Introduction – Design Thinking Is Mainly About Building Innovators

Christoph Meinel and Larry Leifer

1 Is It Really About Building People?

There is mounting evidence that the engineering design thinking paradigm works when applied with diligence and insight, but is it really only about products and services? While profits are typically associated with goods and services, we really must ask, *who* made that happen? Who was responsible for their conception and implementation? Are we too pre-occupied with the innovation when the real story is about the innovators?

Design thinking is mainly about building innovators who can use the design thinking paradigm to transform ideas into reality, to transform organization, and to transform all aspects of life.

When hunting for the "next big idea" the journey to the solution is initially undefined. Every hunt has its unique path, and those who take it learn and discover the unknown. They have to find their way by reading the context, observing and interpreting the signals, understanding and making choices. People indeed face many challenges during their innovation journey. The path is constantly changing as are the activities and roles people play. Thus, we have to find out how are and how can people be best prepared and equipped for a successful journey.

In this volume, we seek to re-focus the attention of the reader on the human innovators. While the design thinking paradigm has always been about people, we are often distracted by the pursuit of "big product ideas" versus "big people." In this phrasing, we seek to get beyond ideas to the creative diligence required to transform

C. Meinel (✉)
Hasso Plattner Institute for Software Systems Engineering, Campus Griebnitzsee, Potsdam, Germany
e-mail: meinel@hpi.uni-potsdam.de

L. Leifer
Stanford Center for Design Research, Stanford University, Panama Mall 424, Stanford 94305-2232, CA, USA
e-mail: leifer@cdr.stanford.edu

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ideas into realities: real companies, real products and services and real organizational transformation. Building on Volume 4 of this series, "Building Innovation Eco-Systems",[1] we will retain the structure of Design Thinking Rules while transforming the conversation to focus on the design requirements for the people we build.

2 What Are the Rules for Building Design Thinkers Who Innovate?

We have evidence (Ju et al. 2014) supporting the role of several design thinking activities that have long been considered important, but were too often perceived through the lens of the product and service versus those who create them. Of these, the over-arching truth lies in the fact that every physical product and/or service is actually owned by the people who make it a reality.

The "***rules of design thinking***" are actually the "***design requirements***" for the behavior of innovators. The challenge and goal of this introductory section is to formulate some new rules for design thinking and to translate them into the design requirements for building innovators.

I. The Human Rule All innovator activity is ultimately social in nature. Never go hunting alone.

Our studies substantiate the assertion that successful innovation through design thinking will always bring us back to the "***human-centric point of view.***" This is the imperative to solve technical problems in ways that satisfy human needs and acknowledge the human element in all technologies and organizations. The innovators we build must have and implement this core value and behavior.

To find "big ideas" we have to learn how to hunt again. Hunting is all about the people we hunt with. However, we are in a system that is based on individuals, just as education is focused on individuals. But a team is necessary. Go hunting with a team that is diverse and agile. People are the most valuable asset in the design process.

Innovator Design Requirements for the Human Rule

Be aware that every human eco-system is unique, as is every business scenario. Thus, observe and document your context carefully. Where are you hunting? Deeply internalize to keep people at the center of all things:

- Cover the walls with images of people you seek to actualize. Celebrate their successes and failures.
- Preserve the "human scale." Forget the organization scale and focus on the innovation team—typically 3–4 core individuals who are co-creating over time.

[1] Meinel and Leifer (2013).

– Envision how the last big innovator in your eco-system delivered winning products and services with "empathy-in-action."
– Strive to become an expert, maybe an Olympian example of empathy-in-action; for yourself and others.[2]

II. The Ambiguity Rule Innovators must preserve ambiguity. Never go home with a lone idea.

There is no chance for your organization to "***discover***" your contribution if you only have one idea. Innovation demands experimentation at the limits of your knowledge, at the limits of your ability to control events, and with the freedom for you to see things differently. The innovators we build must always be in a rebuilding mode.

The hunting path for the "big idea" might be long and the ambiguity sometimes frustrating—but we need ambiguity. This is how we design possibilities to create alternative futures. We want a future with more ambiguity and more options. Keep hunting with ambiguity—the "next big idea" is just around the corner.

Innovator Requirements for the Ambiguity Rule

– Keep track of assumptions.
– Place them boldly in your design space for every constraint you are coping with.
– List a competing opportunity.
– Check your thinking: are you looking for the global fix, or, are you keenly aware that most everything in design and business is context dependent.
– Take time to define the problem and solutions space context.
– Understand the user.

III. The Re-design Rule All innovation is re-innovation. Who is the innovator that preceded you?

The human needs that we seek to satisfy have been with us for millennia. When looking to the future it is always helpful to look to the past. How did people hunt in the past? Try to understand them, learn from them. Never leave them out of your consideration. Through time and evolution there have been many provisionally successful innovators. Do you know who they are and how they got there? Because technology and social circumstances change constantly, it is imperative to understand how needs have been addressed in the past and by whom. Then we can apply "***foresight tools and methods***" to better estimate the social and technical conditions we will encounter 5, 10, 20 years from now.

Innovator Requirements for the Re-design Rule

Hunting is hard work. Taking it home is harder and more dangerous. Nothing beats a prepared mind.

– Be sure your team is well informed about the history of organizational change and context. How did others effect change? How did they circumnavigate the skeptics? In which ways did they satisfy needs?

[2] Kress (2012).

– List the pros and cons—concentrate on the former.
– Take advantage of foresight thinking tools and the foresight playbook.[3]

IV. The Tangible Rule Make innovation tangible. Make your "innovator story" tangible.

Communication within the hunting team is crucial—being tangible is essential because we have to learn rapidly in order to produce well. Make ideas tangible and learn from them. Communicate via prototypes. Conceptual prototyping has been a central activity in design thinking during the entire period of our research, yet it is only in the past few years that we have come to realize that "***prototypes are tangible stories***." Seen as stories, we now have fresh insights regarding the nature of their structure, their narrative and the suspense and surprise they deliver. We are also mindful of the listener's context, the user. The "***make it tangible***" rule becomes, "***make it a good story***."

Innovator Requirements for the Tangible Rule

There are more great ideas out there in the world than those inside our heads.

– Put differently, searching in the world tangibly is a great way to get new ideas, unplanned associations, undreamed metaphors and serendipity squared.
– Show me, don't tell me.[4]

We have summarized, and in some cases paraphrased, the design requirements in the following table. Take the framework and apply it to your project, your organization, and your team. This is not a tool of physics. Everything about it is context dependent. Define your context.

Innovator design requirements

Requirement	Context	Metric	Rationale
The Human Rule: All innovator activity is ultimately social in nature. Never go hunting alone	Every human eco-system is unique. Every business scenario is unique. Take time to observe and document your context. Where are you hunting?	Count the people in your framework. Count your team's linkages. Cover the walls with images of your team, the users, and their team. Count their success. Count their failures. Count the innovators	Capture the narrative about how the last big innovator in your eco-system managed "empathy-in-action" to deliver winning products and services that addressed user needs in compelling ways
The Ambiguity Rule: Innovators must preserve ambiguity. Never go home with just one idea	Check your thinking; are you looking for the global fix, or are you keenly aware that most everything in	Count the last innovator's sense of assumptions, opportunities, and constraints. How	Did the last innovator in your segment really use ambiguity to afford creativity? Did that innovator "get"

(continued)

[3] Carleton and Cockayne (2013).

[4] Edelman (2012).

Requirement	Context	Metric	Rationale
	design and business is "who dependent." Are you really thinking like the customer you seek to take home?	many ways did they define them?	"creative self efficacy"[5]
The Re-design Rule: All innovation is re-innovation. Who is the innovator that preceded you?	Most human needs have been satisfied before. Who did the last innovation? How did they map the foreseeable future? Understand past hunters and the hunted	Count the number of ways this need has been satisfied in the past. Enumerate the pros and cons. Position your team to absolutely nail just one of the cons without losing the pros	Foresightful innovations tend to last. Understanding the past prepares you for the future. Never leave home without it[6]
The Tangible Rule: Make innovation tangible. Make your "innovator story" tangible	There are more great ideas out there in the world than those inside the head of the last innovator. Searching tangibly is a great way to learn from those who have already done so	Count tangible encounters. Make note of who they were with. Who was that innovator? Is their picture on your wall?	Show me, don't tell me[7]

3 The HPI-Stanford Design Thinking Research Program

Started in 2008, the HPI-Stanford Design Thinking Research Program (DTRP) between Hasso Plattner Institute for Software Systems Engineering and Stanford University is financed and supported by the Hasso Plattner Foundation.

3.1 Program Vision

The HPI-Stanford Design Thinking Research Program engages multidisciplinary research teams to scientifically investigate the phenomena of innovation in all its holistic dimensions. Researchers are especially encouraged to develop ambitious,

[5] Albert Bandura: http://en.wikipedia.org/wiki/Albert_Bandura, Carleton et al. (2008).

[6] Carleton and Cockayne (2013).

[7] Edelman (2012), Lübbe (2011).

long-term explorations related to the innovation method of design thinking in its technical, business, and human aspects. The program strives to apply rigorous academic methods to understand the scientific basis for how and why the innovation method of design thinking works and fails.

Researchers in the program study, for example, the complex interaction between members of multi-disciplinary teams challenged to deliver design innovations. The need for creative collaboration across spatial, temporal, and cultural boundaries is an important feature of the domain. In the context of disciplinary diversity researchers explore how design thinking methods mesh with traditional engineering and management approaches, specifically, why the structure of successful design teams differs substantially from traditional corporate structures. The overall goal of the program is to discover metrics that determine the success of challenges approached with design thinking methods. A special interest of the program is to explore the use of design thinking in the field of Information Technology and IT systems engineering.

3.2 Program Priorities

The focus of the Design Thinking Research Program is the collaboration between researchers at Stanford University, USA, and those at Hasso Plattner Institute in Potsdam, Germany. Projects that set new research priorities for this emergent knowledge domain are favorably funded. Furthermore, in this context, field studies in real business environments are considered especially important to assess the impact and/or needed transformations of design thinking in organizations. Project selection is also based on intellectual merit and evidence of open collaboration.

Special interest lies in the following points of view and 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?

3.3 Road Map Through This Book

Divided into three parts, this book compiles the outcomes of the 5th year's projects which have again covered diverse facets of design thinking.

Aspects such as empathy, creativity, personality, culture, and people's actions in their context, play a significant role when approaching challenges with design

thinking. Thus, the chapters in Part I, "***Assessing Influential Factors in Design Thinking***," examine the impact of those factors on design thinking and vice versa.

Design thinking only works in teams. Collaboration is essential for innovative outcomes. Part II, "***Empowering Team Collaboration***," presents insights on how to support teams in their design work.

The question on how to optimally ensure knowledge transfer and avoid information loss during the innovation process and afterwards is addressed in the last part, "***Supporting Information Transfer***."

3.4 Part I: Assessing Influential Factors in Design Thinking

In "**Empathy via Design Thinking: Creation of Sense and Knowledge**," the authors Eva Köppen and Christoph Meinel assess the growing demand to be empathic that can be witnessed in organization studies and management advice literature; a requirement not only for leadership but also for the whole staff. Design thinking has ultimately provided methods and techniques for fostering empathy in teamwork settings. With the help of a study, the article addresses the question of whether design thinking indeed delivers helpful empathy-techniques that will assist employees in their daily routine.

Creativity stands in the focus of "**Developing Novel Methods to Assess Long-Term Sustainability of Creative Capacity Building and Applied Creativity**." The team of Manish Saggar, Grace Hawthorne, Eve-Marie Quintin, Nick Bott, Eliza Keinitz, Ning Lui, Yin-Hsuan Chien, Daniel Hong, Adam Royalty, and Allan L Reiss, investigates the ability to create novel and useful outcomes, which has been widely recognized as an essential skill for both entrepreneurial and every-day success. Their research proposes to examine the impact and sustainability of creative capacity building using targeted training.

Design thinking asserts that individuals and teams have the ability to build their innovative capacity through various tools and methods no matter their predispositions to creativity and innovation. The contexts of design thinking attempt to alter design process towards more innovative ideas. "**The Personal Trait Myth: A Comparative Analysis of the Innovation Impact of Design Thinking Tools and Personal Traits**," by Nikolas Martelaro, Shameek Ganguly, Martin Steinert, and Malte Jung attempts to experimentally disentangle the impact of disposition and situation during design activity. The authors present a variety of design contexts intended to be tested against dispositional factors during an experimental design task. They then present a pilot study exploring how process-priming impacts design process during a problem-solving task and an open-ended design task.

In "**Theaters of Alternative Industry: Hobbyist Repair Collectives and the Legacy of the 1960s American Counterculture**," Daniela K. Rosner and Fred Turner describe initial results from an ethnographic study of design and engineering engagements in community-operated sites at which hobbyists mend and repair mass-produced goods. They conducted participant observation at seven repair

events and two collectives in the San Francisco Bay area where consumer electronics are reassembled. In their study they spoke with approximately eighty repair practitioners. Here they describe surprising connections between repair and social movements that, in turn, reveal deep ties between contemporary hobbyist repair and countercultural design practices of the 1960s. These links, they argue, open new and important areas for design research.

3.5 Part II: Empowering Team Collaboration

Increasingly organizations are turning to off-site design thinking professional development programs as a way to grow design competencies in their workforce. Therefore "**Assessing the Development of Design Thinking: From Training to Organizational Application**," by Adam Royalty, Karen Ladenheim, and Bernard Roth has two main goals (1) To develop an initial assessment tool that helps identify how well organizations support employees' continued learning and application of design thinking. (2) To describe a process for constructing design thinking assessment tools. The assessment created is informed by an exploration of existing design thinking executive education programs and tested in a large organization committed to using design thinking.

Joel Sadler and Larry Leifer contributed "**TeamSense: Prototyping Modular Electronics Sensor Systems for Team Biometrics**." Electronic sensors systems can be used to unobtrusively gather real-time measurements of human interaction and biometrics. However, developing custom sensor systems can be costly, time intensive and often requires high technical expertise in embedded mechatronic systems. The authors present a prototyping case study of a real world system, TeamSense, with the scenario of a manager who wishes to use embedded sensors to develop data-driven insights on team performance. Team Biometrics is a term used here to refer to a sensor system that measures some physical characteristic of a group of individuals. This work has broad implications for design thinking and the importance of toolkits in reducing entry barriers for rapid prototyping with sensors.

In "**Tele-Board MED: Supporting Twenty-First-Century: Medicine for Mutual Benefit**," Julia von Thienen, Anja Perlich, and Christoph Meinel present a medical documentation system designed to support patient-doctor cooperation at eye level. In particular, Tele-Board MED tackles the challenge of turning the task of documenting a patient's medical records—which can disturb the treatment flow—into a curative process in and of itself. With its focus on cooperative documentation, Tele-Board MED embraces patient empowerment and, at the same time, the project is deeply rooted in the culture of design thinking. Results from an initial feedback study with 34 behavior psychotherapists are presented.

Peer and self assessment offer an opportunity to scale both assessment and learning to global classrooms. In "**Peer and Self Assessment in Massive Online Classes**," the team of Chinmay Kulkarni, Koh Pang Wei, Huy Le, Daniel Chia, Kathryn Papadopoulos, Justin Cheng, Daphne Koller, and Scott R. Klemmer, reports its

experiences with two iterations of the first large online class to use peer and self assessment. The team performed three experiments and introduces a data-driven approach that highlights high-variance items for improvement.

In user-centered design processes, one of the most important tasks is to synthesize information from user research into insights and a shared point of view among team members. "**Tagging User Research Data: How to Support the Synthesis of Information in Design Teams**," by Raja Gumienny, Steven Dow, Matthias Wenzel, Lutz Gericke, and Christoph Meinel explores the synthesis process and opportunities for providing computational support. Based on interviews on common practices and challenges of information synthesis, they developed digital whiteboard software for sorting individual segments of user research. Through a case study, they explore the differences between computer-supported group interaction and an individual clustering condition.

3.6 Part III: Supporting Information Transfer

The last chapter in Part II already indicated that information transfer and data handling is crucial for a successful innovation process. Thus the third part of this book picks up the issue of how to avoid losing information and how to properly secure and transfer it.

In "**Embodied Design Improvisation: A Method to Make Tacit Design Knowledge Explicit and Usable**," the authors David M. Sirkin and Wendy Ju present a design generative and evaluative technique that they call embodied design improvisation. It incorporates aspects of storyboarding, Wizard of Oz prototyping, domain expert improvisation, video prototyping and crowd sourced experimentation, to elicit tacit knowledge about embodied experience. They have been developing this technique for their research on physical interaction design over time. On the other hand, practitioners often rely on subtle, shared cues that are difficult to codify, and, as a result, are often left underexplored. Their current technique provides an approach to understanding how everyday objects can transition into mobile, actuated, robotic devices, and prescribes how they should behave while interacting with humans. By codifying and providing an example of this technique, the authors hope to encourage its adoption in other design domains.

Information transfer is explored in "**Connecting Designing and Engineering Activities II**," by Thomas Beyhl and Holger Giese. The transition from designing innovative products or services to implementing them is challenging since innovators and engineers are seldom the same people. A knowledge transfer between both groups is inevitable, but in practice seldom goes smoothly since usually only the final innovative product or service is subject to the handover process. The design path and design decisions need to be recovered later on. The authors introduce their inference engine. It infers the design path and design decisions of design thinkers with the help of their design thinking inference rule set.

The design work for programmers stands in the focus of "**How Cost Reduction in Recovery Improves Performance in Program Design Tasks**," by Bastian Steinert and Robert Hirschfeld. Changing source code often leads to undesired implications, raising the need for recovery actions. Programmers need to manually keep recovery costs low by working in a structured and disciplined manner and regularly performing practices such as testing and versioning. While additional tool support can alleviate this constant need, the question is whether it affects programming performance. The authors present their controlled lab study and their recovery tool called CoExist that makes it possible to easily revert to previous development states and also allows forgoing test runs.

In the last chapter, "**DT@Scrum: Integrating Design Thinking with Software Development Processes**," Franziska Häger, Thomas Kowark, Jens Krüger, Christophe Vetterli, Falk Übernickel, and Matthias Uflacker tackle the problem of what happens when design thinking activities are not properly integrated into production processes, e.g. software development. In this case, handovers become necessary and potentially prevent great ideas from becoming real products. A seamless integration of design thinking into the regular development processes of software development companies is still subject to research. The authors present DT@Scrum, a process model that uses the Scrum framework to integrate design thinking into software development. We are introduced to the results of their experiments as well as possible future applications.

4 Summary

Design thinking is about people. It is about finding innovative solutions for people based on their needs. With this book and the underlying research projects we aim to understand the innovation process of design thinking and the people behind it—the innovators. Discover the unknown and learn. This is not only central in design thinking as a whole, but for our Research Program as well. These contributions shed light on and show deeper insights of how to support the work of design teams in order to systematically and successfully develop innovations and design progressive solutions for tomorrow.

Multi-faceted topics were investigated, studies conducted and experiments conceived. With the help of constant exchange between all research groups, joint workshops and community building activities, the different projects were discussed and enhanced within the research community. By sharing the insights from our research program with you we also invite you to engage in dialogue with us on your ideas, insights, and questions on design thinking. We hope you enjoy and benefit from the content presented and strongly welcome and encourage feedback and further scholary debates. To further deep-dive into design thinking research we invite you to the "Electronic Colloquium on Design Thinking Research" on http://www.ecdtr.hpi-web.de where you can find more materials from the design thinking research community and share your own.

We would like to thank all authors—researchers from the Design Thinking Research Program—for contributing their research results. Additionally we are also thankful to many helping hands from Stanford and HPI who have supported this program with regard to its community building activities and workshops which made this program special and successful, a vivid, inspirational community. Special thanks go to Claudia Koch for preparing this book and supporting the authors and editors as well as Dr. Sharon Nemeth for her constant support in reviewing the chapters.

We strongly hope to inspire our readers with this book and to have contributed to a better understanding of this method. It is our sincere wish that with the help of our findings we might support you in hunting down your big ideas and bringing them home.

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