and behaviours, and will be represented in an understandable, simple way. It is to be used within business, industrial, and academic contexts. The aim is to enable the effective practice of design thinking within and across disciplinary boundaries, and to improve the practice of design thinking.

The model proposed will be largely based on the developments of Stanford University and design consultancy IDEO. These institutions have been at the forefront of design thinking research and practice for the past five decades, and have influenced several other methods, also analysed in this project. Other approaches are included in the study due to their strong similarity to design thinking and to the extent of their influence.

To follow, I first present a definition of design thinking as it prevails in this study, and I discuss a major misunderstanding on the use of the term. I secondly present a historical review of design thinking at Stanford University and its mutual influence with IDEO. This account aims to demonstrate the power of the foundations of design thinking at these institutions. No single comprehensive account on the historical development of Stanford's design thinking knowledge has been previously compiled. Third, I present other methods that will be included in the synthesis: Business Design; the methods of Aalto University's Design Factory; and Buckminster Fuller's Design Science. For these, as for Stanford and IDEO's approaches, I present their background, general characteristics, main value, and communication deficiencies. Finally, I present the research methodology to achieve the objectives of this study.

2 ON DESIGN THINKING

The term *design thinking* has been used in different ways for at least 25 years. However, the term acquired a whole new meaning and popularity in recent years. In the early 90s, a group of design researchers from various disciplines

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began to use the term to refer to the study of the cognitive aspects of designing (1991, p. 1). In the 2000s, the term was adopted by Stanford University and design consultancy IDEO, to name their particular design methods, imbuing the term with a renewed meaning. The success of these two institutions contributed to the extensive adoption of the "new" term.

Today, design thinking is widely said to be a human-centred method –as opposed to a functional system-centred approach– for understanding, defining and solving many kinds of problems, integrating business, technological and human factors. It encourages multidisciplinary teamwork and sets a favourable environment for collaboration. Many authors define design thinking as a unique complex-problem-solving approach, that creates value and achieves innovation (Brown, 2008, p. 86, Brown, 2009, p. 7, Martin, 2009, p. 178, Meinel and Leifer, 2011, pp. v, xiii, xiv).

The meaning of the term design thinking is a contentious topic within the design academic community. The debate centres around whether it is about "research into the cognitive and social processes of designing", or just "the new and massively propagated normative strategic concept" (Jonas, 2011, p. 3), like the one Stanford and IDEO have disseminated. A prominent scholar who has researched the way designers think, Nigel Cross, understands design thinking as the study "of design cognition" (Cross, 2011, p. 2). Nonetheless, it is possible to connect the design thinking principles proclaimed by Stanford and IDEO to the aspects of "design cognition" that Cross presents. In his latest book, Cross implies there is only one meaning for the term design thinking when he writes "it is only in recent times that the ability to design has become regarded as a kind of exceptional talent" (Cross, 2011, p. 4); he refers to the recent popularity of design thinking as per Stanford and IDEO. In this study I acknowledge the significant influence that research on the cognitive and social aspects of designing have had on contemporary design thinking, and I focus on the practice of the methods proposed by Stanford and IDEO.

3 THE HISTORY OF DESIGN THINKING RESEARCH AND PRACTICE AT STANFORD UNIVERSITY AND IDEO

3.1 THE INITIATION OF DESIGN THINKING AT STANFORD UNIVERSITY

Stanford is a pioneer in design thinking. It is a top university with over 50 years of experience researching, teaching, and consulting in design, despite the fact that it has no traditional arts and crafts based design programs. In the 50s, Professor John Arnold, "a visionary thinker" (Kays et al., 1963), positioned creativity at the forefront of engineering education at Stanford. He was the first one to bring to the University "the idea that design engineering should be human-centred". Arnold created the Mechanical Engineering (ME) Design Group, which, until today, teaches, and researches design topics like idea visualization, organizational innovation, product design, creativity, design theory and methodology, human-machine interfaces and bio-inspired design (n.d.-c, Kays et al., 1963). The seed for all subsequent design activity at Stanford has been this Design Group.
In the mid-60s, Professor Bob McKim, an industrial designer brought by Arnold to the Faculty of Engineering, established the Master program in Design as a joint effort between the departments of Art and Mechanical Engineering. The

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program resulted from the interest to imbue design engineering with a more human approach. The Master of Design exists to this date and it is still run jointly (n.d.-c). Regarded as "a pioneer in using experiential psychology in design", McKim's contribution to the consolidation of design knowledge at Stanford was extremely significant. He also created the iconic foundation design course Visual Thinking –which still runs today – and wrote the book *Experiences in visual thinking*, which explores creative thinking (McKim, 1972).

3.2 THE CENTER FOR DESIGN RESEARCH CDR AT STANFORD

Professor Larry Leifer, an engineering and design graduate of Stanford, founded the Center for Design Research (CDR) in 1984 and has been his director since then. He is also the director of the iconic design thinking course ME310 (see 3.3), and this double role has meant that many of his PhD students in the CDR, have done research into ME310, contributing to the development of design thinking methods and principles. By 2005, the CDR had already produced more than sixty PhD theses in topics like design-process-management, design-informatics, and mechatronic-systems design. Many of these PhDs have been the basis for the constant, well-grounded evolution of the ME310 course and of all design activity at Stanford (Dym et al., 2005, p. 120, Lande, 2012, p. 12).

Together with the Design Group created by Arnold, the CDR has been devoted to the research and practice of design at the School of Engineering, supporting the design programs and courses. The most relevant knowledge contributions to the field of design by the CDR, related to the present research project, are those on the process of design in teams, and on the development of advanced tools and methods for the practice of engineering design (n.d.-a).

The CDR also keeps strong links with industry. It is constantly appointed to carry out research for companies, and it keeps close ties with SAP, the multinational software company.

3.3 THE ME310 DESIGN INNOVATION COURSE AT STANFORD

In 1967, a product design course coded as ME310 was launched for students in the Master of Mechanical Engineering: the ME310 Product/Project-Based Engineering Design, Innovation & Development. This is now a historic course, open to students from other areas, and still active in many ways (Carleton and Leifer, 2009, p. 547). It is a global design innovation course where students from Stanford work on corporate projects in teams, with students from other leading universities in the world, to solve real innovation challenges (n.d.-d). Through its history and evolution, the ME310 has contributed to shaping a design thinking body of knowledge. The leader of the course since 1988 is Professor Larry Leifer (Carleton and Leifer, 2009, p. 5).

The ME310 promotes a human-centred approach for creating products and services. It uses an iterative process that involves defining the problem, discovering needs, benchmarking, prototyping, testing and evaluating. For one year, students work as distributed teams and meet face to face on three occasions. They have the advice of expert local teaching teams, access to teaching material from Stanford and a budget to develop prototypes. ME310 simulates the ideal work environment of a design practice. Its workspace is called "the loft", a space promoting creativity and a sense of community.

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ME310 is taught through a set of assignments accompanied by written guidelines and videos. These teaching materials are in the public domain according to Leifer (2014). Nonetheless, only those involved with ME310 can easily find this valuable material, which is lodged in a wiki. The ME310 history is also made up of at least 100 corporate project documents for which there is no integral archive. There is a significant body of academic research material with a particular focus on ME310, made up of journal articles and PhD and master theses. Nonetheless, this material is also not easily accessible to the general public.

Therefore, the ME310 is a valuable source of design thinking knowledge, but because its material is difficult to access, it is not visible enough to the general public.

3.4 THE SUGAR NETWORK: GLOBAL DESIGN INNOVATION

ME310 has influenced many universities around the world since 2004 when, in an effort to augment team diversity, it became global (Carleton and Leifer, 2009, p. 6). The collaboration model has evolved and grown; ME310's academic partners now collaborate with each other, not just with Stanford. The 2013-2014 global course had 250 participants between teaching staff and students, 17 universities in 14 countries, and 24 corporate projects (2014c). Each university involves students and teaching staff from different disciplines. For example, Aalto University in Finland attempts to have one business, one engineering, and one design student per project. St. Gallen University, Switzerland, only involves students from management graduate programs. This variety gives options to universities and corporate partners to choose the disciplinary composition of the global team, depending on the project demands.

Since 2008 this global collaboration is called "Sugar" (2014d). Members are in a constant process of evolving and formalizing the network. Some university members interweave elements of their own research and practice with Stanford's model, thus freely enriching, challenging and transforming it, and evolving design thinking knowledge in general.

The impact of the Sugar network is not quantified. Nevertheless, some figures indicate that it is significant. For example, Pontifical Javeriana University in Cali, Colombia, between 2007 and 2014, has transferred Stanford's design thinking knowledge to 48 engineering students and 19 company employees that have followed the ME310 course. It has partnered with 16 local, national and multinational companies to develop design innovation projects, in association with universities in 5 different countries. Most ME310 alumni in Colombia find innovation related jobs, thus becoming innovation seeds that propagate world-class design thinking knowledge (Camacho, 2011, p. 82).

Although several Sugar members publish about their ME310 experience, there is no global compilation of this material. However it is foreseeable that as the network establishes itself its results will be further disseminated. Sugar has a potential to become a powerful global design thinking research and education network.

3.5 THE INSTITUTE OF DESIGN AT STANFORD: THE D.SCHOOL

In 2005, David Kelley, founder of design consultancy IDEO (see section 3.6), obtained a vast donation from one of the founders of multinational software

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corporation SAP –Hasso Platttner– to launch at Stanford the Hasso Plattner Institute of Design, also known as the d.school (n.d.-b) . This institute was set as an independent, interdisciplinary unit with an aim to teach design thinking to students from any graduate program. Taking the d.school courses, students acquire a new mind-set and a creative problem-solving approach to tackle any kind of problem. The d.school also hosts workshops for executives who come from all over the world.

The d.school has published various documents online, for free access, related to its methods. For example, the Bootcamp Bootleg serves as a guide for the practice of design thinking; however, these publications offer a limited view and guide to design thinking as a concept and as a holistic practice (2010). The d.school and ME310 have different characteristics regarding their methods. Their knowledge does not present complete unification, therefore it is necessary for this project, to combine and synthesize design thinking knowledge from within Stanford.

The d.school brought the world's attention to Stanford's design thinking capability and it has been featured in business magazines and newspapers. This publicity has its benefits, but it can also make the d.school, and Stanford's design thinking knowledge appear to be shallow. The historical evidence provided by the foundational developments of Stanford's design thinking model can override this idea.

3.6 IDEO

Stanford and IDEO have a history of strong mutual influence. In the 70s, engineer David Kelley graduated from Stanford's Master in Design and created a design consultancy that was to become IDEO (2014b). Kelley's design studies at Stanford were key in defining his company's human-centred approach. His relation to Stanford continued, as he became a teacher of design right after graduating and a tenured professor in 1990 (n.d.-b, Steinbeck, 2011, p. 23). Today, the closest ties between Stanford and IDEO are reflected in the d.school.

IDEO is a global design consultancy that in the 2000s acquired fame as a consultancy that made innovation happen, transcending its focus on products, to the development of services and strategies. Today, IDEO even has a foundation to solve challenging problems in poor nations, a focus also embraced by the d.school.

Stanford and IDEO's definition of and approach to design thinking are very similar. Both institutions advocate a human-centred approach to solving poorly defined problems with multidisciplinary teams. They agree on the importance of an environment that promotes creativity; the value of prototyping, testing, iterating and failing; the need to understand and redefine the problem, and other aspects. The differences between Stanford and IDEO's approaches are visible only in details of their methods. A main difference is that the former acts within an academic setting, while the latter acts within a business context.

IDEO's directors have published books explaining the nature of their design thinking approach describing some of their methods. Their books, which have been classified as innovation books, have had a strong influence in the business world (Brown, 2009, Kelley, 2001, Kelley and Kelley, 2013, Kelley and Littman, 2005). IDEO has also published online material which can be downloaded for free: In 2009, it published the Human Centred Design Toolkit (IDEO, 2009), for

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solving social problems; in 2014, it launched IDEO's Design Kit, a basic online course for learning human-centred design (2014a).

IDEO has been the subject of extensive media coverage: High audience TV programs, online conferences, newspapers and popular business magazines and journals have all published about IDEO. This enormous publicity has gained the company followers, but as with the d.school, it has also brought opposition and doubt as to their authenticity.

4 OTHER APPROACHES THAT CONTRIBUTE TO THE DEVELOPMENT OF DESIGN THINKING

4.6 BUSINESS DESIGN

One of the most renowned design thinking based methods existing today, inspired by IDEO, is Business Design, developed at the Rotman School of Management by Roger Martin and Heather Fraser. It is focused on solving problems that imply the redesign of a business strategy, a process or an organizational culture (Martin, 2009, p. 118). Business Design mixes 'business thinking', which is logic, inductive and deductive, with 'design thinking', which is intuitive and creative. Martin believes both ways of thinking are mandatory to obtain innovation. The model also emphasizes the need for empathy, creativity, collaboration and diversity, mixed with analytic thinking in the later configuration stages, when the strategy is created.

In 2005, Martin and Fraser set up Design Works within the Rotman School of Management, a unit to teach Business Design to MBA students (n.d.-a) and to executives. In 2009, Martin presented the adapted design-thinking model in his book *The Design of Business: why design thinking is the next competitive advantage* (Martin, 2009, pp.25, 62-68). Since, business's interest on the acquisition of cognitive design skills has noticeably grown.

The Design of Business (Martin, 2009) has been a bestseller among business books. Nonetheless, even though Martin presents to managers what appears to be a revolutionary model for innovation, the book lacks practical information. The 2012 book *Design Works: how to tackle your toughest innovation challenges through business design* (Fraser, 2012), fills the void. It includes detailed information on how to achieve the design of a business strategy using both design thinking and analytical thinking.

4.2 THE DESIGN FACTORY

Aalto Design Factory (ADF) at Aalto University in Finland is an independent institute of design, with a dedicated space for multidisciplinary collaboration in design education and research. The approach to design promoted by ADF can be categorized as design thinking because of its nature and methods. Several of its researchers refer to their approach as design thinking. Nonetheless, Professor Kalevi Ekman, founder of ADF, does not put a tag name to what they do.

The ADF conception, development and, ultimate implementation in 2007, happened independently from Stanford. The aim "was to develop state-of-the-art innovative physical facilities, tools and practices for interdisciplinary co-operation, and to give a platform for educating the world's best product

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designers" (2009, p. 3). A core contribution of ADF to design thinking is the concept that physical facilities have to support "the needs of the people involved", referring to the emotional as well as the functional needs (Lyytikaïnen and Ekman, 2008, p. 6).

Despite having been developed independently, various characteristics of ADF's approach are similar to Stanford's: building a sense of community, promoting interdisciplinary work, providing exceptional spaces for creative work, building prototypes, working with real life projects and others. Aalto goes further in stressing the need to develop soft skills through its learning experiences: for example social intelligence, communication and presenting skills.

One of the main courses offered at ADF is the ME310 course in collaboration with Stanford University and the Sugar network. This means Aalto is in fact teaching and researching Stanford's design thinking and ADF's culture and spaces are equally suitable for ME310 as for the other ADF activities.

The Design Factory model has extended to five more universities in five different countries. Also, a close collaboration with CERN, the European Organization for Nuclear Research, has derived in it also becoming a member of the network (CERN, n.d.).

4.3 FULLER'S DESIGN SCIENCE

Buckminster Fuller, "one of the greatest minds of our times" (n.d.-e), became very influential in the second half of the 20th century due to his practical and philosophical work on design.

For Fuller, "design is the process of realizing intentions", where *intention* is having a meaningful purpose, associated with the holistic satisfaction of a combination of human needs. Fuller says design is about combining, in a balanced way, and taking into account, a set of values, the intuitive and the rational, the heart and the mind, art and science. He provided "a consistent foundation for an ethics-driven concept of design" (Ben-Eli, 2007, pp. 10, 18, 22).

Fuller created the Comprehensive Anticipatory Design Science (CADS) approach, often simply called Design Science. His approach is of historical value to this project, as it anticipates contemporary design thinking, additionally considering philosophical issues.

Fuller advocated the need of a scientific design method. In his CADS, he stated that creating new artefacts or strategies has to be informed by experience. He believed ideas have to be prototyped, so that they can be tested with users again and again as they evolve (Ben-Eli, 2007, p. 24). Hence, the designer learns from experience, through scientific empirical research.

The comprehensive aspect of CADS is related to Fuller's vision of the world as a whole: a system made up of natural resources and people. Intervening a part of the system will affect another one of its parts. Hence his call to approach problem-solving in a comprehensive way (Edmondson, n.d.). A specialized perspective will not allow understanding a problem in its comprehensive dimension, and therefore it will not allow correctly solving it.

Fuller included the term 'anticipatory' in his CADS, as he believed design has to be practiced foreseeing human needs, and imagining the impact of our creations

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in future contexts. Fuller anticipated per se the 'future' need of a special creative problem-solving method to solve complex problems with outcomes as different as a policy, a strategy or a housing system.

5 NEXT STEPS: CREATING AN INTEGRATIVE DESIGN THINKING MODEL

To achieve good design, Norman (2013) urges us to pursue simplicity among complexity, thus overcoming confusion. To face complexity, he argues that to provide a true understanding of a system, a robust conceptual model should be made available (Norman, 2013, p. 10, 247). Norman's principle can be applied to the design of design thinking itself. This study proposes creating a comprehensive model of design thinking to integrate and synthesize various successful existing models into one.

To achieve the objectives of this study, I chose to focus on a conceptual research approach. The review of existing design thinking methods will be informed by written material, which will in time be analysed and synthesized using methods of qualitative *content analysis* (QCA) and *conceptual ordering*. Also, a few unstructured interviews will be carried out with experts who have been part of the development of the design thinking methods studied. The aim of the interviews is to complement the information found in the literature, to clarify confusing aspects and to fill-in knowledge voids (Firmin, 2008, Julien, 2008, Schreier, 2012, pp. 1-8).

The analysis of written documents as data makes sense, as there is a large amount of reliable and relevant written information available: books, book chapters and journal articles published in print; easily accessible online documents, case studies, and reports; and unpublished material that is in the public domain and which I can get hold of.

The method of QCA aids summarising, categorising and comparing the information within each method. Conceptual ordering assists in building the integrative design thinking model, allowing comparison and analysis across methods and the achievement of enough order. Finally, the method of theme analysis may be a complementary aid on constructing the new model, via restructuring the information (Julien, 2008, Leech and Onwuegbuzie, 2008, Schreier, 2012, pp. 58-71, 104-105, Strauss, 1998, p. 19-21).

In a posterior publication, I will present the results of this research project: an integrative design thinking model, which will combine and synthesize commonalities of existing methods. This model will be enriched by special particularities detected in existing approaches. I anticipate the need for an adaptive model, according to different kinds of projects, as well as a values-centred model.

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