

Understanding Innovation

Hasso Plattner
Christoph Meinel
Larry Leifer *Editors*

Design Thinking Research

Making Design Thinking Foundational

 Springer

Understanding Innovation

Series Editors

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Preface

It is now more than 10 years ago that the Stanford d.school was officially founded. It did not need much persuasion for me to engage in this unique endeavor, as I was instantly electrified by David Kelly's vision of a hub for innovators on Stanford campus where students and faculty from all departments come together. Looking back, thousands of students with diverse backgrounds at Stanford as well as at the d. school's sister institute at HPI Potsdam have learned and experienced how to tackle wicked problems and complex challenges to come up with innovative, human-centered solutions.

Ever since I came into contact with design thinking, I have been convinced of its innovative power. I have seen design thinking bring about countless examples of unexpected solutions, changes in working cultures, and improvements in team performance. Something, traditional approaches usually simply cannot deliver. They often fall short when it comes to complex and wicked problems which require new approaches and creativity—a skill that is often assumed to be the domain of outstanding individuals. But: Creativity is not just a skill of the chosen few; big ideas do not merely happen; the creative spark does not just ignite on command. That's not how we can find solutions—especially not in a world as complex as ours. Rather, creativity is a process that everyone can implement. And that's what design thinking is all about: it's a framework and method that fosters creative confidence which is foundational for innovation and can ultimately enable everyone to be innovative.

Innovation requires curiosity and an open mind. Design thinking is thinking in terms of opportunities, not restrictions or prohibitions. It is a holistic approach and encourages thinking across boundaries, thereby enabling real and fundamental innovations. Once in contact with design thinking, people experience a sustainable shift in their mindset and how they act and think. There is also a shift in the way people approach challenges. The innovation method design thinking views problems from a human perspective, with the objective of designing innovative products, services, or experiences that are technically feasible, economically viable, and desirable for the target group.

There is a tremendous, growing interest and curiosity in design thinking and a need to scientifically understand its underlying principles. This entails finding out how and why design thinking works and what makes it more successful than other management approaches. Not only do these questions drive research worldwide, but they are also the reason behind my support for the Design Thinking Research Program between the Hasso Plattner Institute in Potsdam, Germany, and Stanford University, USA.

The design thinking method has been successfully taught at both institutions for many years now. The research program and its investigation of the technical, economic, and human factors was the logical consequence of simply teaching the design thinking method. Researchers at both institutions, with diverse backgrounds in disciplines such as engineering, humanities, neurology, or economics, examine how the innovative processes that originate in small, multidisciplinary teams can be improved and further developed in the future. Since the implementation of the Design Thinking Research Program in 2008, dozens of research projects have been conducted; our understanding of this field has advanced and new insights and tools have become available. By taking the understanding of innovation to a new level that is relevant to all disciplines, our research contributes to make design thinking foundational. The findings, however, are not only meant to be discussed in the scientific community. The advances made in design thinking should be made known to the public at large and to all who want and need to drive innovation, be it in companies or society. The publication at hand is our contribution.

Today, design thinking is acknowledged and pursued both in study and in practice even though—or perhaps because—it breaks with traditional approaches. It does so with its focus on human needs, empathy, and team work as well as its valuation of different points of view. Sustainably and deeply impressed by the impact that design thinking has on working culture, creative confidence, and innovative power that I can witness, I am delighted to see the scientific foundation and advancement provided by this research program.

Palo Alto, CA
Winter 2014/2015

Hasso Plattner

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Manifesto: Design Thinking Becomes Foundational

Larry Leifer and Christoph Meinel

Abstract With the integration of design thinking into engineering education, a missing link has been created between the science-focused, context-independent part of engineering and the human society focused, context-dependent aspect. The latter area has long been neglected, partly due to the uncertainty that comes with the unpredictability of human behavior. However, years of design thinking research have improved our understanding of the method's underlying principles. As a result, there has been a breakdown in the skepticism toward design. We can now instrument and quantify design behavior, measure its impact, validate engineering work, and continuously advance our knowledge of design thinking and ourselves. In this paper, we argue that design is ready to become a foundational science for engineering, alongside scientific fields such as physics, chemistry, and biology.

The idea that design thinking is foundational for engineering and, therefore, in an engineering education, is derived from the following five questions. These propositions need to be taken together and in context because in all things human centric (business, design, society, . . .) the knowledge worth having is and must be **context dependent**. This point of view balances the equation with physics and math, whereby the knowledge worth having must be **context independent**.

(1) How Might We Address and Measure the Needs of Society?

While engineering has been described as the application of science and mathematics to the needs of society, up until now we have known and taught our students very little about finding and understanding the needs of society. Thus we have indirectly turned out half-built engineers. These were engineers who could only serve the explicit needs of others without a direct understanding of who had the need and why. With the advent of the design thinking paradigm, this situation has changed.

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Engineers are now taught how to engage with society through empathy training, coping with multiple points of view, actively managing teamwork, and realizing the full potential of product and service prototyping (experimenting). In effect, a critical link has been made between engineering analysis, the science-focused part of the discipline, which is context independent, and engineering design, the human society-focused aspect of the discipline, which is context dependent.

(2) Why Must We Accept That Human Needs Are Context Dependent?

Human behavior is overwhelmingly context dependent (Bandura 1986). This makes the formulation of problems and their solutions difficult.

As engineering faculty and technical managers, most of us did not teach engineering design nor did we attempt to manage design thinking because we either did not understand it and/or because it includes unpredictable human behavior within the system boundary. This lack of understanding and perhaps fear of uncertainty and ambiguity often leads to skepticism and even contempt for the human side of engineering—design.

(3) Are We Ready and Do We Know Enough to Change?

The cumulative work of a global design thinking research community demonstrates our ability to instrument and quantify design behavior. We can measure its impact on corporate team performance. We have started to understand the underlying principles. Though valuable insights have been gained and methods and tools further developed, we are just at the beginning. Biology, too, started as an applied science with scientists such as Darwin gathering knowledge by doing hands-on work. Design is now positioned to follow biology as a foundational science.

However, its application is still, and will always be, the key to a better understanding of design thinking. That's why researchers are striving to gauge and assess its impact. One such an attempt is the recently published study report "Parts Without a Whole? - The Current State of Design Thinking Practice in Organizations" by the project team "Impact by Design Thinking" (Eva Köppen, Holger Rhinow, Jan Schmiedgen, and Christoph Meinel). This study is based on survey results. The researchers not only explored the different forms of design thinking adoption, but also share their valuable insights derived from years of profound research on design thinking in organizations (Schmiedgen et al. 2015).

The benefits of their work can be seen at *thisisdesignthinking.net*. This website launched by the research team showcases interesting stories from companies working with design thinking and publishes interviews with experts and practitioners. By drawing a colorful picture of the manifold design thinking activities going on today, the website serves the research community as well as coaches, practitioners and students.

Many more projects pave the way for making design a foundational science.

(4) Why Is This Breakthrough Happening Now?

While design thinking is practiced universally in varying degrees, it is the unique combination of engineering (especially IT), economics, anthropology, psychology, neuroscience and design research that is making it foundational (Mabogunje et al. 2015). Breakthroughs at Stanford University cannot be separated from the

university's location in Silicon Valley and the community's impact. Breakthroughs at the Hasso Plattner Institute at the University of Potsdam cannot be separated from its inspiring founder and the vibrancy of the Berlin/Brandenburg region.

Both universities, and in particular their schools of design thinking at Stanford and Potsdam, and other pioneering universities around the world attract companies and organizations eager to apply new approaches to their challenges and projects. They seek to launch change processes and find new inspiration for their work. On the other hand, d.school graduates have an open mind, are full of ideas and enthusiasm for innovation with an appetite for new solutions that yield better services, products, and even fundamentally better societies. These graduates transport a new spirit to their employers, multiplying it, and implement their own projects that stem from a deep understanding of people's needs.

Frederick Terman, an early Dean of Engineering at Stanford (and widely recognized as the "father of Silicon Valley") re-conceptualized the role of the university as follows:

Universities are rapidly developing into more than mere places of learning. They are becoming major economic influences in the nation's industrial life, affecting the location of industry, population growth, and the character of communities. Universities are in brief a natural resource just as are raw materials, transportation, climate, etc.

Universities are now the knowledge creation engines of society, largely replacing industry R&D for radical breakthroughs. They accelerate the creation of new technologies, new ventures, new markets, and new sources and targets for capital formation.

(5) Is It Time to Professionalize Design Thinking?

To build on our understanding of innovation and the role of design thinking behavior, including supporting brain research (Donald 1991), we propose to move forward with the professionalization of design thinking. Imagine that in time there will be professional schools of design thinking, much as we have schools of engineering, schools of medicine, and schools of business. Imagine too the emergence of pan-disciplinary doctoral programs in design thinking practice.

The first d.school at Stanford started in a garage on the outskirts of the Stanford campus. Hasso Plattner, an early sponsor of the design thinking activities at Stanford, recognized the potential as did the university itself. Ever since, thousands of students of all disciplines have been studying and practicing design thinking. It did not take long to transfer the successful concept to the Hasso Plattner Institute in Potsdam—adapting it to the specific context there. Many universities worldwide approach the two institutes in order to implement a similar school following the "d. school" model. Recognizing the value of such a training facility they strive to create the breeding ground for innovation in their own region. In a cooperative effort, schools of design thinking have been established, for example in Paris, Kuala Lumpur, and Beijing, each one with cultural adaptations based on its unique context. More and more governments and universities plan to establish their own schools of design thinking and integrate design thinking into their curriculum. The design-paradigm is worth your attention.

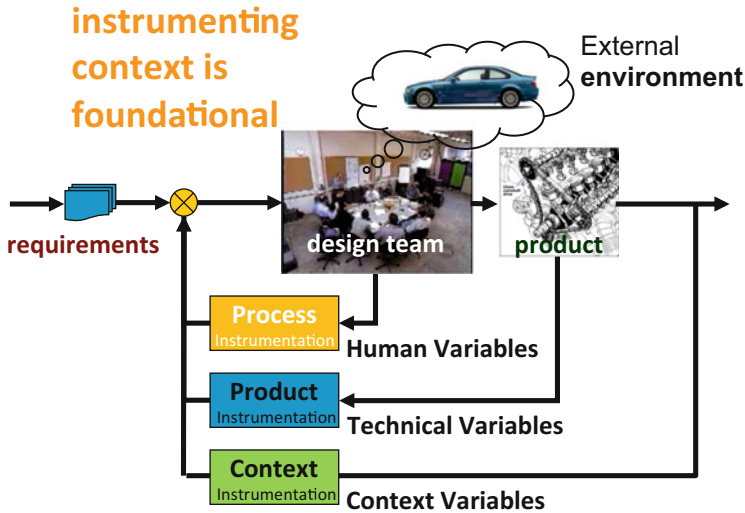


Fig. 1 We build upon advances in design behavior research and corresponding brain research. We quantify action and outcomes. We have a mature measure of predictive power. As a profession, **design thinking is foundational** and can be understood scientifically

Now that we have the roots of the scientific comprehension of design thinking we can expect to continuously improve our understanding of ourselves. We can additionally discover new practices and disseminate these practices through publications, simulations, and emulations. This understanding, which derives from the study of human-human interaction with IT augmentation is embodied in the nature of language—verbal and gestural. It is foundational (Fig. 1).

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Introduction: The HPI-Stanford Design Thinking Research Program

Claudia Koch, Christoph Meinel, and Larry Leifer

Since 2008 scientists from the Hasso Plattner Institute for Software Systems Engineering in Potsdam, Germany, and from Stanford University, USA, have engaged in the joint Design Thinking Research Program, financed and supported by the Hasso Plattner Foundation.

1 Program Vision and Priorities

The multidisciplinary research teams of the HPI-Stanford Design Thinking Research Program scientifically investigate innovation and design thinking in all its holistic dimensions. With backgrounds in engineering, design, humanities or social sciences, team members strive to gain a deep understanding of the underlying principles and, consequently, how and why the innovation method of design thinking works and fails. But the aim is not only to advance design thinking theory and knowledge within the research community. Instead the program seeks to ultimately improve design practice and education by gathering scientific evidence to support design activities.

Applying rigorous academic methods, the researchers study, for example, the complex interaction between members of multi-disciplinary teams. An important feature of this domain is the necessity of creative collaboration across spatial, temporal, and cultural boundaries. The researchers design, develop and evaluate innovative tools and methods that support teams in their creative work. Researchers pursue the common question of why structures of successful design thinking teams differ substantially from traditional corporate structures and how design thinking

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methods mesh with traditional engineering and management approaches. Beyond a mere descriptive understanding, the goal of this program is to develop metrics that allow assessment and prediction of team performance in order to facilitate real-time management of how teams work.

Researchers are especially encouraged to develop ambitious, long-term explorative projects that integrate technical, economical, as well as psychological points of view using design thinking tools and methods. Field studies in real business environments are considered especially important to assess the impact and needed transformations of design thinking in organizations. Projects that set new research priorities in the design thinking research domain are favorably funded. The project selection is further based on intellectual merit and evidence of open collaboration.

Special interest lies in the following guiding questions:

- What are people really thinking and doing when they are engaged in creative design innovation?
- How can new frameworks, tools, systems, and methods augment, capture, and reuse successful practices?
- What is the impact of design thinking on human, business, and technology performance?
- How do the tools, systems, and methods really work to create the right innovation at the right time? How do they fail?

2 Road Map Through This Book

Divided into four parts, this book compiles the results of the research projects of the 6th program year, covering multifaceted features and aspects of design thinking.

Team collaboration is the basis of design thinking and thus of significant importance in the program's research agenda. Different "***Tools and Techniques for Improved Team Interaction***" are presented in the first part of this book. These tools and techniques, which have been investigated and developed in the program, range from the Tele-Board for remote collaboration, to IDN for visual diagnostics, to Google glasses in health applications. A technique for physical interaction and a discussion system to leverage geographic diversity in massive online classes are also introduced.

The chapters in Part II all focus on "***Creativity and Creative Confidence***"—central factors when engaging in design processes. The research projects range from neurological studies on sustainable creativity trainings to the influence of spatial factors on creativity and how creative confidence can be augmented with the help of prototyping tools.

A question that is often asked by people who engage in design thinking, or who intend to do so, is: what is the actual impact of design thinking? Part III "***Measuring Design Thinking***" contains a study giving insight into how the impact of design