Walter Brenner · Falk Uebernickel
Editors

Design Thinking for Innovation

Research and Practice

Springer

Design Thinking for Innovation

Walter Brenner • Falk Uebernickel
Editors

Design Thinking for Innovation

Research and Practice

Springer

Editors
Walter Brenner
Institute of Information Management
University of St.Gallen
St.Gallen, Switzerland

Falk Uebernickel
Institute of Information Management
University of St.Gallen
St.Gallen, Switzerland

ISBN 978-3-319-26098-3 ISBN 978-3-319-26100-3 (eBook)
DOI 10.1007/978-3-319-26100-3

Library of Congress Control Number: 2016933122

Springer Cham Heidelberg New York Dordrecht London

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media (www.springer.com)

Design Thinking at University of St.Gallen

Design Thinking Course with Students from the MOK Master in the Design Thinking Loft at the University of St.Gallen

Annual Paper bike Rally at Stanford University

Marshmallow Tower—A Classic Warm-Up Exercise in Design Thinking

Students conducting a brainstorming outside of classic lecture halls

Preface

Decision Makers

Whether customers, managers, politicians, or judges, all face an increasingly complex world. This complexity is driven by fast technological development and dramatically increasing diversity in culture and lifestyles, which impacts policies and regulations. With an abundance of information and the human brain's limited capacities to digest this information, or even cope with the challenges of social networks, innovative forms of analytical thinking, strategy and product development, as well as teaching and learning are necessary.

Tangible forms of interactions and idea generation allow for creative and analytically sound solutions; this is the basic philosophy of Design Thinking. The University of St.Gallen is proud that this innovative form of teaching and learning was recognized and accepted by—among others—Prof. Dr. Walter Brenner and our Master of Business Innovation program. Because our university has a strong emphasis on new forms of teaching and learning, Design Thinking (and the establishment of a related) can be seen as one of different pilot initiatives in teaching innovation.

A basic element of universities is the combination of teaching and research. The design lab—like a behavioral lab or a trading room—is part of a modern university's infrastructure for economics, social sciences, law, and political science. These infrastructures can be intelligently used, not only in teaching programs but also for services like development work for industries. We see many perspectives for Design Thinking as an important element in our vision for 2020, in which our university wants to contribute to modern economic and social challenges by

becoming a center of thought leadership. We would like to thank the pioneers in Design Thinking at the University of St.Gallen, Prof. Dr. Walter Brenner and Falk Uebernickel.

January 2016 Thomas Bieger

Foreword

Design Thinking is one of the most fascinating concepts currently under discussion in management discourse: human-centered and based on new facilitation methods and spatial concepts. It is not surprising that Design Thinking emerged from Stanford University, in the heart of Silicon Valley; the success of many technology enterprises, as well as Internet giants, is rooted in the combination of technology and human-centeredness.

For us, the best example is Apple. The success of this company is—according to the biography of Steven Jobs by Isaacson[1]—based on the combination of advanced information and communication technology (iPhone and iPad), new business models (iTunes), human-centeredness (minimalistic approach to design), and beauty (iMac 9) demanded by Steve Jobs. With the combination of these four elements, Apple managed both to dispel the prejudice that information and communication technology is ugly and hard to use and to be a very successful and, at times, the most valued company of the world. Design Thinking has been utilized, to our knowledge, continuously for many years at Apple. The first Apple computer mouse was developed together with engineers from IDEO, a spin-off of Stanford University specialized in Design Thinking. With this background, it is now almost unanimously agreed that Design Thinking belongs in the curriculum of every leading technical university. Every engineer graduating from one of these leading universities will need to be proficient in Design Thinking. It would seem that contemporary, innovative product and service development is hardly conceivable now without some knowledge of Design Thinking.

In software development, Design Thinking is also increasingly used. Hasso Plattner, one of the founders of SAP, acknowledged the potential 10 years ago. He then initiated and financed the d.School at Stanford University and built a large area for Design Thinking at the Hasso-Plattner-Institute at the University of

[1] Isaacson, W (2011) Steve Jobs. Simon & Schuster, New York.

Potsdam. Based on concepts, knowledge, and experience from these ventures, he anchored Design Thinking as the central innovation method within SAP.

For years, Design Thinking has steadily gained influence in management. We at the Institute of Information Management at the University of St.Gallen believe ourselves to be, along with Roger Martin[2] from Rotman School of Management, pioneers in the application of Design Thinking in management. Since summer 2005, we have worked in close collaboration with Larry Leifer and Mark Cutkosky of the Center for Design Research[3] at Stanford University's engineering department on the use of Design Thinking in innovation projects for new business models, processes, products, and services. Since then, we have conducted more than 40 projects and are part of a global network of universities applying Design Thinking. We have made Design Thinking an integral part of education at the University of St. Gallen[4]; as of January 2015, it seems that this success will continue. The rectorate of the university has decided to build a new lab dedicated to Design Thinking education, a decision hard to imagine when we started with Design Thinking almost 10 years ago. It is extraordinary how influential Design Thinking has become in research and management education. Through many discussions, we (at the Institute of Information Management) realized that we are not the only unit at the University of St.Gallen working with Design Thinking, which led us to organize this book. Our aim was to gather Design Thinking friends at the university and to invite colleagues from our partner universities (also working together with us on Design Thinking projects) to contribute to this book. We are delighted that most of the colleagues accepted our invitation and contributed. We would like to especially thank the president of our university, Thomas Bieger, who wrote the preface.

For us, it was clear from the beginning that we would not write a book about Design Thinking and innovation in information systems, although we both have a strong background in this field. When we planned this book, our idea—or goal—was to write a book about Design Thinking as a tool for innovation management. The astonishing result is that the final result is a management book with a focus on innovation management. This proves to us that Design Thinking, with its effective method and tool orientation,[5] will play an important role in corporate management, innovation, and management education in the future.

The book is organized into three parts. **Part I** of this book contains an introduction from the editors, Walter Brenner and Falk Uebernickel. In this first contribution, with Thomas Abrell, we—as editors—describe our views on Design Thinking

[2] Martin, R (2009) The Design of Business: Why Design Thinking is the next competitive advantage. Harvard Business Press, Cambridge (MA).

[3] http://me.stanford.edu/research/labs-and-centers/center-design-research

[4] http://dthsg.com/

[5] There is a second book from us about Design Thinking available with a strong focus on project management, methods, and tools in design thinking: Uebernickel, F., e.a., Design Thinking: Das Handbuch (2015): Frankfurter Allgemeine Buch.

and our experiences at the Institute of Information Management with Design Thinking in research and practices over the last 10 years.

Part II of this book presents contributions from research and teaching. We have been able to motivate essential "players" in Design Thinking at the University of St. Gallen and recruited partners—from other universities that have worked together with us for many years in Design Thinking—to submit a contribution.

Thomas Abrell, one of our doctoral candidates at the Institute of Information Management, works at Airbus. He was educated in Design Thinking at Aalto University in Helsinki and is researching Design Thinking and Corporate Entrepreneurship. In his contribution, he points out four promising areas of future research to connect Corporate Entrepreneurship (or Intrapreneurship) and Design Thinking. The first theme he depicts is Design Thinking and opportunity recognition/creation, a concept at the heart of Corporate Entrepreneurship, from which Corporate Entrepreneurship emerges. Secondly, Design Thinking and Effectuation are analyzed; clues emerge that the logic of entrepreneurial expertise—effectuation—and Design Thinking may have strong overlaps in Corporate Entrepreneurship. The third theme elaborates on the intersections of Design Thinking and Corporate Entrepreneurship strategy. The connections are, thus, in strategy-making and a design-influenced Corporate Entrepreneurship strategy that aims at refining elements of Design Thinking to help corporate entrepreneurs. The fourth theme is entrepreneurial design management, with a shift of perspective—instead of ways to support corporate entrepreneurs through Design Thinking, this chapter elaborates on entrepreneurial management principles to manage the design function within corporations.

In their contribution, **Pekka Berg and Jussi Pihlajamaa** from Aalto University, **Poul Kyvsgaard Hansen** from Aalborg University, and **Ade Mabogunje** from Stanford University concentrate on the front-end phase of innovation processes. In this early phase, central attributes of the final product are defined. The authors propose a balanced design front-end model (BDEFM) to help measure radical innovation processes. The model analyzes the early phase of innovation processes from five viewpoints: input, process, output (including impacts), social environment, and structural environment. With the help of three case studies from equipment manufacturing, metal industry, and the animal feed industry, the authors verify their model.

Amir Bonakdar and **Oliver Gassmann**, from the Institute of Technology Management at the University of St.Gallen, present the innovation of business models. Their most important assumptions are as follows: 90 % of all business models can be traced back to 55 core patterns; with the help of these core patterns, the innovation process for business models can be systematized. In their contribution, they define how the business model navigator process can be supported through the strengths of Design Thinking. They explain how, in the three steps "Design," "Ideation," and "Integration", thinking styles and specific methods and tools from Design Thinking can be applied. With their contribution, Bonakdar and Gassmann show how specific methods and models that have been developed in Design Thinking can be selected and applied in different innovation contexts.

In their contribution, **Mateusz Dolata** and **Gerhard Schwabe**, from the University of Zurich, apply Design Thinking in information research projects. Their contribution arises from a perennial collaboration of the Institute of Information Management and the University of Zurich in Design Thinking education. The authors start with the assumption that Design Thinking and scientific work are not initially well connected and then prove the opposite. They show that Design Thinking—as overall mind-set as well as its specific methods—can make a significant contribution to strengthening research in information systems. Central focus is the creation of radical innovations to solve wicked problems. In addition, they show that Design Thinking makes an essential contribution to strengthen user orientation, for example, through applying ethnographic methods. In the second part, the two authors illustrate that Design Thinking is a practice-driven method often in conflict with established methods of research in information systems. An important insight from the contribution of Dolata and Schwabe is a very careful definition of the statement that "Design Thinking is a research method," a topic repeatedly debated in discussions about Design Thinking.

Martin Eppler and **Sebastian Kernbach**, from the MCM Institute at the University of St.Gallen, deal with the visualization of results during a Design Thinking project. They describe dynagrams, which they define as dynamic graphic interactive thinking tools that can be used by members of a working group and result in a joint (often digital) solution space that takes the contributions of all participants into account. They specifically research three dynagrams: the Roper Dynagram, Confluence Dynagram, and Sankey Dynagram. Eppler and Kernbach show that the digital world and application of new methods like Design Thinking require new methods and tools. Within information management (a field where we belong as editors) and other disciplines we will face great challenges in the coming years; we must expand our "toolbox" (a topic we will further explain in our own contribution). Eppler and Kernbach go one step further by introducing concrete and partly digitally supported methods and tools.

Simon Grand, from the Institute for Systemic Management and Public Governance at the University of St.Gallen, connects Design Thinking with management and strategy. His basic assumption is derived from Peter Drucker: ". . .the best way to predict the future is to create it." He sees Design Thinking as an essential component in an entrepreneurial understanding of strategy and summarizes his ideas in 10 practices: projecting, prototyping, evaluating, experimenting, routinizing, mobilizing, realizing, connecting, scaling, and curating. In the second part of his contribution, Grand demonstrates how these practices can be applied to the strategy process. He succeeds in showing that, through the consistent use of ideas and concepts from Design Thinking, new understanding of the strategy process and innovative processes of strategizing emerge.

Dietmar Grichnik, **Ronny Baierl,** and **Michael Faschingbauer**, from the Institute of Technology Management at the University of St.Gallen, illustrate the connection between entrepreneurship and Design Thinking. They draw from the

field of effectuation, concluding that there are comprehensible, documentable methods for entrepreneurship. Effectuation departs from the traditional understanding that entrepreneurs are unique personalities and entrepreneurship results from that. In their contribution, they depict, in fascinating detail, how uncertainty is confronted. They summarize principles of entrepreneurial action: future orientation, means orientation, affordable loss, contingencies, and partnership. Grichnik et al., Grand, and Abrell think in the same direction; they demonstrate that Design Thinking supports entrepreneurial thinking and action.

Claus D. Jacobs, from Berne University of Applied Sciences and the University of St.Gallen, introduces another principle of Design Thinking: the connection of head and hand that he describes as cultural-materialist approach. He aligns his thoughts closely with craftsmanship, which he defines as the "skill of making things right." Like Grand, Jacobs builds a bridge between strategy and Design Thinking, but with different emphasis. Jacobs develops a strategy process using research from the field of design. He distinguishes between the following steps: formulating, representing, moving, bringing problems and solutions together, evaluating, and reflecting. He shows systematically how, in each of the seven steps, Design or Design Thinking can overcome limitations of traditional strategy-making processes and lead to a new strategy-making process.

Larry Leifer, from the Center for Design Research, one of the inventors of Design Thinking at Stanford University and **Alexander Neff** from the Institute of Information Management at the University of St.Gallen work with context dependency in Design Thinking and design research. The starting point for their contribution is a wave of research at Stanford University dealing with autonomous driving and driver experience. Leifer and Neff discuss "complex adaptive machine systems" in this context. Through six examples at the beginning of the article, they show how important context is for interpretation. Based on this, Leifer and Neff distinguish between three distinct forms of dialogue between robot (autonomous car) and driver: information dialogue, emotion dialogue, and knowledge dialogue. In the second part of their contribution, they define their research in the design research context.

Sven Reinecke, from the Institute of Marketing at the University of St.Gallen (who took a sabbatical at the Centre for Design Research at Stanford University), compares marketing and Design Thinking. In his introduction, he explains that marketing and Design Thinking cannot be reduced to one method; both approaches are more like overall (leadership) philosophies. With this argument, Reinecke is in line with many other contributors, including Brenner and Uebernickel and Abrell. The author works systematically through all steps of the Design Thinking process, depicting how it supports marketing management. During this process, he finds that traditional instruments of Design Thinking, like observation, prototyping, and testing with end customers, can expand the method and toolbox of marketing. However, Reinecke also shows that an orientation of marketing processes solely to the paradigms of Design Thinking may be an oversimplification. The author

concludes that an analysis of the competition should be institutionalized in the innovation process; that, in his opinion, is a weakness of Design Thinking.

Part III of this book contains three contributions showing Design Thinking from a practitioner's perspective. It was never the aim of this book to cover all facets of the application of Design Thinking in companies. Nevertheless, we would like to give a glimpse and build the bridge toward the application of Design Thinking—in practice—with these three contributions, which show how Design Thinking offers immediate practical value.

Xiao Ge and **Bettina Maisch**, from Siemens Corporate Technology in China, show how Siemens implemented Design Thinking in China. The i.DT program has two goals: it aims at educating future innovation leaders and strengthening innovation capability. This contribution shows how Design Thinking is adapted to Chinese culture, reflected, for example, in the naming of the project rooms for design teams "Tian Gong Guan," which translates to "innovators' heaven." At the heart of this contribution are applications of Design Thinking in user-driven innovation. In their contribution, Ge and Maisch introduce the Design Thinking process applied at Siemens in China, as well as selected methods. They show that the Design Thinking process, as in the contributions of Brenner, Uebernickel, and Abrell, is applied at Siemens China with only minor changes. In conclusion, the authors show how important management support and a support ecosystem are for the successful implementation of Design Thinking in a large corporation.

Alexander Grots and **Isabel Creuznacher** discuss whether Design Thinking is a process, or leads toward a certain culture, from a practitioner's perspective. It should be noted that Alexander Grots was previously a partner at IDEO, one of the leading consultancy firms based on Design Thinking. Grots and Creuznacher, in line with other authors of this book, come to the conclusion that Design Thinking can be applied as both process and culture. In their contribution, they picture a Design Thinking innovation process compatible with other processes described in this book and describe elements of a Design Thinking culture.

Michael Shamiyeh, a well-known architect and generalist from the University of Linz, critically scrutinizes future orientation in innovation projects and Design Thinking. From a temporal perspective, Shamiyeh distinguishes three approaches to innovation: the past, present, and future as points of reference for innovation. The past is only briefly described. For the presence as point of reference, Shamiyeh chooses Nike + and the Apple sports kit as example. He shows (and this mirrors the experiences from many innovation projects) that, through discussions with real and potential customers, the potential for radical future-oriented solutions is limited. On the other hand, such solutions can actually be sold. For the future as a point of reference, he chooses the example of an engineer at Kodak, who invented the digital camera already in the mid-1970s. As history shows, Kodak did not profit from that. The author shows how important it is, on one hand, to look without restrictions into the future, and, on the other hand, he shows, realistically, that this is difficult and can be frustrating. The development phase of a dark-horse prototype, as described in the macro-process for Design Thinking by Brenner et al., can be seen as an attempt to sketch a "design from the future," as Shamiyeh calls it.

Despite different organizations, knowledge, and author experiences, the contributions in this book are surprisingly homogeneous. We illustrate how the field developed from central works like Simon's Sciences of the Artificial in the 1960s and the evolution of Design Thinking through the engineering department of the Stanford University toward a strong core today, manifested in an innovation process and a specific Design Thinking culture. This core is widely accepted in different application areas and successfully applied. In addition, several authors extended the core to improve the applicability of Design Thinking in other contexts.

To sum up, the contributions in this book lead to the following insights:

- Design Thinking is a body of knowledge that started from the design field as a conception method and from Simon's science of the artificial in the 1960s and has developed into a research and teaching discipline with a fixed place in numerous research fields, broadening steadily. The different fields analyzed in this book range from information management, engineering, innovation, and entrepreneurship to management, showing how broadly Design Thinking can be applied.

  Design Thinking is interdisciplinary, based on knowledge and insights from engineering, management, industrial design, anthropology, information management, and ethnography. Its pragmatic core and understandability allow application in many other contexts.
- Central similarities spanning almost all articles are the connection of human-centeredness of the innovation process, for customers as well as the building and testing of prototypes. Design Thinking works best when teams are heterogeneous. Many additional Design Thinking developments are described in this book; they produced specific knowledge and experience around this shared core.
- Analogous to other processes in the company, innovation processes can be structured and replicated to a certain extent. Design Thinking is a procedure to design innovation processes comprehensibly. Relying on single, unique persons with a specific genius is replaced by a reproducible process.
- Design Thinking offers a platform to answer different questions from areas such as problem-solving, design of business models, facilitation, mediation, visualization, and innovation in one process. It forces the users in these disciplines to enhance their methods and toolboxes.
- The human in different roles, for example, as customer, employee, entrepreneur, or user, is gaining favor in many disciplines. Design Thinking is a proven and robust instrument to uncover and include obvious and hidden needs in innovation-, development-, and problem-solving processes.
- Design Thinking is, despite its broad base, ultimately a pragmatic method based on a few simple principles. Iterative development, contact with humans, and visualization of results as prototypes are examples of these principles.
- To bring about big changes in companies through Design Thinking, it must be understood that company culture needs to be addressed when training employees.

This list summarizes our insights from all contributors and represents the viewpoint of the editors; as such, it is subjective. In the end, every reader needs to decide on her/his own what the take-aways are.

We thank all personalities who contributed to the success of this book. Jennifer Hehn and Barbara Rohner coordinated the book and Roger Furrer assisted with translation and formatting.

St.Gallen Walter Brenner
January 2016 Falk Uebernickel

Contents

About the Authors

Thomas Abrell, M.Sc., M.A. conducts his doctoral research in Intrapreneurship and Design Thinking at the Institute of Information Management, University of St. Gallen. In addition, he is innovation manager at Airbus as well as leading the consultancy Kombinative Oy, which specializes in intrapreneurship. With a background in business as well as International Design Business Management, Thomas Abrell specialized in user involvement, Design Thinking, and intrapreneurship.

Pekka Berg, Ph.D. is Research Director of Aalto University Department of Industrial Engineering and Management and founder and also Director of the Innovation Management Institute under Aalto University. He is, as well, a partner and consultant to Innoman ltd. He has worked with companies like Toyota, Volkswagen, Nokia, Panasonic, Mitsubishi, Rolls-Royce, Wärtsilä, Electrolux, Kone, Metso, Rautaruukki, UPM, and Fortum. His teaching activities in Aalto University School of Science, Aalto Ventures Program, International Design Business Management Program, and MBA program include the courses dealing with Collaborative Innovation Management and Innovation and Project Management. He has publications in the areas of design thinking, general innovation management and innovation policy, innovation measurement, management of intangibles, discontinuous innovations, rapid innovation practices, and user experience in innovation.

Amir Bonakdar, Ph.D. is Head of Business Model Design Research at the University of St.Gallen and Stanford University. After obtaining his diploma in business administration from the University of Erlangen-Nuremberg, he worked for several years as a consultant at SAP, helping various clients optimize and innovate their business processes. He pursued his Ph.D. at the Institute of Technology Management in St.Gallen and at the Center for Design Research at Stanford University. His research interests include business model innovation, Design Thinking, strategic innovation, and networks.

Walter Brenner, Ph.D. joined St.Gallen University in 2001 as a professor after having held the Chair of Information Systems at the University of Essen (Germany) for 2 years and at Freiberg University of Mining and Technology (Germany) for 7 years. His research focuses on Design Thinking, Digital Industrial Services (smart products), and Innovation and Technology Management. He authored and/or edited 30 books as well as more than 300 scientific publications. In addition, Professor Brenner serves on the editorial board of MIS Quarterly Executive and is member of the program committee of international conferences. Professor Brenner received a graduate degree in business administration (lic. oec.) and a Doctorate (Dr. oec.) from the University of St.Gallen. Prior to joining academia, Professor Brenner worked as Head of Application Development with Alusuisse-Lonza AG (Switzerland).

Isabel Creuznacher, Ph.D. is associate director of the "Institute for Transformation in Business and Society" at the EBS Business School (www.ebs-init.de).

She offers companies and educational institutions worldwide customized programs and seminars with a focus on the topic Innovation, Entrepreneurship and Intercultural Management, helps companies to develop new business segments, or does order-related trend research in Innovation worldwide.

She is also assigned as assistant professor in India (Christ University) and Saudi Arabia (Dar Al-Hekmar College) where she is teaching yearly compact courses "Design Thinking and Intercultural Management."

Mateusz Dolata, M.Sc. since 2012 is a Ph.D. student in the Information Management Research Group at the University of Zurich, where he studies the influence of IT on communication in dyads and design teams. He draws his interest from his previous studies in computational linguistics, philosophy, and media informatics. In his current research, he combines methods from those fields to discover changes in vocabulary and language use resulting from the application of particular software, hardware, or a process. He uses the obtained findings to propose improvement in collaboration support systems or strategies. He has published at conferences such as CollaborateCom, DESRIST, and European Conference on Information Systems and at adjunct events to CSCW and ECSCW. He promotes Design Thinking in his teaching activities and acts as a facilitator in research projects conducted with academic or industrial partners.

Martin J. Eppler, Ph.D. is the Chair of Communication Management at the University of St.Gallen, where he is also the director of the university's International Study MBA program and of the = MCM institute for media and communications management. He has been a guest professor at Georgiatech's School of Public Policy, Cambridge University (UK), Aalto University (Finland), Pacifico University (Peru), and the Central University of Finance and Economics in Beijing (China). His research focuses on knowledge management, knowledge creation and innovation, knowledge visualization in teams, and knowledge communication

among experts and decision makers. He is the author of 14 books and more than 150 academic articles. He is the inventor of the visualization software en.lets-focus.com and he has been an advisor and trainer to organizations such as the United Nations, the European Central Bank, Siemens, Daimler, UBS, eBay, Swarovski, GfK, UBS, Roche, AXA, Louis Vuitton, or Ernst and Young.

Oliver Gassmann, Ph.D. is professor of Technology Management at the University of St.Gallen, Switzerland, and Director of the Institute of Technology Management. After completing his Ph.D. in 1996, he was leading research and advanced development of Schindler Corporation. He has published in leading journals such as Research Policy, R&D Management, International Journal of Technology Management, Journal of World Business, European Management Journal, IEEE Transactions on Engineering Management, Journal of Technology Transfer, and Harvard Business Manager. At the core of his research is the pervading question of how companies innovate and profit from innovation. Thus, he is dedicated to discovering new approaches to the management of technology and innovation that contribute to firms' competitive advantage.

Xiao Ge received the B.Eng. degree in Astronautics Engineering from Harbin Institute of Technology, China, in 2010, and the M.S. degree in Mechanical Engineering from Stanford University, USA, in 2012. She is the former Innovation Specialist at Siemens Corporate Technology (CT) China. Since early 2012, together with the pioneers of human-centered innovation at Siemens CT China, she has developed Industrial Design Thinking (i.DT), set up the innovation lab and community, as well as trained/coached Siemens researchers with i.DT along with business projects.

Simon Grand, Ph.D. is a management researcher, knowledge entrepreneur, and strategy designer. He is founder and academic director of the RISE Management Innovation Lab (www.rise.ch) and assistant professor of Strategic Management at the University of St.Gallen, research fellow at the Zurich University of the Arts (www.creativeeconomies.com), and a member of the supervisory board of several companies. In his research, he examines the dynamic interplay between routine dynamics, strategy processes, and managerial engagement, with an empirical focus on entrepreneurial companies and technology corporations in various industry contexts. He also works and publishes on the practice of executive management, corporate governance, and management innovation. His research has been published in academic journals including Long Range Planning and Scandinavian Journal of Management and in several coauthored books: "Executive Management in der Praxis" (2011), "Mapping Design Research" (2012), "Das St. Galler Management-Modell—4. Generation" (2014, 2015), and "Routines, Strategies and Management: Engaging for recurrent creation at the edge" (forthcoming) (see also: www.simongrand.com).

Dietmar Grichnik, Ph.D. is Chair Professor of Entrepreneurship and Director of the Institute of Technology Management at the University of St.Gallen (HSG), Switzerland. He is the Initiator and Co-Director of the Center for Entrepreneurship and Vice Dean of the School of Management at HSG. Before joining HSG, Professor Grichnik served on the faculties of WHU—Otto Beisheim School of Management and Witten/Herdecke University in Germany. Moreover, he held a visiting professorship at the University of Melbourne, Australia, was guest professor at Harvard Business School, USA, and teaches currently at the Swiss Federal Institute of Technology (ETH) Zurich. As an advisor, Professor Grichnik has worked with start-ups and corporations in entrepreneurial decision-making and finance. He takes part in international start-up initiatives as a cofounder and business angel. He supports students and scientists on campus with the HSG Founder Lab and the HSG Founder Garage. He is responsible for the scientific lead of the Swiss Start-up Monitor on behalf of the Swiss Commission of Technology and Innovation and the Swiss National Science Foundation. He has published 5 books and more than 200 articles.

Alexander Grots is an independent innovation consultant and specialist in the "Design Thinking" innovation methodology. He started to work with and teach the method in 2001. His stages included the role of Managing Director for internationally acclaimed innovation firm IDEO in Germany, being in charge of setting up the School of Design Thinking at the HPI Potsdam, founder and managing director of innovation consultancy gravity-Europe, and founding a number of start-ups in the mobility, IoT, and wearables sector.

Poul Kyvsgaard Hansen is an Associate Professor of Technology Management and Organization at Center for Industrial Production at Aalborg University in Denmark. He holds a M.Sc. in Industrial Engineering and a Ph.D. in Technology Management. His current research focuses on various aspects of communicating complex problems and solutions. This includes both organizational and technical issues within three overall research areas: (1) Product modularization—Architectures—Platforms, (2) Innovation Management, and (3) Change Management.

Claus D. Jacobs, Ph.D. is Professor of Strategic Management and Organization at Berne School of Management, Institute for Corporate Development, UAS Berne, a Visiting Professor of Strategy and Organization at the University of St.Gallen, and an Associate Fellow of University of Oxford's Saïd Business School. He holds a Ph. D. from University of Dublin, Trinity College, as well as a venia legendi from University of St.Gallen. From 2008 to 2013, he was Swiss National Science Foundation Professor at the University of St.Gallen. He is member of the editorial boards of Journal of Management Studies and Scandinavian Journal of Management as well as Executive Committee Member of the Strategizing Activities and Practices Division at the Academy of Management. His research has been published in Organization Studies, Journal of Management Studies, MIT Sloan

Management Review, Strategic Organization, Human Relations, Journal of Applied Behavioral Science, and Journal of Organizational Change Management, among others. Recently, he published with Loizos Heracleous (Warwick Business School) "Crafting Strategy—Embodied Metaphors in Practice" at Cambridge University Press (2011).

Sebastian Kernbach, M.Sc. is project manager and research associate at the University of St.Gallen and research fellow at the brand consultancy Interbrand. His doctoral research focuses on knowledge visualization and knowledge communication with a particular emphasis on the facilitation of interpersonal interactions in Professional Services Firms. He is a trainer for visual thinking helping researchers, lecturers, and professionals to support their thinking and communication skills through the use of visualization. He studied economics and communication at the University of Lugano and Copenhagen Business School and his professional experience includes positions in marketing, communication and branding at XEROX, a Swiss startup, and Interbrand.

Larry Leifer, Ph.D. is a Professor of Mechanical Engineering Design and founding Director of the Center for Design Research (CDR) at Stanford University. He has been a member of the faculty since 1976. His teaching laboratory is the graduate course ME310, "Industry Project Based Engineering Design, Innovation, and Development." Research themes include the following: (1) creating collaborative engineering design environments for distributed product innovation teams; (2) instrumenting that environment for design knowledge capture, indexing, reuse, and performance assessment; and (3) design for sustainable well-being. His top R&D priorities in the moment include the Hasso Plattner Design-Thinking-Research Program, d.swiss, and the notion of a pan-disciplinary Ph.D. program in Design.

Ade Mabogunje, Ph.D. is a senior research scientist at Stanford University. Prior to this, he was the associate director of the Center for Design Research (CDR) in the School of Engineering and the program lead of the Real-time Venture Design Lab (ReVeL) in the School of Humanities and Sciences. Ade regularly conducts empirical studies of the engineering design process with a view to developing performance metrics for creative design teams in innovation ecosystems. He is currently investigating alternative mechanisms through which ideas and practices from science, engineering, psychology, and finance can be turned into useful design theories to guide the building of sustainable and scalable ventures in less industrialized economies. He has publications in the areas of design theory and methodology, knowledge management, design protocol analysis, engineering education, simulation studies of design teams, and emotion in engineering.

Bettina Maisch, Ph.D. is in charge for the Industrial Design Thinking (i.DT) Program at the Systems Engineering Group at Siemens Corporate Technology (CT). With strong support by the former Head of CT, Dr. Arding Hsu, she set up

a training program and facility in 2012 in Beijing, China. Bettina and her team adapted the methodologies from Stanford University and the Design Company IDEO to the requirements of an industrial company like Siemens. After 3 years of experience in setting up the industrial Design Thinking program and lab in China, Bettina is ramping up the i.DT activities in Germany since January 2015. Bettina holds a Ph.D. in Business Innovation from the University of St.Gallen, Switzerland. She spent 1.5 years doing research at the Center for Design Research at Stanford University funded by the Hasso Plattner Design Thinking Research Program. Bettina gained working experience in the advertising agency Ogilvy, at the Fraunhofer Institute for Open Communication FOCUS in Berlin, and in various research projects at the University of Arts in Berlin, the University of St.Gallen, as well as at Stanford University.

Alexander A. Neff, M.Sc. is research associate at the Institute of Information Management at the University of St.Gallen (HSG). He holds a M.Sc. and B.Sc. in business informatics from the University of Mannheim which he conducted partially at Singapore Management University, Singapore. His research activities focus on industrial services and enterprise applications in the manufacturing industry. His work is published in Information and Management and several academic conferences.

Jussi Pihlajamaa, Ph.D. is a research manager at Aalto University, School of Science, Department of Engineering and Management, Innovation Management Institute research group, IMI. His main research interests include organizational innovation systems and processes as well as assessment and goal setting methods of national research, development, and technology programs. In particular, radicals and discontinuous innovation have been the subject of his research in recent years. Currently, his research interest is focused on digitalization and its impacts on business model innovation processes and measurement of innovation platforms and ecosystems.

Sven Reinecke, Ph.D. is Executive Director of the Institute of Marketing at the University of St.Gallen (HSG) and Associate Professor of Business Administration and Marketing at the University of St.Gallen, Switzerland. Having joined the faculty in 2004, he is now academic director of the English track of the Master of Art in Marketing, Services and Communication Management and of the Ph.D. program in Marketing. In 2014, he has been Visiting Associate Professor at the Center of Design Research of Stanford University (Palo Alto CA, USA). His main research interests are strategic marketing, marketing management control, pricing, product innovation, and customer retention management. Since 1994, he has (co-) produced over 100 publications, including 17 books (e.g., Marketing Planning, Marketing Management Control, Total Customer Care, Market Research, Luxury Management). He is working closely together with the marketing departments of Bayer Material Science, B. Braun, Continental, Galenica, Hansgrohe, Miele, Swisslife, and UBS. Beyond his teaching activities at the University of St.Gallen,

Sven Reinecke is also active as a lecturer for executive education at several leading European universities. He is chairman of the board of MPM Market Performance Management St.Gallen AG.

Gerhard Schwabe, Ph.D. has been a chaired professor for Information Management at the University of Zurich since 2002 and has applied Design Thinking in teaching and in research since 2012. Since starting as researcher in 1988, he has studied collaboration at the granularity of dyads, small teams, large teams, organizations, communities, and social networks. In doing so, he follows either an engineering approach ("design science") or an exploratory approach—frequently in collaboration with companies and public organizations. He uses the collected experience to study the role and impact of design practices in innovation, software development, and science. His recent research has been published in leading journals such as Journal of MIS, ACM Transactions on MIS, BISE/Wirtschaftsinformatik, and Journal of Computer Assisted Learning as well as in top conferences like International Conference on Information Systems (ICIS) or ACM Conference on CSCW and Social Media.

Michael Shamiyeh, Ph.D. is professor and head of the Design Organization Media (DOM) Research, an academic research and consulting center at the University of Arts and Design, Linz, which helps organizations to define the framework for compelling innovation strategies and to build their own capabilities, systems, and structures that are right for change. He is also partner of the Swiss Board School at the University of St.Gallen. Michael studied strategic management at the University of St.Gallen (Ph.D.) and architecture at Harvard University (MArch postprofessional), the Architectural Association in London (MA), and the Technical University of Vienna (Dipl-Ing). He has published in many international journals, books, and popular media. The work of Michael and his team has won many awards, including two Gold Medals for "Best Invention" given by KIWIE, Korea (2010), and by the World Intellectual Property Organization (2010), and the Innovation Prize (2009), awarded by the Austrian Ministry of Science.

Falk Uebernickel, Ph.D. is associate professor at the University of St.Gallen (HSG), one of Europe's leading universities for Strategy and Management, as well as Managing Partner of ITMP AG. He received his Ph.D. in economics in 2008 in the field of measuring and evaluating performance in large IT organisations. Today, his main focus in research and consulting is on Design Thinking and Information Management. He started his professional Design Thinking career with projects at Deutsche Bank in 2008. He teaches the Masters Design Thinking course together with Stanford University, is active lecturer at the MBA program of HSG and is conducting executive lectures at companies. He has worked for companies like FIFA, Audi, UBS, RBS, Allianz, Merck, Swisscom, ThyssenKrupp, and Airbus and for over 70 more projects. Falk is also responsible for the global design thinking

alliance program—called SUGAR—which coordinates more than 20 universities around the globe. He is also author of over 130 research publications on innovation and information management. His focus is on training and teaching as well as strategic planning of transformational projects for companies. In his spare time, he likes high alpine mountaineering.

Part I
Introduction from the Editors

Design Thinking as Mindset, Process, and Toolbox

Experiences from Research and Teaching at the University of St.Gallen

Walter Brenner, Falk Uebernickel, and Thomas Abrell

Abstract Design Thinking is a development that has recently attracted significant attention in the management discourse. The Institute of Information Management at the University of St.Gallen, the academic home of all three authors, has been conducting Design Thinking teaching and research for 10 years. In this study, Design Thinking is defined as: mindset, process, and toolbox. As a mindset, Design Thinking is characterized by several key principles: a combination of divergent and convergent thinking, a strong orientation to both obvious and hidden needs of customers and users, and prototyping. As a process, Design Thinking is seen as a combination of a micro- and a macro-process. The micro-process—as innovation process per se—consists of these steps: "Define the Problem", "Needfinding and Synthesis", "Ideate", "Prototype" and "Test". The macro-process consists of milestones manifested in prototypes that must fulfill defined requirements. As a toolbox, Design Thinking refers to the application of numerous methods and techniques from various disciplines: design, but also engineering, informatics, and psychology. Today, a growing number of companies, consulting firms, and universities use Design Thinking, continuously enlarging and re-defining its meaning. At University of St.Gallen, Design Thinking is taught as a problem-based course, together with research partner companies, with more than 40 projects successfully completed over the past 10 years. Research in Design Thinking at the University of St. Gallen focuses on aspects of modeling the Design Thinking processes and corporate entrepreneurship. In the near future, Design Thinking is expected to be deployed as an innovative method in corporations and also become an integral part of management education, particularly innovation. In addition, it will be developed further at the interface of design, design management and engineering sciences.

Keywords Design Thinking • Information management • User-centered innovation

W. Brenner (✉) • F. Uebernickel • T. Abrell
Institute of Information Management, University of St.Gallen, Unterer Graben 21, 9000 St.Gallen, Switzerland
e-mail: walter.brenner@unisg.ch; falk.uebernickel@unisg.ch; thomas.abrell@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_1

Introduction

Design Thinking is a term that has is used internationally in a multitude of scientific books, articles, seminars, management talks and consulting firm offers. A closer examination reveals a lack of clarity about what Design Thinking is, which potential it has, and how it can be applied and learned. Building on this, the aim of the article is to describe how we apply and teach Design Thinking at the Institute of Information Management of the University of St.Gallen.

In this article, we define and illustrate Design Thinking as a future-oriented innovation method based on examples. First, we introduce a few examples of Design Thinking projects. In the following section, we elaborate on the nature and origins of Design Thinking, differentiating between Design Thinking as mindset, process, and toolbox. Then, we describe Design Thinking in teaching and information systems and subsequently present Design Thinking activities at the Institute of Information Management of the University of St.Gallen. An outlook for the future summarizes the article.

Design Thinking can be defined as a field, in which many scientists and practitioners from various disciplines work and publish. Within such an extensive field, this article is not exhaustive; it documents knowledge and experience at the University of St.Gallen, which is influenced by the activities at the Stanford University, particularly from the Design Research Center and the d.School (Hasso Plattner Institute of Design Thinking).

Examples of Design Thinking

Design Thinking's potential is illustrated by four examples from different fields, demonstrating some parts of the Design Thinking process and proving that companies can find new solutions with Design Thinking, even in fields where significant research and development has been carried out in the past.

No more fear—pirate journey in the MRI (Kelley and Kelley 2013, p. 13f): Children facing an examination in an MRI-scanner (MRI = Magnetic Resonance Imaging) are scared. The anxiety of parents who know, or at least guess, what their children will experience, is transferred to the children, meaning that approximately 80 % of the children must be sedated to make the examination possible. Through Design Thinking, General Electric found a way to lower the percentage of children needing sedation by working on the children's experience. With only optical changes to the MRI scanner, General Electric was able to change the children's perception and reduce anxiety. In practice, the company does not change the product's complex technological base, but instead designs a story around it that the children experience, supported by graphics. The children are intrigued and not

as frightened; less sedation is needed. General Electric applied this principle to a number of medical devices like the CT-scanner.

Flemo—private car sharing (Design Thinking project at the University of St.Gallen): car sharing is becoming an interesting alternative to buying or leasing a car. In 2011, Audi AG asked the Institute of Information Management of the University of St.Gallen to develop innovative ideas for car sharing. Together with the University of Modena and Reggio Emilia, Flemo was developed: a concept for car sharing in the private environment. The basic idea behind Flemo: multiple family members, neighbors or friends share a car. The source for this solution was intensive conversations with customers all over the world, where it became apparent that car sharing in the private environment can be an efficient way of reducing cost and improving ecological behavior. Private car sharing reduces certain risks: people sharing a car know each other, motivating them to take care of the car. Flemo is centered on an app connected to the car electronics via a box. Through this app, the user can set the maximal reach of the car, maximum speed, reserve the car and do the billing. In December 2014, Audi AG began trial runs of a similar concept with the name "Audi Unite"[1] in Stockholm, Sweden. Again, this project shows how important it is to talk to existing and future customers and identify their needs. With the help of the Design Thinking process, it was possible to find new innovative solutions. In this example, Design Thinking combined customer needs with innovative new technology.

Start—soccer player registration (Design Thinking project at the University of St.Gallen): Soccer is probably the most popular sport in the world, with almost 300 million people playing soccer regularly in 209 countries. Approximately 40 million players are registered in an association that officially organizes soccer. In summer 2012, the FIFA (International Federation of Association Football) contacted the Institute for Information Management at the University of St.Gallen to find a solution for electronically registering the 300 million soccer players worldwide. Together with the University of Zurich and the Pontificia Universidad Javeriana in Columbia, we developed an open platform called "Start" that enables local associations to register players and organize soccer matches. Once again, the researchers talked to executives and football players all over the world. In those conversations, it became clear that most football players wanted to organize football on their own. User-centered research gave FIFA unprecedented insights into the needs of and problems with registration of soccer players in local associations.

Sociapply—a new way of recruiting coworkers (Design Thinking project at the University of St.Gallen): Haufe Lexware is a medium-sized German software company, a market leader for software for small enterprises. A key issue for companies like this is recruiting staff. Haufe Lexware asked the Institute of Information Management at the University of St.Gallen for help in finding a new solution for this challenge. In many interviews with executives of small companies

[1] https://www.audiunite.com/se/service/sv_unite.html, retrieved on 18 December 2014.

and job applicants, it became clear that the concept "co-workers recruit co-workers" offered good possibilities for an answer. On the basis of this idea, the team built a solution using Facebook as a base and tested it with several companies. Using Facebook allowed the companies to address both the pool of people searching for a new job and those not searching. The idea of Sociapply was further investigated after the end of the university project, the concept was further refined and is available today as a product of Haufe Lexware. This example shows the power of Design Thinking as it combined social networks, unsolved problems of companies, and ideas from people currently searching for a new job.

The Nature and Origins of Design Thinking

Tim Brown, CEO of IDEO, one of the leading innovation consulting firms from Palo Alto, California using Design Thinking, defines it as "a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity" (Brown 2008, p. 86). Another definition stems from the Kelley brothers. Dave Kelley, the founder of IDEO, has been working at the Stanford University engineering department where Design Thinking has been developed over the past 40 years by Leifer[2] and others. Kelley and Kelley (2013, p. 24f) define Design Thinking as "a way of finding human needs and creating new solutions using the tools and mindsets of design practitioners." If we combine these two definitions, central aspects of Design Thinking are revealed. Design Thinking starts with human needs and uses suitable technologies with the aim of creating entrepreneurial value through customer value. These definitions show that Design Thinking can be a contrast point to "analytical" management (Shamiyeh 2010).

When examining the origins of Design Thinking research, one must distinguish between research on Design Thinking in the management and design discourse (Hassi and Laakso 2011), or more broadly to research within discipline of design and further (Johansson-Sköldberg et al. 2013), including engineering sciences.

In the discipline of design, research about professional designers' practice has been conducted since Simon's (1969) fundamental work "The Sciences of the Artificial". Despite this, research on Design Thinking in management has been largely independent from research conducted in design (Hassi and Laakso 2011). To acknowledge this, Johansson-Sköldberg et al. (2013) distinguish between "design thinking" and "designerly thinking". Designerly thinking is used to describe professional designers' practice (Johansson-Sköldberg et al. 2013). Design Thinking, on the other hand, is used to describe design practice and design competence practiced for and with non-designers (Johansson-Sköldberg et al. 2013) in the management context (Hassi and Laakso 2011). The term "Design

[2] https://profiles.stanford.edu/larry-leifer, retrieved on 22 January 2015.

Thinking" has received widespread attention in the design community since Rowe's (1987) book with the same title. Design Thinking in management has been developed quite independently from design research (Hassi and Laakso 2011) and is often criticized as being merely anecdotal (Johansson-Sköldberg et al. 2013). Empirical work is thus necessary to complement anecdotal evidence about successful use of Design Thinking (Hassi and Laakso 2011). In the management context, Hassi and Laakso (2011) categorized Design Thinking into practices (closely related to our category of Design Thinking as a toolbox), thinking styles and mentality components. Thinking styles and mentality components refer to our "mindset" category, while we add one dimension—Design Thinking as a process to educate future design thinkers.

The interest in, and eagerness to apply Design Thinking, most notably in IT and management demands a clear understanding of the concept without oversimplification (Dorst 2010). This article gives interested practitioners a first overview of the concept.

When using the term "Design Thinking", one recognizes a linguistic problem. In German, **Design** can be defined as the creation of a "nice" appearance, while **Design** in English can be used as both verb and noun. To design is to "do or plan (something) with a specific purpose in mind" (Oxford Dictionaries 2015). Because of this, Design Thinking projects are often (mis) understood as classical projects conducted to improve product aesthetics and attributed to, thinkers like Colani[3] or followers of the Bauhaus school.[4] This interpretation of the term Design Thinking is misleading for two reasons: on one hand, Design Thinking is an innovation method in which design as aesthetics can play a role, but is not more important than other attributes, such as functionality or usability. On the other hand, Bauhaus followers have created not only timeless objects, but also placed emphasis on using new materials, new technologies and industrial mass production possibilities.

Based on the definitions of Brown and Kelley, from the engineering department at Stanford University, where the ME310 course[5] is conducted (discussed in detail later) and our own activities in Design Thinking,[6] three forms of Design Thinking became important in our environment over the past 10 years:

- Design Thinking as Mindset
- Design Thinking as Process
- Design Thinking as Toolbox

[3] http://www.colani.de/, retrieved on 19 December 2014.

[4] http://www.bauhaus.de/de/, retrieved on 19 December 2014.

[5] http://web.stanford.edu/group/me310/me310_2014/, retrieved on 19 December 2014.

[6] http://dthsg.com/ retrieved on 19 December 2014.

Design Thinking as Mindset

The world of Design Thinking and design thinkers is characterized by principles essential for the method's success. Due to space restrictions in this introductory article, it is impossible to elaborate all these in detail. Thus, we focus on the most important principles.

The first and most important principle is: *Innovation is made by humans for humans*. This simple sentence is the guiding rule for all other principles, as well as for Design Thinking as process and toolbox. Design Thinking is a deeply human-centered method. At the root of every innovation are human needs. If those needs cannot be met through the new solution, the innovation process must be repeated. Innovation processes are made by and for people. As a consequence of the human-centeredness of design thinking various steps of the innovation process are executed differently than in traditional innovation processes. Those steps and settings include interaction, emergence and solving of conflicts during the process, as well as physical spaces where the innovation process takes place that must reflect a different "nature" in their spatial design.

Combining of divergent and convergent thinking is another important principle. Design thinkers enhance the solution space through following unconventional paths, i.e. thinking divergently. At different points in the innovation process, existing, fixed frame conditions are "crashed". Through this radical procedure, new solutions are created, often opening a door to the future. It must be noted, however, that in this divergent phase, many project partners and customers hesitate after recognizing the enormous creativity of the solution and its distance from the original project brief; they temporarily doubt Design Thinking and almost stop believing that the project could be successful. When engaging in convergent thinking, a few feasible solutions emerge.

"*Fail often and early*" facilitates human learning. Design Thinking is based on experimentation with many new ideas. In some projects, more than 100 solution ideas are created and many fail. Through early testing with end customers, design thinkers realize when ideas cannot solve the problem brief. Design Thinking, in practice, means coming up with many ideas and testing them with end customers to learn what works.

Another central principle of Design Thinking is: *build prototypes that can be experienced*. In the innovation process, building prototypes is very important. This principle conflicts with many traditional development methods in information management. Most methods to develop information systems lead to abstract models. These are, often through a step-by-step process, refined to lower abstraction layers. Many decision makers do not understand such models. Design Thinking goes in another direction. Fast and easily comprehensible prototypes are built that allow a new idea to be tested. For a large European bank, we could test whether it made sense to offer banking services in trains. To test prototypes, we modified a train compartment with six seats to create an improvised banking counter and observed customers' reactions. Over the last several years, we built hundreds of

physical prototypes, used role playing and made videos. We differentiate between different resolution prototypes: those with low resolution are often only sketches or paper mock-ups, while high-resolution prototypes can be, for example, programmable interfaces.

The principle *test early with customers* is closely connected with the principles discussed above. The faster a new idea can be tested with users, the sooner one knows which aspects of an idea are suitable. Design Thinking forces innovators to be in constant and direct contact with end customers. This extreme form of customer orientation is one of the central success premises of Design Thinking.

Another principle of Design Thinking is: *design never ends*. This means, work must proceed iteratively in cycles. Whenever a solution idea has been tested, questions will be posed about whether it contributes to a solution for the original problem brief and whether the initial problem brief was the right one. Through constant usage of the innovation process that we describe later in this article in more detail, the Design Thinking team builds up knowledge and experience about the problem, as well as both obvious and hidden needs of customers. This knowledge enables development of extremely customer-oriented solution ideas.

The last principle in this article is: *Design Thinking needs a special place*. To conduct Design Thinking projects successfully, special spaces are required: designed according to the teams' needs and equipped with the right materials. The engineering department at Stanford University conducts its Design Thinking projects in a loft that we "copied" in St.Gallen, shown in Fig. 1.

Fig. 1 The Design Thinking Loft in St.Gallen, retrieved on 22 January from http://dthsg.com/get-involved/

In this loft, each Design Thinking team has its own booth that they can use exclusively during the entire project time, any time of day. In the loft, one can conduct team-internal meetings; materials and tools are available to build prototypes. Communication tools, such as video conferencing are available. The red couch belongs to this loft just like standing tables, stools and writable walls—elements of the typical Design Thinking room equipment.

Design Thinking as mindset is characterized by the simultaneously playful and solution-oriented combination of these principles. Experienced design thinkers recognize those principles as "given" and use them to create innovative and customer-oriented solutions. Our colleagues from Stanford University, especially Leifer, sum up the playful aspect of Design Thinking with the phrase "Letting it happen".

Design Thinking as Process

In our Design Thinking projects with students and practitioners over the past 10 years, we realized that applying the principles alone—without structure—is too demanding for novices. To address this, we developed a two-stepped process model consisting of a micro and macro process, together with the engineering department of Stanford University.[7] Before we describe the process model in detail, we would like to point out that specific methods and tools are used while going through the process steps. These are described later in this article, in the section "Design Thinking as toolbox".

The micro process, [also called Stanford Design Innovation Process[8] or at the Hasso Plattner Institute in Berlin just Design Thinking Process (see Plattner et al. 2009, p. 113f)] is the central process of Design Thinking. Figure 2 shows the micro process we apply in St.Gallen, in research and practice.

The micro process as pictured in Fig. 2 is based on the principles described before. During a Design Thinking project, the micro process is conducted several times. The first process step "Define the problem" means that a so-called challenge, the problem brief, is worked out. The challenge describes the problem-to-solve in form of a question. One example for a challenge could be: "How will learning at universities look in 2020?" The art in formulating a challenge is to find a good compromise between focus and necessary breadth that leaves enough room for innovations. The second step, "Needfinding & Synthesis", is aimed at revealing end customers' needs. We differ between obvious and hidden needs. In Design Thinking projects, teams often succeed in revealing hidden needs that eventually contribute to providing innovative and competitive solutions. In the second process

[7] http://dschool.stanford.edu/, retrieved on 19 December 2014.

[8] http://web.stanford.edu/group/me310/me310_2014/about_design_process_big.html, retrieved on 19 December 2014. These websites provide an idea of Design Thinking education at Standford University's Engineering Department.

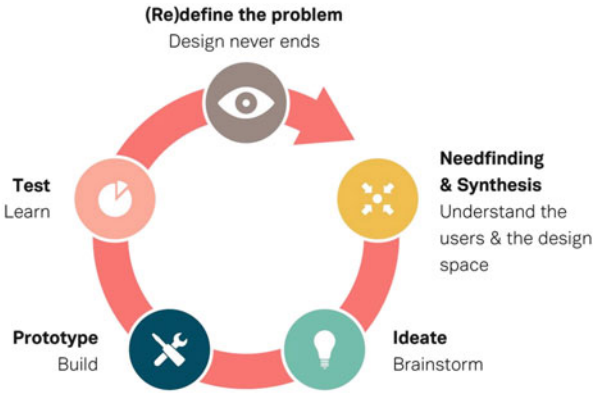

Fig. 2 The Design-Thinking-micro process, adapted from Stanford University (2016)

step, the team builds up expertise in the topic under scrutiny. Expert interviews, literature and web search help to reach a knowledge level needed to have fruitful talks with customers. In the third step, "Ideate", teams are encouraged to find solution ideas through brainstorming. The brainstorming needs to be conducted so that solutions are envisioned based on previous steps, not decoupled from the needs of customers. The aim of the step, "Prototype", is to build prototypes that can be tested in the next step with customers. As mentioned earlier, we differ between different resolution prototypes. The range of prototypes that we built within the past 10 years is large, ranging from wood constructions over paper mock-ups to information systems simulated on paper. One prototype stood out. About one year before the iPhone hit the market and long before the iPad, we developed a prototype for a portable computer very similar in form, appearance, and weight to the later iPad. In the next step, "Test", prototypes are tested with end customers. In many projects, we tested prototypes in market places, railway stations and airports with end customers. For many people, leaving the safe territory of company premises to test prototypes somewhere with end customers is a big obstacle. For the success of a Design Thinking project, this step is of central importance. There is an important reason why "Test" and "Learn" are connected in Fig. 2. While testing, Design Thinkers get important clues whether a prototype works, or reasons why it does not. Following the step "Test", it has to be verified whether the original problem brief was the right one: more concretely, whether the innovation fulfilled obvious or hidden needs of customers. If a positive answer is given, a new micro process can begin. If the answer is negative, the challenge needs to be reformulated based on the new insights.

The macro process (developed at the University of St.Gallen, Institute of Information Management), as pictured in Fig. 3, underlies all structures in the entire Design Thinking project. It is divided into seven process steps[9] coupled to the different kinds of prototypes built in the course of a Design Thinking project.

[9] http://dthsg.com/phases/, retrieved on 19 December 2014.

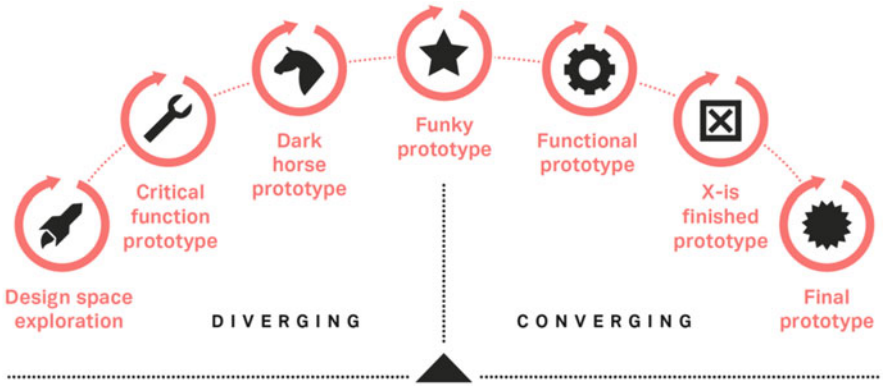

Fig. 3 The Design Thinking macro process, adapted from DT at HSG (http://dthsg.com/phases/, retrieved on 20 February 2015)

In each of the prototype-oriented macro steps, the micro process is conducted several times. In addition, the macro process is divided into a divergent and convergent phase.

The first step of the macro process "Design Space Exploration" explores the so-called design space, based on the challenge. In this step, literature and web research, as well as talks with experts, are recommended. Design thinkers must first gather their own experiences of the relevant industry sector specified by the challenge. If a challenge aims, for example, at car rental, it makes sense to rent and return cars from different rental agencies to experience and explore. It can be also helpful to go through an atypical process, like filing a complaint, to see how a company reacts. In the second step, "Critical Function Prototype", the first prototypes are developed. First solution prototypes are built based on the critical functions revealed in the previous step. In the next phase, a so-called "Dark Horse Prototype" is developed. The name of this prototype comes from horse racing. The "Dark Horse" is the horse that nobody bets on, yet it wins. For the "Dark Horse", the innovation process is started from the beginning—even though critical function prototypes already exist. Before starting with this step, boundary conditions found during design space exploration, already the basis for critical function prototypes, are deliberately disregarded. The solution space is extended and room emerges for new, even more innovative solutions. The dark horse prototypes often scare novices because of their sheer creativity and almost completely disregarded boundary conditions. We learned from our colleagues at Stanford University—and can by now also confirm through our own experience—that, in many cases, central ideas of the prototypes ultimately deployed by the research partner companies are based on the dark horse prototypes. One can imagine the difficulties for a project team—that had already built a critical function prototype—to start all over again. This reboot is particularly counterintuitive for many deadline-driven middle managers, who favor developing the first solution into a final product. With the step "Funky Prototype", the divergent phase is closed. This step aims to merge the best ideas from all

prototypes developed thus far into one prototype, building toward the final prototype. The design team needs to deploy all prior insights, starting from the needs of customers, into a prototype. The step "Functional Prototype" marks another important step to a detailed solution concept. Requirements and boundaries of the final solution are fixed. It is crucial to decide, based on prior prototypes and insights, which solution ideas and which prototypes should be part of the final prototype (Schindlholzer 2014). The Functional Prototype needs to be much more specific than prior prototypes, providing clear insights into customer acceptance and which needs can be satisfied. The requirements of the "Functional Prototype" are strict. The more realistic these prototypes are, the better the insights of the customer tests. The next step is the "X-is-finished-Prototype", which serves to detect one key functionality ("X") and what effort is required to realize the final prototype (Schindlholzer 2014). This step helps the Design Thinking teams discard unrealistic components identified in prior steps. In this step, the team decides which parts can be included in the final prototype. The "Final Prototype" comprises all functions necessary to satisfy realizable customer needs. This prototype's degree of detail needs to be extremely high, so that comprehensive testing with customers is possible. In the past 10 years, many final prototype of Design Thinking process were so extraordinarily detailed that research partner companies, typically big European companies, deployed ideas from the projects. The final prototype needs to be sufficiently impressive to produce a "wow" effect from the decision makers, virtually forcing them to pursue the Design Thinking project idea. The final prototype is accompanied by a presentation showing the process and attributes of the solution. Incidentally, during the last 10 years, numerous videos were also created to clarify and explain projects to a general audience.

Design Thinking as Toolbox

Design Thinking works only when tools and methods used are aligned with this new way of thinking. Schindlholzer (2014, p. 121f) offers a first overview of methods and tools used over the past 10 years at the Institute of Information Management at the University of St.Gallen. There are different method collections, both aimed at practitioners (e.g. Stickdorn and Schneider 2011; Kumar 2012; Martin and Hanington 2013; Lidwell et al. 2004) and academics (Hassi and Laakso 2011).

The range of 47 methods and tools described by Schindlholzer (2014, p. 121f) range from guidelines to design workspaces to methods to define personal strengths and weaknesses, from moderation methods to hints about how 3D printing can be used to build prototypes. In our experience, deployment of appropriate methods is one of the core success factors of Design Thinking projects. The methods and tools used in Design Thinking projects originate from very diverse areas, like quality management, research in creativity and design, research in communication, ethnography, and informatics. It is impossible to describe all the methods and tools

used in Design Thinking projects, but we describe seven tools that give an impression how Design Thinking projects work.[10]

- **Stakeholder Map**: Stakeholders of a project are any internal and external groups or persons currently, or in the future, directly or indirectly affected by the project (Thommen 2012). In management sciences, many approaches (especially the stakeholder-approach, Thommen 2012) begin with a holistic analysis of stakeholders, that can be distinguished from a solely shareholder-oriented firm strategy (Rappaport 1986). The stakeholder map attempts to identify all parties that are relevant for the problem brief. In our Design Thinking projects, we realized that it is important to identify extreme users. Experience in stakeholder mapping shows that it is important to broadly define the term "stakeholder". For example, in a business-to-business environment, it is essential to involve the end customer as stakeholder.
- **Empathy Map**: The empathy map is a method often used at Stanford University d.School.[11] The empathy map analyzes talks and interviews with stakeholders, especially end customers. These talks are categorized into four categories: "Say" (quotations and central terms), "Do" (observed behaviors), "Think" (assumptions of thoughts) and "Feel" (emotions).
- **5-Whys**: The 5-Whys-Method was invented by the founder of Toyota, Sakichi Toyoda (Ohno 1993, pp. 43–44). Today, it is an important element of "root-cause-analyses" of lean management and is also utilized in Design Thinking. The 5-Why method's basic premise is: in the course of analysis, participants repeatedly ask "why", leading everyone deeper into the root-cause of a problem or some similar phenomenon. The number of Why-Questions is not limited to five, as the name suggests. Instead, the number five is an indicator that it is important to ask multiple times "*Why*".
- **AEIOU-Method**: According to our research, this method was invented by Rick Robinson, Ilya Prokopoff, John Cain and Julie Pokorny. Other sources in the internet cite Mark Basinker and Bruce Hannington as inventors. Originally, it was used to code ethnographic data. The AEIOU method defines dimensions to structure a problem: "Activities", "Environment", "Interactions", "Objects" and "Users". Because this method is used often in Design Thinking, dedicated project templates facilitate its use.[12]
- **Persona-Method**: The persona method comes originally from the research area of human-computer-interaction. Personas are, according to Cooper, artificial, invented persons [see Cooper (2004), Schindlholzer (2014, p. 148f)].

[10] We would like to point out that the list of methods and tools is neither complete nor representative. We selected for this introduction a few tools to give a first glimpse into the tools that are used during Design Thinking projects.

[11] https://dschool.stanford.edu/wp-content/themes/dschool/method-cards/empathy-map.pdf, retrieved on 22 January 2015.

[12] http://www.drawingideasbook.com/images/AEIOU_worksheets.pdf, retrieved on 22 January 2015.

As archetypes, they embody the behavior or personality characteristics of a group of persons, e.g. digital natives of the age 16–19. These personas are named—for example Bob, Himo, Mari-Lu. The naming of personas facilitates their use in the Design Thinking process.

- **Observation**: The observation of stakeholders, especially customers, is a proven method to reveal obvious and hidden needs (Schindlholzer 2014, p. 142f). During, or after, the observation of a person, clarifying questions can be asked. When shadowing, researchers accompany a person over a longer period of time as closely as possible. Through the intense and uninterrupted contact, one can observe the use of a product or service, as well as activities before and after, which are often very important and may lead to reformulation of the challenge.
- **Storytelling**: This method originally comes from marketing and is based on the idea that a well-told story captures more attention than a lengthy PowerPoint presentation. Within Design Thinking projects, storytelling is used to present innovative ideas or solution possibilities effectively (Quesenbery and Brooks 2011; Schindlholzer 2014). In many Design Thinking projects, videos emerge, parallel to the prototypes, showing the prototype in a real-life situation or within a process. These videos can be seen as one form of storytelling.

The methods and tools in the toolbox of a design thinker cannot be easily assigned to single steps in the micro or macro process. The experienced design thinker uses from the repository (with more than 100 methods) those appropriate to the situation.

The Design Thinking Team

We spoke on several occasions in the previous sections about design thinkers and Design Thinking teams. Meinel and Leifer (2015) state that Design Thinking is centered on innovators, arguing that the team is of outstanding importance. Design Thinking teams work differently than project teams that we know from software development. One particular challenge is the combination of divergent and convergent thinking—and the mindset and openness that this demands from the team.

The heterogeneity of teams demands openness. Design Thinking teams need to be heterogeneous in various dimensions to be successful. Dimensions of heterogeneity comprise the mixture of men and women and the cultural and ethnical background of design thinkers. Especially in international and even more in global projects, the team needs a good mix of personalities from different countries and cultures. Another dimension of heterogeneity is educational background. In our experience, for projects that target product or service innovations, business people, engineers, and software engineers are good teams. A management-oriented educational facility such as the University of St.Gallen can learn from engineers and software engineers. In the future, it will be even more important to get closer to

obvious and hidden needs and to integrate designers, ethnographers, anthropologists, and psychologists in the teams.

Another dimension of heterogeneity deserves special attention. Design Thinking teams benefit enormously when personalities with different traits are merged. During our university projects, we perform personality tests, such as the Clifton-Strengthsfinder[13] (Quesenbery and Brooks 2011; Schindlholzer 2014 p. 171f) and Teamology (Wilde 2009) or the Myers-Briggs-Test (Briggs-Myers and Myers 1995) with our students. These tests, despite being controversial, give us important clues to the personality profiles of design thinkers and allow us to staff the teams with different personality profiles. We are aware that it is impossible to conduct such tests in many companies.

For Design Thinking teams, so-called T-shaped professionals (Brown 2009) are warranted; they are in-depth specialists in one field, but are knowledgeable in a range of others. This knowledge structure enables action in an area as a competent specialist and discussion in a range of other fields on a high level. The experience of ten years of work with design thinkers teaches us that it is hard to find people with a T-shaped profile. It is easier to find specialists than generalists.

The heterogeneous composition of teams is, on the one hand the fundament for innovation, but on the other hand, also the reason for conflicts. It is a narrow path in a conflict between constructively discussing for a better solution and arguing. The more heterogeneous a team is, the more probable conflicts and arguments are. To counter this, we have developed considerable competence for conflict resolution to prevent that (in principle) positive disputes escalate into personal, unsolvable conflicts. The collaboration between engineers and software engineers and business people can often lead to severe conflicts.

Application Areas: Design Thinking in Teaching and Information Systems

Teaching in Design Thinking is strongly influenced by Stanford University, where lectures and courses were first developed in the 1960s. In the engineering department, there were already 1960 courses about “Creative Design” and a “Product Design Program” was offered together with the fine arts department. Even though Design Thinking at Stanford University began in the engineering department, it subsequently spilled over into other areas like product design, robotics, microelectronics, human-computer interaction, learning, bio design and, recently, also to venture design. Design Thinking activities were later bundled in the Center for Design Research as an integral part of the engineering department. One example of research on integrating creativity into the engineering curriculum was conducted by Faste et al. (1993). When we speak of the engineering department in this article, we

[13] http://www.strengthsfinder.com/, retrieved on 26 January 2015.

mean primarily the Center for Design Research. The d.School at Stanford University, funded by SAP co-founder Hasso Plattner, also developed from the Center for Design Research, but works on an interdisciplinary basis between the faculties.

From a present-day perspective, very early trends in informatics could be linked to Design Thinking. Informatics (as well as later information systems) started to develop information systems in the 1960s. In German-speaking areas, the works of Oesterle (1981) and Balzert (1982) deserve notice. The basis for scientific work, with the development of corporate information systems, was done by Simon (1969), with his seminal work "The Sciences of the Artificial". Many of these works connect to Design Thinking, when one follows Simon's logic.

Design Thinking is also increasingly important in management (Rhinow and Meinel 2014; Shamiyeh 2010; Grand and Jonas 2012). When the Institute of Information Management began to collaborate with Stanford University 10 years ago, we were the only business school in the network of this elite university. The lack of understanding about our engagement in Design Thinking was significant, on the engineering side as well as from our management and information management colleagues. But now, the situation has changed. Many companies are under enormous pressure to become innovative. Many executives realize that Design Thinking—along with other methods—is one promising avenue to become more innovative. Martin (2009) introduces the example of Procter & Gamble, to illustrate what a significant influence Design Thinking can have, not only on the innovation process, but also on the entire corporation. IDEO works more and more on strategy. Mimicking IDEO, many strategy consulting firms build up Design Thinking units. However, we realize that many of these consultants do not understand or master Design Thinking principles and foundations described in this article. Instead, classical innovation, strategy or re-engineering projects are conducted that are merely labelled as Design Thinking.

One aspect of the business and management field where we operate requires more detail: Design Thinking as one approach to corporate entrepreneurship, which is entrepreneurship within large corporations (Kuratko et al. 2011). In one study conducted as part of our Design Thinking research at the Institute of Management, Abrell and Uebernickel (2014) researched whether Design Thinking is a suitable instrument for corporate entrepreneurship. The expert interviews conducted for this research show that the strong focus on customer needs is very helpful for corporate entrepreneurship; strong customer orientation can even lead to changes in the company culture. The culture of listening has an especially big influence on new products and the improvement of existing products and services. Design Thinking increases the understanding about why products and services of a company are used and why not. Many companies suffer today because the time an innovative idea about a product or service takes to reach the market is too long. Design Thinking helps to accelerate this process.

Design Thinking is also of growing importance in information systems development. Work on using Design Thinking in software development has been underway at informatics faculties, for example the Computer Science Department at

Stanford University or the Hasso Plattner Institute at the University Potsdam, for many years. In various engineering areas and for the design of human-machine interfaces, Design Thinking can lead to innovative solutions, especially in the early phase of the software development process. On the basis of these experiences, SAP (one of the largest software companies in the world) has begun using Design Thinking as one of their central methods when developing software.

Design Thinking at the Institute of Information Management at the University of St.Gallen

The activities in Design Thinking at the Institute of Information Management at the University of St.Gallen can be categorized as teaching and research.

Our engagement in Design Thinking began with the establishment of a course modeled on the ME310 course[14] at Stanford University, within the frame of so-called research-, practice- and venture projects in 2005/2006. This practice-oriented teaching instrument allowed us to copy the ME310 course in many respects. SAP financed the first batch, with the challenge for this debut Design Thinking project in St.Gallen to develop a prototype to facilitate executives' access to their own software. Meanwhile, the Design Thinking course is being held in 2015 for the 10th time and more than 40 projects with students have been conducted, financed by large and medium-sized corporations from Switzerland and Germany, and today, China. The structure of the course is oriented to the Design Thinking macro process. It always begins in September, lasting until the end of the spring term at the end of May. All participating students fly at least twice to Stanford University in Palo Alto during the course. The first visit in fall is dedicated to training in Design Thinking and the second trip at the beginning of June revolves around the final presentations, together with the complete network of universities that also have Design Thinking projects in their curriculum. For this Design Thinking course, we established a Design Thinking loft based on the facilities in Stanford in St.Gallen at the Institute of Information Management. The loft is available for students 365 days a year, 24 hours a day—which is unique in St.Gallen. In addition we have—financed through the participating research partner companies—established a teaching and coaching team for the course. This team is large enough that we can offer our students a staff-to-student ratio almost as good as that of our role model in California. The highly motivated students, the Design Thinking loft, and the good staff-to-student ratio contribute to the research partner companies' enthusiasm for the course quality. In 2015, the University of St.Gallen will invest substantially in Design Thinking education and will build another Design Thinking lab. As mentioned above, teaching activities at the Institute of Information Management are embedded into a worldwide network, the so-called SUGAR network, consisting

[14] http://web.stanford.edu/group/me310/me310_2014/, retrieved on 22 January 2015.

mainly of technical universities also offering teaching activities based on the Stanford University ME310 course. At the end of 2014, the following universities were engaged in this network: Aalto University in Helsinki, Paris-Est d.school at École des Ponts, Hasso Plattner Institute at the University of Potsdam, University of St.Gallen, Karlsruhe Institute of Technology, Norwegian University of Science and Technology in Trondheim, Pontificia Universidad Javeriana in Cali, Swinburne University of Technology in Melbourne, Trinity College Dublin, Tongji University in Shanghai, Universidad Nacional Autónoma de México, Università degli studi Modena e Reggio Emilia in Modena, Stanford University, Universidade de São Paulo, University of Science and Technology of China and University of Zürich.

It seems that Design Thinking teaching in St.Gallen will expand and grow. Starting in the spring term 2015, we will extend our offer in Design Thinking. Together with Grand, a strategy researcher, we will offer an "Entrepreneurial Management" course.

In Design Thinking teaching, we collaborate with companies in three ways; most importantly, through the Design Thinking course described above. Another collaboration is Embedded Design Thinking. In this collaboration route, we conduct sessions in partner companies like Deutsche Bank (Brenner and Witte 2011, pp. 167–192) in rooms similar to the Design Thinking loft in St.Gallen innovation projects. This intense collaboration leads to establishing a Design Thinking culture in partner companies and also allows that confidential projects can be conducted. Another type of collaboration is executive education and we are slowly entering this market. We do not conduct consultancy projects at the Institute of Information Management; a separate consulting firm for this work has been set up.

Because we have focused on teaching, we have conducted very limited research in Design Thinking during the past 10 years. For those interested in more information, Schindlholzer (2014), who developed a coaching-oriented approach to Design Thinking based on Method Engineering, as well as the works of Vetterli (e.g. Vetterli et al. 2012) to Embedded Design Thinking and the works of Abrell (e.g. Abrell and Uebernickel 2014; Abrell et al. 2014; Abrell and Durstewitz 2014) who researches Design Thinking and Corporate Entrepreneurship are worth mentioning. Design Thinking and Corporate Entrepreneurship is explained in more detail in a separate chapter.

Outlook

Design Thinking is an innovation method that has become stronger and more established. This trend is expected to continue over the next ten years in numerous areas, as well as management faculties. With more innovation-oriented education, Design Thinking has the potential to be right at the center of teaching and research at some universities. Design Thinking cannot be viewed completely independently, or directly in competition with other management disciplines. The customer orientation basic to Design Thinking has always been at the heart of marketing. Changes

in company and innovation culture, like those initiated by Design Thinking, take place in traditional fields in strategy and innovation research. The proximity to engineering sciences, mechanical engineering, electrical engineering, and informatics offer enormous opportunities for the development of management education. For information management we demanded, based on our experiences with Design Thinking and together with many colleagues from the German-speaking countries, user orientation as new field of research (Brenner et al. 2014). With this background, the research program at the Institute of Information Management has been changed in 2015 to position user orientation as a central target in the future (Leimeister et al. 2014). Design Thinking offers important potential for research and teaching, along with one fascinating central tenet: with all its strengths and weaknesses, opportunities and threats, Design Thinking is completely interdisciplinary.

References

Abrell T, Durstewitz M (2014) User involvement in internal corporate venturing: the viewpoint of the corporate entrepreneur. In: CINet conference 2014, Budapest, pp 1–13

Abrell T, Uebernickel F (2014) Design thinking and corporate entrepreneurship: an exploratory study. In: Bohemia E, Rieple A, Liedtka J, Cooper R (eds) Proceedings of the 19th DMI: academic design management conference, London, pp 1887–1903

Abrell T, Durstewitz M, Uebernickel F (2014) Design thinking and effectuation in internal corporate venturing: an exploratory study. In: Toivonen M (ed) Proceedings 24th annual RESER conference services and new societal challenges: innovation for sustainable growth and welfare, Helsinki, 11–13 September, pp 7–15

Balzert H (1982) Die Entwicklung von Software-Systemen: Prinzipien, Methoden, Sprachen, Werkzeuge. Bibliographisches Institut, Mannheim

Brenner W, Witte C (2011) Business innovation: CIOs im Wettbewerb der Ideen. Frankfurter Allgemeine Buch, Frankfurt am Main

Brenner W, Karagiannis D, Kolbe L, Krüger J, Lamberti HJ, Leifer L, Leimeister JM, Österle H, Petrie C, Plattner H, Schwabe G, Uebernickel F, Winter R, Zarnekow R (2014) User, use and utility research. Wirtschaftsinformatik 56(1):65–72

Briggs-Myers I, Myers P (1995) Gifts differing: understanding personality type. Davies-Black Publishing, Mountain View, CA

Brown T (2008) Design Thinking. Harv Bus Rev June 2008:84–95

Brown T (2009) Change by design: how design thinking transforms organizations and inspires innovation. Harper Collins, New York

Cooper A (2004) Inmates are running the asylum: why high-tech products drive us crazy and how to restore the sanity. Sams Publishing, Indianapolis, IN, Retrieved on 15 Jan 2015 from: http://itu.dk/people/russel/B%F8ger/Pearson.-.The.Inmates.Are.Running.the.Asylum.pdf

Dorst K (2010) The nature of design thinking. In: Proceedings of the 8th design thinking research symposium, pp 19–20

Faste R, Roth B, Wilde DJ (1993) Integrating creativity into the mechanical engineering curriculum. ASME Resource Guide to Innovation in Eng. Design

Grand S, Jonas J (2012) Mapping design research. Birkhäuser, Basel

Hassi L, Laakso M (2011) Conceptions of design thinking in the design and management discourses. In: Roozenburg NFM, Chen LL, Stappers PJ (eds) Proceedings of IASDR2011, the 4th world conference on design research, Delft, pp 1–10

Johansson-Sköldberg U, Woodilla J, Çetinkaya M (2013) Design thinking: past, present and possible futures. Creat Innov Manag 22(2):121–146
Kelley T, Kelley D (2013) Creative confidence—unleashing the creative potential within us all. Crown Business, New York
Kumar V (2012) 101 design methods: a structured approach for driving innovation in your organization. Wiley, Hoboken, NJ
Kuratko DF, Morris MH, Covin JG (2011) Corporate entrepreneurship and innovation: entrepreneurial development within organizations, 3rd edn. South-Western Cengage Learning, Independence, KY, International edition
Leimeister JM, Winter R, Brenner W, Jung R (2014) Research Program "Digital business and transformation IWI-HSG" (Working Paper No. 1). Working paper series University of St. Gallen Institute of Information Management (IWI-HSG)
Lidwell W, Holden K, Butler J (2004) Design: Die 100 Prinzipien für erfolgreiche Gestaltung. Stiebner Verlag, München
Martin R (2009) The design of business: why design thinking is the next competitive advantage. Harvard Business Press, Boston, MA
Martin B, Hanington B (2013) Design Methoden: 100 Recherchemethoden und Analysetechniken für erfolgreiche Gestaltung. Stieber Verlag, München
Meinel C, Leifer L (2015) Introduction—design thinking is mainly about building innovators. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: building innovators. Springer, Cham, pp 1–14
Oesterle H (1981) Entwurf betrieblicher Informationssysteme. Hanser, München
Ohno T (1993) Das Toyota-Produktionssystem. Campus Verlag, Frankfurt
Oxford Dictionaries (2015). Retrieved on 3 Jan 2015 from http://www.oxforddictionaries.com/definition/english/design
Plattner H, Meinel C, Weinberg U (2009) Design Thinking—Innovation lernen—Ideenwelten öffnen. Moderne Industrie, München
Quesenbery W, Brooks K (2011) Storytelling for user experience: crafting stories for better design. Rosenfeld Media, New York
Rappaport A (1986) Creating shareholder value: the new standard for business performance. Free Press, New York
Rhinow H, Meinel C (2014) Design thinking: expectations from a management perspective. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: building innovation ecosystems. Springer, Cham, pp 239–252
Rowe PG (1987) Design thinking. MIT Press, Cambridge, MA
Schindlholzer B (2014) Methode zur Entwicklung von Innovationen durch Design Thinking Coaching. Disseration, D-Druck Spescha, St.Gallen
Shamiyeh M (2010) Ways of bringing it about. In: Shamiyeh M (ed) Creating desired futures—how design thinking innovates business. Birkhäuser, Basel, pp 113–126
Simon H (1969) The sciences of the artificial. MIT Press, Cambridge, MA
Stanford University (2011) ME 310—Stanford design cycle. Stanford University, Stanford
Stanford University (2016) ME 310–Stanford design cycle. http://web.stanford.edu/group/me310/me316 2016/aboutdesignprocessbig.html. Accessed 01 Jan 2016
Stickdorn M, Schneider J (2011) This is service design thinking. Basics—Tools—Cases. BIS Publishers, Amsterdam
Thommen JP (2012) Betriebswirtschaftslehre. Versus Verlag, Zürich
Vetterli C, Uebernickel F, Brenner W (2012) Initialzündung durch Embedded Design Thinking—Ein Fallbeispiel aus der Finanzindustrie. Zeitschrift für Organisationsentwicklung 2:22–31
Wilde D (2009) Teamology: the construction and organization of effective teams. Springer, London

Part II
Contributions from Teaching and Research

Design Thinking and Corporate Entrepreneurship: An Integration and Avenues for Future Research

Thomas Abrell

Abstract Design Thinking and corporate entrepreneurship are both topical in the contemporary innovation management discourse. This study outlines promising avenues for future research for the two concepts' connections and synergies. Four research themes are identified and presented: Design Thinking and opportunity recognition/creation, Design Thinking and effectuation in corporate entrepreneurship, Design Thinking and corporate entrepreneurship strategy, as well as entrepreneurial design management. Promising avenues for each research theme are identified. Two of the research themes are on an individual level, while the other two themes are on an organizational level. The study contributes to the fields of corporate entrepreneurship and Design Thinking by conceptually linking the two, presenting research in the field and noting avenues for further research.

Keywords Design thinking • Corporate entrepreneurship • Entrepreneurial opportunity • Effectuation • Design • Management • Corporate entrepreneurship strategy

Introduction

"Entrepreneurship is associated with innovation, and corporate entrepreneurship is associated with innovation by established firms" (Baden-Fuller 1995, p. 12). Change and knowledge become increasingly important (Toivonen and Tammela 2013), putting established corporations under pressure to innovate (Kuratko et al. 2011). Despite being subject to research for a considerable time (for corporate entrepreneurship Westfall 1969; for Design Thinking Simon 1969), Design Thinking and corporate entrepreneurship are both very topical in the contemporary management discourse on novel innovation approaches (Toivonen and Tammela 2013; Hassi and Laakso 2011; Kuratko et al. 2011; Ireland et al. 2014).

T. Abrell (✉)
Institute of Information Management, University of St.Gallen, Unterer Graben 21, 9000 St.Gallen, Switzerland
e-mail: thomas.abrell@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_2

Corporate entrepreneurship is an option for corporations seeking strategic renewal or the creation of new businesses through innovation and venturing (Guth and Ginsberg 1990). Both corporate entrepreneurship and Design Thinking aim at *doing things differently* and initial research has shown that Design Thinking and (corporate) entrepreneurship do have connections (e.g. Nielsen et al. 2012; Abrell and Uebernickel 2014; Abrell et al. 2014; Abrell and Durstewitz 2014). Nevertheless, research is still in its infancy. This study aims to inspire further research by pointing out promising directions of Design Thinking and corporate entrepreneurship research.

Definitions

Design Thinking

Research in Design Thinking can be categorized into the managerial and design discourse (Hassi and Laakso 2011). In the managerial discourse, Design Thinking is associated with innovation (Hassi and Laakso 2011) and can be defined as "design practice and competence [...] used beyond the design context" (Johansson-Sköldberg et al. 2013, p. 123). In their literature review of the managerial discourse, Hassi and Laakso (2011) describe Design Thinking as a combination of practices, thinking styles and mentality components.

Preceding the managerial discourse, Design Thinking has been a subject of research in the design discourse since Herbert Simon's (1969) ground-breaking work "The Sciences of the Artificial". From a practitioner's perspective, Design Thinking can be described as "primarily an innovation process—part of the fuzzy front end, and a great method with which to discover unmet needs and to create new product concepts" (Lockwood 2009, p. 30).

In this research, we adopt the definition of Johansson-Sköldberg et al. (2013) and Hassi and Laakso (2011) as design practice and competence used beyond the design context with the dimensions practices, thinking styles and mentality components.

Corporate Entrepreneurship

The phenomenon of corporate entrepreneurship (coined by Westfall 1969) has been described in several ways in literature: corporate entrepreneurship (used by Kuratko et al. 2011; Guth and Ginsberg 1990; Van Wyk and Adonisi 2012; Ireland et al. 2009; McFadzean et al. 2005; Shaw et al. 2005 among others), intrapreneuring (Pinchot 1985), intrapreneurship (used by Parker 2011; Monnavarian and Ashena 2009; Duncan et al. 1988; Carrier 1994; Antoncic and Hisrich 2001; Antoncic 2007; Merrifield 1993; Nielsen et al. 1985; Antoncic and Hisrich 2003; Antoncic and

Antoncic 2011 among others) and internal corporate entrepreneurship (Jones and Butler 1992). Sharma and Chrisman (1999) note that there is ambiguity in the terminology used.

The term intrapreneur was introduced by Pinchot (1985, p. XII) as a merger of two words "intra-corporate entrepreneur". Pinchot's definition described entrepreneurship within existing organizations. Corporate entrepreneurship, a term that can be used interchangeably with intrapreneurship (McFadzean et al. 2005), describes entrepreneurship within existing organizations (Antoncic and Hisrich 2003). While intrapreneurship appears to be a new phenomenon, the definition of corporate entrepreneurship above indicates that only the context of entrepreneurship changes from entrepreneurship to entrepreneurship within corporate boundaries (Kuratko et al. 2011) and thus findings of entrepreneurship research may be transferable. Guth and Ginsberg (1990) categorize corporate entrepreneurship into innovation/venturing and strategic renewal of established corporations. In this study, we adopt the definitions of Antoncic and Hisrich (2003), Kuratko et al. (2011) and Guth and Ginsberg (1990): corporate entrepreneurship as entrepreneurship within existing corporations, with the categories innovation/venturing and strategic renewal.

Towards the Four Research Themes

The author proposes four themes to research, selected for their utility in establishing entrepreneurship inside corporations.

The first theme is the topic of creating and/or recognising entrepreneurial opportunities. Discovering and/or creating entrepreneurial opportunities is at the core of entrepreneurial innovation (Kirzner 1973; Schumpeter 1934). Design Thinking, described as a method to embrace innovation activities and combine them with a human-centered design approach (Brown 2008), has great potential to help discover and/ or create entrepreneurial opportunities.

The second theme builds on the notion of uncertainty prevalent in innovation. Highly innovative solutions and launching new businesses always entail risk and uncertainty (Biggadike 1979), and risk taking is an important aspect of entrepreneurship (Antoncic 2003). To successfully build a corporate entrepreneurship strategy on the organizational level, it is necessary to understand how corporate entrepreneurs work on the individual level. The theory of effectuation (Sarasvathy 2001) attempts to explain entrepreneurial decision-making under uncertainty. Originating in the entrepreneurship domain, recent attempts have been undertaken to apply the theory to the corporate context (Brettel et al. 2012; Abrell et al. 2014). Design Thinking is often considered to deal with so-called "wicked problems" (Buchanan 1992) that entail a large amount of ambiguity. Bringing together the theory of effectuation and Design Thinking in the corporate context provides much potential for research to better understand how corporate entrepreneurs work and how to support them in encouraging entrepreneurship inside the corporation.

The third theme addresses corporate entrepreneurship strategy. To establish corporate entrepreneurship, a corporate entrepreneurial strategy is required (Hitt et al. 2001; Ireland et al. 2009). Strategy-making is, however, a demanding task (Mintzberg 1973; Wiltbank et al. 2006). Johansson and Woodilla (2009) examine the epistemological roots of Design Thinking, strategy and innovation. Despite different roots, the discourses interact in the management realm as enablers for a corporation's general development and growth enablers. In this vein, Design Thinking and corporate entrepreneurship strategy yield potential for research: on one hand as part of creating strategy (see, for example, Johansson and Woodilla 2009; Grand 2010), but on the other hand to integrate Design Thinking into corporate entrepreneurship strategy to support corporate entrepreneurs.

The fourth theme is entrepreneurial design management. While the other three research areas address how to support corporate entrepreneurship through Design Thinking, this theme switches the perspective towards the management of design organizations, processes and outcomes (Cooper et al. 2009). In contrast to an administrative approach to management (Kanter 1985), entrepreneurial management (Stevenson and Jarillo 1990) provides potential for effective design management.

Design Thinking and Opportunity Recognition/Creation

There is an ongoing debate whether entrepreneurial opportunities are created [starting from Schumpeter (1934)] or recognized [starting from Kirzner (1973)]. An entrepreneurial opportunity is the "perceived means of generating economic value [. . .] that previously has not been exploited and is not currently being exploited by others" (Baron 2006, p. 107). Nevertheless, it is undisputed that entrepreneurial opportunity is central to entrepreneurship, as it is at the heart of innovation. There has been much research about opportunity creation and/or recognition (see, for example, a recent study of van Burg and Romme 2014; Dimov 2011); Design Thinking may create potential from various perspectives.

On one hand, Nielsen et al. (2012) propose using design methods and processes for opportunity recognition and creation. They propose a combination of design for moving in and moving out. Design for moving in focuses on a linear problem-solving approach when the problem is clearly defined. Design for moving out acknowledges a looser, non-linear approach to design. The problem is often too complex and too ill-defined to simply solve it, thus problem exploration must be conducted. Finally, they propose a stepped approach to opportunity design: opening it up, ideation and conceptualization of opportunities and/ or opportunity selection and exploitation that overlaps with Cooper's (1990) stage-gate process.

Another angle of Design Thinking and opportunity creation or recognition is investigated by Abrell and Uebernickel (2014). User-centricity, as a central concept of Design Thinking, yields opportunities if combined with technology as enabler and championing from the corporate entrepreneur. In line with Burgelman (1983)

and Day (1994), it was deemed crucial that the corporate entrepreneur champions the project, i.e. drives the project proactively. In addition, the technological feasibility is important to pursue user-centric opportunities (Abrell and Uebernickel 2014). User-centricity is also taken into account in concepts such as market orientation (Narver and Slater 1990; Kohli and Jaworski 1990), where latent needs of customers are addressed. "Market-oriented" has been opposed to "customer-led" (Slater and Narver 1998), where companies do what customers explicitly want. There is some evidence that corporate entrepreneurship and market orientation are linked (Barrett and Weinstein 1998; Liu et al. 2002). In Design Thinking, it is important to uncover latent needs and sticky information (von Hippel 1994). Tacit information difficult to obtain by others can be regarded as sticky (Bogers et al. 2010) and sticky information related to the context of use is one opportunity for linking Design Thinking and opportunity recognition and/ or creation (Abrell and Durstewitz 2014)—Design Thinking thus may provide answers how market orientation can be achieved. However, it still needs to be clarified whether market orientation is just a set of activities, rather than culture (Deshpandé and Farley 1998), or a cultural phenomenon (Narver and Slater 1998). Future customers may have difficulties articulating their needs (von Hippel 1994), yet "even if prospective customers cannot (articulate their needs), they may still be able to recognize the value to them in something new when they are presented with it and have its operation and benefits explained. Opportunities seen from the perspective of prospective customers represent value sought" (Ardichvili et al. 2003, p. 108). Thus, more knowledge is needed on how user involvement through Design Thinking can lead to entrepreneurial opportunities. Given the difficulties in studying opportunity creation and/ or recognition (Dimov 2011), Design Thinking may provide potential to examine how opportunities emerge. Market orientation by Design Thinking may be an important construct in the domain of corporate entrepreneurship.

Further, practical knowledge is needed about how corporate entrepreneurs can be supported in applying Design Thinking—in practice—to reveal entrepreneurial opportunities systematically, following a "design mode" (van Burg and Romme 2014) of entrepreneurship research developing "real helps" (Sarasvathy and Venkataraman 2011).

Design Thinking and Effectuation in Corporate Entrepreneurship

It is crucial to be aware of entrepreneurs' behavior (Chandler et al. 2011). Sarasvathy (2001) acknowledges the critical role of the entrepreneur as decision maker in her logic of effectuation. "Characteristics of decision makers, such as who they are, what they know, and whom they know, form the primary set of means that combine with contingencies to create an effect that is not preselected but that gets

constructed as an integral part of the effectuation process" (Sarasvathy 2001, p. 249). The logic of effectuation is described as entrepreneurial decision-making under uncertainty (Sarasvathy 2001). Instead of planning in an uncertain future, the entrepreneur remains flexible, engages in experimentation and attempts to control the future by making alliances with, and getting pre-commitments from, stakeholders such as customers and suppliers (Chandler et al. 2011). Effectuation—based on control—is contrasted to causation—based on a logic of prediction (Sarasvathy 2001, 2008). Wiltbank et al. (2006) argue for a non-predictive strategy. Under uncertainty, strategies of control may be suitable rather than such based on prediction (Wiltbank et al. 2006). Noyes and Brush (2012) extend effectuation towards a predictive and creative approach. Entrepreneurs are more likely to work with means they have under their control, with emergent goals rather than predicting the future (Dew et al. 2009). The predictive approach focuses more on planning, such as through opportunity identification, assessment, determination of resource requirements and actions to exploit the opportunity (Neck and Greene 2011). Chandler et al. (2011) build on Sarasvathy's (2001, 2008) principles of effectuation and interpret them as a focus on short-term experiments to identify business opportunities in an unpredictable future; a focus on projects where the loss is affordable; emphasis on pre-commitments; exploitation of contingencies through remaining flexible.

Several authors argue that the two approaches of causation and effectuation are not mutually exclusive (Harms and Schiele 2012; Chandler et al. 2011; Noyes and Brush 2012), a notion that has been also empirically confirmed (Abrell et al. 2014). Sarasvathy (2001) argues that decision makers in a situation with relatively predictable future tend to use causation, while conditions with little predictability lead to experimental and iterative learning techniques of effectuation. Nevertheless, more research is warranted on how causation and effectuation can be used simultaneously (Harms and Schiele 2012; Chandler et al. 2011). In terms of Design Thinking and corporate entrepreneurship, the relationship between causation and effectuation is of interest, as it determines elements that aid in supporting corporate entrepreneurs.

Another issue is that effectuation is mostly explicated for new venture development and the gestation process (Sarasvathy 2001; Chandler et al. 2011; Noyes and Brush 2012), as the concept originates in the entrepreneurship context. There have been recent attempts to bridge effectuation to the corporate context through empirical studies in R&D projects (Brettel et al. 2012; Küpper 2010) and corporate entrepreneurship through internal corporate venturing (Abrell et al. 2014). Moreover, conceptual work has been conducted (Svensrud and Åsvoll 2012; Duening et al. 2012). During these attempts, the focus of effectuation has expanded from new venture creation to innovation.

Effectuation has been compared to creative approaches such as bricolage (Fisher 2012; Archer et al. 2009). In a recent study, Abrell et al. (2014) conceptually link the concepts of Design Thinking and effectuation and empirically explore their model in internal corporate venturing. They find strong overlaps between Design

Thinking and effectuation, as well as gathering empirical evidence on effectuation in corporate entrepreneurship. The concept of means, described by Sarasvathy (2001), focusing on who the entrepreneurs are, what they know and whom they know has been at the core of the findings of Abrell et al. (2014), suggesting that corporate entrepreneurs draw heavily on their means and entrepreneurial action may be connected to the set of means available (Abrell et al. 2014). Means are crucial to obtain a human-centred approach, as users may not be easily accessible to corporate entrepreneurs (Abrell and Durstewitz 2014). In connection with Design Thinking, it is interesting to encourage research about the connection of means and human-centeredness.

Further, a promising avenue for research is the occurrence of the other principles of effectuation with Design Thinking. Despite initial empirical studies on effectuation in the corporate and entrepreneurship context, empirical studies are warranted (Lundqvist et al. 2013; Read et al. 2009). In an effort to ensure entrepreneurship through adopting the "design mode" as pointed out above, research could be significantly enhanced if effectuation could be reached in practice through applying Design Thinking in internal corporate venturing projects.

Design Thinking and Corporate Entrepreneurship Strategy

The impact of Design Thinking on corporate entrepreneurship strategy needs to be considered. Corporate entrepreneurship is arguably a firm-level phenomenon (Covin and Slevin 1991; Miller 1983) and strategic management practices facilitate entrepreneurial behavior within the corporation (Barringer and Bluedorn 1999). Accordingly, Guth and Ginsberg (1990, p. 5) describe strategic renewal as "the transformation of organizations through renewal of the key ideas on which they are built". It needs to be distinguished between strategy-making as a process (Dess et al. 1997, p. 679), the conceptualization of strategy (see for example Ireland et al. 2009) and different strategic options managers can select (see for example Covin and Miles 1999; Guth and Ginsberg 1990). Strategic options include different forms of corporate entrepreneurship, like innovation and venturing, as well as strategic renewal of firms (Guth and Ginsberg 1990). This study focuses on strategy-making, as well as the conceptualization of corporate entrepreneurship strategy.

Entrepreneurial strategy-making is linked to entrepreneurial orientation on the organizational level describing how strategy-making is addressed (Covin and Slevin 1988; Lumpkin and Dess 1996), with the dimensions risk-taking, innovation and proactiveness (Miller 1983). This has been extended by Lumpkin and Dess (1996) with additional dimensions, autonomy and competitive aggressiveness. In their study of strategic management practices for corporate entrepreneurship, Barringer and Bluedorn (1999) selected five attributes of the strategic management process: scanning intensity, planning flexibility, planning horizon, locus of planning and control attributes. Mintzberg (1973) described the entrepreneurial mode of

strategy-making as being dominated by the active search for new opportunities, dramatic leaps in the face of uncertainty, a centralization focused on the chief executive and high growth.

Grand (2010) conceptualized aspects of Design Thinking for strategy making, i.e. the thinking style "abductive reasoning", mentality components ambiguity tolerance and future orientation, as well as practices like visualizing and a combination of divergent and convergent approaches. Seidel (2000) introduced the term "strategy visualizer" as one role in design-led strategy consulting. Similarly, the term strategy-mapping was used (Anthony et al. 2006). Environmental scanning activities (Hambrick 1981), one attribute of the strategic management process (Barringer and Bluedorn 1999), yield potential for future research. Environmental scanning is learning about events and trends in the environment of the organization (Hambrick 1981) that facilitates opportunity recognition (Bluedorn et al. 1994). Therefore, this stream of research can be complementary to the research theme discussed above on how scanning may be performed through Design Thinking. In addition to the scanning intensity as one element for strategy-making, Mintzberg's (1973) entrepreneurial mode of strategy-making creates potential for Design Thinking research, especially how to make dramatic leaps in the face of uncertainty.

Besides strategy-making, it is important to research the building blocks of a corporate entrepreneurship strategy. Ireland et al. (2009) proposed an integrative model of a corporate entrepreneurship strategy containing antecedents of a corporate entrepreneurship strategy, elements and consequences on the organizational level, top-level managers and organizational members. They define corporate entrepreneurship strategy as "a vision-directed, organization-wide reliance on entrepreneurial behavior that purposefully and continuously rejuvenates the organization and shapes the scope of its operations through the recognition and exploitation of entrepreneurial opportunity" (Ireland et al. 2009, p. 21). According to Ireland et al. (2009), corporate entrepreneurship strategy consists of three elements: entrepreneurial strategic vision, pro-entrepreneurship organizational architecture and entrepreneurial processes and behavior.

Links between a design-influenced corporate entrepreneurship strategy thus may be on the individual (organizational members and top-level managers) or organizational level. There is promise in researching how Design Thinking influences the entrepreneurial strategic vision. Moreover, it is of interest how elements of Design Thinking influence pro-entrepreneurship organizational architecture, as well as entrepreneurial processes and behavior.

Building on the initial links pointed out above, research of Design Thinking and corporate entrepreneurship yields strong potential for integration into a design-oriented corporate entrepreneurship strategy. Understanding corporate entrepreneurs' decision-making under uncertainty and Design Thinking, as well as Design Thinking and opportunity creation and/ or recognition on the individual level yield potential to create a pro-entrepreneurship organizational architecture including elements of Design Thinking. The conceptualization of a design-influenced corporate entrepreneurship strategy offers vast potential for future research.

Entrepreneurial Design Management

Another important issue is management of the design function within corporations. Designers trained in a design discipline, an art or design school (Terrey 2010; Rylander 2009) tend to be in the minority in large corporations. Managing designers using administrative management approaches may create for conflict, as well as stifling creativity. Thus, an interesting avenue for research is to manage Design Thinking and designers using an entrepreneurial approach.

The term entrepreneurial management was coined in a Harvard working paper by Stevenson (1983) and further refined in subsequent publications (Stevenson and Gumpert 1985; Stevenson and Jarrillo-Mossi 1986; Stevenson and Jarillo 1990). Entrepreneurial management was contrasted to administrative management (Stevenson and Gumpert 1985; Stevenson and Jarrillo-Mossi 1986; Kanter 1985; Eliasson and Davidsson 2002). Entrepreneurial management was seen by Lumpkin and Dess (1996) as analogous to entrepreneurial orientation on firm level, while Brown et al. (2001) saw the concepts complementary. Stevenson and Jarillo (1990) referred to entrepreneurial management as the managerial behavior of the entrepreneur. Further, they proposed that the essence of entrepreneurship is the willingness of individuals to pursue opportunities regardless of the resources currently controlled (ibid). The task of management is to encourage entrepreneurial behavior of the individual in order to foster entrepreneurship on the firm level. The pursuit of opportunities by individuals below top management is crucial (ibid). Entrepreneurial management therefore needs to empower employees to detect opportunities and train them for doing so (ibid). In addition, failure needs to be accepted to encourage entrepreneurial behavior, and the amount of entrepreneurial behavior may be related to employees' subjective perception to exploit opportunities (ibid). The concept of autonomy (Burgelman 1983; Hart 1992; Lumpkin et al. 2009) that "affords organizational members the freedom and flexibility to develop and enact entrepreneurial activities" (Lumpkin et al. 2009, p. 47) may also be an important aspect of entrepreneurial design management.

Entrepreneurial management thus can be seen as "a system of opportunity-based management practices that have been suggested to shape a firm's overall capability to act in an entrepreneurial way" (Eliasson and Davidsson 2002, p. 461). Entrepreneurial management focuses on enabling employees to create change through innovation and therefore requires different practices and modes of organization than management of established operations (Drucker 1985; Kanter 1985). In the same vein, Rae (2001) refers to the understanding of how management principles and practices can be applied to the growth of entrepreneurial business.

Brown et al. (2001) built on the concept of entrepreneurial management and operationalized the conceptual dimensions of Stevenson's research (Stevenson and Gumpert 1985; Stevenson and Jarillo 1990; Stevenson and Jarrillo-Mossi 1986) strategic orientation, commitment to seize opportunities, commitment of resources, control of resources, management structure, growth orientation and entrepreneurial culture. Bradley et al. (2011) summarized Stevenson's research as follows: resource

scarcity stimulates managers to adopt entrepreneurial management practices, to look for opportunities outside and to work with the resources at hand.

Cooper et al. (2009, p. 50) defined design management as "the ongoing management—and leadership—of design organizations, design processes, and designed outcomes (which include products, services, communications, environments, and interactions)". Design management definitions mainly emphasize the need for certain managerial activities to optimize the design process (Chiva and Alegre 2009). Design management originates from two distinct fields of research; the relationship between design and management is of scholarly interest (Erichsen and Christensen 2013). Design management is changing from managing the design of products towards managing the design of innovation (Cooper et al. 2009). In design management research, entrepreneurship is currently seldom mentioned (Erichsen and Christensen 2013). Despite this, the concept of entrepreneurial management can hold potential for design management. Building on the definition of Cooper et al. (2009), entrepreneurial management may be applied to the management of design organizations, processes and designed outcomes. Therefore, entrepreneurial design management opens up new avenues for research. How does entrepreneurial management influence design organizations, processes and designed outcomes? Which dimensions of entrepreneurial management are applicable in design management?

In summary, the following overview outlines the open questions and research directions for each theme.

Design Thinking and Opportunity Recognition/Creation
- How can user centricity be utilized for opportunity recognition/creation?
- What role does market orientation play in opportunity recognition through Design Thinking?
- How can corporate entrepreneurs be supported through applying Design Thinking in practice to recognize/create entrepreneurial opportunities?

Design Thinking and Effectuation in Corporate Entrepreneurship
- How does the relationship between causation and effectuation in corporate entrepreneurship influence elements to support corporate entrepreneurs through Design Thinking?
- Concept of means in corporate entrepreneurship—how are the means connected to human-centeredness?
- How are the principles of effectuation connected to Design Thinking?

Design Thinking and Corporate Entrepreneurship Strategy
- What is the influence of Design Thinking on entrepreneurial strategizing?
- How can scanning be performed through Design Thinking?
- How to make dramatic leaps in the face of uncertainty through Design Thinking?
- How does a design-influenced corporate entrepreneurship strategy look like?
- How does design influence the entrepreneurial strategic vision?

- How do elements of Design Thinking influence a pro-entrepreneurship organizational architecture as well as entrepreneurial processes and behavior?

Entrepreneurial Design Management
- How can principles of entrepreneurial management be used to manage design teams?
- How does Brown's (2001) operationalization of entrepreneurial management influence design management?
- How does entrepreneurial management influence design organizations, processes and designed outcomes?
- Which dimensions of entrepreneurial management are applicable in design management?

Concluding Remarks

Initial research has been conducted on Design Thinking and corporate entrepreneurship with promising results (e.g. Abrell and Uebernickel 2014; Abrell et al. 2014; Abrell and Durstewitz 2014; Nielsen et al. 2012; Grand 2010). However, further research is warranted on different levels of analysis to clearly illustrate the connections between Design Thinking and corporate entrepreneurship. On the basis of established definitions of Design Thinking and corporate entrepreneurship, we identify four research themes. Two are on the individual corporate entrepreneur level—Design Thinking and entrepreneurial opportunities as well as effectuation and Design Thinking—while two are on the organizational level—corporate entrepreneurship strategy and entrepreneurial design management. Although it is not exhaustive, this conception opens avenues for further research on the quest to shed light on Design Thinking and corporate entrepreneurship.

References

Abrell T, Durstewitz M (2014) User involvement in internal corporate venturing: the viewpoint of the corporate entrepreneur. In: CINet conference 2014, Budapest, pp 1–13

Abrell T, Uebernickel F (2014) Design thinking and corporate entrepreneurship: an exploratory study. In: Bohemia E, Rieple A, Liedtka J, Cooper R (eds) Proceedings of the 19th DMI: academic design management conference, London, pp 1887–1903

Abrell T, Durstewitz M, Uebernickel F (2014) Design thinking and effectuation in internal corporate venturing: an exploratory study. In: Toivonen M (ed) Proceedings 24th annual RESER conference services and new societal challenges: innovation for sustainable growth and welfare, Sept 11–13, Helsinki, pp 7–15

Anthony SD, Eyring M, Gibson L (2006) Mapping your innovation strategy. Harv Bus Rev 84 (5):104–113

Antoncic B (2003) Risk taking in intrapreneurship: translating the individual level risk aversion into the organizational risk taking. J Enterp Cult 11(1):1–23

Antoncic B (2007) Intrapreneurship: a comparative structural equation modeling study. Ind Manag Data Syst 107(3):309–325
Antoncic JA, Antoncic B (2011) Employee satisfaction, intrapreneurship and firm growth: a model. Ind Manag Data Syst 111(4):589–607
Antoncic B, Hisrich RD (2001) Intrapreneurship: construct refinement and cross-cultural validation. J Bus Ventur 16(5):495–527
Antoncic B, Hisrich RD (2003) Clarifying the intrapreneurship concept. J Small Bus Enterp Dev 10(1):7–24
Archer GR, Baker T, Mauer R (2009) Towards an alternative theory of entrepreneurial success: integrating bricolage, effectuation and improvisation. Front Entrep Res 29(6):1–15
Ardichvili A, Cardozo R, Ray S (2003) A theory of entrepreneurial opportunity identification and development. J Bus Ventur 18(1):105–123
Baden-Fuller C (1995) Strategic innovation, corporate entrepreneurship and matching outside-in to inside-out approaches to strategy research. Br J Manag 6(s1):3–16
Baron RA (2006) Opportunity recognition as pattern recognition: how entrepreneurs "connect the dots" to identify new business opportunities. Acad Manag Perspect 20(1):104–119
Barrett H, Weinstein A (1998) The effect of market orientation and organizational flexibility on corporate entrepreneurship. Enterp Theory Pract 23(1):57–70
Barringer BR, Bluedorn AC (1999) The relationship between corporate entrepreneurship and strategic management. Strateg Manag J 20(5):421–444
Biggadike R (1979) The risky business of diversification. Harv Bus Rev 57(3):103–111
Bluedorn AC, Johnson RA, Cartwright DK, Barringer BR (1994) The interface and convergence of the strategic management and organizational environment domains. J Manag 20(2):201–262
Bogers M, Afuah A, Bastian B (2010) Users as innovators: a review, critique, and future research directions. J Manag 36(4):857–875
Bradley SW, Wiklund J, Shepherd DA (2011) Swinging a double-edged sword: the effect of slack on entrepreneurial management and growth. J Bus Ventur 26(5):537–554
Brettel M, Mauer R, Engelen A, Küpper D (2012) Corporate effectuation: entrepreneurial action and its impact on R&D project performance. J Bus Ventur 27(2):167–184
Brown T (2008) Design thinking. Harv Bus Rev 86(6):84
Brown TE, Davidsson P, Wiklund J (2001) An operationalization of Stevenson's conceptualization of entrepreneurship as opportunity-based firm behavior. Strateg Manag J 22(10):953–968
Buchanan R (1992) Wicked problems in design thinking. Des Issues 8(2):5–21
Burgelman RA (1983) A process model of internal corporate venturing in the diversified major firm. Adm Sci Q 28(2):223–244
Carrier C (1994) Intrapreneurship in large firms and SMEs: a comparative study. Int Small Bus J 12(3):54–61
Chandler GN, DeTienne DR, McKelvie A, Mumford TV (2011) Causation and effectuation processes: a validation study. J Bus Ventur 26(3):375–390
Chiva R, Alegre J (2009) Investment in design and firm performance: the mediating role of design management. J Prod Innov Manag 26(4):424–440
Cooper RG (1990) Stage-gate systems: a new tool for managing new products. Bus Horiz 33 (3):44–53
Cooper R, Junginger S, Lockwood T (2009) Design thinking and design management: a research and practice perspective. Des Manag Rev 20(2):46–55
Covin JG, Miles MP (1999) Corporate entrepreneurship and the pursuit of competitive advantage. Enterp Theory Pract 23:47–64
Covin JG, Slevin DP (1988) The influence of organization structure on the utility of an entrepreneurial top management style. J Manag Stud 25(3):217–234
Covin JG, Slevin DP (1991) A conceptual model of entrepreneurship as firm behavior. Enterp Theory Pract 16(1):7–25
Day DL (1994) Raising radicals: different processes for championing innovative corporate ventures. Organ Sci 5(2):148–172

Deshpandé R, Farley JU (1998) Measuring market orientation: generalization and synthesis. J Mark-Focus Manag 2(3):213–232
Dess GG, Lumpkin GT, Covin JG (1997) Entrepreneurial strategy making and firm performance: tests of contingency and configurational models. Strateg Manag J 18(9):677–695
Dew N, Read S, Sarasvathy SD, Wiltbank R (2009) Effectual versus predictive logics in entrepreneurial decision-making: differences between experts and novices. J Bus Ventur 24 (4):287–309
Dimov D (2011) Grappling with the unbearable elusiveness of entrepreneurial opportunities. Enterp Theory Pract 35(1):57–81
Drucker PF (1985) Entrepreneurial strategies. Calif Manag Rev XXVII(2):9–25
Duening TN, Shepherd MM, Czaplewski AJ (2012) How entrepreneurs think: why effectuation and effectual logic may be the key to successful enterprise entrepreneurship. Int J Innov Sci 4 (4):205–216
Duncan WJ, Ginter PM, Rucks AC, Jacobs TD (1988) Intrapreneurship and the reinvention of the corporation. Bus Horiz 31(3):16–21
Eliasson C, Davidsson P (2002) Entrepreneurial management, corporate venturing, and financial performance. Babson College, Babson Kauffman Entrepreneurship Research Conference (BKERC), pp 461–470
Erichsen PG, Christensen PR (2013) The evolution of the design management field: a journal perspective. Creat Innov Manag 22(2):107–120
Fisher G (2012) Effectuation, causation, and bricolage: a behavioral comparison of emerging theories in entrepreneurship research. Enterp Theory Pract 36(5):1019–1051
Grand S (2010) Strategy design: design practices for entrepreneurial strategizing. In: Shamiyeh M, DOM Research Laboratory (eds) Creating desired futures—how design thinking innovates business. Birkhäuser GmbH, Basel, pp 331–345
Guth W, Ginsberg A (1990) Corporate entrepreneurship (guest editors' introduction). Strateg Manag J 11:5–15
Hambrick DC (1981) Specialization of environmental scanning activities among upper level executives. J Manag Stud 18(3):299–320
Harms R, Schiele H (2012) Antecedents and consequences of effectuation and causation in the international new venture creation process. J Int Entrep 10(2):95–116
Hart SL (1992) An integrative framework for strategy-making processes. Acad Manag Rev 17 (2):327–351
Hassi L, Laakso M (2011) Conceptions of design thinking in the design and management discourses. In: Roozenburg NFM, Chen LL, Stappers PJ (eds) Proceedings of IASDR2011, the 4th world conference on design research, Delft, pp 1–10
Hitt MA, Ireland RD, Camp SM, Sexton DL (2001) Guest editors' introduction to the special issue strategic entrepreneurship: entrepreneurial strategies for wealth creation. Strateg Manag J 22 (6–7):479–491
Ireland RD, Covin JG, Kuratko DF (2009) Conceptualizing corporate entrepreneurship strategy. Enterp Theory Pract 33(1):19–46
Ireland RD, Kuratko DF, Morris MH (2014) A health audit for corporate entrepreneurship: innovation at all levels: part I. J Bus Strateg 27(1):10–18
Johansson U, Woodilla J (2009) Towards an epistemological merger of design thinking, strategy and innovation. In: 8th European academy of design conference, Aberdeen, pp 1–5
Johansson-Sköldberg U, Woodilla J, Çetinkaya M (2013) Design thinking: past, present and possible futures. Creat Innov Manag 22(2):121–146
Jones GR, Butler JE (1992) Managing internal corporate entrepreneurship: an agency theory perspective. J Manag 18(4):733–749
Kanter R (1985) Supporting innovation and venture development in established companies. J Bus Ventur 1(1):47–60
Kirzner IM (1973) Competition and entrepreneurship. University of Chicago Press, Chicago

Kohli AK, Jaworski BJ (1990) Market orientation: the construct, research propositions, and managerial implications. J Mark 54(2):1–18
Küpper D (2010) Die Erfolgswirkung von Effectuation im Kontext von F&E-Projekten. RWTH Aachen, Aachen
Kuratko DF, Morris MH, Covin JG (2011) Corporate innovation & entrepreneurship: entrepreneurial Development within organizations. International edition, 3rd edn. South-Western Cengage Learning, Mason, OH
Liu SS, Luo X, Shi YZ (2002) Integrating customer orientation, corporate entrepreneurship, and learning orientation in organizations-in-transition: an empirical study. Int J Res Mark 19 (4):367–382
Lockwood T (2009) Transition: how to become a more design-minded organization. Des Manag Rev 20(3):28–37
Lumpkin GT, Dess GG (1996) Clarifying the entrepreneurial orientation construct and linking it to performance. Acad Manag Rev 21(1):135–172
Lumpkin GT, Cogliser CC, Schneider DR (2009) Understanding and measuring autonomy: an entrepreneurial orientation perspective. Enterp Theory Pract 33(1):47–69
Lundqvist M, Williams Middleton KL, Careel C (2013) Exploring effectuation in early-stage ventures using the C-K design theory. Working papers Chalmers University of Technology, (ME1204), pp 1–19
McFadzean E, O'Loughlin A, Shaw E (2005) Corporate entrepreneurship and innovation part 1: the missing link. Eur J Innov Manag 8(3):350–372
Merrifield BD (1993) Intrapreneurial corporate renewal. J Bus Ventur 8(5):383–489
Miller D (1983) The correlates of entrepreneurship in three types of firms. Manag Sci 29 (7):770–791
Mintzberg H (1973) Strategy-making in three modes. Calif Manag Rev 16(2):44–53
Monnavarian A, Ashena M (2009) Intrapreneurship: the role of social capital—empirical evidence and proposal of a new model of intrapreneurship and its relationship with social capital. Bus Strateg Ser 10(6):383–399
Narver JC, Slater SF (1990) The effect of a market orientation on business profitability. J Mark 54 (4):20–35
Narver JC, Slater SF (1998) Additional thoughts on the measurement of market orientation: a comment on Deshpande and Farley. J Mark-Focus Manag 2(3):233–236
Neck HM, Greene PG (2011) Entrepreneurship education: known worlds and new frontiers. J Small Bus Manag 49(1):55–70
Nielsen RP, Peters MP, Hisrich RD (1985) Intrapreneurship strategy for internal markets—corporate, non-profit and government institution cases. Strateg Manag J 6(2):181–189
Nielsen SL, Lassen AH, Nielsen LM, Mikkelsen M (2012) Opportunity design: understanding entrepreneurial opportunities through design thinking. Available at: http://www.etrans.dk/fileadmin/PDF/Sunas_forskningsartikel_med_bidrag_af_bl_a__mette.pdf. Accessed 17 Feb 2014
Noyes E, Brush C (2012) Teaching entrepreneurial action: application of creative logic. In: Corbett AC, Katz JA (eds) Entrepreneurial action (advances in entrepreneurship, firm emergence and growth). Emerald Group Publishing, Bingley, pp 253–280
Parker SC (2011) Intrapreneurship or entrepreneurship? J Bus Ventur 26(1):19–34
Pinchot GI (1985) Intrapreneuring. Harper & Row Publishers, New York
Rae D (2001) EasyJet: a case of entrepreneurial management? Strateg Chang 10(6):325–336
Read S, Song M, Smit W (2009) A meta-analytic review of effectuation and venture performance. J Bus Ventur 24(6):573–587
Rylander A (2009) Design thinking as knowledge work: epistemological foundations and practical implications. Des Manag J 4(1):7–19
Sarasvathy SD (2001) Causation and effectuation: toward a theoretical shift from economic inevitability to entrepreneurial contingency. Acad Manag Rev 26(2):243–263

Sarasvathy SD (2008) Effectuation—elements of entrepreneurial expertise. Edward Elgar Publishing Limited, Cheltenham
Sarasvathy SD, Venkataraman S (2011) Entrepreneurship as method: open questions for an entrepreneurial future. Enterp Theory Pract 35(1):113–135
Schumpeter JA (1934) The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle. Harvard University Press, Cambridge, MA
Seidel V (2000) Moving from design to strategy—the 4 roles of design-led strategy consulting. Des Manag J 11(2):35–40
Sharma P, Chrisman JJ (1999) Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. Enterp Theory Pract 23(3):11–27
Shaw E, O'Loughlin A, McFadzean E (2005) Corporate entrepreneurship and innovation part 2: a role- and process-based approach. Eur J Innov Manag 8(4):393–408
Simon HA (1969) The sciences of the artificial. MIT Press, Cambridge, MA
Slater SF, Narver JC (1998) Customer-led and market-oriented: let's not confuse the two. Strateg Manag J 19(10):1001–1006
Stevenson HH (1983) A Perspective on entrepreneurship. Harvard Business School Background Note 384–131
Stevenson HH, Gumpert DE (1985) The heart of entrepreneurship. Harv Bus Rev 63(2):85–94
Stevenson HH, Jarillo JC (1990) A paradigm of entrepreneurship: entrepreneurial management. Strateg Manag J 11(5):17–27
Stevenson HH, Jarrillo-Mossi JC (1986) Preserving entrepreneurship as companies grow. J Bus Strateg 7(1):10–23
Svensrud E, Åsvoll H (2012) Innovation in large corporations: a development of the rudimentary theory of effectuation. Acad Entrep 11(1):59–88
Terrey N (2010) Design thinking situated practice: non-designers-designing. In: Proceedings of the 8th design thinking research symposium (DTRS 8), pp 369–379
Toivonen M, Tammela K (2013) Innovation with effectuation: conceptual discussion and a case study. www.naplesforumonservice.it, pp 1–13. Available at: http://www.naplesforumonservice.it/uploads//files/ToivonenTammela,.pdf. Accessed Jul 2013
van Burg E, Romme AGL (2014) Creating the future together: toward a framework for research synthesis in entrepreneurship. Enterp Theory Pract 38(2):369–397
Van Wyk R, Adonisi M (2012) Antecedents of corporate entrepreneurship. South Afr J Bus Manag 43(3):65–78
von Hippel E (1994) "Sticky information" and the locus of problem solving: implications for innovation. Manag Sci 40(4):429–439
Westfall SL (1969) Stimulating corporate entrepreneurship in U.S. industry. Acad Manag J 12 (2):235–246
Wiltbank R, Dew N, Read S, Sarasvathy SD (2006) What to do next? The case for non-predictive strategy. Strateg Manag J 27(10):981–998

Measurement of Design Front End: Radical Innovation Approach

Pekka Berg, Jussi Pihlajamaa, Poul Kyvsgaard Hansen, and Ade Mabogunje

Abstract The overall structure and main characteristics of a future product are all decided in the front-end phase, which strongly affects subsequent new product development activities. Recent studies indicate that these early front-end activities represent the most troublesome phase of the innovation process and, at the same time, one of the greatest opportunities to improve a company's overall innovation capability. In this paper dealing with criteria, we concentrate only on the objectives viewpoint and leave the attributes discussion for future research. The two most crucial questions are:

- What are the objectives of measurement in radical design?
- What are the most crucial future challenges related to the selection of relevant measurement objectives?

Based on the theoretical part of this paper, our framework of the Balanced Design Front-End Model (BDFEM) for measuring the innovation activities front-end contains five assessment viewpoints; input, process, output (including i), social environment and structural environment. Based on results from our first managerial implications in three Finnish manufacturing companies, we argue that the developed model is flexible and can also be used extensively for companies other than manufacturing, like the service sector.

Keywords Measurement • Radical • Innovation • Design • Development • Front-end

---

This article is based on the paper presented in NordDesign 2014 Conference on August 27–29, 2014, in Espoo, Finland and Melbourne, Australia, with major updates in theoretical background.

P. Berg (✉) • J. Pihlajamaa
Aalto University, Otaniementie 17, 02150 Espoo, Finland
e-mail: pekka.berg@aalto.fi; Jussi.pihlajamaa@aalto.fi

P.K. Hansen
Aalborg University, Fredrik Bajers Vej 5, 9100 Aalborg, Denmark
e-mail: kyvs@business.aau.dk

A. Mabogunje
Stanford University, 440 Escondido Mall, 94305-3030 Stanford, CA, USA
e-mail: ade@stanford.edu

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_3

Introduction

The framework of the model for measuring the innovation and design activities front-end contains, in the first draft, five assessment viewpoints; input, process, output, social environment and physical environment. Connection of these elements in the measurement of innovation and design activities, overall, has been weak, but will now be included in the new approach. In this paper, the theoretical background of design and innovation process front-end itself is described first (1). Second (2), understanding of the radical innovation context is illustrated. Third (3), the social environment perspective is discussed. Fourth (4) contains a description of a physical environment of innovation process front-end. Fifth (5), the most crucial points from the measurement viewpoint in the front-end stage of the discontinuous innovation process are discussed and the idea for the new Balanced Design Front-End Model (BDFEM) is presented. After the theoretical part, sixth (6), methodology and first managerial implications from three Finnish manufacturing companies are described. Finally seventh (7), the study's conclusions are discussed.

Theoretical Background

Front-End Process

The foundation for successful product development is created in the front-end phase, which refers to the activities that take place before the formal development project phase (Koen et al. 2001). The overall structure and main characteristics of the future product are all decided in the front-end phase, which then strongly affects subsequent new product development activities. Recent studies indicate that these early front-end activities represent the most troublesome phase of the innovation process and, at the same time, one of the greatest opportunities to improve the overall innovation capability of a company (Koen et al. 2001; Kim and Wilemon 2002). The front-end phase nourishes the new product development project phase by producing fresh incremental and radical product concepts. The front-end phase results in a well-defined product concept, clear development requirements and a business plan aligned with the corporate strategy (Kim and Wilemon 2002). In addition, the front-end phase may produce a formal project plan, including resource needs, schedule and budget estimates; the decision on how the product concept will be developed further (Khurana and Rosenthal 1997). The decision could be to continue with an immediate development project, or to put the concept "on hold" to wait for more suitable timing, or even to kill the initiative.

Radical Innovation Process

Radical innovation is defined as one with the potential to produce one or more of the following results: an entirely new set of performance features, greater than fivefold improvements in known performance features and a significant reduction in cost, over 30 % (Simon et al. 2003, p. 17; Leifer et al. 2001).

Radical innovation can be a product, process or service, with either exceptional performance features or familiar features offering significant improvements in performance, or costs that transform existing markets or create new ones (Leifer et al. 2001, p. 102).

Commercializing new technologies or services for markets that may not yet even exist, the arena of radical innovation can be characterized as turbulent, and uncertain, even chaotic. Thus, radical innovation projects require different kind of competencies than incremental innovation projects. Incremental innovations often follow a more linear, orderly process with less organizational and resource uncertainties (Leifer et al. 2001). However, the reason for the great value of radical innovations is that companies that have succeeded over the long haul punctuate ongoing incremental innovation with radical innovations that create new markets and business opportunities (Leifer et al. 2001). In the next breath, it must be noted that the radical innovation is like a start-up for a continuous improvement, i.e. incremental innovations, through which the gains of radical innovation are sustainable.

Social Environment

Because social environment encompasses so many elements, there are many perspectives through which it can be perceived. The social environment could be understood as referring to organizational climate, which includes the shared cognitions and perceptions of organizational members (Rousseau 1988). For example, Anderson and West (1998) have developed a group climate model for innovation stating that four factors—vision, participative safety, task orientation, and support of innovation—are predictive of innovativeness in a work group. Another perspective on the social environment is the organizational culture. Numerous studies have listed features of organizational culture that are found to be beneficial for innovation (Hauser 1998; Koberg et al. 1996).

While these perspectives are central and valuable in understanding the elements that support innovative activity of organization, we find that these features of organizational climate and culture remain quite abstract. Thus, we find it useful here to approach the social environment from a more action-oriented perspective. We also do not find the social environment to be a stable social "space", but a dynamic construct involving interaction, practices and activity. The bases of the innovation activity of the work community are innovativeness and creativity.

In general, culture and organizational climate factors have not been traditionally emphasized in measurement literature (Holbek 1988).

Structural Environment

Compared to the impact of the physical work environment on work processes in general, structural environment's impact on the innovation process, or even specifically on creativity, is still highly debated in literature. Impact on the innovation process, or even specifically on creativity, is still highly debated in literature. However, these two issues need to be treated differently. The process of innovation, though not being simply replicable, is being fairly well researched—especially when it comes to the later stages in the process. In its very early stages, where innovation is significantly about creativity and idea generation, this process is not yet fully understood. Therefore, one needs to distinguish precisely between the impact of the physical environment on innovation and its impact on creativity.

Earlier research suggests that the physical environment certainly influences innovation efforts. For example, based on their findings at a large telecommunications company, Haner and Bakke (2004) state that environments influence innovation—both in positive and negative ways. Among others, positive effects of the newly created work environment were particularly related to improved communication and cooperation.

Such findings help establish the link between the physical environment and innovation. Furthermore, these (and other) factors allow measurement of the physical work environment impact on the work process in general and the innovation process in particular.

According to Holbek (1988), innovating organizations must adopt contrasting structures and climates as they move from the initiation to the implementation stages of innovation. Chesborough and Teece (1996) and Burns and Stalker (1961) have also found that there is a relationship between organizational design and type of innovation.

Measurement

Several different kind of measurement gaps have been identified in literature (Holbek 1988). These gaps can be categorized in two types: validity gaps and omission gaps. Validity gaps arise when there is insufficient evidence that proposed measures actually do capture drivers or outputs of innovation management. Omission gaps occur where the importance of an aspect of innovation management is supported in the literature, but measures for this aspect are lacking.

Radical innovation should be measured differently than more conventional projects, since forcing people to follow rules designed for measuring incremental

change will suffocate innovation (Simon et al. 2003). The measuring system is designed to evaluate actions intended to produce profit in a short-term period. The same measures are not valid for evaluating actions in radical innovation projects, which differ substantially from traditional projects, with long-term time spans. Usually radical innovation projects change direction several times from idea conception to implementation. In the very early phase of projects, the focus should be on learning, focusing and redirecting, instead of reaching the milestones. Strict financial analysis or justification too early in the project can be misleading, because of problems with market analysis (Simon et al. 2003).

The design of performance measurement systems emphasizes the need of multiple financial and non-financial performance indicators to evaluate key value-adding activities of an organization (Kaplan and Norton 1992, 1996; Neely 2005; Micheli and Manzoni 2010).

Grafton et al. (2010) argue that strategically-aligned performance indicators are needed to ensure strategy-consistent decision making. According to Lohman et al. (2004), financial and non-financial measures are needed to translate the strategy to provide guidelines for managers' operational action. Financial measures in a PMS are widely used; the adoption of non-financial measures is becoming increasingly common (Lee and Yang 2011). However Perego and Hartmann (2009) note that although the alignment of an organization's performance measurement system with its strategy is widely advocated, it is far from clear what strategic alignment of performance measures entails.

Although the importance of different kinds of innovation measurements, like innovation strategy, idea sources and idea generation, customer user and market understanding, learning and knowledge management tools, enablers like organizational culture and leadership are widely accepted (Crossan and Apaydin 2010), the implementation of measurement systems is often inadequate (Adams et al. 2006).

According to McDermott and O'Connor (2002), management practices vary between incremental and radical innovation performance, which require different structures, processes, strategies, capabilities and cultures. Thus, the measurement system might be incompatible with both incremental and radical innovation measurement.

Nilsson et al. (2012) note that because radical innovation may not fit existing strategies and business models, careful attention is required when designing the measurement system.

The new measurement method concept proposed comprises four stages: selection of measurement criteria (BDFEM-model), selection of data sources, data collection and analysis of results.

We call this four-stage entity the Balanced Design Front End, or BDFEM Method. In this paper, we concentrate on selection of the measurement criteria stage, called Balanced Innovation Front End Model, BIFEM-model. Based on earlier research (Paulk et al. 1995; ISO/CD2 9000 Draft 1999; QS 9000 1998; Berg et al. 2002, 2004), structure of the BDFEM-model model is based on the structure of the Quality Maturity Method QMM, an assessment method for national technology programs in Finland. The methods discussed consist of a three-step

procedure for the setting of objectives, where the objectives of a technology program are divided into impacts, outputs and activities. After we have linked objectives with attributes, we have the entity of measurable criteria. In this paper on criteria, we concentrate only on the objectives viewpoint, leaving the attributes discussion to future research.

Thus, in this paper, the two most crucial research questions are:

- What are the objectives of measurement in radical design?
- What are the most crucial challenges related to the selection of the relevant measurement objectives?

In the selection of objectives, we have several challenging issues to tackle. What is the reliability of potential objectives? Is there any reference data related to the objectives collected in earlier measurements of the same company, or in other partner companies? What factors other than the product development have an effect on achieving the impacts? It is also important to observe overall measurement criteria and interrelationships between the different factors (Khurana and Rosenthal 1997).

Based on the theoretical part of this paper, our model framework for measuring innovation activities front-end contains five assessment viewpoints; input, process, output (including impacts), social environment and structural environment.

Methodology

Case Companies

In this study, we examine three manufacturing companies. Case company A is a global industries equipment manufacturer, Case Company B is a global base metal industry company that also manufactures its own products and Case C is an animal food industry company. All three case companies are in investment–intensive industries and have their own research units or strong external research partners.

Data Collection and Analysis

The data was collected by semi-structured interviews; data source in each company was their CTO. Before asking questions, we found out what a radical innovation means in each company's context and clarified what we mean by the concept of front-end. First, the data was analyzed by comparing the companies' answers in each of the five BDFEM-model measurement areas. The second analysis viewpoint addresses was how the criteria were categorized in the five assessment areas.

Table 1 Interview results: Identified measurement objectives in radical context

Typical innovation measurement objectives and areas in literature (Adams et al. 2006)					
	Input	Process	Output	Social factors	Structural factors
	Innovation strategy, people physical and financial resources tools, new knowledge	Project efficiency, knowledge management, knowledge repository, Optimization tool use Information flows Innovation strategy Strategic orientation Strategic leadership	Risk/return balance, Market research Market testing Marketing and sales	Culture, communi-cations collaboration	Structure
Identified measurement objectives areas in radical context					
Case A Equipment manufacturer	**Input**	**Process**	**Output of front end**	**Social factors**	**Structural factors**
	Market area's novelty	Turnaround time	Number of projects where the role of R&D centers is important	Experience	Structure/roles of the organisation – RTD – Engineering – Marketing and sales
	Market size	Cash flow	Number of projects where the role of R&D centers is crucial	Knowledge and understanding of the operating environment	Structure of the teams – Technological competence – Social competence
	Competitors	Technology parameters	Alternative concepts	Innovation activity	ICT systems (ERP, CRM) work in busi-ness unit/company level
	Lead customers	Investment costs	Demo installations	Ability to create ideas	

(continued)

Table 1 (continued)

Typical innovation measurement objectives and areas in literature (Adams et al. 2006)					
	Input	Process	Output	Social factors	Structural factors
	New opportunities to replace old technologies	Operating costs	Utilizable results in other projects	Local teams vs. Global teams	
	New industries, with the possibility of long-term success	Raw material base	Customer feedback	% of the work in – Informal teams– Formal teams – For team alone – Not for team/ alone	
	Suitability into new markets	Alternative process flowcharts	Cash flow		
			Risk – Probability to be successful		
		Customer requirements	New products/Turn over %		
			Number of commercialised new products		
			Number of invention notices		
			R&D results related Stock Exchange Releases		
			The customer's competitive advantage factors		
			Is the project's argumentation sufficient in the commercialization		
Case B Metal industry	Strategic fit	Cass flow	Stage gate objectives	Ability to get along	Physical proximity of the team

	New technologies	Competences	New meters to replace the tonnage meters—increase in strength, the number of devices	Sociality	
	New global trends like energy efficiency	First in the market	New meters to replace the tonnage meters	Suitable values	
	the business environment data and new business environment			Cross Functionality	
	The development of the industry				
	Potential customers and sub-customers segments				
	Business intelligence data				
Case C Animal feed industry	New research results	Development costs	Suitability for the market	Right partners	Availability of research techniques and equipments
	New technologies	Risk level	Suitability for the existing product portfolio	Added value of networks	Manufacturing capabilities
	Competence networks	Feasibility	Suitability for to distribution channels	Dealer selection criteria	
		Chance of success	New use for current markets		
		Technology maturity	Criteria and scoring system for the concept selection		
		Possibility to go into new markets	Life cycle criteria		
		The price of needed technologies			

We were also interested in the most crucial challenges related to radical innovation front-end measurement in each company.

Results

Results are shown in Table 1 (continued). The identified measurement objectives focused mainly on the innovation process's three main areas: input, process and FE output. The main focus was clearly on FE output objectives. We divided the output objectives into two sub-categories: impact objectives and outcome/selection objectives.

The most interesting main result seems to be that impact objectives are typical incremental innovation objectives, while outcome/selection objectives attempt to minimize risk and uncertainty, thus finding new ways to ensure that output is sufficiently relevant to further development (more or less), under the rules of incremental innovations.

The second analysis viewpoint addresses how criteria are categorized under the five BDFEM-assessment areas. We show the answer in the following order: input, process, output, social factors and structural factors.

Input Objectives New markets and new technologies are typically used dimensions that can be used to assess the radicalness of an idea or innovation. The input responses (Table 2, continued) were found in both categories, but the focus was specifically on input objectives in the assessment of market uncertainty and new market potential. The technology aspect particularly highlights how new or existing technologies should be used to meet new challenges.

Process Objectives Process-related results are divided into two categories (Table 3, continued): cost-oriented and requirement-oriented objectives. Cost-oriented objects are comparable to those used in the incremental innovation indicators. The only exception is the level of risk evaluation. In contrast, requirement-related objectives are more radically-oriented and encourage the possibility of opening new markets and establishing new competence and technology based objectives.

Output Objectives The front-end phase typically ends with concept assessment and selection. Established objects are divided into two categories (Table 4): outcome/selection objectives and impact objectives. The radical level of impact is highlighted in assessing a research unit's role in the development of new concepts. Outcome and selection objectives contain substantial concept development-related issues, typical for radical innovations. Alternative concepts, demos, utilizable results in other projects and entirely new metrics are good examples of radical-oriented measurement.

Social Factors Social and physical factors are enablers for innovation activities. The radical innovation context often requires new kinds of innovation climate.

Table 2 Input objectives

Categories	Input
Business Intelligence and Market oriented objectives	Strategic fit
	Market area's novelty
	Market size
	Competitors
	Lead customers
	Suitability into new markets
	Potential customers and sub-customers segments
	New industries, with the possibility of long-term success
	The business environment data and new business environment trends
	Business intelligence data
Technology and competence oriented objectives	New technologies
	New research results
	New opportunities to replace old technologies
	New global trends like energy efficiency
	The development of the industry
	Competence networks

Table 3 Process objectives

Categories	Process
Cost-oriented objectives	Investment costs
	Operating costs
	Development costs
	Risk level
	Turnaround time
	Cass flow
	The price of needed technologies
Requirement oriented objectives	First in the market
	Possibility to go into new markets
	Chance of success
	Customer requirements
	Raw material base
	Alternative process flowcharts
	Competences
	Feasibility
	Technology maturity
	Technology parameters

Table 4 Output of front-end objectives

Categories	Output of Front End
Outcome and selection objectives	Alternative concepts
	Demo installations
	Customer feedback
	Utilizable results in other projects
	• Minimising of uncertainty
	• Probability to be successful
	The customer's competitive advantage factors
	Is the project's argumentation sufficient in the commercialization
	Suitability for the market
	Suitability for to distribution channels
	New use for current markets
	Stage gate objectives
	Criteria and scoring system for the concept selection
	New meters to replace the tonnage meters
	• Increase in strength,
	• The number of devices
Impact objectives	Number of projects where the role of R&D centers is important
	Number of projects where the role of R&D centers is crucial
	Cash flow
	New products/Turn over %
	Number of commercialised new products
	Number of invention notices
	R&D results related Stock Exchange Releases
	Suitability for the existing product portfolio
	Life cycle criteria
	Risk level

Social factors (Table 5) are divided into two categories: internal and external objectives. In the radical context, these objectives emphasize collaboration and communication, values, sociality, team work and cross functionality. Internal objectives emphasize the importance of the value chain and business networks.

Structural Factors Structural factors (Table 6) are divided in two categories: organizational and system/technology oriented objectives. Radical innovations might need new kinds of roles, tools and organizational changes to obtain all necessary information and competences in use. Mentioned objectives in both categories emphasize the importance of assessing these objectives and changing every-day practices.

Table 5 Social factors

Categories	Social factors
Internal objectives	Culture
	Communications
	Collaboration
	Experience
	Knowledge and understanding of the operating environment
	Ability to create ideas
	Ability to get along
	Sociality
	Suitable values
	Innovation activity
	Local teams vs. Global teams
	% of the work in
	• Informal teams
	• Formal teams
	• For team alone
	• Not for team/alone
	Cross functionality
External objectives	Right partners
	Added value of networks
	Dealer selection criteria

Table 6 Structural factors

Categories	Structural factors
Organisation-oriented objectives	Physical proximity of the team
	Structure/roles of the organisation
	• RTD
	• Engineering
	• Marketing and sales
	Structure of the teams
	• Technological competence
	• Social competence
System and technology-oriented objectives	ICT systems (ERP, CRM) work in business unit/company level
	Availability of research techniques and equipments
	Manufacturing

Conclusions

We conclude that the framework of the model for measuring the innovation and design front-end in radical context contains, in the first draft, five assessment viewpoints; input, process, output, social environment, and structural environment.

Connection of these elements in the measurement of innovation and design activities, overall, has been weak, but will now be included in the new approach, BDFEM. In our research, we are currently processing the first managerial implications of BDFEM in Finnish, Danish, German, Swiss and US companies.

Based on results from our first managerial projects in three Finnish companies, the following points should be taken into consideration in the application and further development of the model:

1. The current situation and the nature of the each company should be taken into careful consideration in the applications of the model. The subjects described in the model are not suitable for all companies, but appropriate tools could be chosen for a single company.
2. The model should be defined as a practical tool for managers. This assumes refining the model description into a concrete assessment and design tool. It should also be noted that the model is primarily a tool for internal assessment (evaluation), which is also clearly related to external audits of companies.
3. Reliability of the data collected by the model should be considered critically. This is especially important when the data collected in internal assessment is also used as basic data for external audits. Special consideration should be given to the sources of information used in the internal assessment: how much information is collected from external experts and from other objective data sources, like documents.
4. Definition of the criteria to be assessed is the most critical stage of the measurement; the central issue is to define sub-criteria supporting the main criteria for a single case. That would enable a clear interpretation of the criteria from two viewpoints: the innovation front-end and discontinuous innovation.
5. Linking of measurement with company strategies should be improved. Corporate strategy work performance could be intensified by inviting experts who have participated in defining operative level measurements: incremental and radical. Strategies are seldom written in easily understandable language. Communication of experience and opinions of external measurement experts to management would enhance the linkage remarkably.
6. Special consideration should be given to front-end impacts: what is the next step after conceptualization? Networking in the company should be further studied. Front-end impacts in the company could, in the future, be divided into the following main criteria:

    - Including changes at the interface and new cooperation parties,
    - Internal impacts on the development phase, such as profitability and export,
    - Better understanding of risks and uncertainty and
    - Internal organizational changes.

The model developed is flexible and can also be used extensively for companies other than manufacturing. Thus far, the study has been mainly targeted the manufacturing industry from a the production of goods perspective. In this study,

the first observation experiences show that the new measurement model might be useful in other industrial areas, like the service sector, as well.

It is not enough to do things right; the right things must be done.

References

Adams R, Bessant J, Phelps R (2006) Innovation management measurement: a review. Int J Manag Rev 8(1):21–47

Anderson NR, West MA (1998) Measuring climate for work group innovation: development and validation of the team climate inventory. J Organ Behav 19(3):235–258

Berg P, Leivo V, Pihlajamaa J, Leinonen M (2002) Assessment of quality and maturity level of R&D. Int J Prod Econ 78(1):29–35

Berg P, Pihlajamaa J, Nummi J, Leinonen M, Leivo V (2004) Measurement of the quality and maturity of the innovation process: methodology and case of a medium sized Finnish Company. Int J Entrep Innov Manag 4(4):373–382

Burns TR, Stalker GM (1961) The management of innovation. Tavistock, London

Chesborough HW, Teece DJ (1996) When is virtual virtuous? Organizing for innovation. Harv Bus Rev January–February:65–73

Crossan MM, Apaydin M (2010) A multi-dimensional framework of organizational innovation: a systematic review of the literature. J Manag Stud 47(6):1154–1191

Grafton J, Lillis AM, Widener SK (2010) The role of performance measurement and evaluation in building organizational capabilities and performance. Acc Organ Soc 35(7):689–706

Haner UE, Bakke JW (2004) On how work environments influence innovation—a case study from a large ICT company. In: CD-ROM proceedings of the XV annual conference of the International Society for Professional Innovation Management (ISPIM), Oslo, 20–24 June 2004

Hauser M (1998) Organisational culture and innovativeness of firms—an integrative view. Int J Technol Manag 16(1–3):239–255

Holbek J (1988) The innovation design dilemma: some notes on its relevance and solutions. In: Kaufmann G, Grønhaug K (eds) Innovation: a cross-disciplinary perspective. Norwegian University Press, Oslo, pp 253–277

ISO/CD2 9000 Draft (1999) Quality management systems—fundamentals and vocabulary

Kaplan RS, Norton DP (1992) The balanced scorecard–measures that drive performance. Harv Bus Rev 70((January–February)):71–79

Kaplan RS, Norton DP (1996) Using the balanced scorecard as a strategic management system. Harv Bus Rev 74(1):75–87

Khurana A, Rosenthal SR (1997) Integrating the fuzzy-front-end of new product development. Sloan Manag Rev 38(2):103–120

Kim J, Wilemon D (2002) Strategic issues in managing innovation's fuzzy front-end. Eur J Innov Manag 5(1):27–39

Koberg CS, Uhlenbruck N, Sarason Y (1996) Facilitators of organizational innovation: the role of life cycle stage. J Bus Ventur 11(2):133–149

Koen P, Ajamian G, Burkart R, Clamen A (2001) Providing clarity and a common language to the "fuzzy front end". Res Technol Manag 44(2):46–55

Lee CL, Yang HJ (2011) Organization structure, competition and performance measurement systems and their joint effects on performance. Manag Account Res 22(2):84–104

Leifer R, O'Connor G, Rice M (2001) Implementing radical innovation in mature firms: The role of hubs. Acad Manag Exec 15(3):102–113

Lohman C, Fortuin L, Wouters M (2004) Designing a performance measurement system: a case study. Eur J Oper Res 156(2):267–286

McDermott CM, O'Connor GC (2002) Managing radical innovation: an overview of emergent strategy. J Prod Innov Manag 19(6):424–438

Micheli P, Manzoni JF (2010) Strategic performance measurement: benefits, limitations and paradoxes. Long Range Plan 43(4):465–476

Neely A (2005) The evolution of performance measurement research—developments in the last decade and a research agenda for the next. Int J Oper Prod Manag 25(12):1264–1277

Nilsson S, Wallin J, Benaim A, Annosi MC, Berntsson R, Ritzen S, Mangnusson M (2012) Re-thinking Innovation measurement to manage innovation-related dichtotomies in practice. In: Proceedings of the Continuous Innovation Network Conference—CINet 2012, Rome, Italy, 17–18 September 2012

Paulk MC, Weber CV, Curtis B, Chrissis MB (1995) The capability maturity model: guidelines for improving the software process. Addison-Wesley, Boston, MA

Perego P, Hartmann F (2009) Aligning performance measurement systems with strategy: the case of environmental strategy. Abacus 45(4):397–428

QS 9000 (1998) Quality system requirements, 3rd edn. Remainder. 142 p

Rousseau DM (1988) The construction of climate in organizational research. In: Cooper CL, Robertson IT (eds) International review of industrial and organizational psychology, vol 3. Wiley, Chichester, pp 139–159

Simon E, McKeough D, Ayers A, Rinehart E, Alexia B (2003) How do you best organize for radical innovation? Res Technol Manag 46(5):17–20

Design Thinking for Revolutionizing Your Business Models

Amir Bonakdar and Oliver Gassmann

Abstract In the age of globalization and intensified competition, there is a need to develop not only new products and processes, but to rethink today's business models. How can firms re-invent their industry to create and capture value successfully? How can firms overcome the dominant industry logic and develop successful and sustainable business models? In our previous research, we found that 90 % of all business model innovations within the last 50 years were based on 55 core patterns. The resulting Business Model Navigator is a systematic methodology comprising four phases of business model innovation: initiation, ideation, integration and implementation. The whole process makes strong use of Design Thinking elements and has been continuously improved by St.Gallen's innovation team, Stanford University's Center for Design Research and several business model innovators in leading corporations within the last 5 years.

Keywords Business Model Innovation • Design Thinking

The Business Model Navigator: How to Revolutionize Business Models

The importance of business model innovation has grown dramatically within the last decade and the importance of thinking beyond products and technologies has been widely acknowledged. However, business model innovation is still recognized as a contribution of talented individuals such as Steve Jobs, Larry Page or Tony Fadell. Our research and work with practitioners has shown that business model design can be done systematically and therefore taught. Our large-scale research

A. Bonakdar (✉)
Institute of Technology Management, University of St.Gallen, Dufourstrasse 40a, 9000 St.Gallen, Switzerland

Stanford University, Stanford, CA, USA
e-mail: bonakdar@stanford.edu

O. Gassmann
Institute of Technology Management, University of St.Gallen, Dufourstrasse 40a, 9000 St.Gallen, Switzerland
e-mail: oliver.gassmann@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_4

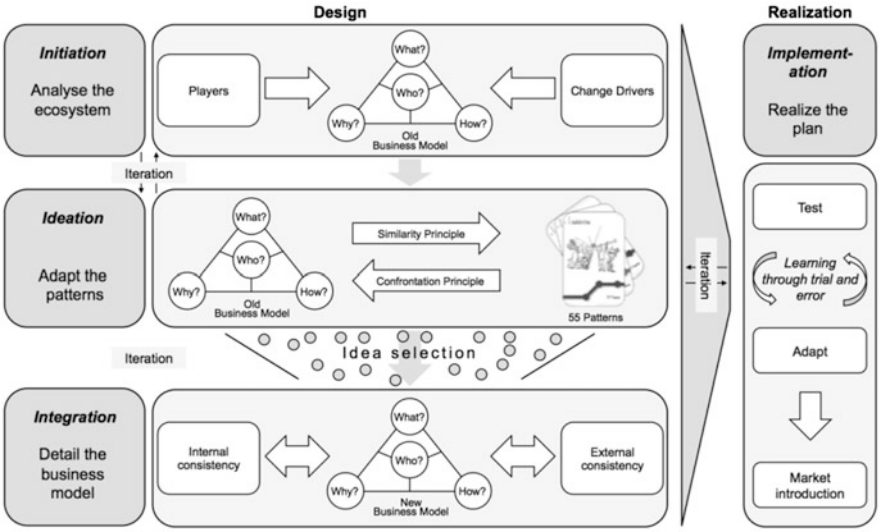

Fig. 1 The Business Model Navigator (Gassmann et al. 2014)

projects and numerous cooperation projects with firms in dozens of industries resulted in the development of the Business Model Navigator (Gassmann et al. 2014). Designing a business model used to be an art; today it has become a craft.

The Business Model Navigator depicts the starting point and baseline for this study and represents a design methodology that firms can use to systematically innovate their business model. Figure 1 represents the Business Model Navigator framework, which suggests innovating business models in a four-step process comprising three phases of business model design, followed by a realization phase. At the heart of the design phases is the business model triangle, which describes a business model in four dimensions (Frankenberger et al. 2013; Gassmann et al. 2014): the What, the Who, the How, and the Why. While the What clarifies the value proposition of a business model—the product or service offerings to its customers—the Who represents the customer segments addressed with the business model. The How points to the way the value is created, e.g. certain internal processes or together with external partners. The Why clarifies the business model's cost-revenue structure: in other words, the firm's revenue model.

1. In the initiation phase, the status quo business model is described along the four business model dimensions. Together with an analysis of the surrounding ecosystem, the team develops an understanding of how the firm relates to its customers, competitors, and partners. Furthermore, in the initiation phase business model change drivers are identified. These drivers can be, for instance, technological, regulatory, or behavioral changes and can initiate business model innovations. The goal of the initiation phase is to obtain a clear understanding of

the current business model and to identify focus areas for potential business model innovations.

2. In the ideation phase, the main goal is to generate new business model ideas. The ideation phase starts with a presentation of inspiring business model examples, typically from different industries. The goal is to inspire the team with cross-industry analogies and to point out how other firms have solved similar challenges to their business model. This is followed by the comparison of the firm's business model with successful business model patterns from multiple companies in various industries (Gassmann et al. 2014; Frankenberger et al. 2013). Thinking about how a manufacturing company would do business with, for instance, a freemium business model (e.g. Skype) or a subscription business model (e.g. Netflix) triggers many new business model ideas. After having generated numerous ideas in the ideation phase, the most promising ones are selected and further elaborated in the integration phase.
3. In the integration phase, selected ideas are further developed. Typically, ideas generated in the ideation phase are still very rough and abstract. They usually focus on only one or two business model dimensions, like a new value proposition or a new customer segment. Therefore, the goal of the integration phase is to align these high level ideas along all four dimensions of a business model and to achieve internal and external consistency. Central aspects in this phase include making sure that enough resources and the right processes needed for the new business model (internal) are in place and ensuring that the new business model fits in its business ecosystem, comprising customer, partners, and competitors (external). "Light" business plans are created and pitch presentations prepared.
4. The implementation phase focuses on investments and pilot projects in test markets to realize the designed business model. Trial and error learning through (test) market introduction can lead to business model re-designs with the aim of realizing a newly designed business model. The focus of the study is on the first three design phases, taking into account trial and error learning from the implementation phase.

The Power of Design Thinking for Business Models

In past years, Design Thinking has emerged as a powerful methodology for innovation (Leifer and Steinert 2011). Its strength is based on the human-centered approach that integrates technological, business, and human elements to create innovative products, services, and enterprises (Meinel and Leifer 2012). Different from traditional strategic approaches to innovation that encourage analysis, planning, prediction, and full-scale launch, Design Thinking inspires design, building, testing, learning, redesigning, iterating and slow launching and scaling (Fixson and Rao 2014). The core is based on rapid learning, especially in changing, uncertain environments. Business model innovation redesigns the entire architecture of a firm

in terms of how it creates value to its customers, integrates partners and generates profits (Teece 2010). Hence, it represents a radical type of innovation, where traditional ways of analyzing historic data to plan and predicting future success are inappropriate. Innovating business models requires experimentation that creates data for further evaluation and justification (Chesbrough 2010). Based on dozens of projects with leading companies, we conclude that the creative, intuitive, human-centered, prototype-driven, and iterative Design Thinking approach adds significant value when creating radical new business models.

Design Thinking Within Initiation

In the initiation phase, the ecosystem of the focal firm is usually analyzed and change drivers are identified. Besides traditional methods applied, like customer surveys (marketing department), competitor analyses (corporate strategy) and technological forecasting (R&D department), Design Thinking can unleash additional innovation potential in the business model ideation phase by revealing potential customers' hidden needs. IDEO's CEO Tim Brown highlights that it is crucial to observe, build empathy and gain insight, thus uncovering needs, which customers are not yet aware of and would therefore not express when simply asked. "The tools of conventional market research can be useful in pointing toward incremental improvements, but they will never lead to those rule-breaking, game-changing, paradigm-shifting breakthroughs that leave us scratching our heads and wondering why nobody ever thought of them before" (Brown 2009, p. 40).

When applying Design Thinking in the initiation phase, it is important not to start from one narrow problem the focal firm is currently facing, since Design Thinking explores not only solutions to specific, predefined problems, but always starts with an understanding of the problem itself—the problem space (Leifer and Steinert 2011, 2014). This is done in two iterative steps (see Fig. 2). In step one, the divergent exploration of the problem space takes place. Mainly qualitative data of

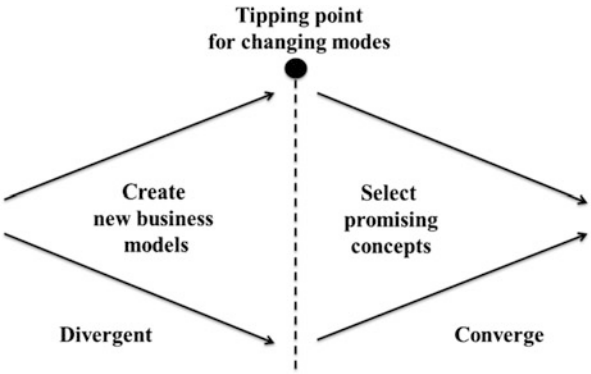

Fig. 2 Ongoing change between creation and selection of business models [adapted from Brown (2009, p. 67)]

customers, competitors, partners, and the focal firm is collected through e.g. recorded interviews, pictures, videotapes, or soaking up the experience of doing business with a company by assuming the role of a customer. This phase is also often referred to as the analysis phase, in which different viewpoints and events are explored. "Connecting" to, and building empathy for, the people and/or companies observed helps for the second step, namely the synthesis, where observations are converted into insights. Empathy plays a crucial role in decoding, synthesizing and converting the masses of raw data into meaningful insight (Brown 2009). Often, the most interesting insights are drawn from what people do not say. Converting the data into patterned characteristics helps to translate the change problem and to make a design problem formulation, the baseline for ideation (Brown 2009).

By observing and building empathy for patients with chronic illness or long-term treatments, the Boston based start-up Pillpack realized that receiving and organizing medication is often a complex undertaking. Patients have to take prescriptions to local pharmacies, order the medication and, if not in stock, pick it up on a second visit. Further, they have to be aware of taking multiple medications with the right doses at the right time. Finally, they must remember to obtain new medications before they run out of their existing ones. Following a human-centered approach, Pillpacks' business model consists of personalized, pre-sorted medication—shipped to the patients' doorstep—paired with a proactive refill management. This all becomes possible through communication with the respective doctors and insurance companies. Keeping the human touch, Pillpack offers a 24/7 phone support where pharmacists answer questions patients might have with regards to their medication, insurance, and doctoral prescriptions. Their revenue model is based on a monthly subscription fee.

Checklist for the Initiation Phase
- Observe with a child's eye. Make yourself free from existing beliefs.
- Ask "why?" and "why not?" questions.
- Instead of using highly specified questionnaires and approaching thousands of people, it is more valuable to find the right people, who do something different and concentrate on them. Typically, they are not key customers or closest partners, as those will only confirm what is already known.
- Building empathy and connecting to what the people feel will reveal their latent needs.

Design Thinking Within Ideation

The center of the ideation phase is the generation of new ideas to tackle the design problem identified in the initiation phase. Design Thinking does not offer a compilation of creativity methods automatically producing great ideas when applied. The additional value of Design Thinking in the ideation phase lies in

complementing these methodological approaches by drawing innovators into a creative state of mind. It is all about teamwork, leadership, and innovation culture. Innovation is a team sport; great ideas evolve only when teams work together with creative confidence and optimism (Brown 2009).

In contrast to the traditional idea funnel, where a great number of ideas are developed, continually selected and reduced to a few by following stage-gate processes (Cooper 2008), the Design Thinking process "looks like a rhythmic exchange between the divergent and convergent phases, with each subsequent iteration less broad and more detailed than the previous ones" (Brown 2009, p. 68). In other words, the process of Design Thinking iterates *multiple* times between generating a variety of new ideas from existing information—divergent thinking—and the logical deduction to a unique solution—convergent thinking (Schar 2011).

A Design Thinking coach usually supports in these multiple iteration cycles until the team feels confident enough to have generated suitable ideas to meet the design challenge. Schar (2011) shows empirical evidence, that "divergers" and "convergers" share more information for group decision making and also share this information earlier, when coached by a pivotal thinking team leader. This experience has been confirmed in numerous business model ideation sessions; when coached professionally by an experienced pivotal thinker, the team is better able to change modes from divergent concept creation for new business models and convergent synthetized concept selection. Timing and iteration cycles have to be managed by cross-industry experienced team leaders in order to maximize project effectiveness.

Team members, as well as team leaders, should be aware of the cognitive abilities of the idea generating team and can use people-centric tools to encourage constructive discussion about ideas. Kelley and Littman (2006) propose ten fictional cognitive roles that people can adopt and play when discussing new ideas. These can be grouped in three categories: anthropologists, experimenters and cross-pollinators depict learning personas, who continuously strive for new ideas outside the firm's current beliefs and views to explore new insights and to break out of the firm's dominant-logic. The organizing personas comprise the hurdlers, the collaborators, and the directors. Their primary goal is to push ideas forward by getting management attention, resources, and align firm politics. The third group of personas is represented by the building personas. The experience architect, the set designer, the caregiver and the storyteller all share an ability to orchestrate insights and the power of learning and organize personas to achieve innovation. Playing certain personas allows innovators not only to identify potential customers and their needs, but also encourages them to create and follow their ideas with confidence and push them forward. Most important, the persona technique strengthens the power of innovators to team up and argue against naggers, who constantly criticize young ideas and are present in almost every innovation project.

When it comes to selecting the most promising ideas, Design Thinking recommends a counterintuitive method, known as the "Dark Horse" approach (Leifer 2012). It is important not to go for the most obvious business model solution.

Checklist for Ideation
- Create many choices to find the breakthrough idea.
- Iterate multiple times between convergent and divergent thinking.
- Prevent premature closure.
- Instead of judging the ideas of others, it is important to build on them to push them forward.
- Using personas can cultivate an innovation spirit in the team.
- Pivotal thinkers as team leaders are able to manage representational gaps between team members.
- Being optimistic and confident during the ideation phase is important, as it triggers the exchange of radical ideas.
- Following the Dark Horse approach means going for the game changer. The most obvious solution often is not the most innovative one.

Design Thinking Within Integration and Implementation

Once innovative business model ideas have been created and choices have been made to focus more deeply on certain ones, further elaboration and integration begins. Design Thinking emphasizes that the biggest mistake, at this stage, would be to optimize one preferred idea using linear steps—steps that lead towards direct implementation. Meinel and Leifer (2012) argue that Design Thinking is not an ideation challenge; it is a synthesis challenge. Their research suggests that linear steps could only be recommended if the innovation team were convinced they had found the right idea.

However, the preferred idea generated during ideation depicts rather a solution space than the solution per se. Multiple prototyping iteration cycles are needed to test, refine, and further elaborate on the idea to reduce uncertainty. Figure 3 portrays Meinel and Leifer's (2012) hunter-gatherer model with point A as the starting point and point B as the dark horse idea.

The model shows that Design Thinking is a prototype-driven approach. Prototyping intangibles, like business models, is extremely challenging; but once achieved, it gives the business model idea a shape, supports understanding and communicating it, and enables to receive valuable feedback. Brown (2009) highlights the importance of shifting from abstract to physical and back, which unlocks imagination, thus strengthening exploration. He recommends various ways of prototyping intangibles—from drawing rough sketches, using post-its, to acting out different business model scenarios as skits. Role-plays add value, as they help innovators build empathy to all business model participants. Another recommended way to make business models tangible is to develop whole "customer journeys", where a fictional customer is taken through all stages of a new business model scenario; from the first interaction with the respective company through all relevant "touch points" to experience the value of the innovative business model.

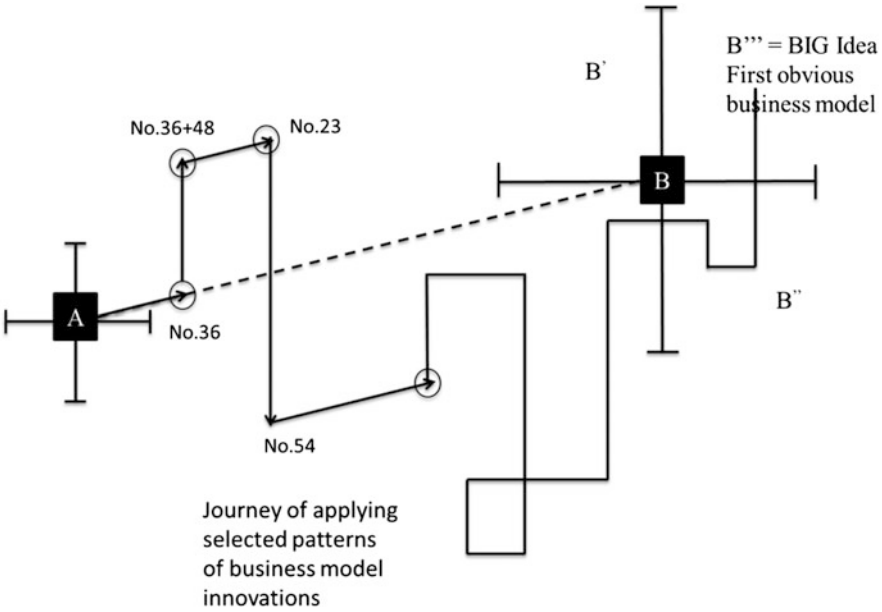

Fig. 3 Hunter-Gatherer Model from Meinel and Leifer (2012) for business model innovation

Rough sketches and rough prototypes lead towards paradigmatic changes, while models with a high level of resolution drive only parametric changes, as Edelman and Currano (2011) point out. Design thinkers can use different media to frame discussion and lead a design strategy. Rough sketches and rough prototypes (ambiguous media) encourage divergent conversations with many possible changes, while high-resolution process models and CADs (mathematized media) encourage convergent discussions that tend to produce small changes. The underlying argument is that the use of different media implies different levels of design idea completeness, triggering different kinds of feedback.

Design thinkers can also use both ambiguous and mathematized media together in so-called hybrid media models, where rough sketches are combined with photographs, drawings, and text. Hybrid models allow for flexibility in exploring the relationships of different elements with each other. Design thinkers can use this framework to guide conversations, depending on how confident they feel about their idea, what kind of feedback they are requesting and how they want to communicate their concepts.

Checklist for Integration

– Don't integrate decision makers only in the first stages of the project. They should have physical interaction with potential customers and receive first hand prototyping feedback.

- Do not over-invest in high-resolution prototypes in the beginning. It will trigger only incremental feedback and you will resist critical feedback, because you have already put too much effort in the prototype. Thus: prototype quick and dirty.
- Iterate multiple times during the integration phase. Design Thinking is not an ideation challenge; it is a synthesis challenge. The initial idea from the ideation phase will change during integration.
- Be open to critical feedback. Multiple iterations should be considered as positive.
- Use different media depending on how you want to lead the discussion. Use rough sketches and rough prototypes for divergent discussions and more sophisticated models for convergent conversations.
- Be a hunter and gather information about the idea.
- Make use of different prototyping ways, by acting models out and creating customer journeys. It is important that customers experience the new concept.

Summary

The Design Thinking approach has added a significant value to the Business Model Navigator in multiple ways. Practice in business modeling has been multiplied by applying Design Thinking elements.

First, during the initiation phase of the Business Model Navigator, the status quo business model is described, change drivers are identified, and the business ecosystem is analyzed. The human-centered Design Thinking approach sharpens the perspective of the business model innovation team by observing the customer and building empathy. Synthesizing these manifold data sources helps to uncover latent customer needs, to clarify the change problem and to formulate the design challenge.

Second, in the ideation phase, the Design Thinking approach enhances the Business Model Navigator by complementing the pattern confrontation method through enhancing creativity with a pivotal thinking team leader. The pivotal thinker is able to guide the team, iterating multiple times through divergent idea creation phases and convergent deducting to single solutions. Further, he can close representational gaps that emerge because of team members' differing problem solving styles based on their cognitive capabilities. This positively impacts teamwork, innovation culture, optimism and creative confidence. Furthermore, Design Thinking offers the use of ten fictional innovating personas that team members can adapt and play, which encourages them to create ideas and push them forward with confidence. For idea selection, Design Thinking offers the dark horse approach, that departs from traditional large corporation management thinking and represents a fundamentally different way of selecting ideas.

Finally for integration, Design Thinking advances the Business Model Navigator by recommending rapid prototyping of business models, testing them against reality

and learning from the feedback for multiple redesign phases until uncertainty is reduced to a level where the company feels confident about launching the new business model. Design Thinking also gives advice on which media to use for prototyping and how to use it to receive the type of feedback (incremental/radical) needed.

Business Model Innovation and Design Thinking are two approaches that share many similarities. The Business Model Navigator has integrated the core elements of Design Thinking and applies them over all phases of the business model innovation process to design and implement innovative business models.

References

Brown T (2009) Change by design. Harper Collins, New York

Chesbrough H (2010) Business model innovation: opportunities and barriers. Long Range Plan 43 (2–3):354–363

Cooper RG (2008) Perspective: the Stage-Gate® idea-to-launch process-update, what's new, and NexGen systems*. J Prod Innov Manag 25(3):213–232

Edelman J, Currano R (2011) Re-representation: affordances of shared models in team-based design. In: Plattner H, Meinel C, Leifer L (eds) Design thinking. Understand—improve—apply. Springer, Berlin, pp 61–79

Fixson SK, Rao J (2014) Learning emergent strategies through design thinking. Des Manag Rev 25 (1):46–53

Frankenberger K, Weiblen T, Csik M, Gassmann O (2013) The 4I–framework of business model innovation: a structured view on process phases and challenges. Int J Prod Dev 18(3):249–273

Gassmann O, Frankenberger K, Csik M (2014) The Business Model Navigator: 55 models that will revolutionise your business. Financial Times Publishing, London

Kelley T, Littman J (2006) The ten faces of innovation: IDEO's strategies for defeating the devil's advocate and driving creativity throughout your organization. Random House LLC, New York

Leifer LJ (2012) Talk at the inauguration of the engineering courses for the academic year 2012/2013 at the University of Modena and Reggio Emilia. http://www.youtube.com/watch?v=VhzrxPgDHbY. Accessed 28 Jan 2015

Leifer LJ, Steinert M (2011) Dancing with ambiguity: causality behavior, design thinking, and triple-loop-learning. Inf Knowl Syst Manag 10(1):151–173

Leifer LJ, Steinert M (2014) Dancing with ambiguity: causality behavior, design thinking, and triple-loop-learning. In: Gassmann O, Schweitzer F (eds) Management of the fuzzy front end of innovation. Springer, Cham, pp 141–158

Meinel C, Leifer L (2012) Design Thinking Research. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research. Measuring performance in context. Springer, Berlin, pp 1–10

Schar MF (2011) Pivot thinking and the differential sharing of information within new product development teams. Dissertation, Stanford University

Teece DJ (2010) Business models, business strategy and innovation. Long Range Plan 43 (2–3):172–194

Design Thinking in IS Research Projects

Mindset and Toolset Perspective

Mateusz Dolata and Gerhard Schwabe

Abstract Many see the primary impact of Design Thinking in the area of industrial innovation. Given the engineering background of the methodology, this is definitely the most straightforward approach, with its practice-oriented nature. We claim, however, that Design Thinking—defined as the mindset as well as the toolset—can significantly contribute to the success of academic research in the Information Systems area. While building on the notion of inquiry from a philosophy of science, as well as the concept of a mindset from psychology, we offer an extended view of Design Thinking as a malleable paradigm. We argue that implementing Design Thinking phases in Information Systems research projects will contribute to a better traceability and understanding of the creative processes, as well as to the credibility of their results. We postulate that Design Thinking will also contribute to new findings, thus leveraging the knowledge contribution. We, provide proven and tested practical guidance on how Design Thinking can be embedded in research projects. While this paper primarily addresses an academic audience, practitioners and facilitators in the field of Design Thinking may benefit from a philosophical perspective on this paradigm.

Keywords Information Systems • Design Thinking • Mindset vs. Toolset • Design Science Research • Modes of Inquiry • Scientific Method

Introduction

In most general sense, research done in academia is committed to making scientific inquiry about the universe, thus addressing the natural world, as well as society and the world of formal abstraction. Science is a goal-oriented and systematic undertaking, which explains things and provides predictions, as well as building and organizing knowledge about them (Longino 1983; Wilson 2000). Consequently,

M. Dolata (✉) • G. Schwabe
Department of Informatics, University of Zurich, Binzmühlestrasse 14, 8050 Zürich, Switzerland
e-mail: Dolata@ifi.uzh.ch; Schwabe@ifi.uzh.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_5

scientific activities of previous generations, as well as the progress made today, contribute to the emergence of a massive knowledge base. According to written records, Bernard of Chartres already introduced the notion of a giant in the twelfth century to describe this construct that has survived generations and even civilizations. Following this allegory, scientists are merely dwarfs sitting on the shoulders of this giant; they benefit from this position and can see more than their predecessors (McGarry 1962; Merton and Bowen 1965). Thus, it is the obligation of each generation of scientists to contribute to the growth of this giant in a sustainable way, primarily through providing true, solid, and substantial explanations and predictions about the universe. Even though philosophy makes efforts to provide unified criteria for the quality of scientific contributions (Wilson 2000; Kuhn 1970b; Hansson 2014; Popper 2014; García 2006), the tradition of particular disciplines and research communities plays an equally important role.

Given the above background, Information Systems (IS) is a specific field of scientific research. The definition of its domain encompasses the development, use and application of Information Systems by individuals, organizations and society as a whole (Baskerville and Myers 2002). IS touches all areas of life and work in a world penetrated by ubiquitous information and communication technology (ICT). Bernroider et al. (2013, p. 74) describe the IS discipline through its primary (but not the only) focus, pointing to the understanding and improving of "how sociotechnical systems comprising technical and human components or sub-systems gather, process and present data, information and knowledge to users, particularly in the context of an organizational workplace". Similar descriptions of IS's domain recur across philosophical discussions within the field (e.g., Benbasat and Zmud 2003; Gregor 2006; Klein and Hirschheim 2008). Notably, while the elaborations confirm the necessity of explaining and understanding this phenomena, they also stress the role of improvement in human condition following successful IS research (Ngwenyama and Lee 1997), thus stressing the engineering character of research done in this field. Additionally, IS is characterized as a discipline that regularly crosses the borders to other fields of scientific inquiry, thus building upon and extending not only its own knowledge base but also those of related disciplines, including, among others, engineering, computer science, marketing, and economics (Baskerville and Myers 2002). The improvement of human condition and the trans-disciplinarity form an intersection between IS and approaches oriented at innovation in the professional world outside academia.

Design Thinking also crosses boundaries between academia and industry. It is an innovation paradigm originating in the academic world, where it was conceptualized as a teaching methodology in the area of mechanical engineering (Carleton and Leifer 2009; Johansson-Sköldberg et al. 2013). Approaches inspired by Design Thinking quickly found their way to industry and were applied to solve practical problems (Johansson-Sköldberg et al. 2013; Brown 2008; Brenner and Witte 2011). Successes of consulting firms, like IDEO, popularized this methodology. Design Thinking is, among others, discussed in the context of improvements in the software development processes (Kowark et al. 2014), IT industry in general (Lindberg et al. 2011, 2012), as well as in the modeling of business processes

(Luebbe and Weske 2011, 2012). In terms of its quality criteria, Design Thinking refers to three basic factors of a successful innovation: desirability, feasibility, and viability, as described by IDEO (Jones and Samalionis 2008; IDEO 2009). However, these features are bound to a particular problem or need and are not extendable beyond the context of a project. While adhering to these boundaries, Design Thinking aims at covering all degrees of innovation, including incremental and substantial changes with special focus on the development of radical or even disruptive ideas (Brown 2009). This paradigm can be considered from the perspective of a mindset and a toolkit. In the former view, it focuses on values and general character ascribed to the design process; in the latter, the process and proposed methodologies stand in the center. Nevertheless, a notion of a general and true knowledge base does not exist in either of these approaches. Consequently, findings made within a Design Thinking project hardly ever leave its very limited, particular context.

At first glance, Design Thinking and scientific inquiry, even when sharing some tools, like methods of enquiry, have little in common, particularly if the mindset perspective is considered. Given these incompatibilities, specifically the missing traceability of results in a Design Thinking project, one may question the sense of considering these two tendencies in one paper, or even directly disclaim the idea of combining the two. So, why shall we bother about compatibility of Design Thinking and scientific research, in particular in the field of IS?

The answer to the above question has a twofold character. First and foremost, science relies on novelty. In the discourse on the differentiation of science from other modes, multiple norms were proposed and questioned, including truth, generalizability, or falsifiability; novelty seems to adhere to scientific inquiry (Hansson 2014). Einstein and Infeld (1966, p. 92) characterize this as follows: "To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science." Design Thinking offers means to meet these requirements: it opens the floor for the problem redefinition, allows for deep and broad search for solutions and values creativity more than objectivity.

The second factor that makes Design Thinking interesting for scientists is the practice of research in today's academia. In 1877, Peirce already proposed a pragmatic view on scientific inquiry. Following his notion of human reasoning, he described inquiry as attempts to eliminate problems, doubts, and dissatisfaction related to them, and replace them with a satisfactory and calm belief that one can act upon (Peirce 1931a, b). In doing so, he criticizes the view that science is the ultimate search for fundamental truth. He characterizes scientific inquiry as one method for settling a belief, which, in particular, is aware of its imperfection and imposes control steps to increase the accuracy of its findings. Almost 100 years later, Kuhn (1970a, b) proposed another pragmatic view of science; he stressed the fact that primary activities of scientists focus on solving particular problems ("puzzle-solving") rather than testing of fundamental theories (Hansson 2014). Peirce's and Kuhn's perspectives on scientific inquiry, even though considered largely independent of each other (Rosenthal 1994), stress the problem-solving

aspects of research. Consequently, they open space for design-oriented approaches to general inquiry, including Design Thinking, and give more credibility to the improvement of human condition, through ICT as in IS.

In this article, we discuss in more detail how Design Thinking as a problem-solving approach with strong focus on the novelty can empower scientific inquiry as a process of search for solutions to irritations and doubts. We take a practical view on research defined through researchers' practices in academia: from state-of-the-art analysis, through definition of a gap (problem to solve/phenomenon to study), proposition of a solution, empirical experiments or testing, to contributions to the knowledge base in form of theories, models, and explanatory statements. We argue that Design Thinking can be applied to complement this process and improve research results. In the following, we ask how this can be enabled in the context of IS research projects.

Twofold Character of Design Thinking

Design Thinking changes the perspective on how people perceive things. First, through a shift in the mindset, it changes priorities and retracted courses of thoughts; it introduces new points of view to the process of reasoning. Second, through consequent application of different techniques inspired by the work of designers and innovators, practices of people involved also change. This synergy of the general approach and particular activities is central to Design Thinking (Leifer and Steinert 2014). This article builds upon the description of Design Thinking through the mindset it promotes and through the toolkit it offers.

Design Thinking as a Mindset

Whoever sees Design Thinking applied in a real work, either in a university course (Carleton and Leifer 2009), in middle school classes (Carroll et al. 2010), or in business (Drews 2009), realizes that the spirit of this paradigm lies not in the set of tools it provides, but rather in the mindset it imposes. Mindset refers to the set of cognitive and motivational states associated with frames of mind in specific situations, e.g., before or after making a decision (Armor and Taylor 2003; Gollwitzer et al. 1990). In common terms, we may consider it to describe the set of assumptions that makes a person or a group adapt to or accept particular choices, behaviors, course of action, or tools. A mindset of a person or group can change over a short-term and in a long-term perspective. In particular, for individuals, it has been shown that mindset can be "manipulated", simply by asking people to conduct a specific task, e.g., decide between two alternatives, or plan an activity (Armor and Taylor 2003; Gollwitzer et al. 1990; Taylor and Gollwitzer 1995). Furthermore, research provides evidence that mindset manipulated with such techniques influences the

subsequent activities (Armor and Taylor 2003) and attitude (Taylor and Gollwitzer 1995); people who are primed to focus on planning execution of activities (implemental mindset) see the world differently than those ones who are primed to make a decision (deliberative mindset).

On one hand, individuals oriented to implementation of activities perceive the world in a more affirmative way, while also tending to overestimate their self-perception and develop illusions of control (Taylor and Gollwitzer 1995; Gollwitzer and Kinney 1989). On the other hand, those who are primed to elaborate on decisions are more open to information from outside and process it in an impartial fashion (Heckhausen and Gollwitzer 1987; Beckmann and Gollwitzer 1987). We argue that the construction of a *Design Thinking mindset* relies exactly on the adequate balance of these two tendencies. Design Thinking has elements of deliberate reasoning on the available alternatives, while clearly promoting implementation over pure decision taking. This is in line with the idea of reflection-in-action that brings together the thinking and the doing. Notably, the mindset-building character of Design Thinking is often used in its promotion and described as the integrative part of the paradigm, in particular by the Stanford d.school (Rauth et al. 2010). This specific mindset is imposed both by the general framing of a Design Thinking project and by the short-term goals and activities.

In terms of the overall framing offered by Design Thinking, one needs to stress the following elements that contribute to the Design Thinking mindset (Rauth et al. 2010): First, Design Thinking strives for *radical innovation* to answer wicked problems—the novelty of ideas and the envisioning of their implementation are the highest goals of a Design Thinking project in various contexts, thus requiring a large portion of creativity. Second, Design Thinking projects guarantee the relatively high *freedom of choice* given to the involved teams—they should consider and assess many alternatives and deliberate on them. Third, Design Thinking emphasizes the *human-centric* character, along with the *empathy* that the designers develop towards their subjects—which mainly results from the intensive need finding done through investigative activities, as well as implementation of prototypes that focus on single critical functions. Fourth, Design Thinking promotes a *culture of prototyping*—it forces the teams to plan their actions and provide an embodied experience to their target group, thus focusing on implementation. Fifth, *open feedback* is necessary to allow for improvement of ideas—this holds for constructive criticism within the team, as well as collection of opinions from target users; it makes alternative ways clear and leads to deliberation. While all those elements contribute to the novelty of solution obtained through application of Design Thinking, freedom of choice and culture of prototyping are, in our opinion, those that, in particular foster creativity. Assessing alternatives and finding out why particular solutions do not work implies creative analysis, thus imposing deliberative mindset. Conceptualizing and planning new prototypes implies creative synthesis, thus imposing implemental mindset. In that sense, creativity is inherent in various elements of Design Thinking mindset and is supported by tools available in this paradigm.

The list provided above does not, of course, approach all elements of the culture promoted in d.schools and similar institutions. It does, however, show that Design

Thinking incorporates the two mindsets described above. It promotes activities and attitudes that put teams into deliberation and others that lead to implementation.

At first glance, the *scientific mindset* may seem radically different. For many, scientific inquiry means reasoning, questioning, and considering alternatives, thus inducing the deliberative mindset. This may hold, in particular, if one considers the classic, philosophical, and truth-oriented perspective on scientific enterprise. The pragmatic view on science, however, unveils a different nature of research, as a paradigm oriented toward envisioning new possibilities that result from the scientific findings. Consequently, science can also evoke the implemental mindset. Particularly in the IS, both mindsets are necessary to address practical problems encountered when humans and computers are considered. Nevertheless, even in the design-oriented IS research, the deliberative mindset receives more attention. Frameworks like the design science research (DSR) (Hevner et al. 2004; Peffers et al. 2007) extensively discuss the deduction of design principles and their formulation, while offering relatively little guidance on solution implementation (e.g., Pries-Heje and Baskerville 2008; Jones and Gregor 2007; Gregor et al. 2013). Thus, the *Design Thinking mindset,* along with the values listed above, may contribute to the IS while complementing the scientific one, so that the positive qualities of an implemental mindset can further enhance scientific inquiry and lead to novel findings.

Design Thinking as a Toolset

Despite the values underlying the Design Thinking mindset, specific activities conducted as part of the process are also characteristic for this paradigm. Design Thinking uses a process model relying on a sequence of divergent and convergent phases. Different versions of the process exist; comparing or event describing them is outside the scope of this paper, but all of them stress the interactive character of design activities (Leifer and Steinert 2014; Rauth et al. 2010). Every iteration consists of alternating activities that either extend the space of possible solutions (divergent thinking) or limit it (convergent thinking). This is one of the basic tools used in Design Thinking and is often considered the basis of the methodology and the Design Thinking practice (Thoring and Müller 2011).

With regard to other tools employed in the Design Thinking, this paradigm borrows a lot from the methodology of scientific inquiry. Most research done within Design Thinking projects uses ethnographic methods such as interviews and observations. Similarly, testing methods resemble those employed, e.g., in the human-computer interaction field of informatics. Many other methods described in the handbooks of Design Thinking (e.g., IDEO 2009) do not differ in the technical sense from the ones applied by scientists around the world, particularly for explorative research.

The actual difference is, however, imposed by the Design Thinking mindset as described above. Whereas scientists employ those techniques to ensure objectivity

of their results, Design Thinking encourages subjective empathy with the user. Whereas scientists focus on contributions that can be easily delimited and described in detail, Design Thinking promotes radical innovation that changes far more than one single factor. Whereas scientists try to frame and present the problem they address as well structured, Design Thinking claims to tame wicked problems (Lindberg et al. 2012). Still, the necessity to communicate ideas and findings to the outer world is characteristic for Design Thinking and for science. Here, however, they clearly differ in the tools they use and activities they conduct. In science, communication happens primarily through publication of generalizable theories or falsifiable statements. Design Thinking uses, among others, embodiment of experience, a technique unthinkable in scientific enterprise, as one of the channels to communicate ideas (Sirkin and Ju 2014; Donati and Vignoli 2014).

Even though the scientific and Design Thinking toolsets share a great deal, we argue that it is not the similarity of tools that makes Design Thinking valuable as a complement to the scientific inquiry in the IS field. Tools, even if similar, differ strongly with regard to the rigor of their application; in academic research, the latter enhances the credibility of the results, in Design Thinking it may be an unnecessary overhead. Consequently, Design Thinking as a toolset cannot be seen as a way to conduct research projects. However, we argue that Design Thinking can play an important role in complementing and supporting particular research project activities, like identification of the research gap or the solution objective in DSR projects. In the following, we show how Design Thinking was proposed as a complementation in a number of industrial branches. Later, we discuss how academic IS research can benefit from including Design Thinking.

Application of Design Thinking Across Domains

Previous research has extensively described the role of Design Thinking in a wide range of areas, including education (Carleton and Leifer 2009; Dym et al. 2005; Jobst et al. 2012), management (Skogstad and Leifer 2011; Currano et al. 2012), software engineering (Kowark et al. 2014) or, the IT industry in general (Lindberg et al. 2011, 2012), just to mention the most prominent cases. Findings described in the relevant literature argue for use of Design Thinking in those areas as a way of, e.g., improving the early phases of an IT project to specify requirements and develop the overall concept (Lindberg et al. 2011), or to enhance the customer-centric character of an enterprise (Leavy 2012), thus supporting the transformation of a marketing model toward the service-dominant logic (Edman 2009). Simultaneously, existing research reports on particular problems in communication across organizational boundaries (Skogstad and Leifer 2011) or implementation difficulties (Lindberg et al. 2012). Notably, much of the discussion concerns areas related to the domain of IS: software engineering and management science. We argue that, from there, only a small step is necessary to position Design Thinking as a valuable element of IS research in academia.

Literature often discusses Design Thinking in the context of IT development (Kowark et al. 2014; Lindberg et al. 2011, 2012; Gabrysiak et al. 2011; Steinert et al. 2012; Steinert and Hirschfeld 2012; Hildenbrand and Meyer 2012; Häger et al. 2015). It describes various benefits that Design Thinking may offer to the software industry, including better understanding of needs, problems, and project targets (Lindberg et al. 2011), improvement of communication during development work and better process traceability (Steinert et al. 2012; Steinert and Hirschfeld 2012), more effective involvement of end-users during implementation phase (Gabrysiak et al. 2011) and smooth linking between the requirements and ideas through story telling (Hildenbrand and Meyer 2012). It provides evidence for overlaps between Design Thinking and primary concepts used in software engineering, such as agile development (Kowark et al. 2014), lean development (Hildenbrand and Meyer 2012), or even more traditional strategies like waterfall (Lindberg et al. 2011, 2012). Whereas lean thinking or agile methods share central elements of their respective mindsets with Design Thinking (Hildenbrand and Meyer 2012; Häger et al. 2015), particular phases of waterfall models, like requirements elicitation, can be well supplemented or equipped with Design Thinking toolset (Lindberg et al. 2011). We argue that the described applicability of Design Thinking in numerous roles in IT development results from the malleability of this paradigm; it may rule the whole process and it may be reduced to a single phase, it may define the overall mindset or it may be seen as a break out from the otherwise dominant implemental mindset and it may provide a single tool like story telling, or adapt tools from other domains.

Another stream of research positions Design Thinking within managerial sciences and discusses its positive impact (Luebbe and Weske 2011, 2012; Skogstad and Leifer 2011; Currano et al. 2012; Leavy 2012; Edman 2009; Edelman et al. 2012; Schindlholzer et al. 2011; Vetterli et al. 2012, 2013). It describes Design Thinking as an potentially important factor in the transformation of existing testing and evaluation practices (Skogstad and Leifer 2011), in the improvement of communication and reflection activities (Currano et al. 2012), in the change of prior processes through tangible modeling (Luebbe and Weske 2011, 2012) and in promoting small, flat teams as a valuable structural unit in organizations (Edelman et al. 2012). Existing case studies provide evidence for considerable changes in multiple organizational aspects: processes, methods, work context, environment, team management and project setup were all impacted by application of Design Thinking in the financial industry (Schindlholzer et al. 2011; Vetterli et al. 2012, 2013). This shows how massive the potential of paradigms like Design Thinking can be, if applied in settings other than education or engineering. Consequently, when considering application of Design Thinking in domains only loosely related to those above, a particular framing should be provided to restrain unwanted effects and foster those desired: transformation of some areas may positively influence the enterprise, while changes in others may cause irreparable damage. In case of scientific inquiry in IS, it is particularly important to protect the scientific rigor and credibility of the findings to be able to communicate the results to other researchers. As communication poses one of the essential practices in science,

one must guard the influence of Design Thinking accordingly. Setting a frame for a research project in an adequate way is, however, a valuable effort, given the potential contributions of Design Thinking.

Science by Design in IS

Given the above discussion, Design Thinking can be considered a holistic paradigm for problem solving (Rauth et al. 2010; Vetterli et al. 2011). It provides a specific toolset and imposes a particular mindset. Even though there are overlaps with scientific mindset and some research methodologies applied within the IS field, priorities differ between those paradigms, so that neither are exchangeable, nor directly compatible, particularly if science is taken in its classic meaning as a search for truth. We argue that, if we consider it in a pragmatic perspective through the Design Thinking-typical practices, activities, and procedures, then this paradigm contributes to the success of scientific inquiry. It may support the novelty of the findings and the emergence of an adequate, open mindset. As Design Thinking is malleable and since IS possesses a set of rules on how to conduct research projects, it is possible to combine those two approaches, at least on the conceptual level. In the remainder of this paper, we discuss how to frame research projects in the field of IS to benefit from the incorporation of Design Thinking.

Notably, all examples of successful Design Thinking implementation in business rely on practical application of knowledge and collection of specific, context-dependent information. However, as discussed earlier, the key duty of science in academia is the generation of new knowledge and communication to the audience that may benefit from it. Impactful findings are transferable to many other disciplines and thus form the basis of the "giant" we introduced earlier. Findings obtained from a Design Thinking project are mostly limited to a very narrow context. Even if novel or surprising, such results would find only a small audience and little attention. This is because Design Thinking addresses the level of particular and concrete facts deliberately, while scientific inquiry strives for abstraction, completeness and reflection. This dilemma shows that communication of insights is, indeed, central to the scientific enterprise and is the origin of many of the rules to be followed in research. In the IS community, communication of results requires a specific rigor; contributions must reach a specific level of theoretical maturity to be considered valuable.

Gregor (2006, 2002) discusses the topic of theory building in IS research and provides a taxonomy of IS theories. In her studies, a theory is used to understand the world, accumulating knowledge about particular sets of phenomena (Gregor 2002). Accordingly, she provides a set of components to be included in IS theories (Gregor 2006). She argues that a theory commonly consists of the following: (1) a physical representation, e.g., words or diagrams, (2) a set of well-defined constructs or phenomena, e.g., observational terms or theoretical terms, (3) a set of statements of relationship among the constructs, e.g., association or composition, (4) a defined

scope to describe the generality of the theory. Additionally, a theory may provide causal explanations that link the phenomena to every other testable proposition, so that identified relationships between constructs can be evaluated and prescriptive statements issued specifying how people can reach a point in practice. Based on the description of a theory according to the above criteria, a classification in one of the following classes will be possible: analysis, explanation, prediction, explanation-and-prediction, as well as design-and-action (Gregor 2006).

Design Thinking focuses on particular solutions to particular problems. Of course, it deals with real world phenomena or connections between them, and when reframing the problem iteratively, may contribute to their understanding, but within a very limited scope. It also promotes use of physical representations to address the problems, but the constructs to which the physical representations correspond are mostly specific entities in a predefined context [real units according to Dubin (1978)], not things of purely abstract character [nominal units (Dubin 1978)]. In Design Thinking, complex problems are reduced to specific situations to enable embodied cognition and experience, whereas an IS researcher tries to identify particular constructs and understand or establish the mechanics behind them. Those insights are then communicated to the outer world. When we see communication of results as an inherent goal of IS inquiry and acknowledge the fact that it governs how research will be done, we arrive at the following conclusion: if Design Thinking is used in an IS research project, it is the construction of the research project that will guarantee that the results of Design Thinking will positively influence the overall goal of research, indirectly or directly flowing into the publication of results.

Given the above reasoning, we assume that certain specific steps will be taken within research projects to incorporate Design Thinking, either as a mindset or as a toolset. In the following, we discuss those steps. We will first approach the question of how IS can benefit from including Design Thinking in research projects. Later, we will discuss how to assure that the obtained results can still be published and accepted by the IS community.

Bringing Design Thinking to Science

The beginnings of scientific activities had their roots in ancient Greece, starting with great philosophers like Aristotle, who broke the ground for scientific inquiry. The way science proceeds has changed a great deal since then. Nevertheless, as discussed earlier, novelty of an insight, e.g., a novel construct or a previously unknown relationship between constructs, as in Gregor (2006), is almost inevitable to be considered valuable in a scientific community. Finding this new thing is a highly creative task, whether discovering a phenomenon, a previously undescribed problem, or a systematic solution to a problem. Straightforward deduction or induction from an existing body of knowledge or available data is often considered too mundane to attract attention. Only when deduction or induction involves an

unusual step or establishes a previously unconsidered, but far-reaching, relationship between facts, does it meet the criteria of scientific relevance. Consequently, the novelty results from making a step in the process of reasoning that does not necessarily follow from the premises. It is like bridging a gap in reasoning, as described by Peirce (1931a, b). Today, this gap is often referred to as *creativity gap* (Gaut 2010).

In IS, this kind of gap occurs when a surprising or unknown phenomenon occurs and none of the available explanations covers this fact. Also, when an irritation or problem must be resolved, but no existing solution exists, a gap has to be bridged. According to Peirce, in such situations humans use the *abductive* inference, different from induction or deduction (Peirce 1931a, b; Wirth 1998). Abduction is often represented as the first and most important step of scientific inquiry: it embraces the selection and formation of a hypothesis in behavioral IS research (Wirth 1998), as well as the creative act of setting the design rationale in design-oriented IS research (Holmström et al. 2009). While the role of abductive reasoning, often compared to creative guessing, is obvious, its mechanism is not yet well understood; no existing artificial intelligence is able to automatically make creative guesses (Wirth 1998). Consequently, this step is not communicated in IS literature. Instead, we often find an extended explanation for the relevance and correctness of the hypothesis, with roots in the available literature or empirical data. The actual formation process of hypothesis or design rationale remains concealed and not traceable.

We argue that Design Thinking offers a way to improve this situation. First, it provides a process and methodology that structure the creative inference. Second, particularly in long-term projects, it generates a specific kind of tension—converging on a solution is deliberately delayed. Consequently, the process results in a large number of alternative designs or problem formulations, which are turned into prototypes and other artifacts. Those artifacts form a documentation of the project and turn the creative guessing into a partially traceable creative search. If a person returns to such project after it is finished, based on the available documentation and artifacts, he or she can reproduce the process. In particular, it is possible to study the rejected alternatives, reasons for rejection, and their features, and, eventually, avoid ineffective repetition of mistakes. Overall, Design Thinking answers the issue of the creativity gap, while providing not only means to bridge it, but also to reproduce the process and decisions involved in the act of bridging it.

Bringing Science to Design Thinking

Even though Design Thinking helps manage the novelty of the findings as well as the creativity gap, it does not suffice to account for a full contribution to the knowledge base. As discussed earlier, scientific rigor requires the findings to be positioned within the state-of-the-art; therefore, an extensive review of literature is necessary. Furthermore, the internal and external validity of the study must be guaranteed. Design Thinking promotes empathy and involvement, features that

may lead to a strong personal bias and cause systematic error—this may cause difficulties with regard to the internal validity. As explained earlier, the external validity of findings obtained through Design Thinking is problematic, as the projects focus mostly on particular cases and are limited to a predefined context. Checking for the correctness of the insights and solutions outside this scope is uncommon, at least in Design Thinking. Since those requirements are very important to scientific inquiry, a repertoire of means to address the validity issues includes, among others, independent experiments and evaluations, manipulation checks, reliability checks, etc. Yet another issue is the assessment and classification of the findings, which can be done in IS research through the assessment of knowledge contribution, as proposed, e.g., by Gregor and Hevner (2013). Design Thinking lacks means to answer these issues, typical for academic research; however, if embedded in a research project, it may positively influence its success, as discussed earlier. Therefore, we propose operationalizing research projects accordingly. In the following, we specifically discuss how to embed Design Thinking in design-oriented IS research.

Operationalizing Design Thinking in Design-oriented IS Projects

Nunamaker and Briggs (2012) distinguish three stages of design-oriented IS research projects: in the *proof of concept* stage, an idea is tested for the first time using a rapidly developed prototype. In the *proof of value* stage, researchers focus on how the new solution specifically creates value and how understanding of value creation process can contribute to existing theory. In the *proof of use* stage, researchers strive to maximize their innovation without support in the market environment, using a theoretical lens to study emerging challenges.

Since Design Thinking fits best in the proof of concept stage, we will now focus on that; both Design Thinking and proof of concept projects strive for novel solutions, typically apply prototyping and value evaluation of solutions with real users, while testing the general feasibility and desirability of the solution. Yet, Design Thinking changes the way proof of concept prototypes are developed. If IS research uses any methodology for designing and prototyping, it typically relies on human-centered methods, such as Scenario-Based Design (Rosson and Carroll 2002). To a large extent, these methods derive from creativity, in searching for solutions, and from empathy, in understanding user problems. Here, IS researchers can benefit from Design Thinking: they can embed a phase following the Design Thinking paradigm into their research project. This phase should typically start after a thorough review of both literature and state of the art. In a minimal proof of concept project, Design Thinking suffices to collect user needs. However, Design Thinking provides little rigor in user studies. Therefore, those user studies cannot be

published, as they cannot be considered as a contribution to knowledge on user problems in the scientific sense.

The Design Thinking mindset and toolset is not open to augmentation by traditional time-consuming methods on user studies and user evaluations. Researchers would experience cognitive dissonance while continuously switching between rigorous and latent thinking and in this mode, a single iteration could last too long. Thus, systematic user studies must be placed before or after the Design Thinking phase embedded in the research project; we propose running them afterwards—even after the evaluation. In doing so, the researcher may use the evaluation outcome to inform the tests and, consequently, prepare the proof of value phase. In summary, a possible proof of concept research project progresses through the following core phases: (1) scientific study of the state-of the art, (2) Design Thinking (with several iterations), and (3) scientific evaluation. These core phases are followed by preparations of contributions to knowledge. In this phase, researchers validate the problem statement using systematic user studies, abstract the design principles from the tested prototypical instantiations [this ex-post activity has also been proposed by Gregor and Hevner (2013)] and start theorizing.

This description leaves two issues open. First, *how can we evaluate without systematic user studies as a starting point?* We argue that in the proof of concept phase it is possible: prototypes in this phase are evaluated only in a very general manner. Thus, researchers can rely on general evaluation methods on user acceptance (e.g., Venkatesh et al. 2003), system usability (McNamara and Kirakowski 2006) or user satisfaction (e.g., Briggs et al. 2012). Furthermore, researchers should, possibly, rely on open and semi-structured interviews based on user feedback generated during the Design Thinking iterations.

Second, *how can we make best use of the Design Thinking results for IS research?* As discussed above, the Design Thinking process typically produces a far better documentation of the design rationale than traditional proof of concept prototyping. However, frequently the documentation is difficult to comprehend for outsiders. Thus we propose incorporating a *documentator,* who captures (e.g. with photos) key artifacts, structures them and provides the core content to a shared documentation pool (e.g., a Wiki). Progress in meeting documentation systems may, in the future, provide functionality that automatically captures and indexes the participants' contributions. This documentation could then be the starting point for both reflections on design principles and systematic user studies.

We want to finish with one important limitation: embedding Design Thinking in the proof of concept research requires more resources than traditional proof of concept research. First, the more thorough exploration of the design space requires more time for prototyping. Furthermore, Design Thinking works best with professional external facilitation. This external facilitation is expensive and may even be unavailable. Yet, this should not discourage researchers: we have benefitted from a Design Thinking phase as short as 1 day in our research projects and Ph.D. students (or even Master students) can provide at least a basic facilitation service to one another.

Conclusion

This article discusses the relation between Design Thinking and scientific inquiry in the IS field. While following the mindset and toolset perspective, it addresses differences and overlaps between the two paradigms, and points to potential advantages of combining them. Finally, it provides a set of practical clues resulting from our previous projects where Design Thinking was embedded in design-oriented IS research.

The primary audience for this article includes researchers in a many fields. Those who conduct design-oriented research and struggle with reporting on the creative processes should find here in-depth motivation and guidance for using Design Thinking in this context. In particular, younger researchers may benefit from learning about Design Thinking and IS through their comparison. Scientists interested in philosophy of IS should consider our assumptions on the compatibility of IS and Design Thinking (or similar methods) as a call to action. The issue of abductive reasoning in the scientific inquiry remains open and becomes particularly critical in the context of design-oriented IS research. Similar issues will probably occur in sciences with strong engineering background, such as in biotechnology, mechanical engineering, or architecture. Practitioners, such as the facilitators of Design Thinking, may consider the concept of mindset that we derive from psychology. It shows how activities and tools change the short-term mindset of individuals, and how such priming influences subsequent actions—this may be a useful factor to consider when designing curricula or preparing Design Thinking workshops. Finally, they should also gain inspiration to offer their facilitation skills to academia and scientists, thus extending their portfolio, until recently focused on teaching and industry.

References

Armor DA, Taylor SE (2003) The effects of mindset on behavior: self-regulation in deliberative and implemental frames of mind. Pers Soc Psychol Bull 29(1):86–95

Baskerville RL, Myers MD (2002) Information systems as a reference discipline. MIS Q 26 (1):1–14

Beckmann J, Gollwitzer PM (1987) Deliberative versus implemental states of mind: the issue of impartiality in predecisional and postdecisional information processing. Soc Cogn 5 (3):259–279

Benbasat I, Zmud RW (2003) The identity crisis within the IS discipline: defining and communicating the discipline's core properties. MIS Q 27(2):183–194

Bernroider EW, Pilkington A, Córdoba J-R (2013) Research in information systems: a study of diversity and inter-disciplinary discourse in the AIS basket journals between 1995 and 2011. J Inf Technol 28:74–89

Brenner W, Witte C (2011) Business Innovation CIOs im Wettbewerb der Ideen; mit der Methode Design Thinking. Frankfurter Allgemeine Buch, Frankfurt am Main

Briggs RO, Reinig BA, Vreede G-J (2012) The yield shift theory of satisfaction and its application to the IS/IT domain. In: Dwivedi YK, Wade MR, Schneberger SL (eds) Information systems

theory: explaining and predicting our digital society. Vol. 2, vol 29, Integrated series in information systems. Springer, New York, pp 185–217
Brown T (2008) Design thinking. Harv Bus Rev 86:84–92
Brown T (2009) Change by design. HarperCollins, New York, e-books
Carleton T, Leifer L (2009) Stanford's ME310 course as an evolution of engineering design. In: Proceeding of CIRP design conference. Cranfield University Press, Cranfield
Carroll M, Goldman S, Britos L, Koh J, Royalty A, Hornstein M (2010) Destination, imagination and the fires within: design thinking in a middle school classroom. Int J Art Des Educ 29 (1):37–53
Currano R, Steinert M, Leifer L (2012) Design loupes: a bifocal study to improve the management of engineering design innovation by co-evaluation of the design process and information sharing activity. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: studying co-creation in practice. Springer, Berlin, pp 89–105
Donati C, Vignoli M (2014) How tangible is your prototype? Designing the user and expert interaction. Int J Interact Des Manuf (IJIDeM) 9(2):107–114. doi:10.1007/s12008-014-0232-5
Drews C (2009) Unleashing the full potential of design thinking as a business method. Des Manag Rev 20(3):38–44
Dubin R (1978) Theory building, 2nd edn. Free Press, New York
Dym CL, Agogino AM, Eris O, Frey DD, Leifer LF (2005) Engineering design thinking, teaching, and learning. J Eng Educ 94:103–120
Edelman J, Agarwal A, Paterson C, Mark S, Leifer L (2012) Understanding radical breaks. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: studying co-creation in practice. Springer, Berlin, pp 31–51
Edman KW (2009) Exploring overlaps and differences in service-dominant logic and design thinking. In: First Nordic conference on service design and service innovation, Oslo, 24–26 November 2009
Einstein A, Infeld L (1966) The evolution of physics: from early concepts to relativity and quanta. Simon and Schuster, New York
Gabrysiak G, Giese H, Seibel A (2011) Towards next generation design thinking: scenario-based prototyping for designing complex software systems with multiple users. In: Meinel C, Leifer L, Plattner H (eds) Design thinking: understand—improve—apply. Springer, Berlin, pp 219–236
García CE (2006) Popper's theory of science: an apologia. Continuum, London
Gaut B (2010) The philosophy of creativity. Philos Compass 5(12):1034–1046
Gollwitzer PM, Kinney RF (1989) Effects of deliberative and implemental mind-sets on illusion of control. J Pers Soc Psychol 56(4):531
Gollwitzer PM, Heckhausen H, Steller B (1990) Deliberative and implemental mind-sets: cognitive tuning toward congruous thoughts and information. J Pers Soc Psychol 59(6):1119
Gregor S (2002) A theory of theories in information systems. In: Gregor S, Hart D (eds) Information systems foundations: building the theoretical base. Australian National University, Canberra, pp 1–20
Gregor S (2006) The nature of theory in information systems. MIS Q 30(3):611–642
Gregor S, Hevner AR (2013) Positioning and presenting design science research for maximum impact. MIS Q 37(2):337–355
Gregor S, Müller O, Seidel S (2013) Reflection, abstraction and theorizing in design and development research. Paper presented at the European conference on information systems, Utrecht
Häger F, Kowark T, Krüger J, Vetterli C, Uebernickel F, Uflacker M (2015) DT@Scrum: integrating design thinking with software development processes. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: building innovators. Springer, Switzerland, pp 263–289
Hansson SO (2014) Science and pseudo-science. Stanford encyclopedia of philosophy. http://plato.stanford.edu/entries/pseudo-science/. Accessed on 13 Mar 2015

Heckhausen H, Gollwitzer PM (1987) Thought contents and cognitive functioning in motivational versus volitional states of mind. Motiv Emot 11(2):101–120
Hevner AR, March ST, Park J, Ram S (2004) Design science in information systems research. MIS Q 28(1):75–105
Hildenbrand T, Meyer J (2012) Intertwining lean and design thinking: software product development from empathy to shipment. In: Maedche A, Botzenhardt A, Neer L (eds) Software for people. Springer, Berlin, pp 217–237
Holmström J, Ketokivi M, Hameri A-P (2009) Bridging practice and theory: a design science approach. Decis Sci 40(1):65–87
IDEO (2009) Human centered design: an introduction, 2nd edn. IDEO, Palo Alto, CA
Jobst B, Köppen E, Lindberg T, Moritz J, Rhinow H, Meinel C (2012) The faith-factor in design thinking: creative confidence through education at the design thinking schools Potsdam and Stanford? In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: measuring performance in context. Springer, Berlin, pp 35–46
Johansson-Sköldberg U, Woodilla J, Çetinkaya M (2013) Design thinking: past, present and possible futures. Creat Innov Manag 22(2):121–146
Jones D, Gregor S (2007) The anatomy of a design theory. J Assoc Inf Syst 8(5):1
Jones M, Samalionis F (2008) From small ideas to radical service innovation. Des Manag Rev 19 (1):20–26
Klein HK, Hirschheim R (2008) The structure of the IS discipline reconsidered: implications and reflections from a community of practice perspective. Inf Organ 18(4):280–302
Kowark T, Häger F, Gehrer R, Krüger J (2014) A research plan for the integration of design thinking with large scale software development projects. In: Leifer L, Plattner H, Meinel C (eds) Design thinking research: building innovation eco-systems. Springer, Switzerland, pp 183–202
Kuhn TS (1970a) Logic of discovery or psychology of research? In: Lakatos I, Musgrave A (eds) Criticism and the growth of knowledge. Cambridge University Press, Cambridge, pp 1–23
Kuhn TS (1970b) The structure of scientific revolutions, 2nd edn. Chicago Univ. Press, Chicago, IL
Leavy B (2012) Collaborative innovation as the new imperative—design thinking, value co-creation and the power of "Pull.". Strateg Leadersh 40(2):25–34
Leifer LJ, Steinert M (2014) Dancing with ambiguity: causality behavior, design thinking, and triple-loop-learning. In: Gassmann O, Schweitzer F (eds) Management of the fuzzy front end of innovation. Springer, Switzerland, pp 141–158
Lindberg T, Meinel C, Wagner R (2011) Design thinking: a fruitful concept for IT development? In: Meinel C, Leifer L, Plattner H (eds) Design thinking: understand—improve—apply. Springer, Berlin, pp 3–18
Lindberg T, Köppen E, Rauth I, Meinel C (2012) On the perception, adoption and implementation of design thinking in the IT industry. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: studying co-creation in practice. Springer, Berlin, pp 229–240
Longino H (1983) Beyond "Bad Science": skeptical reflections on the value-freedom of scientific inquiry. Sci Technol Hum Values 8(1):7–17
Luebbe A, Weske M (2011) Bringing design thinking to business process modeling. In: Meinel C, Leifer L, Plattner H (eds) Design thinking: understand—improve—apply. Springer, Berlin, pp 181–195
Luebbe A, Weske M (2012) Determining the effect of tangible business process modeling. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: studying co-creation in practice. Springer, Berlin, p 241
McGarry DD (1962) The metalogicon of John Salisbury. University of California Press, Berkeley, CA
McNamara N, Kirakowski J (2006) Functionality, usability, and user experience. Interactions 13 (6):26–28

Merton RK, Bowen CD (1965) On the shoulders of giants: a Shandean postscript. Free Press, New York
Ngwenyama OK, Lee AS (1997) Communication richness in electronic mail: critical social theory and the contextuality of meaning. MIS Q 21(2):145
Nunamaker JF Jr, Briggs RO (2012) Toward a broader vision for information systems. ACM Trans Manag Inf Syst (TMIS) 2(4):20:1–20:12
Peffers K, Tuunanen T, Rothenberger MA, Chatterjee S (2007) A design science research methodology for information systems research. J Manag Inf Syst 24(3):45–77
Peirce CS (1931a) Partial synopsis of a proposed work in logic. In: Hartshorne C, Weiss P (eds) Collected papers of Charles Sanders Peirce. Harvard University Press, Cambridge, MA
Peirce CS (1931b) The fixation of belief. In: Hartshorne C, Weiss P (eds) Collected papers of Charles Sanders Peirce. Harvard University Press, Cambridge, MA
Popper K (2014) The logic of scientific discovery. Routledge, London
Pries-Heje J, Baskerville R (2008) The design theory nexus. MIS Q 32(4):731–755
Rauth I, Koppen E, Jobst B, Meinel C (2010) Design thinking: an educational model towards creative confidence. In: Proceedings of the 1st International Conference on Design Creativity (ICDC 2010)
Rosenthal SB (1994) Charles Peirce's pragmatic pluralism. SUNY Press, Albany, NY
Rosson MB, Carroll JM (2002) Usability engineering: scenario-based development of human-computer interaction. Morgan Kaufmann Publishers, San Francisco, CA
Schindlholzer B, Uebernickel F, Brenner W (2011) A method for the management of service innovation projects in mature organizations. Int J Serv Sci Manag Eng Technol 2(4):25–41
Sirkin D, Ju W (2014) Using embodied design improvisation as a design research tool. In: Proceedings international conference on human behavior in design, Ascona, Switzerland, 14–17 October 2014
Skogstad P, Leifer L (2011) A unified innovation process model for engineering designers and managers. In: Meinel C, Leifer L, Plattner H (eds) Design thinking: understand—improve—apply. Springer, Berlin, pp 19–43
Steinert B, Hirschfeld R (2012) Applying design knowledge to programming. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: studying co-creation in practice. Springer, Berlin, pp 259–277
Steinert B, Taeumel M, Cassou D, Hirschfeld R (2012) Adopting design practices for programming. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research: measuring performance in context. Springer, Berlin, pp 247–262
Taylor SE, Gollwitzer PM (1995) Effects of mindset on positive illusions. J Pers Soc Psychol 69 (2):213
Thoring K, Müller RM (2011) Understanding the creative mechanisms of design thinking: an evolutionary approach. In: DESIRE'11 proceedings of the second conference on creativity and innovation in design. ACM, New York, pp 137–147
Venkatesh V, Morris MG, Davis GB, Davis FD (2003) User acceptance of information technology: toward a unified view. MIS Q 27(3):425–478
Vetterli C, Brenner W, Uebernickel F, Berger K (2011) Die Innovationsmethode design thinking. In: Amberg M (ed) Dynamisches IT-Management. So steigern Sie die Agilität, Flexibilität und Innovationskraft Ihrer IT. Symposium Publishing, Düsseldorf, pp 289–310
Vetterli C, Uebernickel F, Brenner W (2012) Initialzündung durch Embedded Design Thinking—Ein Fallbeispiel aus der Finanzindustrie. Zeitschrift für Organisationsentwicklung 2:22–31
Vetterli C, Brenner W, Uebernickel F (2013) A design thinking role model enables creativity in IT: case of the financial industry. In: CONF-IRM 2013 Proceedings
Wilson EO (2000) Consilience: the unity of knowledge. Knopf, New York
Wirth U (1998) What is abductive inference? In: Bouissac P (ed) Encyclopedia of semiotics. Oxford University Press, Oxford

Dynagrams: Enhancing Design Thinking Through Dynamic Diagrams

Martin J. Eppler and Sebastian Kernbach

Abstract In this chapter, we propose a visual, diagrammatic approach to Design Thinking and innovation practices that we call Dynagrams. Dynagrams are dynamic, graphic, interactive thinking and deliberation tools that innovators can use to design joint (digital) solution spaces, taking the contributions of all participants into account. Dynagrams are based on three principles from diagram theory: law encoding, representational guidance and free riding. We show how these principles can be applied in design thinking and illustrate their use through design thinking application examples. We present three specific kinds of dynagrams: the Roper dynagram (to better understand client preferences), the Sankey dynagram (to match needs and solution features) and the Confluence dynagram (to explore and design prototype features). We conclude the chapter with an outlook on future development needs in this area.

Keywords Collaboration • Team communication • Knowledge visualization • Diagrams

Introduction: The Promise

In this chapter, we propose a visual, diagrammatic approach to Design Thinking and innovation practices that we call Dynagrams. Dynagrams are dynamic (fluid), graphic, interactive thinking and deliberation tools that can be used by members of a working group and result in a joint (often digital) solution space taking the contributions of all participants into account. We argue that such interactive diagrams can be fruitfully used in Design Thinking contexts, as they act as malleable boundary objects that let team members integrate what they know graphically—even across disciplinary boundaries.

Shared rapid visualizations are a central and respected pillar of Design Thinking, as it is currently applied in numerous organizations. Through the use of drawings, sketches, posters and even animations, ideas are made visible. Pictures enable joint,

M.J. Eppler (✉) • S. Kernbach
Institute for Media and Communications Management, University of St.Gallen, Blumenbergplatz 9, 9000 St.Gallen, Switzerland
e-mail: martin.eppler@unisg.ch; sebastian.kernbach@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_6

tangible discussions of analyses, ideas and plans, leading to rapid improvement cycles through feedback. This iterative approach is central and vital to the Design Thinking process and techniques, where sketching methods, as well as simple visualization techniques, dominate. Examples of such visual Design Thinking techniques are: the Empathy Map, the Business Model Canvas, Personas, or Customer Journeys. For complex Design Thinking and innovation contexts, however, these techniques are pushed to their (physical and conceptual) limits. These ad-hoc analogue techniques do not always allow adequate consideration and display of different expertise areas, to represent mutual dependencies and structure complex solutions. Dynagrams thus offer a promising complementary tool to augment Design Thinking practices.

To construct such Dynagrams, researchers and designers can rely on three key diagram mechanisms identified and described in diagram research: the concept of representational guidance (i.e., the conversational guide posts provided by a diagram), the notion of diagrammatic free ride (its ability to surface novel insights at one glance) and the idea of law encoding in diagrams (i.e., enabling the users to take certain pre-discovered patterns or rules into account).

Based on the latest research on diagrams, we illustrate these three core diagram principles through three examples: the Roper Dynagram, Sankey Dynagram and Confluence Dynagram.

Context: The Premise

Knowledge-intensive teamwork (Jackson et al. 2006; Eppler and Sukowski 2000) and team meetings form the basis of many organizational innovation and decision processes. Yet, such group-based work is often fraught with a multitude of challenges, such as problematic team dynamics, misunderstandings and conflicts, bad preparation, or group decision biases [see, for example, Jones and Roelofsma (2000), who reviewed group biases like the false consensus effect, groupthink, group polarization, or escalation of commitment]. As Design Thinking teams deal with heterogeneous expertise present in their groups and face environments characterized by increasing volatility, uncertainty, complexity, and ambiguity [abbreviated as a VUCA context, see Bennet and Lemoine (2014)], they struggle to effectively utilize their entire know-how to tackle poorly-structured problems in an agile manner.

Many management scholars have used the concept of *boundary object* as a way of overcoming such team-based knowledge-sharing and decision-making barriers. Boundary objects enable "representing, learning about, and transforming knowledge to resolve the consequences that exist at a given boundary" (Carlile 2002, p. 442). To achieve this, however, boundary objects must be *flexible* enough to accommodate the needs of diverse experts, and yet *robust* enough to maintain common meaning across teams. The concept is based on the work of sociologists Star and Griesemer (1989), and has received considerable attention in literature on management, communication and organizations (Carlile et al. 2013; Leonardi

et al. 2012). In this chapter, we would like to argue that dynamic diagrams can serve as such tangible boundary objects for interdisciplinary Design Thinking teams, although current management literature has not explored this (often software-supported) visual practice in detail yet.

In the next section, we describe our methodological approach to studying the potential of diagrams that act as boundary objects for teams. We then describe three key mechanisms we have identified in the diagrams literature and show how we used them to develop novel diagrammatic methods for knowledge integration and deliberation in teams. Finally, we describe how these methods could be used in the Design Thinking process by giving three illustrative examples of Dynagrams.

Approach: The Procedure

This chapter's main premise is that the field of diagrammatic reasoning and communication (Glasgow et al. 1995; Gurr 1999) can significantly improve the quality of team communication in Design Thinking. As Charles Peirce famously wrote "diagrammatic reasoning is the only kind of really fertile reasoning" [Peirce (CP) (1958), 4.571]. Peirce defined diagrammatic reasoning in the following manner:

> By diagrammatic reasoning, I mean reasoning which *constructs a diagram* according to a percept expressed in general terms, *performs experiments upon this diagram*, notes their *results*, assures itself that similar experiments performed upon any diagram constructed according to the same percept would have the same results, and expresses this in general terms [Peirce (NEM IV) (1976), pp. 47–48].

While Peirce extended the notion of diagrammatic reasoning even beyond graphic diagrams, our contribution in this chapter is limited to diagrams as *concise, abstract graphical representations of information* (qualitative and quantitative) and this in the business (and more specifically innovation) context. We call these forms Dynagrams, as we conceive of them as dynamic, interactive and fluid images that can then be "frozen" for documentation purposes, as requested by boundary object theory (Carlile 2002). We thus define a Dynagram as any interactive diagrammatic visualization that allows its users to collaboratively create, alter or extend the diagram in order to conduct analyses, explore scenarios, make insights jointly visible or graphically record experiences, evaluations, and decisions.

Existing examples of such Dynagrams are interactive Sankey charts, dynamic decision trees, or interactive radar plots. While these diagram forms are useful, they are not yet widely used in Design Thinking contexts and are not applicable to many recurring team situations. Our main focus is to adapt such diagrams to (synchronous, face to face) team collaboration contexts, to enhance their performance by taking recent developments in diagram theory into account, and to test and evaluate them in realistic Design Thinking settings.

To develop a small set of robust and yet versatile Dynagrams, we took the following three steps:

In a first step, we have analyzed the corpus of diagrammatic reasoning literature and screened proceedings of the Diagrams conferences (www.diagrams-conference.org) over the last 20 years, as well as numerous relevant journals (such as the Journal of Visual Languages and Computing) to harvest influential and practical concepts. This literature review has culminated in the identification of three concepts that help in the construction of useful interactive diagrams, namely Suther's concept of *representational guidance* (Suthers 2001), Shimojima's *free ride* idea (Shimojima 1999, although this idea surfaces in many other studies as well) and Cheng's development *of law encoding diagrams* (Cheng 1999, 2011). These concepts are further described and applied in the next section. The rationale of this choice is based on three criteria; the concepts have been widely discussed in the relevant scientific community (they have impact), are applicable to the design of diagrams (they are useable), and dramatically increase the value of diagrams for team use (they are useful).

In a second step, we identified three organizations that faced team deliberation challenges due to increasing complexity and were willing to innovate and experiment with novel forms of diagrammatic team-based collaboration tools. Together with these companies from the travel, security, and professional services industry, we developed prototypes of Dynagrams and tested them in workshops and work sessions. Our research approach is thus deeply rooted in the design science paradigm (Hevner et al. 2004) and in the action research mode (Eden and Huxham 1996). We do not only wish to better understand a phenomenon (i.e., diagram use in teams), but actively want to improve the problem solving abilities of practitioners by proposing, deploying, and evaluating new artifacts.

Last, in on-going research, we are testing the developed Dynagrams in focus groups, in experiments and in more long-term oriented real-life settings to learn about adoption patterns of Dynagrams. In this paper, we report on the first two steps of this approach and provide an outlook on the third one.

Results I: The Principles

As mentioned above, our journey to make diagram research relevant to Design Thinking began with a systematic review of the existing literature. To identify useful concepts from diagram theory, we defined (in close collaboration with research partners from the practice domain) three overall research questions:

1. How can diagrams **capture knowledge** and make it accessible for subsequent use?
2. How can diagrams help in **facilitating team discussions** by guiding the conversation process productively and capturing people's contribution?

3. How can diagrams provide **added value** in joint analysis and provide benefit as a decision support tool?

For each of these three questions, we found corresponding answers in the rich field of diagram research and diagrammatic reasoning [for a current literature review on this field, see Purchase (2014)].

To answer the first question, we found that diagrams capture knowledge by encoding it as image- or interaction-constraints, thus preventing users from reaching inconsistent (i.e., incompatible with identified laws) findings or decisions. A leading diagram researcher, Cheng (1999), referred to this as LEDs for *law encoding diagrams*. He defined them as "representations that capture the important relations of a law in the structure of a diagram using geometric, topological or spatial constraints, such that each instantiation of a diagram represents an instance of the phenomenon modeled or one case of the law represented" (Cheng 1999, p. 310). A law in this context can be any pre-discovered consistent pattern or useful action constraint. According to Cheng, such law encoding diagrams must be interactive and computer-supported to construct and transform them according to the embedded (interaction) constraints.

As an application example of law-encoding, we used this concept by linking elements within a diagram, if it was determined that they influence one another. Whenever a team changes one element in a diagram, other (dependent) elements will change automatically (see the Confluence diagram described below). In another use case, we embedded law-like patterns through differing relative sizes of diagram segments (see the Roper case below). One famous diagram that encodes a law is Gartner's hype cycle chart visually representing the law that new technology is over-hyped in the short run and underestimated in the long run (Bresciani and Eppler 2008).

For the second question, diagrams can help to facilitate team discussions, if they offer what Suthers (2001, p. 257) called adequate "*representational guidance*", that is to say if they lead the team visually into a fruitful sequence of conversation steps. This can be done by "partitioning" the diagram temporally, or, in other words, segmenting it into different development phases. That is achieved by giving the elements of a diagram different degrees of visual salience or by using the tendency of people to read a diagram from left to right (as in a timeline), top to bottom (e.g., in flow charts) or bottom-up (as in the case of a pyramid diagram).

As an application of this concept, we split up a Dynagram into five phases that must be sequentially completed: from defining the team's overall decision topic and parameters, to defining options, evaluating and comparing them visually to choosing the best one—all in one single Dynagram (see the Confluence case below).

Regarding the third question, diagrams can provide the greatest added value in analysis and decision making if they make new important patterns visible and help teams draw higher-level conclusions from their discussion (Larkin and Simon 1987; Tufte 1983). This can be achieved by building so-called *free ride effects* into the diagram, that is to say, by ensuring that a dynamically completed diagram makes insights visible at low (or no) cognitive costs. A more technical definition of

Table 1 Three key concepts of diagram research and their application

	Law encoding	Representational guidance	Free ride
Key proponents	Cheng	Suthers, Hundhausen	Shimoshima, Tufte, Larkin and Simon, Gurr
Interpretation of the concept for team contexts	Diagrams can capture real-life constraints and dependencies and thus ensure that a team comes up with consistent problem or solution space representations	Diagrams can be constructed or used in a way that is conducive to team communication and joint learning if they provide the right affordances	The use of a diagram by a group should lead to certain positive side effects insofar as the diagram's use *makes new patterns visible* that can be detected at one glance
Our application of the concepts in our Dynagrams for Design Thinking	Build intelligence into a diagram, so that changes in one area automatically affect elements in other, dependent areas of the diagram	Provide diagram software enabling a team facilitator to guide the team step-by-step through a systematic information gathering, combination, exploration and decision making phase that is captured in real-time within the diagram	The use of a diagram by a group should lead to certain positive side effects insofar as the diagram's use makes new patterns visible that can be detected at one glance

this effect was provided by Gurr et al. (1998): "Where a sequence of valid operations is performed which cause some consequence to become manifest in a diagram, where that consequence was not explicitly insisted upon by the operations, a free ride occurs" (Gurr et al. 1998, p. 544). This concept is sometimes also called "derivative meaning" and was studied extensively by Shimojima (1999).

We have applied this idea by making key decision variables visually salient and by enabling team members to visualize their opinions in a way that makes a profile of their overall assessment visible at one glance (in the case of the Confluence Dynagrams). In another application case (the Sankey dynagram below), the free ride emerges as more connections are made visible and aggregated through vertical bars.

The application possibilities of these three mechanisms will be shown next in our Dynagrams prototype discussion below. First, we have summarized the results of our analysis of diagram literature in Table 1. Based on these insights, we can now extend our initial definition of a Dynagram:

A Dynagram is an interactive visualization that allows users to collaboratively create, alter or extend it to conduct analyses, explore scenarios, gain jointly visible insights, or record experiences, evaluations, and decisions by *encoding laws* in its (space and interaction) *constraints*, by *guiding the conversation productively* through its structure and interaction patterns, and by making *new emerging insights visible* at one glance.

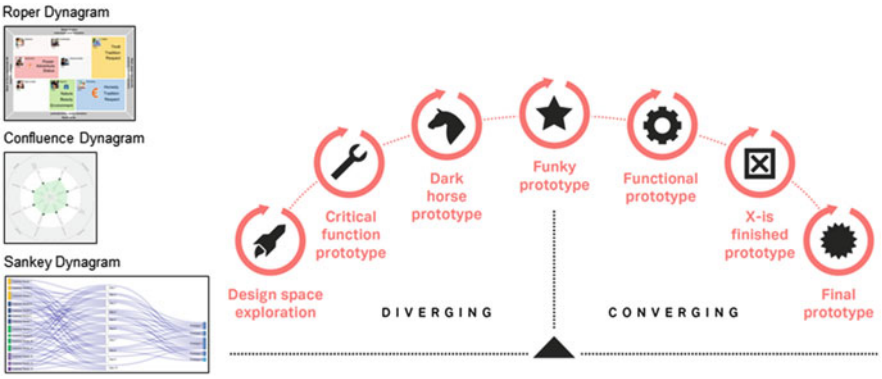

Fig. 1 The Design Thinking Model of the University of St.Gallen and the three supporting Dynagrams

Results II: The Prototypes

We can apply these principles to support the knowledge-intensive communication and decision making of Design Thinking teams in the different phases of the Design Thinking Model of the University of St.Gallen (Fig. 1).

We propose the use of three Dynagrams in the Design Thinking process (Fig. 1): (1) the Roper Dynagram to ensure client-focus through an empirically validated customer segmentation (in addition to the anecdotal forms of empathy maps and personas) along the entire Design Thinking process—with emphasis on the first phase during design space exploration, as well as in the last phase of presenting the final prototype, (2) the Confluence Dynagram to reduce ambiguity and clarify focus, particularly when ambiguity is high before and after the funky prototype phase and (3) the Sankey Dynagram as a tracking tool along the entire Design Thinking process to help teams to reflect about the link between needs, ideas and prototypes.

In the following, we will explain the three Dynagrams in more detail and illustrate their application using an example: the design challenge of recruiting the best graduates for an organization.

The Roper Dynagram for Rigorous Client Focus

What Is It?

As the first support of the Design Thinking process, we turned a static diagram, the so-called Roper consumer styles map (Peichl 2014)—a segmentation of global consumer lifestyles based on global consumer surveys—into a Dynagram by

embedding it in an interactive graphic facilitation software package (en.lets-focus.com) and by making its segments dynamically changeable (i.e., resizing them, (de-) emphasizing them through hues, or adding information to them).

The relative size of the sections in the Dynagram corresponds to the relative size of the consumer segment in the target (client) population. The Dynagram is used to target products, services, or campaigns to the needs and values of certain consumer groups. Whereas demographic details no longer predict preferences, these consumer segments based on lifestyles have been shown to successfully group like-minded individuals.

How Can the Dynagram Be Applied in the Design Thinking Context?

The Roper Dynagram provides Design Thinking teams with eight different consumer segments representing different lifestyles, including values, consumer behavior, media consumption patterns and others. During design space exploration—when the level of ambiguity is low—it enables Design Thinking teams to explore those consumer segments empirically, in addition to the more anecdotal empathy map and personas. It allows teams to locate different consumer segments on the Roper Dynagram and annotate the Dynagram with helpful comments. The Roper Dynagram can be updated and adjusted throughout the process by adding, deleting, and changing consumer segments or annotations. Different versions of the Roper Dynagram can be saved, to allow later reflection on the process, using the Dynagram as a tracking device.

Usually teams have to reduce the consumer segment options from the early stage to one consumer segment, before starting to prototype. However, in the last stage of the final prototype, the Roper Dynagram can be used to check the consistency between the prototype and values of the targeted consumer segment(s). It can also help to expand the prototype by displaying how it can be scaled to other consumer segments previously explored along the process. Finally, the different versions of the Roper Dynagram support teams as a documentation and reflection aid to record the current process and learn for future projects.

An Example Illustrating the Advantages of the Dynagram

In our application example, a design team has to figure out how an organization can recruit the best university graduates. Among other things, the team can use the Roper Dynagram during the phase of design space exploration to explore which lifestyle segment represents those graduates the organization wants to attract. Figure 2 provides an illustration of the main process steps in this endeavor. The exploration of values, preferences and needs helps the team to find appropriate segments. In our example, the team chooses to focus on the following segments:

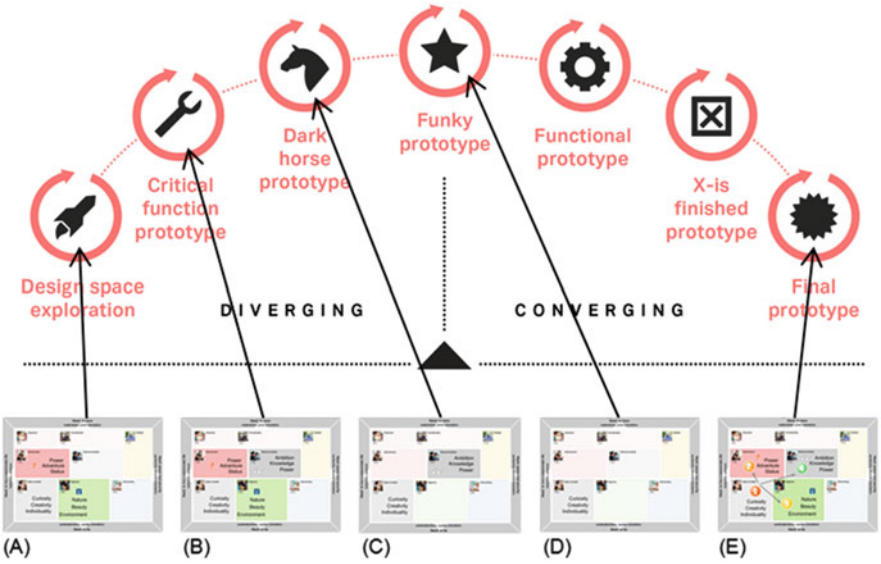

Fig. 2 Different Roper Dynagrams along the Design Thinking process as documentation and reflection device

Open Minded, Adventurers, and Organics (Fig. 2: A). This selection also helps the team to focus other information-gathering activities in this early stage, such as selecting interview partners, observation scenarios, etc.

In the phases following the design space exploration, the team adds the segment Realists (Fig. 2: B), before it reduces the segments to Open Minded and Realists (Fig. 2: C) and then focuses on one target segment, Open Minded, to streamline the funky prototyping efforts (Fig. 2: D).

In the presentation of the final prototype, the team is able to demonstrate consistency between the prototype features and target group needs by referring to the value set and other characteristics of the segment Open Minded and is able to show scaling options from the Open Minded to the Adventurers, Organics and Realists target segments explored in earlier stages of the Design Thinking process (Fig. 2: E, Fig. 3).

The Dynagram Principles in Action

In terms of *representational guidance*, the Dynagram first asks the design team members to adapt the segment sizes to their context, so that they correspond to actual relative importance or size. It then invites participants to first view the entire Dynagram and to then select those lifestyle segments most relevant to the creative

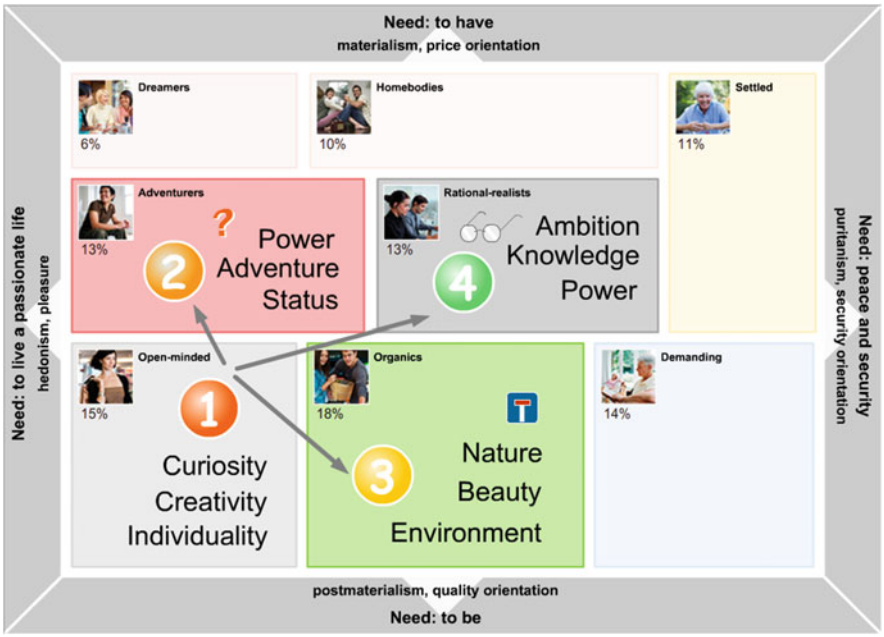

Fig. 3 The Roper Dynagram in the presentation of the final prototype illustrates consistency with the chosen focus on the consumer segment "Open Minded", as well as demonstrating a scaling strategy to other segments explored in earlier phases of the Design Thinking process

brief, or the organization's products or services (by making them more salient through stronger color coding). In a next step, the team members fill the relevant segments with planning information, insights, options, ideas, or actions. Last, but not least, they number the priorities or temporal sequence of addressing these consumer groups.

The Dynagram provides a *free ride* as the most important consumer groups pop out visually, either because of size, color intensity, or because of the number of comments within them.

The *law encoding* can be seen in the default relative sizes of the segments, which are based on statistical analyses of large survey panels. Today, Design Thinking experts can use this Dynagram to efficiently discuss appropriate target audiences for the creative brief at hand, to focus on particular target audiences to focus prototyping efforts and to demonstrate potential target audience extensions of the final prototype, to name just a few Design Thinking application opportunities.

Confluence Dynagram for Ambiguity Reduction and Focus Clarification in Prototyping

What Is It?

A second support of the Design Thinking process consists of what we call the *Confluence Dynagram*, a multi-dimensional configurator in the shape of a radar plot. This Dynagram can be dynamically labeled and adapted to capture the constraints defining the development of any prototype.

How Can the Dynagram Be Applied in the Design Thinking Context?

The Confluence Dynagram enables teams to display various needs of clients translated into features of prototypes and show the interdependencies (including trade-offs) between the features. In this way, the Confluence Dynagram helps teams to support their discussion before the phase of the funky prototype and supports joint reflection later on, when the level of ambiguity and the need to focus are high. The Confluence Dynagram makes trade-offs explicit and fosters focused and fruitful discussions in the team. It also allows creating a "lock" of a certain set of features, to create a briefing for the production of the funky prototype when different aspects of the earlier prototypes must initially be put together.

An Example Illustrating the Advantages of the Dynagram

Continuing our example of the design challenge to recruit the best graduates for an organization, the team focused on the Roper consumer segment "Open Minded" and decided that an online portal would be appropriate for the organization to recruit the best graduates. Now, the team gathers to discuss the funky prototype features of the online portal, in line with the Roper segment expectations. The team uses the Confluence Dynagram to discuss the funky prototype features (Fig. 4). They use an empty Confluence Dynagram projected on a large screen to build common ground and make sense of their situation. To do so, they first segment the circle into four dimensions, labeled as: content, interaction, design, and IT-requirements that they believe determine (and constrain) their prototype according to the insights generated from earlier process phases.

Then they define important factors in each of these four dimensions. For example, for content, they define two factors of the online portal's content features: degree of multimedia components and level of gamification. They continue for the remaining dimensions (Fig. 4). For each factor, they define a spectrum; for example, with regard to level of gamification, they specify a continuum from "low" to "high". After all spectrums have been defined, Design Thinking team members define the parameters of their prototype (where their prototype characteristics

Fig. 4 Confluence Dynagram for the funky prototype of the online portal for graduates

should be located on the spectrum). They move a slider knob on each spectrum to a position representing the desired prototype in line with the customer segment needs. In Fig. 4, they perceive the required level of gamification as rather low. They also agree that the degree of multimedia components should be fixed at a high level. This step will yield a status-quo configuration of the prototype and a corresponding profile of their solution space (the profile line connecting all slider knobs). This way, the team gains a first visual insight into to the constraining qualities of their prototype.

As a next step, the team members discuss each factor's impact on other factors in the same dimension, or in other dimensions. If, for example, the degree of multimedia components is high, this will also indicate that the IT streaming performance has to be high. To define these dependencies, the facilitator simply clicks on the affected knobs and on a "+" sign (for a "more leads to more" relation) or "−" sign (for a "more leads to less" relation) (Fig. 5).

Fig. 5 Visually defining trade-off among variables (a *straight line* indicates a "more leads to more" relation, a *dotted lined* indicates a "more leads to less" relation)

The more a factor affects other factors, the larger the slider knob automatically becomes. Whenever the facilitator moves the mouse over a certain slider knob, all affected knobs will automatically be highlighted. When that slider knob is moved, all affected knobs also immediately move in the defined direction. Based on these relationships, the team now examines the ramifications of different changes by moving a few of the larger slider knobs (a what-if conversation). The team can discuss various scenarios for the prototype (such as a high degree of personalization or a sudden reduction of IT streaming performance).

In a final step, the project team uses the inner space of the profile line to place keywords/fixed parameters for each factor. It places out-of-scope features outside the profile area. The Design Thinking team ends the meeting with a much clearer and more aligned understanding of the features in the areas of: content, interaction, design and IT-requirements for the online portal funky prototype for the best graduates belonging to the consumer segment "Open Minded". The team members

understand the dependencies among key factors of the prototype much better and know what to monitor more closely. In addition, their insights (into which factors matter and how they influence one another) are stored for later prototypes, so that other design teams can benefit from these experiences by using and adapting the pre-defined configurator.

The Dynagram Principles in Action

The *free ride* that results from this conversation is the profile area of the constraints, i.e. where constraints are narrow or rather wide. The diagram also signals which factors are particularly influential. The diagram *encodes laws* by capturing the dependencies of different prototype factors. Last, but not least, the steps to build or label the Dynagram (from the dimensions on the arch, to the factors within it and the spectrums and the knobs' positions thereon) provide *representational guidance*.

Sankey Dynagram as Tracking Device and Reflection Aid

What Is It?

As a third support of the Design Thinking process, we developed an interactive Sankey Dynagram (Schmidt 2008) to help teams in their review after each iteration step, along the process described in the Design Thinking Model of the University of St.Gallen.

How Can the Dynagram Be Applied in the Design Thinking Context?

The Design Thinking team can use the Sankey Dynagram in review meetings to analyze and discuss which current ideas address which consumer needs. They can also examine which prototypes are most affected by these ideas. It thus allows for a crosscheck between consumer needs, ideas and prototypes.

The Sankey Dynagram is a tracking and synthesis device and a reflection aid along the collaboration process. It enables spontaneous insights about how needs and ideas are reflected in each prototype. It is possible to discover which needs have been considered sufficiently, or insufficiently, in the ideas and prototypes. It helps as a reflection aid after each phase and also as a decision aid and preparation aid for the next phase.

The Dynagram allows teams to first position needs, ideas, and prototypes in the order of importance. In a second step, they can connect ideas and needs as well as prototypes. In a third step they analyze the resulting pattern: are high priority needs supported by more ideas than lower priority needs and which prototypes implement these ideas? Elements with large vertical bars signal high leverage, those with small

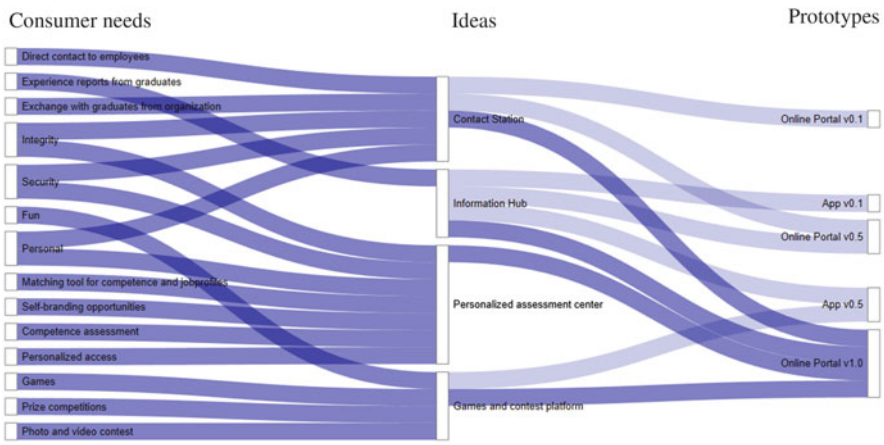

Fig. 6 The Sankey Dynagram to discuss consumer needs, ideas, and prototypes alignment in Design Thinking process review meetings with all connections of the final prototype "Online Portal v1.0" to respective ideas and needs highlighted for consistency and reflection purposes

vertical bars ideas that offer little support for needs. In a fourth and final step, the team discusses changes to the priority order or how to focus on certain needs, ideas, or prototypes.

Figure 6 shows a screenshot from the Sankey Dynagram. Each item can be moved. Upon mouse-over, a particular connection line is highlighted for easier identification; this also allows seeing the connection between prototype and idea, as well as which needs are covered by one prototype. Among other things, the Dynagram reveals that the idea "personalized assessment center" supports most customer needs. The prototype "Online Portal v1.0" covers all ideas and consumer needs, differing particularly from the earlier prototypes "Online Portal v0.1" and "Online Portal v0.5" which cover only a few ideas and consumer needs.

An Example Illustrating the Advantages of the Dynagram

In our example of the design challenge to recruit the best graduates for an organization, the team came up with the Roper consumer profiles "Open Minded", "Adventurers", and "Organics" during the design space exploration phase. Based on these consumer segments, materials were collected; interviews and observations were conducted, resulting in the identification of many consumer needs like "direct contact to employees", "experience reports from graduates" and "photo and video contests". These needs can be listed in the left column of the Sankey Dynagram in order of importance (which can be discussed among team members). The middle column of the Sankey Dynagram allows teams to list ideas developed throughout the iterative Design Thinking process; for example, an "information hub" or a "personalized assessment center", also listed in the order of importance. In the right column of the Sankey Dynagram, teams can list the prototypes of each phase; here,

the order of the prototypes could again refer to importance, but could also be chronological, so that the first prototype is at the top and the final prototype at the bottom, making it possible to review the prototype development process to define how they reflected ideas and needs. Through the connection of consumer needs and ideas, as well as ideas and prototypes, the linkages between these three can be made visually. The elements and their order can be adjusted in every process phase of the Design Thinking process to discuss the relevant connections between consumer needs, ideas and prototypes in that specific process phase.

The Dynagram Principles in Action

Teams can see the patterns resulting from connections between needs and ideas, as well as between ideas and prototypes (the *free ride effect*). If connections from one prototype to the respective ideas and needs are highlighted, it is visually recognizable which needs are covered in the prototype, how many needs are covered and also whether these needs are more important (in the upper part of the left column) or less important (in the lower part of the left column).

The Dynagram guides the discussion; the degree to which ideas support needs is visible through the vertical bars of each element. If the vertical bar is large, it signals high leverage; if the vertical bar is small, it indicates ideas that offer little support for needs. Based on this information, the team can discuss the order and focus of needs, ideas, and prototypes with the possibility of changing the priority order. In this way, the Dynagram steers the conversation productively (*representational guidance*).

The Dynagram *encodes laws,* capturing participants' knowledge about which ideas are aligned with which needs. These connections remain intact even if ideas, needs, or prototypes are moved to a higher or lower priority.

Dynagrams Resources

More information about Dynagrams, download of templates, and further online tools are available at: http://www.dynagrams.org.

Conclusion: The Perspectives

It seems to be an idea whose time has come: the real-time use of Dynagrams in Design Thinking teams. It is surprising that the great advances in our diagram understanding has not yet had a bigger impact on the meeting practices of today's managers—who, for the greatest part, still run meetings the same way as 20 years ago. Through Dynagrams, we hope to enable Design Thinking teams to literally see

what they mean and build their prototypes and decisions on the best available knowledge in their organization. This is a vision that obviously cannot be achieved through tool development alone. In our work with three organizations, we have seen that existing routines are deeply embedded, as are the tools used—such as PowerPoint and thus difficult to change. Much remains to be done to convince managers to change their old meeting habits and embrace the power of dynamic diagrams at work.

Acknowledgements We would like to thank our partner organizations Kuoni, GfK Verein, and armasuisse for their collaboration and support. We also thank *interactive things* for their valuable contributions to the ideas and prototypes described in this chapter.

References

Bennet N, Lemoine GJ (2014) What a difference a word makes: understanding threats to performance in a VUCA world. Bus Horiz 57(3):311–317

Bresciani S, Eppler M (2008) Gartner's magic quadrant and hype cycle. USI case study series. Available at www.thecasecentre.org, ref. no. 908-029-1

Carlile PR (2002) A pragmatic view of knowledge and boundaries: boundary objects in new product development. Organ Sci 13(4):442–455

Carlile PR, Nicolini D, Langley A, Tsoukas H (2013) How matter matters: objects, artifacts, and materiality in organization studies, vol 3. Oxford University Press, Oxford

Cheng PCH (1999) Interactive Law Encoding Diagrams for learning and instruction. Learn Instr 9 (4):309–325

Cheng PCH (2011) Probably good diagrams for learning: representational epistemic recodification of probability theory. Top Cogn Sci 3(3):475–498

Eden C, Huxham C (1996) Action research for management research. Br J Manag 7(1):75–86

Eppler M, Sukowski O (2000) Managing team knowledge: core processes, tools and enabling factors. Eur Manag J 18(3):334–341

Glasgow J, Narayanan NH, Chandrasekaran B (1995) Diagrammatic reasoning: cognitive and computational perspectives. MIT Press, Boston, MA

Gurr CA (1999) Effective diagrammatic communication: syntactic, semantic and pragmatic issues. J Vis Lang Comput 10(4):317–342

Gurr C, Lee J, Stenning K (1998) Theories of diagrammatic reasoning: distinguishing component problems. Mind Mach 8(4):533–557

Hevner AR, March ST, Park J, Ram S (2004) Design science in information systems research. MIS Q 28(1):75–106

Jackson SE, Chuang C, Harden EE, Jiang Y (2006) Toward developing human resource management systems for knowledge-intensive teamwork. Research in personnel and human resources management, pp 27–70

Jones PE, Roelofsma PHM (2000) The potential for social contextual and group biases in team decision-making: biases, conditions and psychological mechanisms. Ergonomics 43 (8):1129–1152

Larkin JL, Simon H (1987) Why a diagram is (sometimes) worth Ten Thousand Words. Cogn Sci 11(1):65–100

Leonardi PM, Nardi BA, Kallinikos J (2012) Materiality and organizing: social interaction in a technological world. Oxford University Press, Oxford

Peichl T (2014) Von Träumern, Abenteurern und Realisten—Das Zielgruppenmodell der GfK Roper Consumer Styles. In: Halfmann M (ed) Zielgruppen im Konsumentenmarketing. Springer, Wiesbaden, pp 135–149

Peirce CS (CP) (1958) Collected Papers of Charles Sanders Peirce (Volumes I–VI, ed. by Charles Hartshorne C, Weiss P, 1931–1935, Volumes VII–VIII, ed. by Arthur W. Burks AW, 1958, quotations according to volume and paragraph). Harvard UP, Cambridge, MA

Peirce CS (NEM) (1976) The New Elements of Mathematics by Charles S. Peirce (ed. by Carolyn Eisele) vol I–IV. Mouton/Humanities Press, The Hague-Paris/Atlantic Highlands, NJ

Purchase HC (2014) Twelve years of diagram research. J Vis Lang Comput 25(2):57–75

Schmidt M (2008) The Sankey diagram in energy and material flow management. J Ind Ecol 12 (1):82–94

Shimojima A (1999) Derivative meaning in graphical representations. In: IEEE (publ) Proceedings of the 1999 I.E. symposium on visual languages, pp 212–219

Star SL, Griesemer JR (1989) Institutional ecology, 'translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. Soc Stud Sci 19 (3):387–420

Suthers DD (2001) Towards a systematic study of representational guidance for collaborative learning discourse. J Univer Comput Sci 7(3):254–277

Tufte E (1983) The visual display of quantitative information. Graphics Press, Cheshire, CT

What if? Strategy Design for Enacting Enterprise Performance

Simon Grand

Abstract Strategy making is confronted with a flow of issues and challenges, simultaneously implying fundamental uncertainties and strategic opportunities for current and future enterprise performance. For entrepreneurial strategizing, it is important to successfully translate such issues and challenges into value-creating initiatives, businesses, solutions, and products. In this chapter, we argue that strategy design is essential under these conditions, because it allows proactive creation and realization of promising strategic opportunities, while at the same time establishing organizational pre-conditions for future opportunity creation and realization. Specifically, we identify 10 strategy design practices and show how they shape entrepreneurial strategizing and enterprise performance. Additionally, we identify specific steps to introducing such practices into the strategy process of an enterprise.

Keywords Strategy design • Entrepreneurial strategizing • Enterprise performance • Practices • Uncertainties

Focus: Enacting Enterprise Performance

Strategy making is confronted with a continuous flow of challenges, implying, at the same time, fundamental uncertainties and strategic opportunities (Quinn 1980; Burgelman 2002): for example, investing in novel knowledge domains and research areas, which might shape future innovation opportunities. Other challenges include: interpreting changing rules of the game in an industry, which might disrupt established value constellations, exploring the emergence of disruptive technologies, which outperform incumbent systems and solutions, or making sense of changes in current business models—as well as related shifts in pre-dominant modes of organizing and collaborating. Thus, an entrepreneurial approach to strategy making implies not only successfully enacting such opportunities and challenges, but always shaping the organizational pre-conditions for systematically seizing such opportunities and taking on such challenges as a company, in specific

S. Grand (✉)
Institute for Systemic Management and Public Governance (IMP-HSG), University of St.Gallen, Dufourstrasse 40a, 9000 St.Gallen, Switzerland
e-mail: simon.grand@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_7

situations over time. As Rei Kawakubo, the founder of the fashion label Comme des Garçons argues: "My work takes place where creating a company as a whole and creating clothes overlap. It cannot be one or the other" (Shimizu and NHK 2005). In an entrepreneurial perspective, creating and realizing opportunities and creating and advancing a company can only be understood as connected and mutually interdependent (Grand 2016, forthcoming).

We learn, then, from Peter F. Drucker, that the best way to predict the future is to create it. Creating the future is characterized by a series of challenges; it implies dealing with the inherent uncertainty embodied in any attempt to deal with the future. It also implies imagining novelties, which go beyond the taken-for-granted, to envision alternative futures. It implies making possible what is not possible today, thus enriching and enlarging the entrepreneurial action space. This also implies an exploration of what should be, having a normative dimension: how desirable, relevant, valuable is the future we build? It is only by explicitly considering these challenges that we can understand why Joseph A. Schumpeter describes entrepreneurial practice as "creative destruction" (Schumpeter 1942): it implies critical challenge, proactive transformation and creative transcendence of the present, taken-for-granted, self-evident—whether it is a known product, an established technology, a known business model, a routinized organizational structure or unquestioned management practices.

Entrepreneurial strategy making is thus creative action, the proactive enactment of the world as it is, "... to create worlds as they could be" (Simon 1996, p. 4). The central question in entrepreneurial practice is: what if? ... what if it would be possible to use our mobile phones as multimedia and entertainment devices; ... what if it would be possible to access valuable information and expert knowledge for free; ... what if it would be possible to systematically cure cancer; ... what if our current products would be out of the market in one year; ... what if societal value creation becomes as central for enterprise performance as financial success. Interestingly, this is also a guiding focus in design practice: "The impossible drives the possible. A designer's motto should always be: what if?" (Lukic and Katz 2011, p. XXIX), identified as an essential focus in any creative design process (Dunne and Raby 2013). The present chapter argues that we gain relevant insights for entrepreneurial strategizing from a design perspective, which allows creative and robust answers to the question: what if?

Approach: Ten Practices of Strategy Design

Relating Strategy and Design

Understanding entrepreneurial practices as strategy design requires opening the black boxes of "strategy" and "design". By strategy, we understand not primarily what executives say, state and plan as their so-called strategy, but what

organizations actually do (Mintzberg and Waters 1985); in other words, strategy in our view is best identified with the actual action patterns characterizing ". . . how an organization moves forward" (Rumelt 2011 p. 6). This also implies identifying strategy as the realized strategy of the company and its management (Bower and Gilbert 2005). By design, we understand not primarily the creation of visual and material artifacts, but the practices and processes necessary to create, establish, enact and sustain such visual, discursive and material artifacts and actions as materializations of possible, potential worlds (Bleecker 2009; Auger 2010; Dunne and Raby 2013). This requires considering strategy making primarily as creative action (Joas 1992). We identify the 10 core practices essential for entrepreneurial strategizing "in the making": these practices, through their interplay, ensure enterprise performance under conditions characterized by fundamental uncertainty.

The practices are identified through our empirical research on strategy processes in various industry and technology contexts, including software engineering, information technology, pharma and life sciences, engineering, robotics and artificial intelligence, as well as fashion and design in the context of our RISE Management Innovation Lab [www.rise.ch; see also Grand (2016)]. Furthermore, our argument is strengthened by our research on creative economies and creative enterprises in partnership with the Zurich University of the Arts, as well as various collaborations with artists and designers, exploring their creation and realization practices, methods and tools [www.creativeeconomies.com; see also Grand and Jonas (2012)]. The 10 practices of strategy design are also inspired by our innovation partnerships with various companies, mobilizing the practices and developing them into their own repertoires of strategy making. They are also tested in our own entrepreneurial engagements, to explore them from "inside".

Practice 01: Projecting

From our perspective, entrepreneurial strategizing is not primarily an analytical process: under uncertainty, we are not able to develop a clearer perspective by adding more information, analyzing more data or systematically exploring the world as it is (March 1994; Shapira 1995). Rather, it is important to imagine, launch and formulate desirable, valuable, attractive and relevant futures, as they could be, in the form of questions, hypotheses, propositions, and simulations: for example the question Winy Maas from the architectural practice MVRDV asks in one of his projects: how would a city have to be built to allow anyone to get from any place to any other place within less than 5 minutes? (Maas 2003). Similarly, we find such projection in the business world, very prominently in the proposition Apple has formulated decades ago, leading to the Macintosh: we build a computer that is easy to use, of high quality, affordable and beautiful (Kawasaki 2000). Such questions, propositions and hypotheses make a substantial leap forward and open action spaces for the creation and realization of entrepreneurial opportunities. At the same time, they transcend and critically reflect the present we know.

Entrepreneurial strategizing asks "What if?" and systematically develops proposals to answer the question in novel, inspiring and attractive ways.

Practice 02: Prototyping

Prototyping is another important practice to project attractive future possibilities. It is important to make proposals as tangible as possible, not sticking with the general idea or broad image, but concretizing them in the form of specific concepts, material prototypes and precise stories. We know from design practice how important specific materializations are, because they substantially influence what is possible and what is not (Gänshirt 2007). In the context of entrepreneurial strategizing, we observe that different materializations also matter: strategy making by drawing a business model on paper is different from simulating a strategy by trying out its consequences for the future website of a company, by putting together a simplified material artifact of a potential future product in a bricolage process, or by explaining the value proposition of the enterprise in an elevator pitch. Most often, specific media like PowerPoint are used without further consideration to developing and specifying a strategy. However, this always introduces specific technical features and media-specific qualities into the process (Tufte 2003; Orlikowski and Yates 1994; Kaplan 2011). Obviously, strategy design through prototyping implies reflecting the current strategy process and the usage of media, stories and artifacts, as well as identifying the most productive media for prototyping, thus materializing strategic ideas and novel concepts.

Entrepreneurial strategizing explores the potential of specific media for prototyping strategic ideas, proposals and stories.

Practice 03: Evaluating

Whatever strategic ideas and stories are proposed and prototypically explored, it is essential to be explicit about specific criteria, which will evaluate the strategic relevance of such ideas and stories: what are the predominant expectations concerning growth potential, radical novelty, distinctive features, financial success, social relevance and how are they evaluated in the strategy process? (Rüegg-Stürm and Grand 2015). We learn from design practice how important it is to translate and operationalize often intuitive, subjective judgment into robust evaluations. These can systematically be applied to proposed ideas and concepts, stories and prototypes, then communicated and justified as an enterprise-specific reference system or performance model (Grand and Bartl 2011). Entrepreneurial strategizing poses the challenge of deciding whether it is possible to quantify certain dimensions in terms of numbers and metrics, and how they are combined with qualitative evaluation dimensions including aesthetic or societal aspects. How elegant is a new

business model; or how normatively valid is a new product; or how successful is an existing product? Exploring different types of judgment devices, including operating figures, rankings, benchmarks, expert opinions, references to experience and subjective judgment is thus essential for entrepreneurial strategizing.

Entrepreneurial strategizing systematically mobilizes various judgment devices for translating subjective judgments into justified evaluations.

Practice 04: Experimenting

It is one thing to build prototypes for exploring the potential of promising ideas and fascinating concepts; it is another to systematically experiment with testing such ideas, concepts, stories and prototypes. While experimenting is often associated with informal trying-out, we learn from research on scientific experimentation and design processes how important it is to introduce a systematic structure into the experimentation process (Brown 2009). This is guided by asking a set of questions: what exactly are the questions asked and how far do specific prototypes answer those questions? How exactly are experiments evaluated? How are experiments tracked by the usage of inscription systems, allowing reconstruction of experimental events? How systematic is the confrontation of a new prototype with actual and potential user communities? How explicit is the application of particular test criteria tracked before taking decisions and prioritizing options? How do experiments build on each other to allow for creative variation and serial validation (Knorr Cetina 1981, 1999)? Experimenting does require laboratories as experimental systems (Rheinberger 1997), which frame, structure, equip, protect, track and document experiments, making them traceable and accessible (Latour 2004).

Entrepreneurial strategizing requires experimental systems, which allow systematically testing of novel concepts and prototypes.

Practice 05: Routinizing

It is one kind of challenge to imagine attractive opportunities, develop convincing prototypes and systematically evaluate and test them, and another to develop the organizational context, which systematically enables and fosters the creation of novel, inspiring and attractive opportunities. It is thus essential, in entrepreneurial strategizing, to translate new insights, concepts, perspectives and experiences into organizational knowledge, expertise and practices, as well as enacting them systematically, so that they become organizational routines. Furthermore, it is important to routinize such creation processes themselves (Grand 2016). Interestingly, successful design enterprises are often characterized by highly routinized creation processes (Hargadon and Sutton 1997; Salvato 2003, 2009). To ensure enterprise performance in this perspective requires systematic routinization, which allows

recurrent translation of novel ideas, concepts and proposals into successful products, solutions and technologies. To sustain enterprise performance implies going through this process not only once, but in a recurrent mode. This can also be identified as the dynamic capabilities of an enterprise (Eisenhardt and Martin 2000), which go beyond the competence to create, by embedding creation into organizational action and strategy making (Floyd and Wooldridge 2000).

Entrepreneurial strategizing engages for the systematic, enterprise-specific routinization of creative concepts and the creative process itself.

Practice 06: Mobilizing

Materializing, experimenting and routinizing are very costly processes; typically, they lead to many variations that do not work, do not survive a disciplined evaluation process and cannot be realized within a reasonable time frame. As a consequence, entrepreneurial strategizing continuously engages in the mobilization of relevant resources to make such processes possible. Resource mobilization implies diverse resources as: financial resources allowing for strategic investment (Burgelman 2002), customer insights exploring the actual and potential relevance of any new concept (Brown 2009), relevant expertise in various competence fields etc. It is important to explore to what extent external parties must be mobilized in relevant ways and to what extent internal capabilities and related processes can be established, to ensure that the translation of promising ideas, concepts and perspectives really takes place (Murtha et al. 2001). Resources are, therefore, not simply tangible and intangible assets; they provide potential to act, opening up entrepreneurial action spaces for the creation of novel products, solutions and businesses (Rüegg-Stürm and Grand 2015).

Entrepreneurial strategizing systematically attracts relevant resources, while engaging in their creation and allocation, to enlarge the action space.

Practice 07: Realizing

Whatever is created, imagined and developed gains impact through its successful translation into a relevant product, an attractive service, or a working business model. It is essential for entrepreneurial strategizing to focus on actual value creation and return appropriation from initial ideas, prototypical artifacts and interesting stories. We learn from design practice that this translation is in itself a highly creative process, which potentially transforms the entire concept or project again. This implies that we understand the transition from prototypical concepts into working products as a highly creative and transformative practice, which substantially influences the actual success and enterprise performance. Through systematic routinization over time, the alignment and productive interaction

between projecting, prototyping and experimenting—on one hand and evaluation, structuring and realization on the other—can be intensified and further strengthened. Entrepreneurial strategizing thus substantially relies on the establishment of dynamic interfaces, interaction processes and communicative platforms relating different strategy design practices, recognizing the creative potential in all of them.

Entrepreneurial strategizing systematically concentrates on the translation of concepts, ideas, stories and prototypes into actual outcomes.

Practice 08: Connecting

Whatever emerges from entrepreneurial strategizing, both in terms of specific products and services, but also of organizational action patterns and moves, essentially depends on how it is connected to relevant contexts and environments. How are current customer expectations met or challenged, how are products connected to stories that make sense, how are external parties and communities mobilized for the successful translation of novel products and services into actual usage and conviction? Connecting like this is a continuous activity for entrepreneurial strategizing, with an impact on strategy design practices, for example . . . evaluating: what are important criteria, dimensions and related judgment devices in the eyes of relevant customers and communities (Bower and Gilbert 2005); . . . or mobilizing: how can relevant environments and actors be mobilized as resources for the value creation and strategic advancement of the organization, thus contributing to the creation, enlargement and ensuring of entrepreneurial performance now and in the future; . . . or realizing: how can a robust network of strategic partnerships be ensured over time (Dyer and Singh 1998). Connecting is a highly creative process; not just a simple transfer from one context to another, but a highly creative translation process as well (Callon 1986; Latour 2005).

Entrepreneurial strategizing systematically connects organizational activities to relevant contexts, while proactively enacting the resulting interfaces.

Practice 09: Scaling

Business impact and enterprise performance do not automatically result from creation and innovation. It requires continuous scaling of the highly situated activities involved in entrepreneurial strategizing (Thévenot 2006; Grand 2016): proposing a new concept, exploring a new prototype, applying a judgment device, interacting with an investor, propagating a new product through attractive stories are always highly situated activities. However, at the same time, creation and innovation have the potential to shape organizational outcomes and enterprise performance: how an organization moves forward. As a consequence, entrepreneurial strategizing constantly attempts to explore potential for any activity and

practice beyond the situation, to shape other situations and interactions, but also to amplify the impact across space and time. This explains the importance of entrepreneurial engagement for proactively establishing new possibilities and opportunities, at the same time mobilizing relevant resources and connections. Furthermore, it explains the importance of standardization, formalization, structuring and routinization for entrepreneurial strategizing (Grand and Ackeret 2012); only these processes allow transcendence of situatedness, localness and fragility of strategizing activities and interactions towards distinctive, sustainable and competitive performance.

Entrepreneurial strategizing proactively interprets situated interactions as possibilities to leverage local activities for global impact.

Practice 10: Curating

Overall, the different strategy design practices discussed so far are individually relevant. At the same time, they work only in relation to other practices and their continuous enactment. We learn from the creative economies that continuous interaction cannot be managed or governed in a linear and directive sense (Boland and Collopy 2004). It must be curated by playing with existing dynamics and connecting unconnected processes, remaining open to both unexpected events and incidences, (which turn into promising possibilities for new interpretations of individual practices), but also to ways of advancing their interactions, interfaces and complementarities in novel directions (Grand and Weckerle 2014). "There is a fundamental similarity within the act of curating, which, at its most basic, implies connecting cultures, bringing their elements into proximity with each other—the task of curating is to make junctions, to allow different elements to touch" (Obrist 2014, p. 1). For realizing such novel connections, it is often essential to work toward alternative institutionalizations by building enterprises to provide the context for successfully moving forward.

Entrepreneurial strategizing requires curating both of situated events, actions and initiatives, as well as of their interactions, connections and scaling.

Conclusion: Exploring Strategy Design Practices

Obviously, strategy design is straightforward, but also implies challenges. As a consequence, it is essential not to approach strategy design in its entirety as a complex, distant, abstract concept, but to start with one specific practice after the other, while at the same time carefully curating the overall interaction and interplay with established practices. Specifically, we suggest the following starting points for exploring strategy design practices:

Practice 01: Projecting: *Ask "What if?" and develop proposals to answer the question in novel, inspiring and attractive ways.*

Strategy making is often characterized by the implicit assumption that the past can be used as a good reference for extrapolating the future. Asking "What if?" in a strategy workshop is a good way of challenging such taken-for-granted continuity: . . . what if our most successful product would have to be sold at half price . . . what if our most important customers were located in a different part of the world than they are today . . . what if it would be possible to completely automate our manufacturing process . . . what if our customer interaction would be completely digital. It is important, in strategy design perspective, not only to formulate such questions and explore their potential, but to actually develop prototypes of resulting products, interfaces or marketing campaigns (Practice 02: Prototyping), as well as defining the experimental system necessary to test them systematically (Practice 04: Experimenting).

Practice 03: Evaluating: *Entrepreneurial strategizing systematically mobilizes various devices for translating subjective judgments into justified evaluations.*

Strategy making is often characterized by just a few explicit, quantified, typically financial measures of business success and entrepreneurial performance. At the same time, we observe in many strategy workshops and management meetings how important subjective judgments, feelings and intuitions are for evaluating novel ideas, surprising events or unexpected developments. Specifically discussing evaluation criteria and related judgment devices is a good way of making evaluation in entrepreneurial strategizing more explicit and appropriate for creation and innovation processes. It makes sense to identify how the pre-dominant evaluation criteria relate to the expectations of the most important strategic enterprise partners (lead users, major investors, technology providers, . . .) (Practice 06: Mobilizing), as well as to the most important aspects that drive a successful realization and commercialization of a new initiative (Practice 07: Realizing).

Practice 08: Connecting: *Entrepreneurial strategizing connects organizational activities to relevant contexts, while proactively enacting the resulting interfaces.*

Strategy making is often seen as a specialized executive management activity, without consideration of how other actors, either in or outside the enterprise, can be mobilized for entrepreneurial strategizing. As a consequence, involving novel perspectives and relevant actors, (typically not involved in strategy making) can substantially strengthen the process. Strategy making is often seen as irrelevant to the overall organization; systematically communicating about strategic issues, ideas and initiatives, (thus elaborating convincing modes, media and platforms for communication) can make a substantial difference. Opening up strategy making in these two directions also allows more systematic anchoring of novel perspectives into organizational capabilities, practices and routines (Practice 05: Routinizing), thus leveraging them systematically across situations, activities and initiatives (Practice 09: Scaling).

The fundamental guiding principle for entrepreneurial strategizing is that strategy design always occurs while both creating a company as a whole and creating novel products, solutions, stories and businesses, not just one or the other.

References

Auger J (2010) Alternative presents and speculative futures. In: Swiss Design Network (ed) Negotiating futures—design fiction. HGK Basel, Basel, pp 42–57
Bleecker J (2009) Design fiction: from props to prototypes. In: Swiss Design Network (ed) Negotiating futures—design fiction. HGK Basel, Basel, pp 58–67
Boland RJ, Collopy F (2004) Managing as designing. Stanford Business Books, Stanford, CA
Bower JL, Gilbert CG (2005) From resource allocation to strategy. Oxford University Press, Oxford
Brown T (2009) Change by design. Harper Business, New York
Burgelman RA (2002) Strategy is destiny: how strategy-making shapes a company's future. Free Press, New York
Callon M (1986) Some elements of a sociology of translation: domestication of the scallops and the fishermen of St. Brieuc Bay. In: Law J (ed) Power, action and belief: a new sociology of knowledge? Routledge, London, pp 196–229
Dunne A, Raby F (2013) Speculative everything: design, fiction, and social dreaming. MIT Press, Cambridge, MA
Dyer JH, Singh H (1998) The relational view: cooperative strategy and sources of interorganizational competitive advantage. Acad Manage Rev 23(4):660–679
Eisenhardt KM, Martin JA (2000) Dynamic capabilities: what are they? Strateg Manag J 21(10/11):1105–1121
Floyd SW, Wooldridge B (2000) Building strategy from the middle: reconceptualizing strategy process. Sage, London
Gänshirt C (2007) Werkzeuge für Ideen: Einführung ins Architektonische Entwerfen. Birkhäuser Verlag, Basel
Grand S (2016) Routines, strategies and management: engaging for recurrent creation 'at the edge'. Edward Elgar, Cheltenham
Grand S, Ackeret A (2012) Management knowledge: a process view. In: Schultz M, Maguire S, Langley A, Tsoukas H (eds) Constructing identity in and around organizations. Oxford University Press, Oxford, pp 261–305
Grand S, Bartl D (2011) Executive Management in der Praxis: Entwicklung—Durchsetzung—Anwendung. Campus Verlag, Frankfurt am Main
Grand S, Jonas W (2012) Mapping design research. Birkhäuser Verlag, Basel
Grand S, Weckerle C (2014) Global creative systems, curatorial strategies. Working paper. www.creativeeconomy.ch. Accessed 27 Feb 2015
Hargadon A, Sutton RI (1997) Technology brokering and innovation in a product development firm. Adm Sci Q 42(4):716–749
Joas H (1992) Die Kreativität des Handelns. Suhrkamp Verlag, Frankfurt am Main
Kaplan S (2011) Strategy and PowerPoint: an inquiry into the epistemic culture and machinery of strategy making. Organ Sci 22(2):320–346
Kawasaki G (2000) Rules for revolutionaries: the capitalist manifesto for creating and marketing new products and services. Harper Business, New York
Knorr Cetina K (1981) The manufacture of knowledge: an essay on the constructivist and contextual nature of science. Pergamon Press, Oxford
Knorr Cetina K (1999) Epistemic cultures: how the sciences make knowledge. Harvard University Press, Cambridge, MA
Latour B (2004) Von "Tatsachen" zu "Sachverhalten": Wie sollen die neuen kollektiven Experimente protokolliert werden? In: Schmidgen H, Geimer P, Diering S (eds) Kultur im Experiment. Kulturverlag Kadmos, Berlin
Latour B (2005) Reassembling the social: an introduction to actor-network-theory. Oxford University Press, Oxford
Lukic B, Katz BM (2011) Nonobject. MIT Press, Cambridge, MA
Maas W (2003) Five minutes city. Episode Publishers, Rotterdam
March JG (1994) A primer on decision making: how decisions happen. Free Press, New York

Mintzberg H, Waters J (1985) Of strategies, deliberate and emergent. Strateg Manag J 6(3): 257–272
Murtha TP, Lenway SA, Hart JA (2001) Managing new industry creation. Stanford University Press, Stanford, CA
Obrist HU (2014) Ways of curating. Penguin, London
Orlikowski WJ, Yates J (1994) Genre repertoire: the structuring of communicative practices in organizations. Adm Sci Q 39(4):541–574
Quinn JB (1980) Strategies for change: logical incrementalism. Irwin, Homewood, IL
Rheinberger HJ (1997) Toward a history of epistemic things: synthesizing proteins in the test tube. Stanford University Press, Stanford, CA
Rüegg-Stürm J, Grand S (2015) The St. Gallen management model. Haupt, Bern
Rumelt R (2011) Good strategy/bad strategy: the difference and why it matters. Profile Books, London
Salvato C (2003) The role of micro-strategies in the engineering of firm evolution. J Manag Stud 40(1):83–108
Salvato C (2009) Capabilities unveiled: the role of ordinary activities in the evolution of product development processes. Organ Sci 20(2):384–409
Schumpeter JA (1942) Capitalism, socialism and freedom. Harper and Brothers, New York
Shapira Z (1995) Risk taking: a managerial perspective. Russell Sage, New York
Shimizu S, NHK (2005) Unlimited: Comme des Garçons. Heibonsha, Tokyo
Simon HA (1996) The sciences of the artificial, 3rd edn. MIT Press, Cambridge, MA
Thévenot L (2006) L'action au pluriel. Sociologie des régimes d'engagement. Editions La Découverte, Paris
Tufte ER (2003) The cognitive style of PowerPoint. Graphics Press, Cheshire, CT

Effectuation: Control the Future with the Entrepreneurial Method

Dietmar Grichnik, Ronny Baierl, and Michael Faschingbauer

Abstract Entrepreneurship is a core process in business innovation. In fact, entrepreneurship and innovation are two sides of the same coin and both create value for society and for the individuals involved. The ingredients for successful value creation are not part of the genetic makeup of super entrepreneurs like Richard Branson of Virgin Group or Mark Zuckerberg of Facebook but instead they comprise a method that anyone can learn. The cookbook for the entrepreneurial method provides useful patterns of entrepreneurial thinking and acting employed by successful entrepreneurs to develop innovative products and business models in the midst of uncertainty. And innovation does not stop once a new business is founded. Established enterprises can be revitalized through innovation and the creation of entrepreneurial opportunities. This chapter presents the elements of the entrepreneurial method "effectuation" and identifies ways in which start-ups and managers in large and small enterprises can learn from experienced entrepreneurs how to control an uncertain future, instead of predicting it.

Keywords Entrepreneurship • Effectuation • Entrepreneurial Method • Prediction • Control • Uncertainty

---

The chapter presented here is a translation of "Entrepreneurship: Gestalten der unsicheren Zukunft mit der unternehmerischen Methode. Elemente und Zusammenspiel unternehmerischen Denkens und Handelns" in "Business Innovation" by Wolfgang Stölzle et al. (editors), Springer Gabler, Berlin, 2016. The core principles are explained in Grichnik 2012.

D. Grichnik (✉)
Chair for Entrepreneurship, Institute of Technology Management, University of St.Gallen, Dufourstrasse 40a, 9000 St. Gallen, Switzerland
e-mail: dietmar.grichnik@unisg.ch

R. Baierl
SRH Hochschule Berlin - The International Management University, Campus Dresden, Georgenstrasse 7, 01097 Dresden, Germany
e-mail: ronny.baierl@srh-hochschule-berlin.de

M. Faschingbauer
Effectuation Intelligence, Mühlgasse 61/53, 8020 Graz, Austria
e-mail: office@faschingbauer.at

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_8

What Is Entrepreneurial About an Entrepreneur?

Do You Know Successful Entrepreneurs?

Do you know entrepreneurs? Perhaps a woman who has established a successful business? If so, that is a true privilege. Statistically, they are a rare species, at least when viewed from the perspective of entrepreneurship. Entrepreneurship refers to innovative action that creates value in which the outcome is uncertain. Sounds too academic? Not at all. Just think of the new hobby that some successful entrepreneurs have taken up, namely pioneering commercial space travel. It is definitely new, it certainly creates value—for some people—and is highly uncertain. Richard Branson's prototype, the Spaceship, certainly will not take off without technical risks, and it is not clear who among the prominent names on the current waiting list will actually step on board or what they will pay for the ride. Well-known competitors like Jeff Bezos of Amazon (Blue Origin) and Paypal founder Elon Musk (SpaceX) are increasing the market risk additionally. You may object that this example is too unusual. It certainly is. But the high degree of uncertainty that confronts entrepreneurial activity in various domains is not. In these times of new media and technologies, how can an entrepreneur predict consumer behavior? When will e-books completely replace the printed variety, or will there be bookshelves for years to come because we simply refuse to give up our friend, the good old printed book? How can the head of a textile corporation budget her electricity costs in times of energy transformations? Which Internet start-up will become the new Facebook, or will Facebook continue to dominate our lives, together with Google, Apple, etc.?

Entrepreneurship research cannot provide answers to all these questions. But it can pose the right questions and step by step explore what it means to be an entrepreneur. A misleading question would be: Who is an entrepreneur? Anyone can be an entrepreneur. No one is born to the job, just as no one is born a student, a manager, or priest. Everyone must grow into the role. The right question is: Can and should I think and act like an entrepreneur? Entrepreneurial cognition and actions are the subject of intensive research, not for their own sake, but in order to understand whether specific patterns of thought and action are useful for entrepreneurs. Cognition directs decision-making and action. It is fascinating to discover the specific patterns that entrepreneurs apply to make assessments and decisions. These include patterns of creating, evaluating and exploiting new opportunities. There is nothing "divine" about this creation, however, it is quite profane, such as founding a new corporation, a new business model in a quickly growing enterprise, or an innovative product in an established small, medium-sized, or even large corporation. Entrepreneurs are often rule breakers and destructive creatives in the best sense because they revolutionize established markets and create new value. By connecting private hosts and guests through the Internet, AirBnB has shaken up the hotel industry. Apple's iTunes has revolutionized the music market. To accomplish that, entrepreneurs are prepared to take on major risks and sometimes fail, more

than once, before they develop true customer value through many market experiments, often together with their customers. This approach is entrepreneurial and is worth a closer look. It is vital in creating something new in many situations of tremendous uncertainty.

What makes an *entrepreneur entrepreneurial*? And how can entrepreneurship be encouraged within corporations? These and other questions will be answered on the basis of the current findings of entrepreneurship research. We draw upon the effectuation approach, a method of thinking, decision-making, and acting in an entrepreneurial way that is both teachable and learnable. This thinking and deciding approach taken by successful entrepreneurs can also be applied in the context of established corporations. But first, it makes sense to grapple with the "style of play" involved in entrepreneurial action. The setting: uncertainty.

On the Role of Uncertainty

Many decisions in established corporations are risky. Investing in a new production line, developing a new product variant in an existing market, or reorganizing a logistic chain are based on meaningful prognostic data deployed to calculate probabilities. What is not known is researched (for example, through market research) and the risk is quantified. These risk conditions are the foundation for best and worst case scenarios which, in turn, form the basis for making risky decisions. The approach in classic management can be summarized as prognosis, planning, and action. This management method is based on an inherent assumption that "what we can predict, we can also control."

A thought experiment illustrates the difference between risk, ambiguity, and uncertainty. Imagine three boxes whose contents are not visible.

Risk: In addition to the contents of the box, you also know the exact distribution of the contents.

First, you reach into box 1. It contains red and white balls in equal numbers. Then you are asked about your willingness to draw balls from the box if only red balls are worth 100 Euros. Considered rationally, an average of 50 Euros would be anticipated.

Ambiguity:
While you know the contents of the box, the specific distribution remains unknown.

Now imagine that you are supposed to declare your willingness to pay, but you do not know anything about the frequency of occurrence of certain contents.

In classic management thinking, to the extent practicable, you would attempt to do market research to determine the distribution. In this specific example, you could observe others playing the same game and, by doing so, estimate the distribution of the valuable red balls. Due to the possible inexactness of this estimate, you will calculate a risk markdown, also a rational step. You could, for instance, decide to pay no more than 30 Euros for one draw from the box.

(Knightian) Uncertainty: The possible contents of the box are completely unknown and constantly changing.

Now try to determine your willingness to pay if you know nothing at all about the contents of the box—nothing about the balls or other contents, nothing about their distribution, nothing about the value of the contents. Even observing other players does not help in this situation of uncertainty, because all you obtain is diffuse and ambivalent information. Of course, you can completely forego taking part in the game. But what if you later learn that other players have drawn "diamonds" from the box?

In contrast, when something truly new is brought into being, we run into decisions made under conditions of a completely different character. In the 1990s, for instance, who could have made reliable predictions about the probability of success for book sales on the Internet (Amazon) or an Internet auction site, like eBay? Where do you find data about a market or customer need that do not even exist yet? What can you rely on when radically new business models are in play? For these questions and more, there is simply no basis for reliable prognosis—the odds of success when making such decisions are not only unknown, they are incalculable. Complete uncertainty reigns, in the sense that Frank Knight (1921) uses the term: there is simply no valid basis for predicting or calculating risk. Anyone looking for reliable guideposts in such circumstances will come up against incomplete and equivocal data and information that could be used to support almost any decision but which cannot ensure the validity of any.

Now let us apply the three boxes from our thought experiment above to a real world example from the business practice of an established corporation.

What we call a *risky decision* is one in which, to cite one example, an established publishing corporation publishes a technical book with a narrowly defined topic written by a renowned scientist in the field. Of course, how many books will be sold cannot be calculated exactly, but, in general, publishers are quite adept at determining the quantity of a first run. That figure is primarily based on existing data on the size of the market and what we can call a market penetration coefficient. In particular, the willingness of university libraries to buy such a volume can almost be considered a fixed quantity.

If the same established publishing corporation faces a decision on whether to publish the first novel of a young writer, however, making that decision in such an uncertain situation is considerably more difficult. While here, the corporation can also attempt to estimate the first print run, it usually comes up against its limitations.

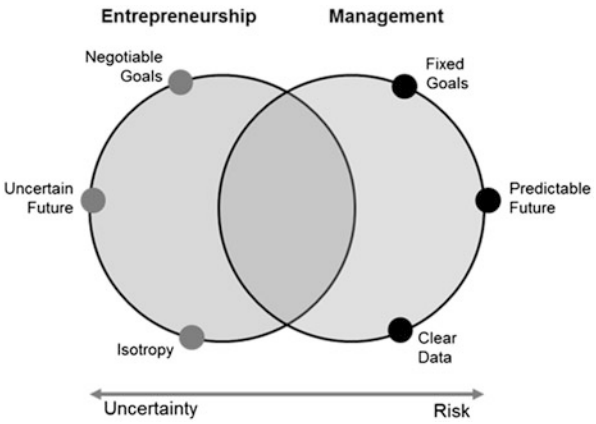

Fig. 1 Problem areas between uncertainty and risk (Faschingbauer 2013)

The result? On one hand, surprising reprint numbers on the fiction best seller list but, on the other, the costly destruction of books still in their original packaging because they could not find a market. While major publishers can balance these outcomes across their entire portfolio, several such mistaken decisions can soon result in real trouble for a smaller publishing house.

The overall direction of the publishing industry remains *uncertain*, however, in the face of new technologies. Independent publications available on the Internet that have become bestsellers without a publisher at all underscore this reality. Are e-books here to stay, will they grab a more or less long-term share of the market, or will they revolutionize the market entirely? All that remains to be seen. Publishers can now attempt to observe the market, estimate future developments and in the process develop their own position on e-books. But it is debatable how such established methods that are already stretched to their limits in uncertain situations would be effective in even more complex and uncertain situations. Are publishers not better advised to proactively join with technology partners to control the future of the e-book market themselves?

Classic goal-oriented management is at a serious disadvantage when it comes to true uncertainty, since that management approach is based on predictions and planning. Here, an entrepreneurial thinking individual has an advantage. Entrepreneurial logic foregoes the elements of predictability and planning and instead relies on what is pragmatically feasible. “Everything that we can control, we do not need to predict.” Figure 1 illustrates the problem area between uncertainty and risk.

Learn from Experienced Entrepreneurs

Experienced serial entrepreneurs are people who have repeatedly proven their ability to create something new and monetized it in uncertain circumstances.

This group of experts is particularly interesting because they have developed a specific method to get involved with something new without risking their entire survival.

Not all attempts to research entrepreneurial excellence have achieved their ends. For instance, proponents of what is known as the "trait school" spent a great deal of time trying to discover the personality traits that characterize entrepreneurs. The results were sobering. It just was not possible to categorize entrepreneurs based on their personality. Another popular explanation for entrepreneurial excellence focuses on the conditions within which people become successful entrepreneurs. Here too, it simply was not possible to deduce reliable answers to the question of what external factors drive *entrepreneurial success*.

Successful entrepreneurs are often portrayed in the media as artists with special talent and luck. They are considered to be rule breakers and unconventional thinkers who, like geniuses in other domains, may be admired, but cannot realistically be modeled—an attempt at an explanation without much evidence, and it certainly does not provide encouragement to emulate them.

Thus far, one is left with little of use from entrepreneurial heroes like Pierre Omidyar (eBay), Richard Branson (Virgin Group), or Muhammed Yunus (Grameen Bank) for one's own entrepreneurial future or business practice. For that, a change of perspective is required. The issue is not how successful entrepreneurs are but rather how they *successfully think, decide, and act* in uncertain situations.

Saras Sarasvathy, cognitive scientist and professor of entrepreneurship at the Darden Business School, University of Virginia, has published the results of a fascinating field study on just that question. She had a select group of successful serial entrepreneurs brainstorm out loud about a fictitious business idea and discovered surprising commonalities in their approach. Her exclusive test subjects all avoided market research and predictions and instead relied on exploratory action based on what was immediately available to them: their identity (who they are), their experience (what they know), and their networks (who they know).

Sarasvathy (2001) discovered that, when faced with uncertainty, experienced entrepreneurs preferred methods diametrically opposed to those of classic management. In the approach that she calls "effectuation", the future is not seen as predictable, but as something human action can control. That is the source of the name she gave this approach: to effectuate means to make something happen. Sarasvathy's study has been taken up by other researchers and her insights regarding entrepreneurial expertise have been applied in the context of existing companies as well. We will now describe the essential principles of this entrepreneurial method, including a description of an example derived from business practice, along with readings to pursue a deeper understanding of the phenomenon.

Principles of Entrepreneurial Action

Principle of Future Orientation

When there is a lack of relevant information for truly innovative products and business models, new industries or markets, experienced entrepreneurs do without predictions of the future and instead rely on actively controlling it. They direct their focus to the here and now, they take on what can be done, and they negotiate the future with other stakeholders. To do this requires that they understand themselves as shapers of the future. "I don't know exactly what the future will bring but I do know that through my actions, I can influence the direction the future takes."

When you control the future, you do not need to predict it!

The principle of future orientation describes how the future is viewed from the effectuation perspective and lays the foundation for the other principles. But how do you actively control something that eludes prediction and exact planning? And how does this mechanism function in the practice of existing corporations? We will discover the answers by exploring the following principles that together constitute the effectuation process (Baierl and Grichnik 2013; Grichnik and Gassmann 2013).

The case of **IBM Research** clearly shows the foundational assumptions of the effectual approach: creating trends and actively shaping them is much better than chasing existing market developments. That is the superior way to secure a leading position over time. This is all the more true, the more dynamic the market involved. The example of IBM illustrates the great uncertainty that dominates future developments in the IT industry. The approaching end of Moore's law, the global energy crisis in computing centers, and the explosive growth in data quantities are three outstanding examples of the inherent uncertainty of this market. These are all the more reason that this market environment demands an entrepreneurial approach, as evidenced in the Global Technology Outlook or the Industry Solutions Lab workshops. Here the future is thought through and controlled, together with others.

The "Grand Challenges" which explore future trends in IT and create new markets and application possibilities, clearly illustrate this same basic attitude toward the future. The example of bionic-inspired refrigeration demonstrates how a market can be created, a market that just a few years earlier would have been dismissed by many experts. To summarize, IBM Research is less about classic trend scouting and more about actively controlling and creating their own trends that have had market-wide, even worldwide, impact.

The Principle of Means Orientation

When someone in a corporation wants to start a project, they typically start by formulating a clear goal. In classic business management, it is customary to argue for those goals and proceed on that basis. First the goal, then the means and the

ways to achieve that goal as quickly, economically, and safely as possible—in other words—efficiently. An approach with good prospects to succeed with problems in risky conditions but one that runs up against its limits in conditions of uncertainty. How can a clear goal be defined for a future that is largely uncertain?

Start with the means at hand—who you are, what you know, and who you know—and not with some "mythical" goals!

Experienced entrepreneurs do not start by defining a clear goal, but rather take their initial orientation from the means they have at hand. Results are sought that can be realized with existing abilities, resources, and networks, through their own efforts. The decision on what specific results to aim for will be based on personal preferences (identity, values, culture). Feasible goals serve as a point of orientation in order to take action and not as the definition of what must be achieved. That makes it possible to design highly innovative products, processes, and business models. The starting point of entrepreneurial action is the means, not the (resulting) goals.

To be able to concentrate on the means available in a business context, even organizational changes can sometimes be very helpful. The New Business division at **Giesecke & Devrient** (G&D), specialists for demanding security technologies, shows how the technological knowledge and market-specific know-how of people working on the project can be bundled by creating a new division on an equal footing. If this is supported by the entire organization's reputation, an internal incubator for innovation can ensue, based on the means available. At G&D the whole corporation's mission—ensuring secure transactions and authenticity of identities and values—forms the foundation of all entrepreneurial activities. Without providing the specific target product but instead developing and implementing the direction of new business ideas, real innovations can be created on that foundation. In this way, G&D shows how the orientation based on available means can be implemented in the context of an established corporation. "Make something out of your own resources!" may be the daily motivation for people working in the New Business division—knowing that they are not operating in a vacuum. That's how innovations are created on a highly regarded foundation at G&D.

The Principle of Affordable Loss

When managers have to choose among a number of possible actions, they usually ask "What will we get out of that?". Only projects with high anticipated value will be undertaken. In order to estimate that value, trend analyses, market research data, and predictive data all go into producing present value calculations. This is the approach to making solid investment decisions in stable conditions that allow for such planning. But where to begin when something radically new is involved? What present value calculations would have resulted in Post-it notes from 3 M, search engines such as Yahoo and Google, social networks like Facebook, or smart

phones like those by Apple—before these projects were launched and before markets for them even existed? And what certainty does a calculation based on uncertain assumptions provide those who must act on it in any case?

Base your planning on the affordable losses, not on the expected return!

Successful entrepreneurs have learned from experience that, in the end, it is just not possible to predict earnings from projects marked by such uncertainty. So they simply do not waste their effort trying to attach risk numbers to their actions and instead set definite limits on what they themselves have at hand: what they are prepared to invest. The rule on deciding for or against a project is thus "What can we afford to lose?". Depending on the starting point, affordable loss may be defined in terms of money, time, attention, effort, or even in opportunity costs. This way of thinking defines the leeway for action ("up to there. . .") and the cut-off criterion (". . .and no further") for entrepreneurial projects. Affordable loss as a criterion for such a decision leads directly to exploring activities in small steps. It can be applied to small everyday decisions ("Is this worth a meeting?") to major projects ("Do we want to put our efforts into a 12-month pilot project?").

Investments in high tech start-ups are extremely risky, prospects of success can barely be predicted in advance, and in fact only few start-ups result in successful market launches. In this environment, **Zühlke Ventures** follows the principle of affordable loss in making its investments. In its first few years, the Zühlke Group provided capital for investments according to a clearly defined formula: total investment for the year after next depends on free cash flow, that is, from cash that is actually on hand. This defines the lower limit of the maximum permissible loss. Zühlke Ventures' goal of being self-financing in subsequent years underscores the aim of using these funds consciously and taking losses only in the worst case. This basic approach is reflected even in everyday operations at Zühlke Ventures: What expenditure is acceptable for an evaluation of the start-up that is applying? What total amount can Zühlke Ventures invest? What amount would Zühlke Ventures be prepared to lose in the worst case? The principle of affordable loss answers all these questions, not least because an orientation toward anticipated or desired profit is not constructive in this highly dynamic and uncertain environment. As a consequence, promising opportunities exist in relation to this uncertainty. If an innovative high-tech corporation does indeed succeed, the return on investment for Zühlke Ventures can amount to quite impressive sums.

The Principle of Contingencies

Once a project has been defined by a clear goal, managers take care to ensure that as little as possible is left to contingencies. Risk management is deployed to attempt to exclude all foreseeable disruptions and to protect the project against surprises. Once the project has been carefully planned, almost anything unexpected is viewed as a disruption of the plan and a possible diversion from the goal that has been set.

Make use of contingencies, accidents, and the unplanned as an opportunity rather than attempting to corral them.

Experienced entrepreneurs have recognized that accidents and the unexpected often bring innovation with them. Where managers will attempt to exclude accidents, entrepreneurs strive to give the unexpected a chance. It should be noted that here accident has a neutral connotation and only becomes "lucky" or "unlucky" by how it is handled. Sometimes that means flexibly adjusting goals when circumstances change or an accident occurs in the form of events, new information, or unintended contacts. The latter enrich the entrepreneur's inventory of means available and expand the target portfolio.

3 M illustrates impressively how employees who think and act entrepreneurially can actively incorporate accidents and achieve a positive 'accidental return on investment'. This makes it possible to consciously build in true entrepreneurship into an innovation process that must be solely goal oriented due to the character of the process. Using multiple technologies and access to technology information across platforms, the know-how and diversity of all employees in the corporation can be accessed. This means that accidents can be put to positive use. There is hardly another success story that has been told as many times as the story of Post-it notes, the core message of which still characterizes the process of innovation at 3 M today. A culture of positively approaching false starts, paired with effective information flows, is the source of this widely used and extremely successful product for office and at home. 3 M's unique culture of innovation is also evident in their pigeon prevention spikes. At 3 M, an idea that fails is better than one that is not tried. The troika of opportunity—openness—flexibility forms the framework for successfully making use of accidents, contingencies, and surprises, all of which are really unavoidable in uncertain innovation situations.

The Principle of Partnerships

Every business undertaking needs partners. No corporation gets along without stakeholders such as customers, suppliers, peers, employees, and even competitors. But how can this network of stakeholders be developed for something new and innovative? According to classic management and for projects under risk conditions, it makes sense to search for the optimal partner. This involves maximizing returns by selecting the *right* customers, suppliers, employees, etc., and by excluding the *right* (according to your analysis) competitors. Customers are selected according to the process of "find a need and fill it." This type of network development resembles putting a puzzle together, where each piece has a specific shape which defines its place in the overall picture.

Negotiate the future with your partners! Make agreements and form partnerships rather than excluding them or searching for the *right* partners!

In uncertain projects without fixed goals, there is little basis for the early optimization of a network of stakeholders. There is not the kind of information

corporations need in order to decide who the *right customer* is. And there is little rational basis to determine who to take on board as a partner or exclude as a competitor. So, experienced entrepreneurs do not start out attempting to optimize their network of partners, instead they look for those who are prepared to make a contribution at this early stage. These are the people they take on board and then negotiate the future together with them. Network development in this process looks more like knotting together agreements than putting together puzzle pieces. Since the whole does not yet exist, the point is to explore intentions and means as openly as possible, so that others can get connected and something innovative can come alive through the combination of means. Entrepreneurial partners contribute their means and cooperatively help determining goals.

The significance of internal and external partnerships for the success of an innovative product is particularly evident in the story of **BMW MINI Connected**. Right from the start, local technology leaders and start-ups were brought in as the core idea was developed in BMW's Technology Office in Palo Alto. These included a partner from the mobile communications field, a search that was strongly supported by internal promoters. The partnership approach in developing MINI Connected was also evident in the creation of an interdisciplinary team that was given wide-ranging decision-making powers. Based on a new app store concept, independent corporations and external partners were able to provide interesting applications and functions for MINI Connected. Some apps were jointly developed by MINI and established Internet corporations and start-ups. Even marketing for the MINI was on a partnership footing: by working together with experts from outside the automotive industry, it was possible to better identify customer needs in this new market segment. In a nutshell, the integration of outside partners was vital to the success of the project in no small part because the various stakeholders themselves made a strong commitment to it. At the same time, internal partners helped to achieve success for this cutting edge project within a narrow timeframe. All in all, harmonious cooperation among all the internal and external partners is considered critical for success.

From Action Principles to an Entrepreneurial Method

The Classical Management Process

As the preceding examples show, we find the elements of entrepreneurial activities in many advanced corporations today. The principles of an orientation toward the future, using means at hand, of affordable loss, making use of accidents and contingencies, and the element of controlling the future with self-selected partners are evident in countless stories of successful innovations. In order to consciously and systematically apply entrepreneurial expertise, however, a process is needed that combines the individual elements into a sequence of step to guide action.

Only such a process can transform diffuse elements into a method directly applicable in practice so the potential for innovation in start-ups and established corporations alike can be unleashed.

The traditional management approach in risk environments is well known and widely applied successfully as a method. As a rule, it begins with an idea for a project that is the basis for extensive analysis that sheds light on the given conditions, trends, markets, and target groups. Based on the predictive data assembled, a decision is made as to exactly what for exactly whom exactly when should be done. The clearly defined goal serves as input for planning the path to that goal and supplies information about the resources required. If this is successfully supplied in the form of a budget, it is then up to management to organize the implementation of the project.

This classical management process even works in the kitchen. Someone who wants to entertain guests on a Saturday evening must decide what exactly he or she will buy and cook, and for whom and when. A recipe says which ingredients are needed and how to proceed so that the results can be served. This is the pattern not only for preparing meals but for making investments, delivering customer projects, improving products, and marketing products with incremental innovations. It leads to success anywhere that the environment is stable and conditions are predictable.

The Process of Entrepreneurial Activity

The process of entrepreneurial activity is also familiar in the kitchen (see Fig. 2). However, it starts with checking the refrigerator and the pantry. Then ideas are

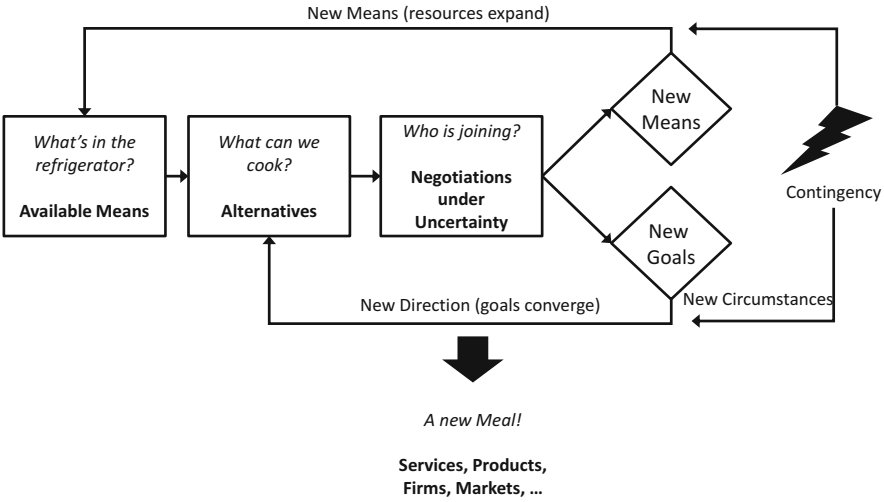

Fig. 2 The process of entrepreneurial activity according to Grichnik et al. (2010) and Sarasvathy & Dew (2005)

generated about what can be prepared given what is available. Personal tastes and cooking ability determine the direction the meal will take. Beyond that, the taste and materials provided by others who will share in the meal can also be included. In this process too, you must be able to cook the food, and a delicious dinner results. The odds that it is something new and really innovative are considerably better with the entrepreneurial approach, however.

The entrepreneurial method does not begin with the search for brilliant ideas, but rather by taking stock of the means available—who we are (identity, culture, values, preferences), what we know (abilities, skills, know-how, technologies) and who we know (socially and individually as well as internally within the corporation and networks beyond it). All that tells us what we could do (feasible but vague goals). This is the basis for interactions with internal and external stakeholders. Our own means and intentions are disclosed so that others can come on board. Here, that means entering into agreements, for instance, in the form of their own capital. A larger pool of resources opens up new possibilities, and a more ambitious "recipe" can be prepared. Some stakeholders are only willing to come on board and make contributions when they have an opportunity to influence the direction of the project. Goals are then renegotiated for the joint project and the focus becomes sharper. Through a number of such steps, new, highly innovative goods, services, corporations, and even entire industries and markets are born.

The Interplay: Entrepreneurial Management

Until now, we have acted as if classic management approaches and the entrepreneurial method of effectuation were mutually exclusive entities. Now we must point out two anomalies:

1. There is almost nothing in entrepreneurial life that can be categorized clearly as black or white. Reality is much more complex. So in that sense there can hardly be an "effectual" corporation or its opposite, a "causal" corporation. Nonetheless, it is possible to distinguish whether a corporation tends more or less toward an effectual approach to innovation. Similarly, it can be shown that more effectuation in a corporation's reality makes it more innovative, competitive, and agile while it also significantly improves the odds of survival for an established corporation today and in the next generation and the one after. These methods support each other, flow together, and are in fact interwoven. What makes implementing the entrepreneurial method more difficult in practice, however, is the fact that in many corporations there is just no accepted vocabulary for it. Even those engaged in entrepreneurial projects often have a hard time expressing exactly why they do what they do. In the conference room, they sometimes have to rely on terms like "gut feeling" and "intuition" or improvisation, up to and including even the less well-regarded "muddle through".

2. It can often be difficult to even precisely describe and fully characterize what is entrepreneurial about successful businesses. The same can be said about entrepreneurial businesses: What makes this particular corporation agile, innovative, flexible, and vital? The effectuation approach offers five elements that provide easier access to this complex phenomenon, the action principles that make it possible to describe what is entrepreneurial about both entrepreneurs and corporations. The question of the connections between and among these action principles remains open. But it is certain that it is hardly possible to identify this at the level of the individual principles, just as there is no black/white thinking at the aggregate level either. Once again, these principles are not pieces in a puzzle that must fit together perfectly. This is no simple addition problem but rather there are almost an infinite number of possible combinations. To that extent, different variations of the principles cannot simply be added up to arrive at an "effectuation score". Not unlike a good spice mix, it does not depend on more of each ingredient but rather the right balance of all of them.

In practice, a great deal of attention is paid to the question of when effectuation should be preferred over classic management and in which instances it is better to use the new toolbox as a supplement. It can be shown in many examples in which phase of the project effectuation gives the greatest benefit—right at the beginning, or to put it in more determinist terms, when uncertainty is greatest.

The more uncertainty can be reduced through market information and the more predictable the future becomes through that process, the more sense it makes to supplement the process with classical management and planning methods. As already pointed out, entrepreneurial thinking and management thinking are not mutually exclusive but rather can and should be implemented in combination—with the proper emphasis depending on the degree of uncertainty (see Fig. 3). Goal-oriented planning and exploratory entrepreneurialism according to effectuation run parallel as core processes so that, depending on the environment, more emphasis can be placed on one or the other.

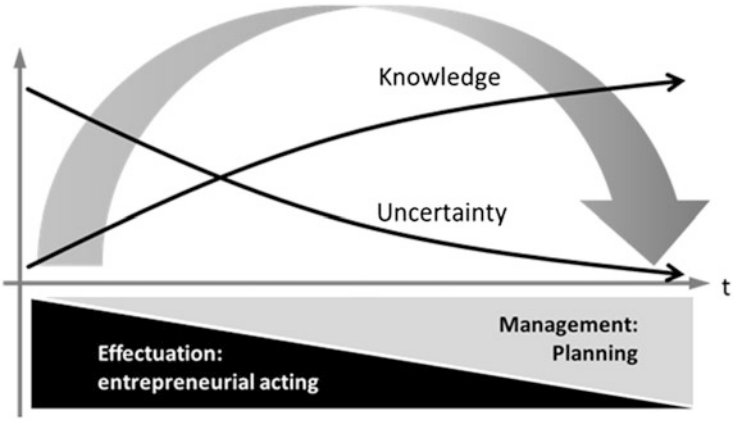

Fig. 3 Life cycle of an entrepreneurially-driven project according to Faschingbauer (2013)

References

Baierl R, Grichnik D (2013) Effectuation in etablierten Unternehmen. Die Handlungsprinzipien in der unternehmerischen Praxis. In: Grichnik D, Gassmann O (eds) Das unternehmerische Unternehmen. Springer Gabler, Berlin, pp 67–81

Faschingbauer M (2013) Effectuation. Wie erfolgreiche Unternehmer denken, entscheiden und handeln, 2nd edn. Schäffer-Poeschel, Stuttgart

Grichnik D (2012) The ten myths of entrepreneurship. Video on http://www.youtube.com/watch?v=qaXuHlRqTes. Accessed 18 Mar 2015

Grichnik D, Gassmann O (2013) Das unternehmerische Unternehmen. Springer, Berlin

Grichnik D, Brettel M, Koropp C, Mauer R (2010) Entrepreneurship. Unternehmerisches Denken, Entscheiden und Handeln in innovativen und technologieorientierten Unternehmen. Schäffer-Poeschel, Stuttgart

Grichnik D, Baierl R, Faschingbauer M (2016) Entrepreneurship: Gestalten der unsicheren Zukunft mit der unternehmerischen Methode. Elemente und Zusammenspiel unternehmerischen Denken und Handelns. In: Hoffmann C, Lennerts S, Schmitz C, Stölzle W, Uebernickel F (eds) Business innovation: Das St.Galler Modell. Springer Gabler, Berlin

Knight F (1921) Risk, uncertainty and profit. Houghton Mifflin Company, Boston, MA

Sarasvathy S (2001) Causation and effectuation: towards a theoretical shift from economic inevitability to entrepreneurial contingency. Acad Manag Rev 26(2):243–288

Sarasvathy S, Dew, N (2005) New market creation through transformation. J Evol Econ 15(5):243–288

"Making Is Thinking": The Design Practice of Crafting Strategy

Claus D. Jacobs

Abstract Strategic thinking involves a creative, divergent and synthetic mindset and associated practices often seen as a useful way to achieve direct involvement in strategizing processes, as well as highlighting sensitive organizational and strategic issues that challenge conventional planning. How can we make strategic thinking, as a core component of organizational strategy, work more effectively? Firmly grounded in Richard Sennett's cultural materialist approach on crafting, this chapter offers a conceptualization strategy work as design practice of crafting embodied metaphors. The chapter demonstrates the approach with a case example of CellCo's postacquisition sensemaking and concludes with discussing benefits of strategizing as a design practice.

Keywords Cultural materialism • Strategy work • Metaphors

"Making Is Thinking": The Design Practice of Crafting Strategy

Strategic *planning* has been associated with a rational, objective, structured, analytical, convergent mindset and associated practices that most organizational members consider abstract and distant from their daily work. Strategic *thinking*, on the other hand, involves a creative, divergent and synthetic mindset and associated practices (Heracleous 1998), often seen as a useful way to achieve direct involvement in strategizing processes, as well as highlighting sensitive organizational and strategic issues that challenge conventional planning. While the technologies and frameworks of strategic planning—despite their shortcomings (Mintzberg 1993)—have been highly developed and refined over time (e.g. Ansoff et al. 1976), the creative processes of strategic thinking remain a fragmented, underspecified group

This chapter draws on Heracleous and Jacobs (2011), Jacobs et al. (2013), and Jacobs and Heracleous (2007).

C.D. Jacobs, PhD (✉)
Center of Competence for Public Management, University of Bern, Schanzeneckstrasse 1, 3000 Bern, Switzerland
e-mail: claus.jacobs@kpm.unibe.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_9

of approaches with no clear connections to strategizing processes. How can we render strategic thinking more effective as a core component of strategy work in organizations?

A Cultural Materialist Perspective on Design

While we traditionally associate craftsmanship with a pre-industrial, manual worker involved in making singular objects, such as a medieval carpenter, US-American sociologist Richard Sennett refers to craftsmanship more generally as "the skill of making things well" (2008, p. 8). In his compelling analysis, he defines craftsmanship as "an enduring, basic human impulse, the desire to do a job well for its own sake" (2008, p. 9). Such an impulse is not limited to manual workers, but also resonates for people in diverse occupations, like contemporary artists, doctors, architects, designers or computer programmers. Skill, commitment and judgment of intimately connecting hand and head are crucial to understanding craftsmanship in this broader sense: "every good craftsman conducts a dialogue between concrete practices and thinking" (2008, p. 9). However, several fault lines seem to have arisen between theory and practice, technique and expression, craftsman and artist, as well as designer, producer and user. In social science, these, in turn, have resulted in prioritizing mind over body, head over hand and subsequently, cognitive over manual work (2008, p. 11). To counter this development, Sennett proposes a "cultural-materialist" approach by asking "what the process of making concrete things reveals to us about ourselves" (2008, p. 10). He operates on two premises: that "all skills, even the most abstract, begin as bodily practices" (2008, p. 10), as well as "that technical understanding develops through the powers of imagination" (2008, p. 10). While the first premise emphasizes the connection between hand and head, as well as the knowledge created through touch and movement, the second premise suggests that imagination and creativity mainly develop through, and are triggered by, the use of incomplete tools or objects (2008, p. 10). In following Sennett's broader notion of craftsmanship as an ethos of making things well, an individual's engagement with a specific task at hand is then mainly driven not through instrumental, but rather through practical reasoning—supporting the effort of making things well. Moreover, the motivation then is intrinsic and the rewards are emotional in nature. Like anchoring in tangible reality and taking pride in one's work. Work ethics, rather than extrinsic rewards, drive the individual's commitment to quality and its improvement: "the aspiration for quality will drive a craftsman to improve, *to get better* rather than *to get by*" (2008, p. 24; author's emphasis).

When emphasizing the relevance of our bodily experience when planning and designing, Sennett illustrates the consequences of a disconnect between hand and head by drawing on a widely used electronic design and architecture tool, namely computer-aided design (CAD) which allows architects to instantaneously draw and design buildings of any shape; to zoom in and out; and to rotate in 3D, as well as

to amend the size. Traditionally though, architects had sketched and drawn the design of a building, and would subsequently build a physical model. The architect learned and explored the territory and its affordances through drawing and physically constructing. Quoting a young architect from MIT: "When you draw a site, when you put in the counter lines and the trees, it becomes ingrained in your mind. You come to know the site in a way that is not possible with the computer . . . You get to know the terrain by tracing and retracing it, not by letting the computer 'regenerate' it for you" [Turkle (1995), quoted in Sennett (2008, p. 40)]. On the same note, renowned architect Renzo Piano emphasizes the crucial quality of the 'recursive journey'—visual and manual practice in design work: "You start sketching, then you do a drawing, then you make a model, and then you go to reality—you go to the site—and then you go back to drawing. You build a kind of circularity between drawing and making and then back again" [Robbins (1994), in Sennett (2008, p. 40)]. In other words, architects explore the possibilities of the territory and the building when sketching, much more effectively and closely than through software. In addition, CAD risks glossing over potential detail problems that the software simply cannot detect—but an experienced architect would. While CAD might enable faster virtual modeling, it cannot substitute for the tactile and bodily experience of sketching, drawing and exploration of a physical model. In acknowledging the usefulness of machines such as CAD, Sennett concludes that if head and hand are disconnected, the intended outcome of such design effort may not be as inspiring, or inspired, as when the head and the hand are integrated.

As strategists, what can we learn from Sennett's cultural materialist reflections? First, we can deduce two fundamental premises: to conceive of strategy work as a form of craftsmanship bound to the ethos of doing things well and to strive to conceptualize and mobilize our bodily and tactile faculties even better when designing our organization's strategy. Furthermore, as a direct consequence of these two premises, we can deliberately probe the role of bodily experience in strategy development. If all skills (including the most abstract, such as strategy) are ultimately rooted in our bodily experience and in hand movement, how can we utilize such insight when designing strategy? In a related observation, we might deliberately find inspiration in the physical design practice of architects, who clearly involve a material representation of the planned object in their design development. Also, while analytical, deductive planning practices are acknowledged, we should seek to close the artificial separation between hand and head in strategy work. Thus, might a closer linkage between hand and mind, in terms of constructing physical analogues, be productive for strategy work? Furthermore, if the hand is a window on to the mind, how can we better involve manual practice in the development of strategy? What processes and technologies are, or should be, involved? If designers and architects find imagination through engaging with, and reformatting of material objects, which material objects could be constructed, examined, and reformatted to spark the strategist's imagination? And last but not least: how can strategy work be conceptualized and informed by design practice?

A Design Perspective on Strategy Work

Viewing strategizing as a process of design is, in essence, a metaphorical gesture using knowledge from a source domain (in this case, Design Thinking), then mapping it onto a target domain (in this case, strategy work), with the aim of gaining insights on the target domain. Viewing creative strategizing as design can shed light on how strategy work is accomplished in organizations.

According to architect Bryan Lawson (2006), there is little consensus in the design field about what the term "design" actually means. Both a noun and a verb, design can refer to an end product, as well as to the processes involved. A variety of professions employ the term "design"—each with a different interpretation. On one hand, a structural engineer might refer to design as a systematic, quasi-scientific sequence of steps describing the requirements and desired specifications of the end product; a fashion designer engaged in next season's collection can also refer to a fluid, open-ended, inspirational practice as design. While these two professions exemplify extremes of a design continuum, for our purposes, we will draw on the design field of architecture that integrates systematic with imaginative thinking, as well as related technical skills. This design domain is also most relevant to involving physical objects in the design process.

In spite of the fragmented nature of the design field overall, particularly architecture, Lawson (2006) attempts to provide an integrated model of the design process consisting of six stages outlined briefly below. We then discuss how these six steps might relate to conventional, analytical strategic planning, as well as more creative, synthetic strategy work in organizations.

First, designers must be capable of effectively identifying, stating, understanding, exploring, and providing structure to ill-structured design problems—a step called "formulating". They should also be capable of framing and examining these problems from different points of view and perspectives. In particular, the ability to generate stories to reframe issues is key.

Then, designers employ various techniques and materials to externalize their ideas and thoughts as to "represent" the issue at hand. This might take the form of models, sketches or prototypes. Importantly, these are created through a variety of media, including drawings, computer models or tangible three-dimensional entities. These physical representations are not simply outcomes of an abstract thought process, but are seen as essential inputs to a conversation about the representations and ideas they embody.

Third, designers create solution ideas, or moves, relevant to a design problem—Lawson (2006) refers to this stage as "moving". They distinguish between lateral design moves (the extension of an existing idea or its application to a new setting) and vertical design moves (the development of a novel idea). Interestingly, in anticipation of later stages of the process, designers also develop initial experimental ideas about solutions early on and sometimes even before they have fully understood the problem.

Designers often do not explicitly draw a hard line between problem and solution, since they consider these to be intertwined—thus "bringing problems and solutions together" is the next stage in the overall process. Furthermore, in design practice, problem and solution rarely follow a clear, linear sequence (Lawson 2006). In contrast to a universal route map of design process, briefing (making sense of the issues and challenges at hand) is a continuous, recurring element, rather than just the first sequential step of design. Finally, great designers are capable of developing parallel lines of thought about the problem–solution situation. Especially this skill involves maintaining a sense of ambiguity and fluidity and not getting too concerned about the single right answer or silver bullet during the process. The narrative, storytelling capability of designers to integrate problem and solution into a relatively coherent story is important here.

Designers often have to judge between alternatives along dimensions where no common, universally accepted, "objective" metric is available—yet "evaluation" is necessary. Thus, designers must be capable of integrating objective/technical and subjective/aesthetic judgments in making choices among competing designs. One of the key skills in this context is the ability to temporarily suspend judgment so as to maintain the creative flow. In effective design, ideas often reach a level of maturity before they are subjected to robust criticism.

Ideally, designers are capable of "reflecting" *in* action—a skill that is, of course, required for the above dimensions as well. But great designers are also able to reflect on action—on how they go about the design process itself, on the design philosophy and guiding principles they follow; a process analogous to what Argyris (1977) referred to as double-loop learning. Skilled designers draw dramatically on episodic evidence, for example by keeping sketchbooks or collecting artifacts reflecting what they consider to be good design, and can integrate these precedents and references into their design process.

If we mobilize these six generic stages of the design process to reflect on traditional more progressive strategic practices, we can see both the limitations of traditional strategizing as well as the opportunities we might gain through strategizing as design practice. Table 1 summarizes these considerations.

A Design Practice for Strategy Work: Crafting Embodied Metaphors

Crafting embodied metaphors is a design practice for strategy work that complies with many guiding principles derived from our reflections so far (Heracleous and Jacobs 2011). Based on the serious play technique developed in the late 1990s (Roos and Victor 1999), it uses three dimensional objects (construction toy materials) to engage organizational actors, or strategists for that matter, in an exploratory, yet structured, process of designing physical models of rather abstract and hairy issues in strategy development. Occasions for crafting embodied metaphors

Table 1 Design Thinking, traditional and progressive strategy work (adapted from Heracleous and Jacobs 2013, p. 10)

Key stages	Design thinking	Limitations of traditional strategizing	Opportunities of strategizing as design practice
Formulating	Identifying, naming and structuring ill-defined design problem	Conducting rational, systematic analysis drawing on convergent thinking and tools	Exploring alternative, creative and divergent perspectives on strategic issues
Representing	Employing various modalities, materials and prototypes to externalize ideas and thoughts	Employing typically mono-modal, conventional strategy frameworks, such as 2×2 matrices	Employing various modalities and materials to enable subconscious understandings to manifest in the representation of the issue at hand
Moving	Developing preliminary ideas about solutions very early on	Strategic frameworks used imply corresponding evaluations and "prescribed" solutions	Potential solutions emerge throughout design process, but are less well structured
Bringing problems and solutions together	Seeing problem and solution as interconnected and not imposing a linear order	Dominant, pre-existing understandings and rationalist frameworks foster sequential, linear, discrete-terms thinking	Process allows for maintenance of ambiguity and encourages parallel lines of thinking
Evaluating	Judging and selecting among alternatives where no universally accepted metrics exist	Decisions ideally based on objective metrics (e.g. projected return on investment and profitability impact)	Privileging non-metric, holistic, divergent thinking and encouraging aesthetic judgment
Reflecting	Reflecting in action Reflecting on action	Reflection remains within the boundaries of the strategic paradigm	Reflection as a core, implied component of the process

range from exploring a company's strategic landscape (Buergi et al. 2005) via post-acquisition sensemaking (Heracleous and Jacobs 2008a, b) and ex-ploration of a new go-to market strategy (Jacobs and Heracleous 2006, 2007) to diagnosing organizational identity beliefs (Jacobs et al. 2013).

The generic process involves 6–12 participants in designing first individual, then collective models of strategic issues. Often, participants first build individual models of the organization, debrief and inquire into them in plenary as to then integrate these in a single model. Second, crucial players in the organization's landscape are individually, then collectively constructed and positioned. Ultimately, this physical configuration of the organization in its competitive landscape provides ample opportunity to probe different aspects and scenarios for strategy work. For more details, see Heracleous and Jacobs (2011).

Strategy Work as Design: Making Sense of Post-Acquisition Integration at CellCo

In 2000, CellCo was the fastest growing of the three largest players in its domestic market, with a market share of nearly 25 %, and an image of a dynamic, innovative and unconventional company. Then two strategic changes impacted the company and its business landscape. First, CellCo purchased a domestic 3G license through competitive bidding, financing this purchase through huge debt. Second, shortly after making this purchase, CellCo was acquired by FixCo, a large, European competitor that was market leader in its own domestic market. FixCo subsequently decided to create a new organizational entity called "CellCo Global", and place CellCo—as well as FixCo's entire international mobile telephony operations—into this new entity to benefit from CellCo's superior brand recognition.

Despite assurances by FixCo that CellCo Global would retain a high degree of autonomy, CellCo Global's management team was highly concerned that the acquisition would have an impact on the company's strategic direction and operational priorities. During a 2-day retreat, eight managers of business operations divisions—the division head and his direct reports; four male and three female—explored and built a shared view of the adjusted, post-acquisition business landscape of their respective domains.

The group's final embodied metaphor portrayed CellCo as a castle, the most recent conquest of the "FixCo Empire". A previously strong, defendable fortress had become vulnerable and been conquered—with its members now taking orders from the conqueror, the new owner of the castle (Fig. 1).

To elaborate, the 'target domain' of the mapping consisted of CellCo as an organization. To make sense of CellCo's current status, participants' discussion led them to draw on the source domain of a 'conquered castle'. This mapping resulted in emergent new meaning, and its "fit" was appreciated by participants, as it represented the issue of bygone strength and autonomy in the acquisition process.

On entering the CellCo 'castle' through a castle gate entrance with CellCo's brand icon on top, symbolizing the organization's image to the world, business functions such as call centers or customer service were portrayed as disconnected platforms to represent their lack of organizational alignment or co-ordination. A call center was portrayed as six call center agents working at their PC's, where a person figure wearing a crown and a whip symbolizing strict, authoritarian management represented the call center manager. The central castle square hosted the "heart" of CellCo's service, the mobile network.

A white tower hosted several person-figures with black hats, all in the same posture and facing in the same direction, to represent the accounting department—and the renewed emphasis on the re-affirmed dominant business logic of shareholder value, after the acquisition. The accounting function was portrayed as a remote, yet powerful, politically ambiguous, uniform and faceless activity in CellCo.

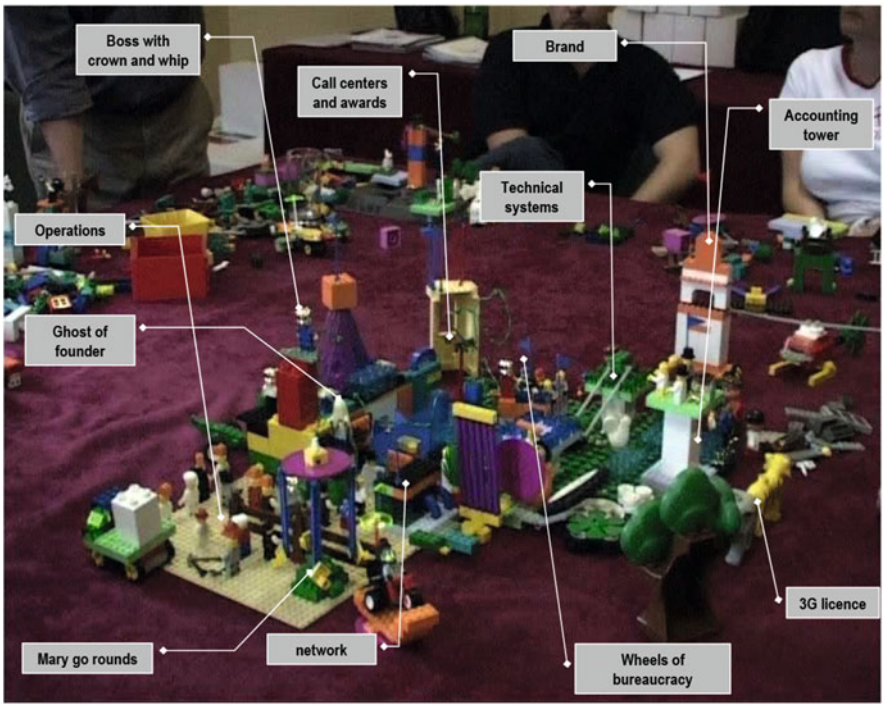

Fig. 1 Strategic design work at CellCo (Jacobs et al. 2013, p. 11)

The brand that had driven CellCo in the past was symbolized by a tall, mobile lighthouse on wheels, deliberately positioned outside the castle walls. While the brand was still relevant and influential, it was somewhat remote and disconnected. Also outside the castle was a set of scattered grey bricks, representing a "grey invasion" of bureaucracy and business logic in CellCo. On the castle square was a set of disconnected wheels also representing dysfunctional bureaucracy. Close to them, yet outside the castle, were two animal figures: an elephant and a tiger, facing opposite directions, representing the perceived ambiguity and risk of the 3G license purchase that could either turn out to be "an elephant around our neck" or as a "tiger of growth".

Next to the castle's main compound was an annex building located on a smaller platform. It hosted a set of upward facing purple tubes representing "projects in the pipeline": yet unused, since they were not physically connected to any of the functional domains. An unpopulated carousel with yellow seats (merry-go-round) represented the potential and (past) fun of working in the organization. Next to the carousel and, by far, the largest population in this annex building was a "herd" of person figures symbolizing members of operations staff. They were all positioned within a fenced area, facing different directions, thus indicating a lack of direction and coherence. While some of them wore brand icon hats, others were "brandless", thus considered outsiders who were nevertheless inside.

On top of a pyramid-type construction, representing formal hierarchy was a person figure wearing a crown and a whip with his back to the team, representing the head of business operations. This authoritarian figure did not wear any brand icons at all, also symbolizing a certain foreignness relative to "branded" members of the organization. On the bottom of this winners' podium, on the same platform as operations staff, was a ghost figure, "the ghost of the founder", symbolizing the founder's image at an earlier time as "one of the lads".

The above compound metaphor 'authored' by participants lends itself to a detailed strategic diagnosis of organizational identity beliefs that prepared the ground for the following, more conventional process of CellCo's strategy work. For instance, the portrayal of CellCo as having lost its former strength and autonomy—do participants believe that CellCo lost a *central* feature? Similarly, portraying the lighthouse as a peripheral feature of the compound metaphor—has CellCo lost a *distinctive* feature? Also, representing the founder as a ghost and the bygone fun as empty merry-go-round—have these features not endured as participants had hoped they would? Such questions were further probed in dialogue with participants to gain further insights on why participants were feeling as they did, and what might be appropriate directions for the future—which is ultimately at the core of any strategy work.

Benefits of Strategizing as Design Practice

Strategizing through design allows companies to address a wide range of strategic challenges, which are built into the brief for the process. For instance, when a mobile telephony's strategy team reviewed the implications of their recent acquisition by a main state-owned competitor, they realized (thus far) neglected, impending competitive threats, which, in turn, triggered a critical reflection on the firm's brand positioning. When engaging in design processes after being split over the strategic relevance of their company's after-sales activities, senior management team of a food packaging firm appreciated their relevance and subsequently discussed strategic options for developing world-class after-sales processes. Finally, a newly formed, poorly-integrated regional management team of a global software firm was able to start defining a shared identity and platform for debating differences as a basis for improving future lateral collaboration.

What all the above examples have in common is that the process of design-based strategy work enabled them to address pressing strategic issues in a productive manner. Thus, strategizing through design can deliver insights and potential shifts in managers' mindsets by providing a context where senior teams can surface and debate contentious or critical management issues, by "concretizing" these issues into "embodied metaphors" (or some other artefactual representations) imbued with meaning and that can be debated from a variety of perspectives. Precisely this potential to conjure rich imagery and stories triggered by the models facilitates the development of a memorable shared language for the future that can even feed into

and inform more formalized forms of strategizing. Furthermore, strategizing as design practice creates a sense of involvement and ownership that not only facilitates effective team building among senior managers, but also aids implementation of the directions that emerge from the debates. Such a process can also help in identifying necessary revisions in strategy, in the implementation plan, or even highlight the need to garner political support before any initiatives. Since the process tends to bring surface dissonances, rather than (false) consonances to the surface, strategizing through design helps identify potential road-blocks to effective strategy implementation.

References

Ansoff HI, Declerck RP, Hayes RL (1976) From strategic planning to strategic management. Wiley, London

Argyris C (1977) Double loop learning in organizations. Harvard Business Review 55(5):115–125

Buergi P, Jacobs C, Roos J (2005) From metaphor to practice in the crafting of strategy. J Manag Inq 14(1):78–94

Heracleous L (1998) Strategic thinking or strategic planning? Long Range Plan 31(3):481–487

Heracleous L, Jacobs C (2008a) Understanding organizations through embodied metaphors. Organ Stud 29(1):45–78

Heracleous L, Jacobs C (2008b) Crafting strategy—the role of embodied metaphors. Long Range Plan 41(3):309–325

Heracleous L, Jacobs C (2011) Crafting strategy—embodied metaphors in practice. Cambridge University Press, Cambridge

Jacobs C, Heracleous L (2006) Constructing shared understanding—the role of embodied metaphors in organization development. J Appl Behav Sci 24(2):207–226

Jacobs C, Heracleous L (2007) Strategizing through playful design. J Bus Strateg 28(4):75–80

Jacobs C, Oliver D, Heracleous L (2013) Diagnosing organizational identity beliefs through eliciting complex multi-modal metaphors. J Appl Behav Sci 49(4):485–507

Lawson B (2006) How designers think—the design process demystified, 4th edn. Architectural Press, Oxford

Mintzberg H (1993) The pitfalls of strategic planning. Calif Manag Rev Fall 36(1):32–47

Roos J, Victor B (1999) Towards a model of strategy making as serious play. Eur Manag J 17(4): 348–355

Sennett R (2008) The craftsman. Allen Lane, London

Turkle S (1995) Life on the screen: identity in the age of the Internet. Simon & Schuster, New York

Context Dependency in Design Research

Larry Leifer and Alexander A. Neff

Abstract Design research at Stanford's Center for Design Research (CDR) has always been user-centric. Over time, the focus has been extended beyond user needs and product specifications to include the "human-machine-experience". A recent wave of research on the autonomous-car/driver experience has focused our attention on the role of "complex adaptive machine systems" in defining the human-experience. The pursuit of a unified model for interaction design has yielded a surprising three-factor concurrent experience framework. Our intention in this article is to give readers insights into context dependency as the defining requirement of the model for autonomous-car/driver experience. As design researchers, we have observed that communication between the autonomous-car and driver takes place through three concurrent dialog channels: information, emotion and learning exchange.

Keywords Context dependency • Design research • Human-machine-experience

Design Research Beyond Context Independency

Traditional engineering focuses on products and services from a context-independent perspective. Previous work in research and practice has highlighted the need for inventive approaches that aim at creativity and innovation (Buchanan 1992; Simon 1996). Beyond studies of user needs and product specifications, human-machine interaction design has become the prominent concern (Wu and Leifer 2008) for "smart-machines". Smart systems can sense the user and other environmental factors that affect performance and experience. In fact, the communication of context between the machine-systems and humans must now account for

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

A.A. Neff
Institute of Information Management, University of St.Gallen, Unterer Graben 21, 9000 St.Gallen, Switzerland
e-mail: alexander.neff@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_10

information exchange (e.g. mutual status updates), emotion exchange (e.g. sensing human temperament and machine performance limits) and learning exchange (mutually building a knowledge base for trusted and future performance).

Scenarios that Exemplify the Meaning of Context Dependency

We shall use a set of scenarios to expand on the distinction between context independence versus context dependence. Two types of context-dependent experiences are explored: those based on sensing human performance variables and those based on sensing machine performance variables. Scenarios 1 and 4 refer to human-motivated experience, while scenarios 2, 3, 5 and 6 start from the perspective of the machine's status and its impact on the mutual experience.

Each scenario is briefly described in its initial condition. Then, we introduce events that force adaptation; this need is explored from both context-independent and context-dependent perspectives. We try to illustrate that context awareness always helps the system-of-systems to search for "better", i.e. more comprehensive, adaptation.

Scenario 1: Kids Crying in the Car

In the morning, a mother is driving her two children to kindergarten. After a few minutes the children get thirsty and start to cry. The mother, however, does not notice it, since she is taking a phone call.

Context Independent Experience The children cry louder and louder. The call with her boss is interrupted at a certain point. However, the route on the highway has few convenience or restaurant opportunities. It takes quite a while until the mother can park the car and solve the situation with something to drink for the children.

Context Dependent Experience Being a smart system, the car uses acoustic sensors and analysis software to interpret the situation. Then the in-car interface system reports, textually, the children's distressed situation. Since the mother does not confirm, the car interrupts the call and talks to the driver. Meanwhile, the car searches for a possible parking lot and recalculates the route plan. The mother follows the updated route plan, stops at a nearby store and can give her children both comfort and something to drink.

Technical Levers for Context Dependency audio sensor and microphone, sound interpretation software and in-car interface system.

Scenario 2: Perceived Heat in the Building

It is summer; sunlight is burning on the office building of an international bank in Tokyo. There is a heat wave and the air-conditioning system has set itself to a much warmer level than people are used to. The programming rationale is to save energy. The management justification is to show solidarity with the population after the dramatic events taking place in Fukushima.

Context Independent Experience Office building heating and ventilation systems sense the high heat load and corresponding high energy demand. The energy control system allows inside temperatures to rise to match energy saving goals. While building management appreciates that the high temperature will reduce productivity, there is no humanly accessible override.

Context Dependent Experience Smart facility management software differentiates between the dress code in front and back office departments. This allows a more intensive cooling of front office where the dress code is business suit, while energy can be saved in the back office because those employees have no direct interaction with customers. Employees in the back office are invited to wear informal clothing comfortable at higher temperatures.

Technical Levers for Context Dependency the energy management system is zone usage aware, individual rooms are controlled according to user preferences, business dress codes are temperature aware.

Scenario 3: Production-Line Sensing with Smart Equipment and Remote Diagnosis

An equipment manufacturer produces and services printing machines. Customers, i.e. printing shops, employ these long-lasting investment goods in a highly productive environment. They print newspapers, magazines, brochures, and packaging units on a 24/7 basis.

Context Independent Experience Customer operation staff documents a considerable increase of defective units in the production's output. Running a local self-diagnosis brings no insights and all lights are green on the manufacturing control dashboard. Since the customer's operation unit is clueless, they call for manufacturer's support. The call center takes a service request and sends out a field service team for an unplanned maintenance issue. The field service team plugs the diagnosis device into the machine, but no failure code is reported. Based on his long experience, one of the senior service engineers has a guess. When considering the production output, he thinks of a temperature or humidity issue, so he recommends that the customer call the air conditioning company service support and facility management.

Context Dependent Experience Smart equipment continuously communicates with the remote service center. The embedded sensors collect data being transmitted in a centralized repository. Analytics conducts a cross-comparison and detects a humidity irregularity. Operational rule system retrieves and visualizes this irregularity to the manufacturer's service staff. They log into the machine, but the machine is working according to specifications. So, they advise the customer to check the production facility air conditioning system. The facility management team replaces the humidity sensor and the air conditioning system restores the required humidity level.

Technical Levers for Context Dependency smart equipment, smart production line simulation, real-time remote diagnostics, smart analytics, service and data integration between the manufacturing client and the equipment manufacturer's enterprise application team.

Scenario 4: Heart Attack and Emergency Ride to the Hospital

A couple is driving in a car; suddenly, the woman has a heart attack.

Context Independent Experience The man accelerates the vehicle, while searching for the nearest hospital in the navigation system. After finding the targeted address, he drives at excessive speed. His wife loses consciousness 10 min into the estimated 27-min route. A police car forces them to stop. This check and accusation for speed violation cost valuable time until the situation is understood by the police officers. Finally, the police escort the car to the closest hospital.

Context Dependent Experience The car detects the heart attack and calls the emergency hotline. When the connection to the hotline is established, the medical tele-service agent instructs the driver to do first aid. Then, based on the location reported by the car's global positioning system, the tele-service agent sends an emergency ambulance to the car's current location, saving time and intervening medically before arriving at the hospital.

Technical Levers for Context Dependency smart car, automated emergency call, medical tele-service.

Scenario 5: Flight Connection with Stopover

A man is planning a business trip for a global human resource meeting in Asia. He identifies a reasonable flight from Frankfurt to Ho Chi Minh via Abu Dhabi. He selects the tickets using an independent service provider and proceeds to payment processing. The flight involves two different airlines and leaves the traveler only 45 min for catching the connecting flight at Abu Dhabi Airport.

Context Independent Experience The man booked the flight by finishing the payment process. Then, 2 weeks later, he is flying to Abu Dhabi. The flight is 15 min late; he cannot make it through baggage claim. After (re-)check-in and a second security check, he misses the next flight too and re-booking adds additional costs.

Context Dependent Experience Before proceeding to payment is allowed, a verification process is initiated. It flags an exception reporting the lack of buffer time for baggage claim, (re-)check-in and security check at Abu Dhabi Airport. The service provider gives a warning message to the user and suggests the selection of another flight connection. The user selects one of the suggested flight connections, pays a little more but receives a timely and manageable route.

Technical Levers for Context Dependency intelligent airline reservation system, check-in and security check time estimations for all airports. It is not just about the flights, the systems must be ground operations aware.

Scenario 6: Field Service at Customer Construction Site

A field technician is called for an unplanned service incident to an old building in midtown Chicago where a woman reported a delayed closing of the elevator door, confirmed by the building's janitor. From experience, the service technician knows that this event is a serious indication that immediate maintenance is needed and schedules a customer visit. Equipped with a laptop and a mobile communication device, he has access to the service order and installed base information, as well as best practice guidance stored on his laptop. There are several possible reasons for the failure and different recovery steps for each alternative. However, it is the first time that this service technician has entered that specific building and the elevator set-up does not match his expectations. He places the lift in maintenance mode so he can enter the elevator through its roof.

Context Independent Experience However, when he tries to access the roof, he realizes that there is no security barrier to prevent him from falling. In fact, there is immediate danger, since the lift tube access is 5 ft away over the abyss. To continue at this stage, he needs a colleague who can join him and secure him with a rope. This results in additional costs and hours of unproductive waiting.

Context Dependent Experience Informed by status light indicators and detailed information about the elevator displayed, in context via wearable augmented reality, the technician calls for assistance before heading to the scene. The team arrives together and context-aware; the elevator is repaired within the hour.

Technical Levers for Context Dependency laptop with Wi-Fi and/or cellular, mobile communication device, service history database, on-site and remote system status display with a focus on safety.

Autonomous-Car/ROBOT and Driver-Passenger/HUMAN Experience Has Sharpened our Attention to the Role of Context Dependency

Based on scenario 1, a project has been launched in my lab at Stanford to assess the nature of the relationship-experience. The car manufacturer is interested in the interaction between the "autonomous-car/ROBOT" and the "driver-passenger/HUMAN". Findings on context-dependent experience are consolidated in a unified model for autonomous-car/driver relationship design (see Fig. 1).

As design researchers, we learned that communication between the autonomous car and the driver takes place in three dialog forms: information, emotion and (re-) learning exchange.

Information Exchange, by Far the Most Familiar Interface

Information dialog refers to the exchange of information and represents the most familiar interface. Today, this capability is widespread among current car offerings. The car displays a variety of driving-related information, such as route information, driving data, fuel consumption, barometric pressure, traffic information, temperature data etc. The driver, in turn, enters data by voice recognition or more common interfaces like the iDrive system of BMW or the MMI (car multimedia & navigation system) from Audi. Typical use cases are phone calls, navigation, and entertainment programs for passengers.

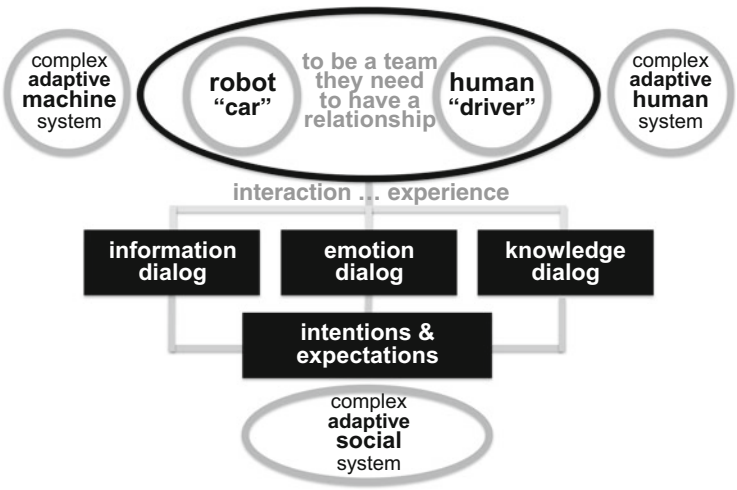

Fig. 1 A unified model for "autonomous-car/driver-passenger" relationship design

In scenario 1, the woman takes a phone call from her boss, an interaction presenting a classic information exchange. If the interaction level is limited to this experience level, it will probably be part of a context-independent experience.

Emotion Exchange, the Best Predictor of Team Performance

An emotion dialog requires a far more advanced set of technical and social capabilities. For the car/driver experience, this refers to audio sensor and microphone sensor data processing and analysis, voice recognition and sound interpretation, video analysis and face expression recognition, mobile computing and machine-to-machine communication. The car takes these emotion-related data and uses them to augment information exchange. Pattern recognition allows the car to come up with context-appropriate decision support for the driver.

In scenario 1, the car is able to assess the situation based on the sound volume of the crying child. During the phone call, the car interface suggests a stop at the next parking lot. While the driver (i.e. the woman/mother) is still talking to her boss, the car prepares a recalculated route.

Learning Exchange, the Least Understood Interface

Learning constitutes the most advanced design of a dialog between car and driver and is particularly relevant for the autonomous car. To master the learning dialog challenge, understanding and interpreting the context has become one of the most powerful enablers. This interface between autonomous car and driver/semi-passenger is least understood and calls for further investigation.

A learning experience goes far beyond the storage and retrieving of driving behavior to detect irregularities such as fatigue or inebriation. Moreover, the car learns from the individual drivers and passengers. Being a trustful partner, the autonomous car has acquired certain knowledge about the family's behavior. It has learned how to assess a child's vocal level—as well as the frequency—and can suggest possible actions to remedy the situation. In scenario 1, the child's sound volume and frequency has exceeded the average level. Since the mother does not confirm a text notification, the autonomous car interrupts the call and talks to the mother. The derived action is based on former experience with this individual driver and usage behavior from all car fleet drivers.

Implications for Design Science Research

Insights on context dependency are structured with design science guidelines to reflect and discuss the contribution to the extant literature. Studying context-dependent experiences gives a first indication on anticipating the interface between human and machine.

Design as an Artifact

Design-science research is characterized by the production of a viable artifact that might be a construct, a model, a method, or an instantiation (Hevner et al. 2004). The artifacts in this article comprise the prototypes of the machine (i.e. the car), derived design principles to include context dependency, the unified model for autonomous-car/driver-passenger experience, and sensing devices to capture context. Actually, the artifact (e.g. the autonomous car) can deliver experience to the human (i.e. the driver or semi-passenger).

Problem Relevance

The problem relevance of this research endeavor is given, since it starts with a need-and-requirement initiation (Hevner et al. 2004) of global-acting car manufacturers. Internet of things, smart equipment, smart car, mobile computing, in-memory databases and tele-service confirm the technology-based solution part of relevant business problems. This research is clearly focused on solving business problems, in research referred to as field problems (Denyer et al. 2008).

Design Evaluation

"The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods" (Hevner et al. 2004, p. 83). Traditional design research differentiates between construct and evaluate activities for singular design iteration (March and Smith 1995) that can be synthesized in a process (Peffers et al. 2007). Sonnenberg and vom Brocke (2012) even prompt a design evaluation principle that suggests having multiple evaluation episodes throughout a single iteration of a design process. The evaluation of context-dependent experiences calls for additional methods. Besides classical approaches such as expert interview, workshop, focus group evaluation, ethnography and survey, the primary method of inquiry at CDR is the video interaction analysis

(cf. Tang and Leifer 1991). This method is most appropriate since it captures a wide band of behavioral data suitable for very fine-grained analysis and cross-observer reliability measurement. Importantly, it is capable of observing and quantifying implicit interactions between humans and their artifacts in context. At the same time, this qualitative research method minimizes subjectivism in the data analysis, while strengthening measurement traceability and reliability.

Research Contribution

The provisioning of clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies is still essential for effective design-science research (Hevner et al. 2004). The design artifacts in this article incorporate prototypes of the machine (i.e. the car), derived design principles to include context dependency, the unified model for autonomous-car/driver-passenger experience and sensing devices to capture context. The design foundations are implicitly addressed in the human needs for the artifacts discussed. The design methodology is intended to investigate communication between the autonomous-car and driver. Observation, expert interviews, focus group workshops, surveys, field experiments, ethnography and prototyping serve as typical data collection techniques. Data analysis comprises different coding methods, video interaction analysis and statistical analysis software. Experience and interaction are design requirements for the measurement instrument. In fact, the design research lab at Stanford has produced over 40 Ph.D. dissertations as research contributions over the past 30 years, including over 100 journal and peer-reviewed conference papers. We have an existence proof for the "research contribution factor".

Research Rigor

Design-science research relies on the application of rigorous methods in both construction and evaluation of the design artifact (Hevner et al. 2004). Aircraft manufacturers, for instance, use a machine environment to train the airline's cockpit crew to create a context-dependent experience. The simulation is also possible at a normal working station, but it turns out that a simulator in a rebuilt cockpit environment achieves better learning results.

Design as a Search Process

The problem space describes the desired state, the present state and the differences between both (Simon 1996). Search techniques are actions that might remove

differences between present and desired state (Simon 1996). This search for an effective artifact utilizes available means to reach the desired state, while satisfying laws in the problem environment (Hevner et al. 2004). The inclusion of technological means, such as audio sensor and microphone, sound interpretation software and in-car interface system in scenario 1, presents the outcome of such a search.

Communication of Research

Design research should reach a broad community, including technology-oriented as well as management-oriented audiences (Hevner et al. 2004). Of course, the best communication will take place if research results are applied in real-world context that makes them available publicly (e.g. all car drivers, all pilots etc.). Communication becomes observable when the aircraft manufacturer optimizes the arrangement of cockpit instruments or when the autonomous car learns from the driver's behavior.

References

Buchanan R (1992) Wicked problems in design thinking. Des Issues 8(2):5–21

Denyer D, Tranfield D, van Aken JE (2008) Developing design propositions through research synthesis. Organ Stud 29(3):393–413

Hevner AR, March ST, Park J, Ram S (2004) Design science in information systems research. MIS Q 28(1):75–105

March ST, Smith GF (1995) Design and natural science research on information technology. Decis Support Syst 15(4):251–266

Peffers K, Tuunanen T, Rothenberger MA, Chatterjee S (2007) A design science research methodology for information systems research. J Manag Inf Syst 24(3):45–77

Simon HA (1996) The sciences of the artificial, 3rd edn. MIT Press, Cambridge, MA

Sonnenberg C, vom Brocke J (2012) Evaluations in the science of the artificial–reconsidering the build-evaluate pattern in design science research. In: Peffers K, Rothenberger M, Kuechler B (eds) Design science research in information systems. Advances in theory and practice: 7th international conference, DESRIST 2012, Las Vegas, NV, USA, May 2012, proceedings. Springer, Berlin, pp 381–397

Tang JC, Leifer LJ (1991) An observational methodology for studying group design activity. Res Eng Des 2(4):209–219

Wu J, Leifer L (2008) The design of implicit interactions: making interactive systems less obnoxious. Des Issues 24(3):72–84

What Is It That Design Thinking and Marketing Management Can Learn from Each Other?

Sven Reinecke

Abstract Marketing and Design Thinking are rarely associated with each other because they stem from very different fields of science and application sources: thus, different paradigms. In this paper, fundamental similarities between the two approaches are discussed and it is shown systematically how the two points of view can benefit from each other. Design Thinking can effectively help accelerate learning processes in marketing—and marketing science can help ensure that in Design Thinking one does not neglect fundamental knowledge from the social sciences.

Keywords Marketing • Design Thinking • Empathy • Market research • Personas • Innovation • Learning • Knowledge management

Introduction: Common Elements of Design Thinking and Marketing

Although marketing and Design Thinking have a lot in common, there is not a strong joint (research) tradition. The origins of Design Thinking lie more in the areas of mechanical engineering, product design and innovation management. Marketing, however, is a core area of business management research. Even though marketing and Design Thinking have their roots in the US, the intersection between the two areas is relatively small, at first glance. Design Thinking is strongly influenced by the innovation and engineering culture of Silicon Valley, while marketing is seen as a "necessary" evil by startups: certainly not a leading management function.

Examining the definitions of Design Thinking and marketing, however, there are surprisingly similarities. Brown (2008, p. 68) outlines Design Thinking as follows: ". . . rather than asking designers to make an already developed idea more attractive to consumers, companies are asking them to create ideas that better meet consumers' needs and desires." This seems to agree with the latest—and in 2013

S. Reinecke (✉)
Institute of Marketing, University of St.Gallen, Dufourstrasse 40a, 9000 St.Gallen, Switzerland
e-mail: Sven.Reinecke@unisg.ch

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_11

reconfirmed—definition by the American Marketing Association: "Marketing is the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large", or the more concise definition by Kotler and Keller (2011, p. 5): "meeting needs profitably".

Customer orientation (e.g. Deshpandé et al. 1993) is the major paradigm in marketing. Both Design Thinking and marketing are, thus, ultimately geared to solving customer problems.

Interestingly enough, neither discipline deliberately defines itself as a method, but rather as an overall (leadership) philosophy: "In the end, Design Thinking is more culture than methodology, and building such a culture may require a fundamental transformation" (Gobble 2014, p. 60). The modern understanding of marketing also does not view it as (only) planning and implementation of the four classical marketing tools (product, price, promotion and place), but rather as market-oriented corporate management strategy that has to be supported and implemented by all employees in the company (for the marketing term in detail, see Kotler and Keller 2011, p. 5). Design Thinking falls decidedly short of the mark when it degenerates to a Taylorist "process trick" (Nussbaum 2011)—just as well, as marketing must not be misunderstood as a technocratic marketing mix optimization exercise.

In contrast to classical engineering sciences, Design Thinking relies on a sociological foundation by having the attribute "human-centered" prefixed to the term Design Thinking. This human orientation opens many interfaces for modern marketing, which relies heavily on insights from psychology and sociology in the field of consumer behavior. Thus, Design Thinking scholars Clark and Smith (2008, p. 10) cite a well-known marketing principle attributed to the famous IBM salesman F. G. "Buck" Rogers as central foundation of Design Thinking: "Customers buy on emotion and then justify with logic." (Clark and Smith 2008, p. 10).

Despite the numerous outlined fundamental similarities there are many areas where the two "ways of thinking" can profit from one another, not least due to their long-standing tradition of research and application. The following, based on the ideal-typical Stanford University Design Thinking process, shows on one hand how Design Thinking can fertilize classical marketing planning approaches. On the other hand, further methods and aspects of marketing research and practice are described that could be used to inspire and enrich Design Thinking application.

Design Thinking's Contribution to Marketing Management

Figure 1 shows the ideal-typical Design Thinking process of Stanford, which ultimately outlines five steps of an innovation process:

In the *"Empathize"*-phase, the primary objective is to put oneself in the situation of the "customer" and to ask open ended questions. The empathetic understanding ("Why?") takes center stage. In the following *"Define"*-phase, the problem

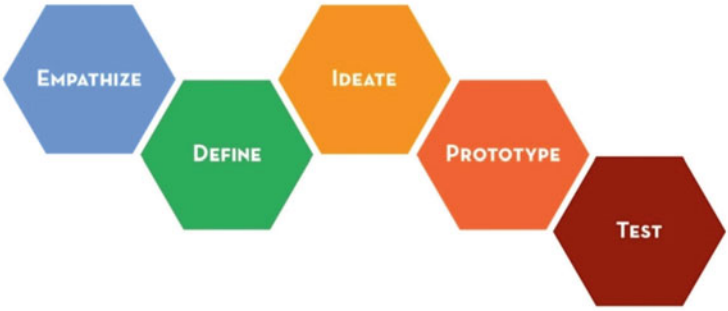

Fig. 1 Design Thinking process (Stanford University 2014)

statement is formulated; i.e. the focus is on verbalizing specific needs in an action-oriented way, based on the insights gained. For the *"Ideate"*-step, the goal is to generate as many first troubleshooting ideas as possible, as quickly as possible, in a highly creative process. "Go for volume" is the focal point of this activity. Ideally, spontaneous ideas should be shared within the team and reflected upon openly. Defending the solution should be avoided—it is instead a matter of impartially generating as many new solutions as possible.

The step *"Prototype"* underlines the action-oriented view of Design Thinking; it is about building a physical prototype and creating something with which your partner can engage. Team members should share their solution and get feed-back. Not just the solution is valuable, but the feedback: What worked? What could be improved? In this phase, time pressure has been found to be helpful to avoid over-engineering of prototypes: "Prototypes should command only as much time, effort, and investment as are needed to generate useful feedback and evolve an idea." (Brown 2008, p. 87).

Subsequently, the prototypes are tested to stimulate the learning process and go through the previous phases again until a satisfactory solution has been found. It may be necessary to newly question a prototype originally deemed valuable and completely restart the process.

The following sections discuss each phase individually to demonstrate the explorative potential of Design Thinking for marketing management.

Empathize: Deepening and Broadening the Perspective

Marketing requires a deep understanding of customers' needs. Yet, one criticism of marketing—as executed in many companies—is its focus on traditional market research approaches, e.g. standardized surveys. One may object here that market research has developed considerably in recent decades and that it readily offers a broad variety of different marketing research instruments to generate customer insights: qualitative market research instruments like focus groups and in-depth

interviews, monitoring processes, observations and, particularly, lab and field experiments to analyze actual customer behavior. In marketing management, current wisdom downplays standardized customer surveys, particularly for the development of product innovation, as the instrument of first choice. Design Thinking clearly favors observation to surveys (Beckman and Barry 2007, p. 32).

The tool of the *"personas"* in this phase of Design Thinking can, however, lead to a deepening of empathy in marketing. This tool forces all those involved to assume a human-centered focus and thus enhances the personal touch: "it focusses on the needs and experiences of real people—not hypothetical 'market segments'—as a source of inspiration and insight." (Gobble 2014, p. 59). The visualization of personas allows more intensive dealing with specific customer needs and encourages discussion in the team more effectively than traditional market research reports. It prevents the user "getting lost" in an anonymous analysis.

Storytelling facilitates synthesis and leads to a concreteness that releases more emotions than customer or market segment descriptions.

If one bears in mind that many market research results in the future will be based on the analysis of "big data", it becomes clear that the deepening potential of Design Thinking regarding empathizing will grow strongly to keep intuition and reflection in balance. Human insight is needed to make real sense of data; Design Thinking can be seen as one way to combine intuition and creativity with analysis (Gobble 2014, p. 59).

The pragmatic approach of Design Thinking also helps avoid over-engineering in this phase. For certain topics it may make sense to rely on common sense—and, if necessary, to refrain entirely from market research.

Design Thinking can also help prevent an overly narrow perspective of marketing on customers and customer groups—and thus cause a broadening of the perspective. In the characterization of Design Thinking as "human-centered approach to problem solving" (Brown 2008, p. 86) and as "human centric point of view" (Meinel and Leifer 2013, p. 3) respectively, it becomes clear that it should not just be all about customer orientation or "customer centricity", but that the emphasis should be on the broader notion of "human-centricity". It stresses that it is necessary to acknowledge a broader view of the human element in all technologies and organizations ("empathy in action"). Although customer orientation is definitely important, it should not be the only focus of a company within the innovation process. Just as brand management has broadened over the last decade to integrate employee behavioral aspects, the marketing management process should focus more on the human role and thus on all humans involved (e.g. managers, employees of other departments, neighbors, shareholders, dealers, partners—not only customers). The integration of this Design Thinking aspect into marketing management would strengthen the cross-functional definition of marketing management and enhance its multidisciplinarity nature.

Define: Be Inspired and Solution-Based—And Learn to Dance with Ambiguity

Design Thinking is really inspiring and empowering: two core strengths. Focusing on generating something completely new, but simultaneously intentional, sets creative energy free and inspires everyone involved: "Design is about making intent real. [...] When you design, something new is brought into world with purpose." (Clark and Smith 2008, p. 8) Marketing usually starts with the analysis of challenge and "shortage" (needs)—Design Thinking turns it around and starts with a solution-orientation. It can help enhance the traditional marketing planning process through a solution-based thinking approach focusing on improved future results, starting with the goal to be achieved (Cross 1982), making marketing much more inspiring.

Traditional marketing often—but not always—aims more at optimization and improvement during the goal definition phase. This is particularly true if marketing is not seen as an integrated part of corporate strategy, but only as a tool for communicating and implementing strategy. Design Thinking, however, tries harder to target "disruptive" goals (Christensen 1997; Christensen et al. 2004) that require completely new approaches. This may lead to a completely new definition of the original problem. At the same time, this means that marketing must learn *"to dance with ambiguity"* (Leifer and Steinert 2011): Ambiguity implies that not only are variable characteristics unknown, but that the variables themselves are not yet known. Design Thinking can thus contribute towards shifting marketing focus more towards corporate strategy—or business model definition.

Ideate: Multi-discipline and Thinking in Alternatives

One thing that marketing and Design Thinking have in common is their conscious *inter-* and *multidisciplinarity* nature. Design Thinking as a creative process is an interdisciplinary process by definition. According to the modern understanding of marketing, "marketing concerns all"—it is thus not just the sum of all activities carried out in the marketing, communications or advertising departments; engineers in the research and development department certainly assume marketing roles as well.

However, multidiscipline in Design Thinking is not limited to functions, but also integrates ability profiles of various team members. Based on Leonard-Barton's T-profiles (1995), it is distinguished—in each case—between subject-specific knowledge (knowledge deepening, visualized as a vertical bar) and comprehensive know-how. The latter is reflected in connecting openness and curiosity, or interest in other people, the environment and other functions and disciplines (horizontal bar). Real innovation and creativity require both depth of knowledge and connecting breadth. Furthermore, each person uses his or her brain differently, which means possession

of specific competences and preferences. In the context of Design Thinking innovation projects, at Stanford University teams are formed as heterogeneously as possible, based on a psychological test by Herrmann (1996), to take advantage of full team potential. Such an approach in business administration is known mostly in human resource science and organizational behavior areas. It might make sense to examine the usefulness of this approach for marketing innovation projects.

The phase of "ideation" is relatively under-represented in classical business literature and practice. Both in practice and education, marketing management is still dominated by traditional marketing plans (e.g. Kotler and Keller 2011). These marketing plans are based on linear analytical thinking and typical sequential phases (e.g. SWOT-analysis, goal-setting, strategy, marketing-mix and control). Generally, one finds that true "thinking in alternatives" rarely occurs in management, or in marketing. In practice, the scope of action is seldom consciously expanded, nor are many different strategies and courses of action generated to be systematically compared, combined and evaluated. In only 29 % of cases, is more than one option considered in management decisions (Nutt 1993). Instead, the scope is framed very early on and reduced to one, at most two, strategic "pet alternatives": An important challenge is management's emotional attachment to a predefined solution (Heath and Heath 2013, p. 37). Within these strategic specifications, marketing may take operative action creatively—but not with respect to the fundamentally conceivable solution space, only in the creative design of a given option (e.g. of an advertising message). Creativity is "outsourced" and management reserves censorship rights (Skogstad and Leifer 2011, p. 39) to make a final decision after the presentation.

In classical product innovation projects, it is not uncommon to define so many "must" criteria, that the solution space is seriously restricted. Or, classic customer surveys lead to situations where customers are overstrained because they do not know what a new product or service innovation ought to look like. Thus, the innovation space is closed too soon and customers and managers define constraints very early in the innovation cycle.

Through ideation and prototyping marketing, professionals would enhance their thinking in alternatives, preserve ambiguity and widen their choice options; this would already lead to better decisions (Heath and Heath 2013). From the Design Thinking principle "Give questioning an equal or greater status than deciding" (Leifer and Steinert 2011, p. 152), one could learn to not make preliminary decisions, but rather to try and evaluate as many fundamental versions as possible.

Prototyping: Making Marketing Tangible

A paradigm of business management practice is that marketing managers develop a comprehensive marketing plan in which the most important strategic and operational rough decisions in marketing are recorded. The advantages of a written,

communicable marketing concept are not questioned below—still, marketing suffers when many concepts remain "paper tigers" and are not really implemented.

In advertising and exhibition booth construction, prototypes are quite common; but even in more conceptual, strategic areas, it would be helpful if marketing could force itself to make conceptional considerations tangible as some sort of prototype. "What if you could express your strategy, not as numbers or frame-works or even a rhetorical narrative, but as something concrete? What if your strategy took shape as a prototype that shows your organization what success will look like when you have delivered against your goals?" (Holloway 2009, p. 51) Possibilities of visualization and prototyping in marketing outside the traditional product innovation range would be, for example:

- "marketing war rooms"—rooms where an organization's own strategy and competitors' are visualized and played out;
- "customer experience"—events where top level managers are confronted with real customer tasks (for example, bank managers are asked to carry out payment orders using their own online banking system or to find current exchange rates from their website);
- prototypes of marketing dashboards or marketing scorecards (Reinecke 2004), that help depict and interpret specific marketing situations.

The fundamental principle of Design Thinking "Show, don't talk" or the "make it tangible-rule" (Meinel and Leifer 2013) is primarily based on the principles of Visual Thinking (Arnheim 1969). For marketing, three central advantages can be gleaned from this (based on Holloway 2009, p. 55):

1) *Improvement of top management buy-in of solutions:* prototypes help marketing to better market itself to the top management. Tangible results trigger many emotions and fascinate more than pure concepts: "They say a picture is worth a thousand words; if that is true, then a prototype must be worth about a million." (Holloway 2009, p. 51).
2) *Stimulation of the knowledge transfer:* Prototypes stimulate the exchange of knowledge and ideas and thus automatically initiate further developments: "Prototypes tell their own stories [. . .]. Good prototypes raise questions and stimulate discussion [. . .]." (Holloway 2009, p. 52).
3) *Increasing the bias towards action*: a prototype is the first step in the concrete implementation of a marketing concept. Experience shows that this first step significantly increases the likelihood that a comprehensive strategy will actually be implemented in some form.

Test: Accelerating Learning Processes in Marketing

Especially in large organizations, a common challenge for marketing management is its limited ability to engage in learning processes. Marketing professionals change jobs very frequently, especially in stock-listed companies. This endangers

learning and inhibits the process of making tacit knowledge explicit (Nonaka and Takeuchi 1995).

The redesign and fast prototyping approach of Design Thinking could accelerate learning processes in the marketing area. Until now, marketing research, especially direct marketing professionals, has embraced experiments as dominant methods. But these experiments are very often limited to operational marketing, e.g. A/B-testing of marketing campaigns or internet web-sites. Design Thinking would enable a much broader use of experiments not only limited to the operational marketing-mix, but also extended to strategic marketing. This approach would improve marketing performance through faster learning cycles.

Although test markets and market tests are traditional market research methods, they are often bypassed due to their high planning and implementation costs, which makes it all the more sensible to introduce lean tools and techniques in marketing and sales: "Far from creating a rigid, hierarchical process, this model frees up individuals to iterate quickly—what is sometimes called 'failing fast forward' in the world of high tech." (van Bommel et al. 2014, p. 7) It is less a matter of checking and confirming finished concepts, than of creating an agile marketing organization, whose members have adopted a war room mentality (van Bommel et al. 2014, p. 7). Real learning through rapid experiments and field tests would accelerate many processes in marketing—and simultaneously save costs, because insights would be gained earlier in the decision-making process.

In summary, it can be seen that each phase of Design Thinking offers impressive creative impulses for marketing management (see Fig. 2).

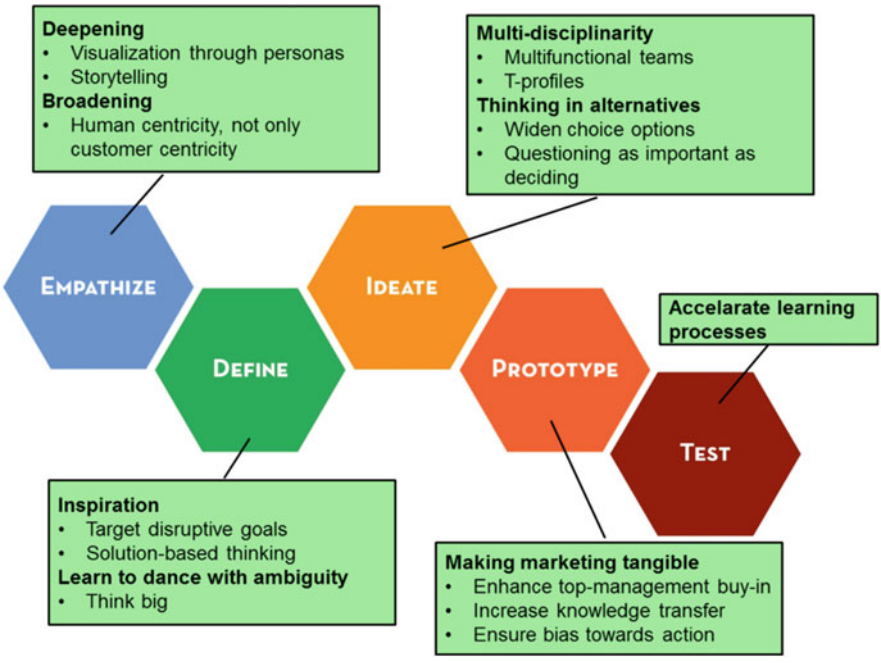

Fig. 2 What marketing can learn from Design Thinking

Marketing's Contribution to Design Thinking

After demonstrating the benefits of Design Thinking for marketing management in the previous section, it will be explained below how marketing practice and research provide insights from which companies can gain in Design Thinking contexts. These insights relate to aspects of market research and segmentation, competitive orientation and the limits of experiments.

Necessity of a Social Science Foundation in Market Research and Business Management Segmentation

The most important phase of human-centered Design Thinking is certainly empathizing. The advantage of visualizing specific personas is undisputed. Nevertheless, this procedure can also be quite critical when market research is abandoned because one thinks that that one already empathizes sufficiently with the user's situation. Thus, Chen and Venkatesh (2013, p. 1688) report, for example: "Although most firm representatives cite end-user research as important, very few organizations actually implement end-user research because it is too costly and time intensive. [. . .] Instead, organizations favor *end-user profiles*, imaginary portraits of target customers, which display their lifestyle, consumption preferences, fashion sensibilities, and demographic make-up." Thus, there is a risk that market research makes unsupportable claims.

Managers are not always able to empathize with customers' thoughts and feelings. Current research reveals a negative effect; managerial empathy may even facilitate egocentric predictions of consumer preferences (Hattula et al. 2015), meaning that managers who try to develop empathy for the customer's situation reinforce their own prejudices.

Furthermore, faked market research using personas can be misused very easily and retroactively to validate design and justify design decisions.

Additional methodological research insights relate to more recent developments in psychological means-end chain theory. Means-end chain theory proposes that knowledge held in consumer's memory is organized in a hierarchy, with concrete thoughts linked to more abstract thoughts in a sequence, progressing from means (i.e., product features), to psychological and social consequences and finally to ends (i.e., fulfillment of personal values) (Woodside 2004). These techniques can be broadly applied in Design Thinking.

In German-speaking areas, marketing practice also uses sociological milieu research much more frequently than in the US (e.g. Sinus-Institut 2010). Milieu research helps to develop a deeper understanding of customers—particularly how living environment and lifestyle affect consumers' attitudes and behavior. This is particularly important for the economically relevant questions of broad social diffusion of innovations. The research by Rogers (2003), heavily influenced by

marketing science and the findings of Berger (2013) on why ideas and concepts spread virally, provide social-science-based advice and checklists that Design Thinking could employ very constructively.

A further marketing-related topic dealt with—fairly rudimentarily—in Design Thinking is customer segmentation. Economically, it only makes sense to deal with customers and customer groups that meet the following criteria (Kotler and Keller 2011, p. 231f); the segments shoud be: measurable (size and purchasing power of segments can be measured), substantial (customer segments should be large and profitable enough to serve) and accessible (the segments can be reached and served effectively). Personas representing market segments not meeting these criteria should be critically examined.

Design Thinking may not lead to replacing the spreadsheet crowd with creative types—that's no panacea (Merholz 2010, p. 18).

Competitive Orientation as Conditio Sina Qua Non

Competitive orientation in marketing is inherent to the system, which means that it is a very important dimension. Customers always compare a supplier's with competing offers; a competitive orientation is the ability of an organization to identify, analyze, and respond to competitors' actions (Moll et al. 2007; Narver and Slater 1990). In Design Thinking however, competitive orientation has acquired the aura of "imitation" and is sometimes frowned on, as is evident from the statement of a senior designer at Red Tag Toys: "We will never take what [competitors] do and try to do it better. That is a concept that has been done and it's over. By the time it gets to market, it is so outdated, it's not worth doing that. A lot of companies do that, but that is not being an innovator." (Chen and Venkatesh 2013, p. 1692).

Still, one should never forget to think about the competitors and anticipate their action. This does not mean that a company should imitate the competition, but it might be dangerous to neglect such an important information source. Through the entire innovation process, it is important to avoid the "not invented here" syndrome and to use good ideas as an information base for possible improvement. Therefore, it makes no sense to waive competitive information only because the pride of some designer or innovator could be affected.

Know the Limits of Testing!

Marketing practice has vast experience of the advantages and disadvantages of experiments, especially in the field of online and direct marketing. For example, companies like Amazon, EBay and LinkedIn frequently conduct hundreds of A/B tests to increase the usability of their websites, as well as the response rate. In this

area, experiments have proven to be extremely helpful, because they reflect real customer behavior. Nevertheless, it is known that A/B testing does not ensure obtaining the best possible solution—often, these experiments lead to sub-optima. Therefore it is important that enough creativity is used in initial phases of Design Thinking to cover the solution space as widely as possible. Experiments and tests then help (only) to identify and implement the best partial solution.

Finally it is important to note that it should not be about "scientificizing" the Design Thinking process or extending the planning stages. Design Thinking should always remain action-oriented. This does not mean, in any way, that tried and tested knowledge, for instance in the area of marketing, should be done away with.

Conclusion

Marketing and Design Thinking have much in common, but they can also greatly benefit from each other. Design Thinking can help to make marketing plans more creative, faster and more flexible, by helping to accelerate learning processes in marketing management.

On the other hand, marketing can give Design Thinking impulses so that it does not fall too quickly into the pitfalls of oversimplification—and that the central foundations in social psychology and business management are not neglected in the innovation process. Ultimately, the principle by Design-Thinking-inspired firm IDEO applies (Cannon and Edmondson 2005, p. 310): "Enlightened trial-and-error succeeds over the planning of the lone genius".

References

Arnheim R (1969) Visual thinking. University of California Press, Berkeley
Beckman SL, Barry M (2007) Innovation as a learning process: embedding design thinking. Calif Manag Rev 50(1):25–56
Berger J (2013) Contagious—why things catch on. Simon & Schuster, New York
Brown T (2008) Design thinking. Harv Bus Rev 6:84–92
Cannon MD, Edmondson AC (2005) Failing to learn and learning to fail (intelligently): how great organizations put failure to work to innovate and improve. Long Range Plan 38(3):299–319
Chen S, Venkatesh A (2013) An investigation of how design-oriented organisations implement design thinking. J Mark Manag 29(15–16):1680–1700
Christensen CM (1997) The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business School Press, Boston, MA
Christensen CM, Anthony SD, Roth EA (2004) Seeing what's next: using the theories of innovation to predict industry change. Harvard Business School Press, Boston, MA
Clark K, Smith R (2008) Unleashing the power of design thinking. Des Manag Rev 19(3):8–15
Cross N (1982) Designerly ways of knowing. Des Stud 3(4):221–227
Deshpandé R, Farley JU, Webster FE (1993) Corporate culture, customer orientation, and innovativeness in Japanese firms: a quadrad analysis. J Mark 57(1):23–37
Gobble MM (2014) Design thinking. Res Technol Manag 3:59–61

Hattula JD, Herzog W, Dahl DW, Reinecke S (2015) Managerial empathy facilitates egocentric predictions of consumer preferences. J Mark Res 52(2):235–252
Heath C, Heath D (2013) Decisive—how to make better choices in life and work. Crown Business, New York
Herrmann N (1996) The whole-brain business book: unlocking the power of whole brain thinking in organizations and individuals. McGraw-Hill, New York
Holloway M (2009) How tangible is your strategy? How design thinking can turn your strategy into reality. J Bus Strateg 30(2/3):50–56
Kotler P, Keller K (2011) Marketing management, 14th edn. Pearson Education, Upper Saddle River, NJ
Leifer LJ, Steinert M (2011) Dancing with ambiguity: causality behavior, design thinking, and triple-loop-learning. Inf Knowl Syst Manag 10:151–173
Leonard-Barton D (1995) Wellsprings of knowledge: building and sustaining the sources of innovation. Harvard Business School Press, Boston
Meinel C, Leifer L (2013) Design thinking research—building innovation eco-systems. In: Plattner H, Meinel C, Leifer L (eds) Design thinking research—building innovation eco-systems. Springer, Wiesbaden, pp 3–10
Merholz P (2010) Why design thinking won't save you. Harv Bus Rev 1:18
Moll I, Montaña J, Guzmán F, Parellada FS (2007) Market orientation and design orientation: a management model. J Mark Manag 23(9–10):861–876
Narver JC, Slater SF (1990) The effect of a market orientation on a business profitability. J Mark 54(4):20–35
Nonaka I, Takeuchi H (1995) The knowledge creating company: how Japanese companies create the dynamics of innovation. Oxford University Press, New York
Nussbaum B (2011) Design thinking is a failed experiment. So what's next? Fast company, April 5. http://www.fastcodedesign.com/1663558/design-thinking-is-a-failed-experiement-so-whats-next
Nutt PC (1993) The identification of solution ideas during organizational decision making. Manag Sci 39(9):1071–1085
Reinecke S (2004) Marketing performance management. Deutscher Universitäts-Verlag, Wiesbaden
Rogers EM (2003) Diffusion of innovations, 5th edn. Simon & Schuster, New York
Sinus-Institut (2010) Die Sinus-Milieus—update 2010. Sinus-Institut, Heidelberg
Skogstad P, Leifer L (2011) A unified innovation process model for engineering designers and managers. In: Plattner H, Meinel C, Leifer L (eds) Design thinking: understand—improve—apply. Springer, Heidelberg, pp 19–43
Stanford University (2014) The design thinking process. http://dschool.stanford.edu. Accessed 28 Mar 2015
van Bommel E, Edelman D, Ungerman K (2014) Digitizing the consumer journey. McKinsey Insights, New York
Woodside AG (2004) Advancing means–end chains by incorporating Heider's balance theory and Fournier's consumer–brand relationship typology. Psychol Mark 21(4):279–294

Part III
Contributions from Practice

Industrial Design Thinking at Siemens Corporate Technology, China

Xiao Ge and Bettina Maisch

Abstract The innovation challenges for a foreign business-to-business company in China are huge. It has to quickly respond to the diverse and rapidly changing customer needs in the large emerging market, while facing strong competition from both local newcomers with disruptive threats and other established global players. To build up its innovation capability, Siemens Corporate Technology China has developed a practical innovation methodology adapted from Design Thinking and integrated with the best practices of other user-driven approaches, to adjust to both China's and industry requirements. A training/coaching program has also been created to support real business projects and other innovation activities at Siemens. The article includes (a) the overview of the Industrial Design Thinking (i.DT) program and methodology at Siemens and a highlight of its uniqueness compared with traditional ways of research; (b) the step-by-step i.DT process and methods explained with project examples; and (c) knowledge about critical i.DT innovation projects success factors at Siemens in China. By sharing the i.DT practices at Siemens in China, we hope to provide valuable insights into the development of creativity and innovation capability, as well as the adoption of Design Tinking or other user-driven approaches in industry.

Keywords Innovation methods • Multinational organization • Training • Coaching • Management • Creativity • Human-centered • Implementation

From the perspective of the innovation driving force, there have been two typical innovation models—vertical and horizontal innovation. Vertical innovation is technology-driven (push): with predetermined topics in a certain discipline, in-depth research is conducted to generate new theories, new scientific findings

X. Ge (✉)
Center for Design Research (CDR), Stanford University, 424 Panama Mall, 94305 Stanford, CA, USA
e-mail: xiaog@stanford.edu

B. Maisch
Siemens AG, Corporate Technology, Industrial Design Thinking at the Competence Center for User Experience Design, Otto-Hahn-Ring 6, 81739 Munich, Germany
e-mail: bettina.maisch@siemens.com

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_12

and new technologies which will drive commercial applications. Examples of technology-driven innovation are mobile communication and touch screen technology. Horizontal innovation is market-/need-driven (pull). Understanding of user needs is the key to the assessment of such innovations, which often entail the integration and fusion of cross-disciplinary technologies and a new business model to best satisfy user needs. Steve Jobs' revolutionary innovations of an easier-to-use Mac-intosh, as well as the iPod that allows music lovers access to thousands of songs anytime, anywhere, exemplify this type of innovation.

China is an extreme market for Siemens in many ways. To sustain business in such an environment requires a strategic innovation methodology and its management. Siemens Corporate Technology (CT) China has developed a combined vertical and horizontal innovation system driven by the needs of customers in the extreme environment in China, that also takes advantage of Siemens' global technology strengths. This integrated approach aims to generate innovations with disruptive potential for China, and from China to the world. It asks Research and Development (R&D) to build empathy with the extreme user of emerging markets, provide quick solutions by a mix and match strategy and then develop sustainable innovations by furthering technological strengths in a viable business model. Such an innovation approach will not only give Siemens a competitive advantage in the emerging markets, but also in mainstream markets.

In addition to establishing the right innovation ecosystem, the key is to systematically train development teams in a need-driven innovation approach; traditional innovation education has a deep-set bias towards cultivating technology-driven abilities. Thus, Siemens Corporate Technology developed the i.DT (Industrial Design Thinking) program to systematically build up innovation leaders by (a) enhancing horizontal, need-driven creativity with China's vast and diverse user needs, and (b) strengthening vertical, technology-driven creativity through the integration and fusion innovation—combining existing and/or new technologies, as well as a sense for the market to generate value for unmet needs with innovations with disruptive potential in a new way.

i.DT Program at Siemens CT China

The initial impulse to develop a specific user-driven innovation approach for Siemens in China came from former Head of Corporate Technology in China, Dr. Arding Hsu, and former Senior Innovation Consultant, Dr. Gautam Bandyopadhyay. The theoretical basis of i.DT is "Design Thinking", advocated by Stanford University and the design and innovation consulting firm IDEO. Design Thinking has gained huge popularity since the success of Apple's products and services, as well as the huge investment of one of the founders of SAP, Hasso Plattner, in financing the d.school at Stanford University and at the University of Potsdam.

i.DT introduces systematic principles and applications based on the human-centered approach of Design Thinking. It is distinctive for addressing the industrial or business-to-business (B2B) markets in China, as well as optimizing creative learning for Chinese development teams.

The projects executed between 2012 and 2014 were selected largely from existing R&D projects in Siemens China, with particularly strong links to business units (BU) and market needs. Four teams from different technology fields were selected to work in parallel on project topics of the involved BUs. The project duration was 4 months; each team had a dedicated workspace in the i.DT lab—Tian Gong Guan, which can be translated as "Innovators' Heaven". The goal behind locating the teams in one space was to increase the exchange of information within each team, but also between the different teams to get outside-the-box inspiration more easily, as well as to improve the quality of the project outcome through internal competition. Interdisciplinarity of engineers and BU people has been strongly encouraged in each team, not just for cross-field inspiration, but also to overcome the challenges of implementing the project outcome.

The team typically consisted of a team leader and two to four team members. Most of the team members were R&D engineers, experts in a specific technology domain. Involvement of marketing, sales and distribution was requested and highly recommended but not always possible. The team members generally spent around 50 % of their effort on their specific i.DT projects, because their time had to be split among multiple activities (as is often normal in an industrial environment), due to the strong demand for their expertise and experience. Two dedicated i.DT method experts facilitated the learning of the methodology through weekly training, as well as giving hands-on support in project execution through intensive coaching. The aim of the i.DT program in Siemens CT China was to cultivate development teams capable of user-driven innovation, as well as providing promising, innovative solutions that would become part of their product roadmap and deliver value to Siemens and its customers. Table 1 shows the unique approaches applied in the i.DT program based on the accumulated experience by i.DT method experts. These unique approaches, combined with i.DT process and methods, are introduced in detail in the following chapters, showing how i.DT has reduced obstacles to innovative thinking and acting in development teams at Siemens and facilitated the generation of sustainable innovations with disruptive potential.

i.DT Process and Methods

As Fig. 1 shows, in the i.DT process, each project starts with the business goal from a BU, which is aligned with its innovation roadmap. The process incorporates five steps, as shown in the colored rectangles: defining, needfinding, brainstorming, prototyping and testing. The results of each step, shown in the rectangles, are ecosystem, opportunity areas, unique ideas, low/high-resolution prototype and, in the end, after several quick iterations, a validated functional prototype which should

Table 1 Uniqueness of the i.DT training program and project execution

Category	Elements of i.DT (process, methodologies, training program and project execution)
Industrial business	Develop systematic "step-by-step" and "hands-on" need-driven innovation training and coaching courses customized for various complex industrial projects Provide a platform and encourage development teams from different disciplines to communicate with, challenge and learn from each other to think outside their technology field and in a system level Set up interim Steering Committee to involve high-level management, on a regular basis, to review, evaluate and guide project team with their insights on Siemens business, technology and market experience
Idea implementation	Train/coach along real projects with the goals of training development teams as well as generating need-driven innovation with business value for Siemens and its customers Build systematic training/coaching structure, including support from high-level management, close collaboration between CT and BU, etc. to enable the potentially disruptive project outcome to overcome implementation barriers and increase the go-to-market rate
China markets	Set a short-term (e.g. 4 months) training/coaching model to quickly understand the market breadth and depth, and generate innovations for the unique market needs in China
Development teams	Focus on R&D managers and engineers, instead of marketing people, in order to purposely train technical experts to think from the user perspective (horizontally) and to build up T-shape talents Focus on open-minded leaders to quickly spread and pass along i.DT methodology and its application Build up a database of case studies for i.DT methods and projects, in order for teams to best learn from example Empower teams to apply the i.DT methodology in their own future projects, generating business value

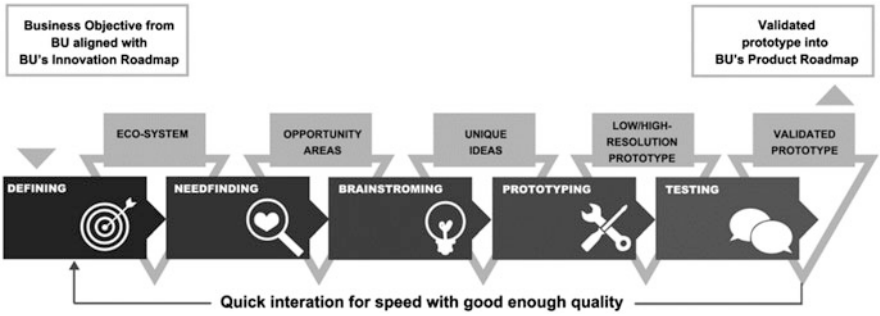

Fig. 1 The i.DT process

Table 2 Comparing i.DT with traditional R&D in terms of process and methods

Phase	Traditional R&D	i.DT
Defining	Define project topics with technology requirements	Gain a holistic project perspective through visualization of the ecosystem with all stakeholders involved and their relation to each other. Define project objective with Job-to-be-done from the perspective of user instead of technology
Needfinding	Focus on decision makers on the customer side and their requirements	Broaden the attention to all important stakeholders in the project innovation ecosystem, with comprehensive needfinding
	Focus on mainstream users or target group of users	Use extreme users to effectively find out hidden needs in the vast and diverse markets in China
Brainstorming	Idea generation sessions are often not structured. The efficiency of such sessions is low in terms of numbers as well as uniqueness of ideas generated	Ideation tools/methods that fit with the learning style and thinking mode of Chinese, e.g. interactive storytelling, brainwriting, etc. to stimulate teams to think out of the box, to express ideas even when they are immature
Prototyping	Time-consuming functional prototype building, simulation and testing, in order to validate the feasibility of the technology	Incorporate different levels of prototyping (from low to high resolution, etc.) and different stages of prototyping (Critical Function/Critical Experience Prototype, Dark Horse, etc.) to speed up the innovation cycle, especially on complex projects
	Start prototyping only when ideas are mature and specifications are complete, which happens nearly at the end of a project, resulting in costly big changes late in the process, caused by hidden problems that should have been discovered earlier	Build to think, and make ideas tangible immediately, especially in early stages, through low-resolution prototyping, to rule out risks as well as maximize learning experience
Testing	Within R&D, focus on functional testing to ensure feasibility and validate requested requirements	Test not just for technical feasibility, but also for human desirability and market viability
	Test within the project team	Test with peers from other disciplines for feedback from different angles, and test with high-level management for strategic guidance
	Technical feasibility is tested via simulation, functional prototyping or commissioning of pilot project	Technology feasibility is not enough. The competitiveness of the outcome is improved with two special testing criteria in China: unique ("not-me-too") ideas and "not easily copied" ideas

(continued)

Table 2 (continued)

Phase	Traditional R&D	i.DT
	Conduct benchmarking mostly about the features, functions and price on solutions of top players/competitors in the field	Three types of benchmarking are introduced: market, function, and experience benchmarking across boundaries of disciplines
Iteration	Try to perfect an idea with over-analysis and documentation before getting feedback from stakeholders	Fast iterations are enforced to quickly redefine challenges, re-synthesize user needs, explore possibilities and identify most promising solutions

be taken over by the BU as a part of its product roadmap. This iterative process involves a huge amount of work in exploration, convergence and readjustment with regard to potential user needs and innovative ideas.

Compared with traditional R&D in the industry, the process and methods of i.DT are featured in Table 2.

Defining for a Holistic Understanding of Project Scope from Stakeholders' Perspectives

In the "defining" phase, the project team starts by building an innovation ecosystem around the innovation challenge taken from a BU, mind-mapping different stakeholders and making the relations between each other visible; based on the initial understanding of the facts, barriers, and opportunities of their challenge, the team visualizes full-size personas for the identified key stakeholders. This first empathy-building activity enables the team to put themselves in the shoes of the persona and have an initial understanding of what the stakeholders' "Job-to-be-done"—a concept popularized by Clayton Christensen of Harvard University—could be. For example, for a project with the initial innovation challenge to "develop a urine strip reader for the Chinese market with a cost lower than €50", the team got a holistic picture of medical care in China by broadly mapping the different players, from the local government to patients' families, in an innovation ecosystem. This drew attention to medium/low-end markets for rural hospitals, where supply fails to satisfy demand due to huge patient flow. To have a clearer picture of the target user and his/her needs, the team created a persona—a visualized and detailed description of a typical user for whom the team designs. The persona in the urine project was a young physician in a rural hospital in Anhui Province named Dr. Wang. Putting themselves in the shoes of their persona and having empathy with him, the team understood that the "Job-to-be-done" for Dr. Wang had to be "to provide fast and accurate urine tests for indigent patients", instead of providing a cheaper urine reader device.

Rather than providing solutions to the initial innovation challenge, innovation ecosystem asks the team to take one step back. With "Job-to-be-done", the team is

guided to resolve the right problems by understanding the fundamental needs of the key stakeholders. An accurate and final "Job-to-be-done" usually cannot be achieved right away at the beginning of the project. With an initial assumption of the "Job-to-be-done" made from a preliminary analysis, the team experiences the whole i.DT process, during which they conduct observations and interviews, brainstorm, prototype, test, and redefine the "Job-to-be-done" based on their learning. Through several iterations of the process, the team's understanding of various stakeholders' needs is deepened, even changed fundamentally, and their final functional prototype is expected to be validated in terms of user desirability, technology feasibility and business viability.

Needfinding to Identify Critical and Hidden User Needs

Siemens' i.DT needfinding stage has two distinctive features: the first is to emphasize extreme users and the second is to engage R&D engineers, rather than people from marketing or sales, to conduct needfinding in the field.

Extreme Users

The method used in Design Thinking is to study the two ends of the bell curve of the user span to uncover hidden needs of mainstream users more easily. Mainstream users usually don't realize, or cannot communicate, their potential unmet needs, whereas the needs of extreme users are amplified and easier to study.

The concept of extreme users is extended and systematically developed in i.DT: Sorted by the frequency of using certain products or services, extreme users can be frequent users, less frequent users, or non-users. As for user experience, extreme users can be hackers or novices. Considering other aspects, extreme users can be the ones who use products in an unconventional or wrong way (e.g. WLAN as a product used by miners to communicate, locate or conduct rescue in extreme conditions of coal mines). Extreme users can also be defined as those who use alternative products to serve needs that might be shared by the mainstream (for instance, in the miner localization project "DigitUp", the team studied ants as extreme users who have lived for hundreds of millions of years as "miners" in order to explore all possible solutions of communication for coal mines; another team that researched shop lighting made some interesting observations and interviewed users in a "dark restaurant" where clients dine in complete darkness).

In the project CEEB—"Cozy and Energy-Efficient Building", a building management project, the typical users of the building's control systems are building managers and staff in the control room. The development team broke the thinking box of focusing on "central control system", and instead, investigated extreme users: home dwellers and office staff. To take the temperature control system as

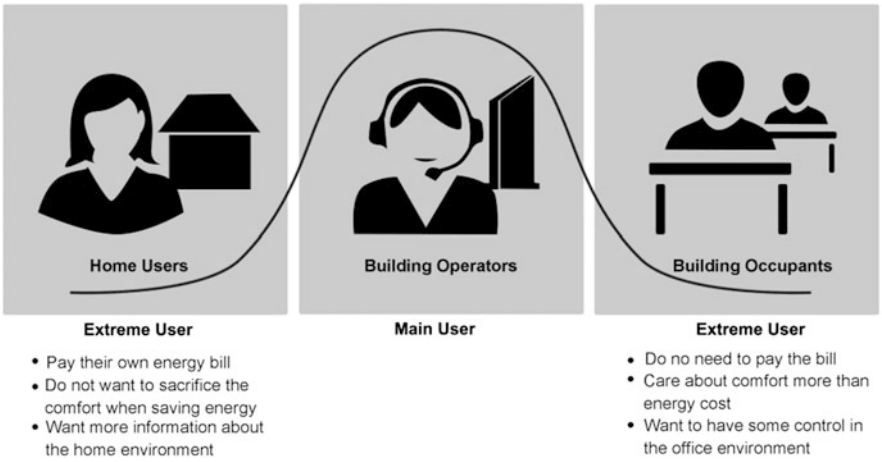

Fig. 2 Extreme users in building temperature control

an example, energy-saving and environmental protection are both hot trends in the area of smart buildings. But just as Fig. 2 shows, building occupants do not care about the energy bill because they do not have to pay it, but they care a lot about their personal comfort. In observation and interviews, the team recognized that, particularly, female office workers in a high-rise building feel too cold in summer and put blankets on their desk. The team made another interesting observation that some of the office staff "go against" the smart system. Some office staff blocked the smart curtains that fall automatically for shading the sunshine in the summer, just because they wanted to enjoy the sunshine!

There are different levels of needs, which make it harder to identify the hidden needs. For example, the basic need of the office staff in Fig. 2 is "to control temperature", which is easy to meet, but products that only meet the basic needs are not competitive enough. A higher level of the needs—"to conveniently control temperature" would rule out some products with low usability. Moreover, the ultimate goal is to find out the meaning behind the user's needs, which enables the team to think beyond short-term solutions. For the employees working in smart buildings of tier-one cities in China, they typically pursue premium purchases and seek highly-rewarding lives. Thus, only when "temperature control" is linked with "high-quality life" can the hidden needs of the office staff be met. In this case, "to have enough freedom to adjust the surrounding environment to their comfort" was the basis for the team to look for opportunity areas and move on to brainstorming.

Needfinding Conducted by Engineers

Most of Siemens CT's R&D personnel are experts in a certain technology field and hold a Master's or Ph.D. degree. Contrary to the stereotype of experts sitting in front of computers, or conducting experiments in labs to solve a technical problem, engineers in i.DT projects must go into the field to face end users and other stakeholders. The development team collects first-hand information on the real situation through carefully prepared and conducted observations and interviews. The resource from Siemens marketing is certainly important, but the goal is not only to uncover real hidden needs, but also to enable a development team to create innovative products through strong empathy with their users, rather than simply satisfy rigid product requirements delivered to them. This qualitative approach to collect needs of extreme users by engineers has proven to be very powerful. "It took this young team in CT just 3 months to get such a thorough understanding and many insights about the market, while it usually takes more than a year for a mature marketing department to do it", a manager said during an inspection of an i.DT project.

Brainstorming to Generate Unique Ideas

i.DT brainstorming is designed to fit with the learning style and thinking mode of Chinese, encouraging leading experts to think out of the box and stimulating them with inspirations for unique ideas. Examples of brainstorming tools are: inviting colleagues from other technology fields, thinking by action: sketching and prototyping, interactive storytelling, "yes, and" rather than "yes, but", as well as brainwriting. Most Chinese engineers are reserved, and tend to keep any thought to themselves unless it can be deemed perfect. But most brilliant ideas are incubated by collision of thoughts from different people. How might we encourage teams to express their immature ideas?

Taking "interactive storytelling" as an example, team members are asked to tell different stories about their project stakeholders through role-playing. Freeing their bodies helps to build a lively brainstorming atmosphere and stimulate ideas through stories. For example, in a medical care project, the team members conducted brainstorming sessions in this interactive way to find breakthrough ideas about how to provide fun medical services for child patients. A female engineer, over 30, assumed the role of a 7-year-old patient talking with her mom at home when she received regular urine tests. The engineer recalled that "I am a mother of a 5-year-old boy, so I supposed I had a pretty good knowledge of what he thought every day. To my surprise, it still brought me many new ideas and inspirations in the story-telling exercise." She found out that, in the world of the little girl, the household urine test equipment was old-fashioned and scary, although she was always awarded with candies after every test! If the process of a urine test could be

designed as a relaxing chat, resembling one between the girl and her Barbie, then the urine results would be much easier to get, and moreover, the experience for both the mom and her child would be much more enjoyable.

i.DT method coaches have developed different brainstorming methods and workshops customized for the needs of different types of projects and teams. The ideas from brainstorming are converged and selected by criteria: user desirability, technology feasibility and business viability.

Low-Resolution Prototyping and Testing to Speed Up the Innovation Process and Mitigate Risk

Benchmarking is conducted along the project to evaluate and further develop ideas. i.DT benchmarking is not just about product positioning vs. competitors (market benchmarking), but also about particular functions (function benchmarking) and user interaction (experience benchmarking). In one example of experience benchmarking, fast-food chains like McDonald's are famous for the speedy convenience brought to clients; it became one team's benchmark for setting up high-volume processes in Chinese hospitals for well-developed health care procedures in brain stroke care.

In addition, prototyping and testing are extensively applied to verify and explore of ideas and user needs. In i.DT's 4-month training/coaching program, needfinding serves as the basis, brainstorming serves as the medium and prototyping serves as the framework. Prototyping tasks are assigned every month to achieve different goals and motivate teams to study the project topic from different angles. For each prototyping stage, the team is expected to go through the whole i.DT process, and in the end, four iterations of the i.DT process are completed to achieve a validated functional prototype.

The four prototyping stages are adapted from the ME310/Engineering Design Thinking course at Stanford University. The first prototype stage is Critical Function/Experience Prototype (CFP/CEP), which asks the team to get started beginning with the one or two most critical aspects, rather than trying to conquer the whole innovation challenge at once. After the first round of prototyping, teams usually tend to focus on a certain solution, ignoring other opportunities in the project. The second Dark Horse Prototype lets teams put existing findings aside, pick a different critical aspect not yet considered, investigate needs of corresponding stakeholders, and develop wild idea-based prototypes with a low assumed likelihood of success. The first two stages are in the diverging phase of the project, whereas the last two stages, the FunKtional Prototype and FunCtional Prototype, are in the converging phase. During FunKtional Prototype, teams ought to crystallize their learning and ideas into one to two system-level prototypes that do not have to function completely. At this point, teams should take into consideration requirements from people, technology and the market. In the final phase, an original functional project

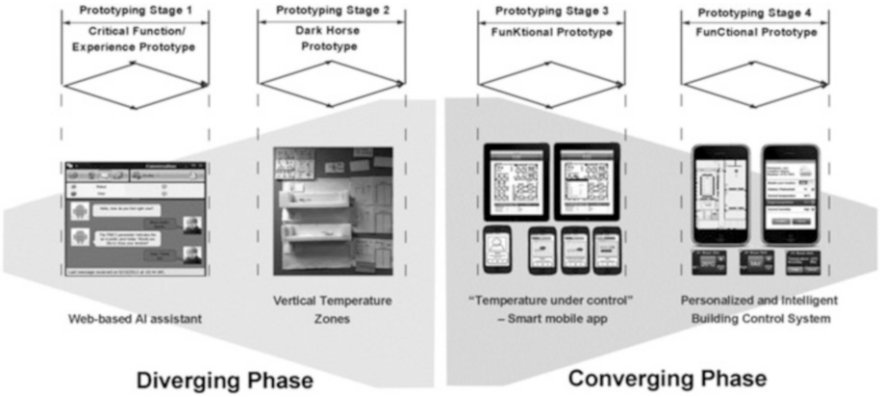

Fig. 3 Prototype stages of the building management project "CEEB—Cozy and Energy Efficient Building"

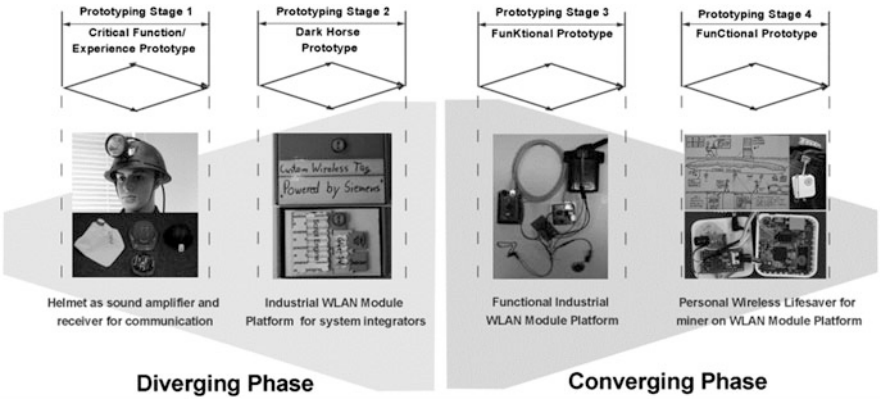

Fig. 4 Prototype stages of the miner project "DigitUp"

outcome with disruptive potential is expected, which should be presented with a practical business model, ready to convince the BU about user desirability, technology feasibility and business viability. The four prototypes from CEEB, as shown in Fig. 3, exemplify how development teams, by following the iterative i.DT process based on different prototyping tasks, can effectively develop innovations with disruptive potential.

In i.DT, a prototype is not used for verifying technology feasibility (e.g. whether the structural strength of gas turbine blades meets standards or not), but as an effective tool to communicate ideas, lubricate brainstorming and get feedbacks. Figure 4 shows several examples of the concept prototype from miner localization project "DigitUp". Rather than spending several weeks of hard work with hardware assembly and software programming, this project team put together some paper

models costing only one fun hour to make their ideas tangible, enabling them to test their ideas with system integrators to get timely and critical feedback.

Testing is not only a way to get feedbacks from users on whether a solution is desirable or not, but also a way to test products' technological feasibility and commercial viability. i.DT propels teams to use "not-me-too" and "not easily copied" as principles to come up with competitive ideas and prototypes. This usually requires strategic feedback from upper management and business experience shared with the BU. The i.DT training program provides a platform for innovation where ideas with disruptive potential could become more than just patents: actually a part of the business roadmap, and later on, new products or features for products in the market.

i.DT Outcome

In the previously mentioned building control project, CEEB, the team un-earthed one need of extreme users: "to have enough freedom to adjust the surrounding environment to their comfort". Through several iterations of the i.DT process, the team consolidated their innovative ideas: to provide building users with a personalized and intelligent control system. In a building with Siemens' smart building management system installed, the interior space is virtually divided into a number of sub-spaces; each employee—as a building user—can personalize temperature, light, even the health index of the surrounding environment, simply on their smart phones. The building management system will design the sub-spaces according to each user's locations and personal preferences, so that users can directly interact with the building and enjoy a better working environment.

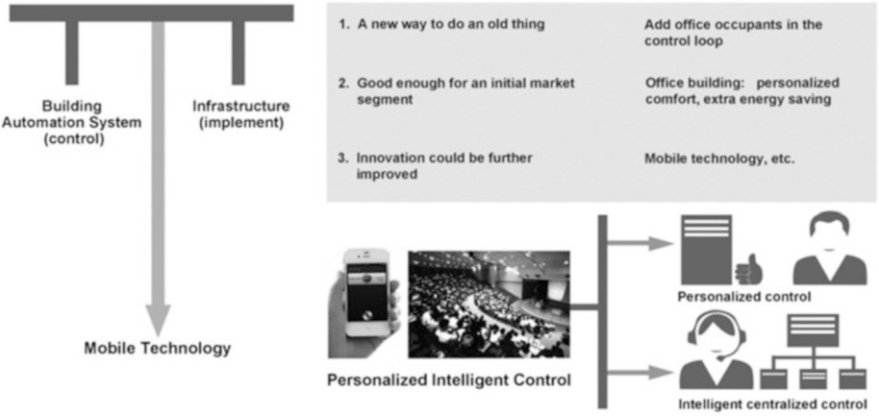

Fig. 5 The integration and fusion innovation in the building management project CEEB: starting horizontal with market-/user-needs and going vertical through technological strengths

As Fig. 5 shows, this innovation outcome has overthrown the first generation of personalized, but general control using control panels and the second generation of smart, but centralized control using control centers. To develop sustainable innovations, the team went into great depth and identified vertical technologies that could be continuously improved by leveraging Siemens technological strengths in areas like mobile technology. Moreover, based on the concept of accurate energy distribution that fulfills users' different needs, the innovation outcome also satisfies the needs of other stakeholders (government, building owners, etc.) by saving 15 % more energy than the existing smart building control system.

i.DT projects always have two goals: the first is to provide an innovative outcome with disruptive potential that becomes a part of the BU product roadmap. The second goal is to have trained team members able to apply a need-driven i.DT approach in their future projects and disseminate i.DT methods and mindset to the innovation community in Siemens.

Learning and Future Plans

Supportive Innovation Management and Supportive Ecosystem Are Critical Success Factors of i.DT Innovation Projects

The validated functional prototype as the outcome of the i.DT process is expected to return to the BU for implementation and commercialization, to create real business value. For any innovative ideas to traverse pre-development in the R&D department and enter the development stage in the business unit (valley of death), the challenge in a multinational company like Siemens is to have strong upper management support, as well as close collaborations between Corporate Technology and the various business units. To reinforce supportive innovation management, the i.DT expert team has set up a Steering Committee with stage-gate project reviews to encourage active participation of upper management from the project's starting point. The project development teams are also urged to build up strong networks with upper management teams from both CT and BU to guarantee both access to critical resources and their commitment in decision-making processes. But in the entrenched business culture defined by hierarchy, discipline and profit, establishing such management support and empowering network is extremely difficult, as is ensuring that any original idea can survive from the bottom up.

Thus, it is critical to build up a strong database of case studies to establish i.DT's reputation through successful projects. In the absence of data for direct comparison of project outcomes with and without the intervention of i.DT, as well as long-term evidence of increased patents, publications or increased new products coming from i.DT-based innovations, the i.DT expert team has nonetheless built a framework for each distinctive case and extracted best practices from every project. The i.DT

program, with its process and methods, is exemplified by these case studies that have had impressive positive impact in upper management meetings and new rounds of i.DT training. In addition, extensive research has been carried out to collect case examples of human-centered B2B development projects from external resources, to convince internal upper management from both CT and BU.

The i.DT expert team has also been committed to strengthening the necessary support for project development teams by fostering the innovation ecosystem. Since the beginning of the program, the i.DT lab Tian Gong Guan has been designed as a busy and colorful workspace, where teams from different departments come to work together. Over time, this space, the creative atmosphere and design artifacts from former projects, like personas and prototypes, have proved to be very interesting to various internal departments, as well as external media and governments. After 3 years of successful project development in the creative working environment, it has now expanded to the whole first floor of Siemens CT China. The new i.DT space consists of a multifunctional workshop space, three project rooms and a professional machine shop for advanced prototyping.

To cultivate the i.DT innovation culture, an innovation community was also set up, in the form of an informal lunch meeting each Thursday at noon. The innovation community has reacted quickly, with more and more former i.DT team members involved in the loop. Moreover, the activities during the lunch meeting have expanded from the early-on improvising exercises to more diverse events that empower interdisciplinary collaborations. For instance, different research departments have volunteered to present their ongoing project activities in show-and-tell form, and researchers invited from Tsinghua University shared their interesting projects. Such events, traditionally held in closed-door meetings with decision-makers, have given free access for the audience spanning numerous disciplines, including healthcare, city and infrastructure, industry, energy and personnel from Intellectual Property, Human Resources, etc.

But this is still not enough. There are a number of different innovation initiatives within the huge global network of Siemens; the i.DT expert team believes future collaboration with these internal innovation initiatives will be as important as cooperation with external innovation communities.

Customization of Innovation Programs Is Critical for Industrial Business in China

The innovation program was initiated as a systematic short-term (4-month) training program, with four teams working in parallel on four distinct topics. The program's short time horizon was determined by the profit-driven business environment that demands potential business value for ramp-up. It was also intended to reinforce speedy iterations of the innovation process, which is especially critical in the rapidly growing markets in China. But early on, the i.DT expert team figured out

that a fixed training duration was impossible in a business environment where different research projects have different timelines and the availability of researchers is highly unpredictable. And, usually, further support from i.DT method experts is needed after the completion of i.DT training, which marks the start of a new project to nail down user requirements, technical specifications and a business plan. Thus, more flexible i.DT training, from short-term introductory workshops to long-term collaborations, has been designed and provided.

An intentionally diverse team from different departments (R&D engineers from CT and BU, marketing, sales) is hard to fulfill, sometimes because of the lack of resources and availability, but also because of internal competition and the discrepancy of interests among decentralized departments of a big company. But interdisciplinary collaboration has been proven to be very powerful, even when different teams sit in the same workspace, occasionally exchanging thoughts. For instance, one team working on indoor navigation was inspired by a shop lighting project team to use light as a tool for navigation. The i.DT expert team has thus designed several cross-team collaborative exercises to encourage such outside-the-box inspirations.

In addition, the training program has been customized to incorporate hands-on training and coaching with teaching-by-doing. Unlike university students who regard learning as the key driving force for projects, most project teams expect i.DT to be an effective tool to better deliver business value. Many new team members are skeptical about i.DT upon entering the lab. Learning an ambiguous innovation process is not simply about knowledge delivery; the team has to learn by doing, with interest and motivation. Thus, the i.DT expert team acts more like an active participant in the project team, going together with the team into the field, conducting brainstorming with different stimuli, and building low-resolution prototypes with them. For instance, in a past medical care project, the team had made little progress for 2 weeks in terms of needfinding, since they were reluctant to reach out to hospitals to get first-hand information about the environment, stakeholders and processes; one i.DT expert took them into a hospital on the following Saturday. By observing patients and talking with the patients' families in the brain stroke inspection ward, the team found many unexpected insights, especially about how completely ineffective the current pre-hospital workflow was. Such hands-on training and coaching gradually changed the team's mindset to actively apply i.DT methods in their project.

Building up case studies with close relations to Siemens businesses is also a big part of the i.DT training program. As mentioned before, the case study is a powerful tool to secure business collaboration supported by upper management and it has been used as intuitive training material for teams to quickly learn by example. The most frequent question the i.DT expert team faced by team members has been "Have you got a successful example using this methodology from a project similar to ours?" The i.DT expert team believes that human-centered design innovation exists everywhere, from gas turbine to IP services, but if documenting and sharing learning stop, method experts and development teams will have to start from scratch and will not be able to build on it and speed up the process.

Useful and Unique User-Driven Innovation Methods Are Critical to Cultivate Innovative Thinking and Doing

To cultivate innovative thinking and doing of the development teams, the i.DT expert team had to first prove the innovative nature of i.DT methods. Taking needfinding as an example, if the experienced marketing departments have already collected so much data about user needs, what is the point of starting over again? How can we prove that hidden needs can be retrieved through i.DT needfinding rather than traditional marketing? By resolving such questions, the i.DT expert team has consolidated some unique user-driven innovation methods proven to be useful for development teams in the Siemens environment in China.

For instance, the "Job-to-be-done" is early in the first phase of an i.DT project to transform the development team's business objective from the perspective of technology to a focus on users. The immediate overturning of the original innovation challenge at the beginning of the process effectively encourages participants to start thinking unconventionally throughout the project process.

Many useful and unique lessons were learned from experimental exercises in one project and were immediately applied to others in the program. The development of the brainwriting method is such an example. Brainwriting asks the team to write, rather than talk, to communicate and generate ideas, which is especially effective in Chinese teams, where members are often too reserved to talk. Later, the i.DT expert team also found out that brainwriting can be a powerful idea generation tool to overcome cultural barriers in ideation sessions.

Some of the lessons-learned are yet to be built into the methods database for training innovative minds. For instance, many i.DT team members have used other innovation tools before: TRIZ, which provides successful principles in innovative problem-solving of a particular problem; SCRUM, which is a powerful agile approach to deal with complex projects in software development; and Six Sigma, which is an analytic tool to systematically improve existing products. These innovative approaches are not mutually exclusive with user-driven innovation processes and methods, and should be intelligently incorporated together, to facilitate better innovation outcomes.

The i.DT expert team has kept updating the useful and unique methods in the industrial environment in China that have become important assets for cultivating innovative thinking and doing of the people. To foster this approach within the talent pool, the i.DT expert team is also working closely with the Human Resource department and offering workshops, as well as short-term projects, with the Siemens People Development Program.

The world has been changed by innovation; so has innovation itself. The innovation model of i.DT, developed by Siemens CT China and based on China's innovation environment, has achieved initial success. Corporate Technology in China has over 400 employees, issued more than 1500 invention reports and has had a great impact on Siemens global and domestic business. Through i.DT alone,

nearly a hundred managers and researchers have been trained, with more than 13 business projects conducted. Many of the graduates from i.DT are now leading i.DT innovators in their own areas of research. In addition, a number of "not-me-too" innovation outcomes are in the pipeline of business implementation.

i.DT is still evolving. Development of i.DT itself is a human-centered project in which the i.DT expert team is constantly adjusting existing methods and creating new approaches, as well as developing programs to foster the generation of innovations for Siemens' customers.

Design Thinking: Process or Culture?

A Method for Organizational Change

Alexander Grots and Isabel Creuznacher

Abstract The Design Thinking method is often applied as a process for innovation. Innovation, however, also always means change and requires a culture open to change. To what extent can Design Thinking be used to implement change in organizations?

Design Thinking is actually more than just a process; it stems from the classical disciplines of design and engineering. People with a professional background in these disciplines—who had not only applied the practices and steps of Design Thinking, but who had also internalised them—developed the method from their daily work procedures. Today, we would call them "Design Thinkers". The companies where Design Thinking was formulated, especially the design agency IDEO, had an established corporate culture. The components of this culture shaped the characteristics of Design Thinking and are the foundation for every Design Thinking process.

Organizations interested in using the method should differentiate between the following two aspects and decide how far down the road they wish to go in a change process:

- Are they only interested in the method's classical function as an innovation process—as a tool to develop innovations and shape change?
- Or do they want Design Thinking to become an element of their corporate culture—as a sum of characteristics that make a company culture generally more innovative, more agile, more adaptable and more flexible, thus creating a culture of change?

These two aspects can not only be used together, but can also work separately from each other; as the process can not only be a fixed part of the culture, but can also help in its transformation. Design Thinking can be used beyond products and services to change organisations and create new corporate cultures.

This is a translated and revised version of an article initially published in the "Zeitschrift für Organisationsentwicklung", issue number 2/2012, from Handelsblatt Fachmedien GmbH.

A. Grots (✉)
e-mail: alex.grots@bashiru.net

I. Creuznacher
Institute of Transformation in Business and Society, EBS Universität für Wirtschaft und Recht, Rheingaustraße, 65375 Oestrich Winkel, Germany
e-mail: isabel.creuznacher@ebs.edu

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_13

Keywords Design thinking • Design culture • Innovation culture • Change management • Innovation characteristics

To initiate a process of change by Design Thinking, the following methodical steps must be interpreted in the according context (Fig. 1):

Design Thinking as a Step-by-Step Process

The first step in a process of change, called UNDERSTAND or DEFINE, involves describing and taking a snapshot of the status quo—or current, company-specific ecosystem. This situation is described as a classical analysis of the current situation. The purpose of this first step is to identify an initial approach to change in the existing company structure. Often, "low hanging fruits", (aspects of an organization easiest to change) hold the greatest wealth of information. Based on the research and analysis of hard facts (among others: external and internal communication, previous measures implemented for change, processes for personnel development and motivation), Design Thinking also involves the collection of "soft facts"—information that has not been documented and therefore can seldom be read.

The Design Thinking team's objective in this phase is to acquire a feeling for the current nature of the organization, which gives the Design Thinkers the necessary basis and confidence to take the next step to the most important, most difficult unit of an organization: the people who must be changed.

The Design Thinking team collects more than just company data; it seeks and defines the nature of the organization.

The next step, OBSERVATION, is the main source of information to uncover the organizational structure's "soft factors"; the main inspiration for change comes from qualitative investigation of people. These people can be employees, managers, partners of the company or former and, perhaps, even future employees. This step

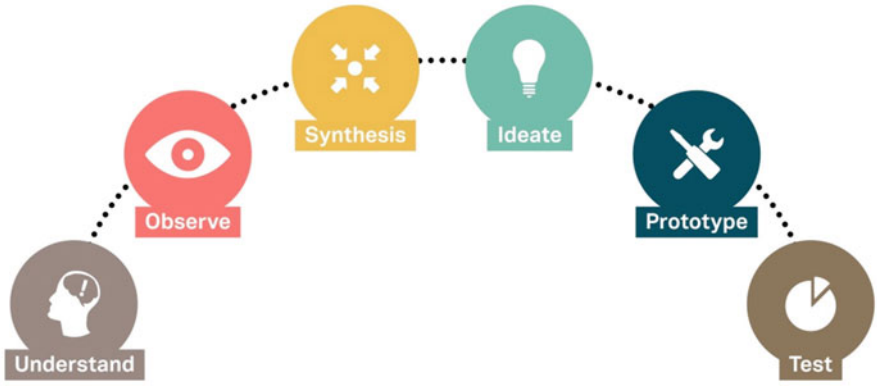

Fig. 1 Steps of the design thinking process (Lornes)

simply involves questioning people while they do what they do and observing their behaviour while they do it, as well as during other necessary activities. The real value of this important step only becomes apparent when careful observation and the dialogues and interactions building on it are brought together.

This approach helps the Design Thinker to develop empathy with the employees and relevant stakeholders; what do they think about the processes, hierarchies and organizational structures? What are their rational conclusions and what are their emotional reactions? The aim is to augment the information base acquired in the first step of understanding with further perspectives, thereby obtaining a more comprehensive, qualitatively finer picture of the company. This also involves the observer immersing himself in the change context to get a feel for motivations, motives and attitudes of employees and decision-makers in the face of change.

Conscious observation can already produce surprising insights in a short time: an exercise called "Whose life is it?" was conducted in a Design Thinking workshop held by a premium automotive manufacturer for a large group of middle management. The objective was to answer qualitative questions about a stranger as a team. The only help the participants had was a pile of photos that the person concerned had taken of his everyday life, but which did not show the person himself. The team thus had to construct answers to unknown facts on the basis of a few visible data points.

For example, what media is read/used in the household? What daily rituals does this person have? One of the many questions about the stranger in this workshop was "What car does this person drive?". Six teams from the manufacturer took part in the exercise, each with a different set of photos. The sets covered a broad spectrum of society, from a Berlin based student, through a pensioner and her family in the Bavarian countryside, to a high net worth individual in Frankfurt (Fig. 2).

When the teams presented their results, the director of the unit noticed that none of his managers had had the confidence to think that even one of the strangers from the pictures would drive the company's brand. This observation alone woke him up to the fact that there were fundamental problems with self-perception in his organization and in his departmental culture.

In the very important strategic step of SYNTHESIS, the information, statements, observations and assumptions collected in the former step are visualized in their totality and in context. The original ecosystem of the organization drawn up at the beginning should, by now, have been augmented by much more information, many questions and a few answers. This wealth of data now needs to be "boiled down". It is checked for what fits together, what leads to the next, where dependencies exist and where, for example, tensions make a relationship interesting. By sorting information and questioning, behaviour, needs and motivations become clearer, but in an abstract way. The aim is to distil the essence from the complexity of information, to create an overview of the most important dimensions of the organization.

This overview is the most important result of a Design Thinking process, especially for organizational tasks, as it serves as a tool, not only unveiling the potentials for change and improvement of organizational objectives in a clear way,

Fig. 2 Whose life is it sheets (IDEO)

but also, creating a decision-making basis, giving the potentials possible direction and priorities.

The end of the synthesis step is formed by the important apex between the large input part, which involved mainly collection, understanding and processing and the output part, with the goal of designing something new. Only now does the team actively engage in the next process step of developing solutions for the hurdles and use of the drivers it identified.

The original terms of reference or orientation of the project are often adjusted on the basis of the synthesis. It sometimes happens that a problem at product level turns into a completely different problem at an organizational-cultural level; for example, in a large hospital challenged to improve the service. The synthesis of the collected information resulted in an overview, comparing patient and hospital motivations to discover potential for innovations. The motivations of the organization and patients proved to be completely different. For patients, there were few more emotional experiences in their lives than their hospitalization. For the privately run hospital, efficiency was the overriding imperative. The representation of this situation as a Venn diagram alone sufficed to convince hospital management to rethink its strategy. The processes were redrawn in the end; all situations where there were points of contact with the customer, (the patient), were re-examined and the process redesigned with consideration of the role and effect of the personnel, from the patient's point of view. This resulted in a complete reorganization of the hospital, leading to significantly greater customer satisfaction (Fig. 3).

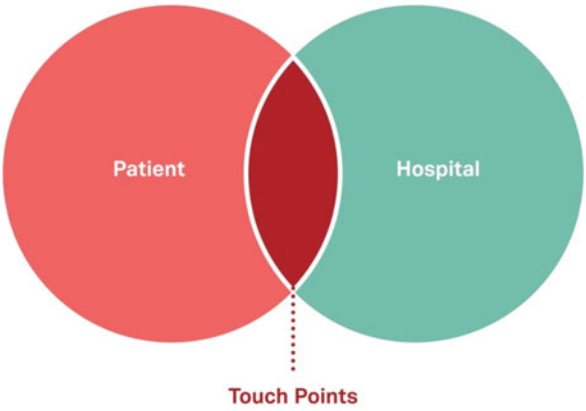

Fig. 3 Hospital opportunity framework (IDEO)

The IDEATE step is actually the easiest part of the Design Thinking process. This is because the team already knows, from the intensive work performed, where solutions are to be found and can now finally begin giving them form. An ideal psychological starting point for the generation of ideas; everyone knows that almost all ideas will go in the right direction. The only question is; which are the best? This phase forms a team-dynamic highlight in the process, because it makes much that was previously theoretical and vague, concrete and tangible. A variety of creativity techniques can now stimulate the imagination of the idea generators. In addition to team members, people who have not yet, or barely, played a part in the process so far are also welcome to take participate in this step.

The basis for every idea generation, if formed by the potentials and directions derived from the synthesis, are the questions resulting from them. The formulation of these questions is an art, because it should leave the idea generators with enough room for free thinking, but still lead to a specific goal. It is important though, that the ideas are as concrete as possible: especially, when it comes to ideas for organizational development. They can be certain measures or even product ideas that embody a process or a new role in the organization. The more tangible an idea is, the greater the chance that non-participants can understand and therefore accept it quickly. They will understand not only the idea and its objective, but also how it is to be implemented.

An organization can recognize the value of change best if its effects can be seen in real results, better procedures, more transparent processes, appropriate role allocations and innovative and marketable products and services. Such concrete results radiate into the organization and all organizational units understand their value immediately. The step of PROTOTYPE is thus also extremely important for changes in the organizational context: very early and rough implementation of ideas encourages the people concerned to make mistakes and learn from them. Deliberate use of prototyping as a tool usually fosters a very fertile “error culture”. Mistakes that are made and identified early on in the process are seen here as progress and

thus accepted as a success. The general speed of development and, therefore, the agility of a company can be increased substantially by this mindset.

Prototypes can be role-plays, presentations, drawings or ideas put together in the most rudimentary form. Anything and everything is allowed to give employees, managers and other stakeholders a concrete impression of what the new structure or conceived process or product will feel like in the company and how it will unfold. The aim of the prototyping phase is to understand ideas with more than just a rational-logical mind. A prototype helps not only in understanding an idea, but experiencing it! That applies not only to future users, but also to the Design Thinking team itself. Prototypes are the only way to simulate the interaction between motivation and the corresponding context, thus obtaining a holistic reaction to an idea in the last step of testing.

A large company in the telecommunications sector wanted to stop subscribers leaving. Solutions were to be developed in a Design Thinking process. While preparing the synthesis presentation, the project team realized that the steps that would be necessary to solve the problem required an almost revolutionarily different organizational mindset and management of the organization. Management was reticent in the first talks on the change being considered. To address this, the team decided to recreate the key moments the team itself had experienced in the field while observing customers, in a rough and simple way. This took place in a large room where the journey through a 2-year tariff contract could be "experienced". Before the proposals for change were then presented to a large group of decision-makers, every participant first had to experience the "prototype" of a 2-year tariff contract. They were thus able to experience their own brand and offer from the customer's point of view, as well as a customer's time perspective. This procedure did not produce the expected result. But the "room" was used at the end of the project to extend the company's management training using the experience of the "tariff" room. The room was developed and expanded during the following years; every new middle management employee must now experience this room and develop solutions on the basis of this experience. After enough company employees had worked with this method, a new tariff was actually introduced 3 years later, shaking up the market considerably; it soon became the number one tariff in the market. This product would not have been possible in this form 3 years before; all triggered by a prototype.

The phase of prototyping is closely connected with the TESTING step be-cause the prototype serves the Design Thinking team as a starting point for testing the effect of the solution developed on people who will be concerned/affected by it in the future, thus incorporating them into the design process. In contrast to the generative research in the observation step, which seeks inspiration, this phase involves formative research; the ideas are refined and perfected, taking future users into account. This step is critical for the success of the planned measures, particularly for organizational change, because an extensive testing phase counteracts the risk of a "not-invented-here" attitude, or top-down implementation.

Characteristics of a Design Thinking Culture

There is an ideal set of circumstances that those applying the Design Thinking process should have for the best-possible implementation of the process, including the characteristics mentioned initially, which already existed in the corporate cultures of the "fathers" of Design Thinking. The characteristics or features described below are rarely mentioned in literature. They are, however, the properties that make up the actual value of the method and place a company in a position to establish a corporate culture that uses change in a creative way.

Holistic
One of the big advantages of the Design Thinking approach is the holistic examination of both, the problem and the possible solutions. The method is very similar to systematic thought; the wealth of knowledge can only come from understanding the context and influences between people and their environment, people between each other and people themselves in the context of their behaviour, needs and motivation.

This means those who apply the Design Thinking process must perceive both separate elements and their interaction as a whole, probably discovering inspiration for solutions in the spaces in between.

Open
The most important feature distinguishing Design Thinking from other methods is its openness: openness to other approaches, to extensions and additions, as well as openness to adaptation of the process specific to each problem; the steps of the process should be understood more as an orientation than as a strict sequence. This essential feature of the method establishes the prerequisite that various disciplines are able to work with it. This is a secret of its success; the method manages again and again to give creative people direction and to induce logicians to think laterally!

This openness demands quite a bit from Design Thinkers; above all, that they feel comfortable with uncertainty, or ambiguity—a fundamental requirement when creating something new. As Captain Barbossa said, in the blockbuster film "Pirates of the Caribbean": "For certain you have to get lost to find the places that can't be found. Elseways everyone would know where they were!" His enthusiasm for the unknown and his logical conclusion make him a perfect Design Thinker. He knows that he needs to experiment to get ahead. Experimentation, in turn, requires creativity and then assessment. Quick trying, making mistakes and learning from them: openness means having control over the interplay of convergent and divergent action, of width and depth.

Empathic
Empathy, the ability to put oneself in somebody else's shoes, is essential to incorporate their wishes, hopes and fears in one's own perspective. This empathy should also go so far as to be able to understand situations and their causes and effects. The ability embodies looking beyond the obvious and perceiving more in what one sees than mere data and facts. These qualities allow us to derive

unexpressed relationships and draw conclusions—beyond visible behaviour—on the needs and motivations of other people, who are always at the heart of every challenge.

Empathy is also the fundamental requirement for Design Thinkers, enabling them to accept team members with different backgrounds and the members of other organizations. It is important that each team member can assess the strengths and weaknesses of his colleagues: what ideas, feelings and intentions do the individual stakeholders have and which of them need to be addressed?

Intuitive

Design Thinking also differs from other methods in this point because most other processes explicitly exclude intuition. However, the growing complexity of tasks and relationships requires a new way of looking at things and a new way of thinking. It no longer suffices to extrapolate a future from available facts alone. The changes of today's times are too multifaceted and too fast-paced for soft factors to be ignored. The inclusion of intuition offers a dimension that should not be underestimated. After all, intuition is a characteristic inherent to virtually every human being. By immersing themselves in a problem, Design Thinkers sharpen their senses for another view of the world—a view through the eyes of the problem. This changes not only their data basis used for logical thought, but also their feelings. The feelings are fed and lent expression in intuitive reflection of the problem: the synthesis of understanding and what has been experienced, which constitutes the actual learning effect, the increased insight acquired through Design Thinking.

Optimistic

Design Thinking is a method aimed at positive change. This can be improvement of a product or service with regards to function, benefit, value or price, or the goal could also be direct growth or an increase in productivity.

However, it is in the nature of Design Thinking not to achieve growth or an increase in productivity for its own sake, but (in the sense of holistic thinking) by changing or improving products, services or environments. The last-mentioned includes organizations and their work environments, conditions and processes: their corporate culture. Many examples show that a positively changed corporate or management culture can lead to growth.

Last, but not least: Design Thinkers never see problems as problems, but as a challenge producing a chance to create change from them! The ultimate goal of the Design Thinker should be to improve life quality of the people concerned—whether customers, stakeholders or employees.

Chances and Limits

The future of the method lies in linking the use of the process steps with development of the characteristics described. The characteristics associated with Design Thinking represent a way of thinking, or philosophy, which can be the basis for a (corporate) culture in the long term; good Design Thinkers are not only able to use the process to identify, articulate and leverage existing possibilities, but also to change their own thought modes so that they can recognize potential they themselves must first bring about. That means they can find answers to questions that do not yet exist!

The method can also help to estimate to what extent a change is necessary, or how far it must go; it leads through questioning of the obvious—in the best case—to rethinking what exists and to "creative destruction", as Schumpeter describes it. Growth through change is a goal that is a market-economy law affecting every company.

Change is usually a lengthy process. The method has a clear role in the overall process of change, forming the first step, the start, to bring about systematic changes. It helps deal with ambiguities and articulate the right questions, as well as identify and formulate possibilities and potentials. The ideas that are then generated and represented in rough outline are extremely useful for initiating change.

Designers are not necessary to apply the method successfully; few people have the talent to create good design. However, it is possible for many people to learn the method and become good Design Thinkers.

Such a clearly defined role, however, also limits the method at the same time; Design Thinking is not able to cover the span from the need for change to final implementation of results. Design Thinkers usually lack the patience for detailed implementation of solutions. They leap too quickly into the method of the new, the different, the extra: that path between the possible and the necessary. Design Thinking is ideal for discovering the possible, for finding arguments for a decision and for prioritizing them. Its repertoire even includes a first form as ideas. However, the method does not contain what is necessary to turn this into a usable and accepted solution. This is where the individual disciplines come in (among them: designers, organizational experts, HR professionals), with the knowledge and skills to fill a new idea with life and to implement it in a company.

Another limit of Design Thinking comes from one of its biggest assets: openness. The various configurations of the process make it difficult for many people to understand it and often do not offer decision-makers enough reliability and certainty. You definitely need courage to use the method; but on the other hand, courage is the most important fundamental requirement for innovation and change. And Design Thinking is the first step in the right direction.

Designing from the Future

Michael Shamiyeh

Abstract In the last decade we have witnessed vibrant interest in Design Thinking that certainly has surpassed other important debates in management, such as on disruptive innovation or business model innovation (*Google Trends* or references listed in *Google Scholar* portray an impressive picture!). This development is remarkable insofar as research on Design Thinking is still in its infancy, generally lacking in robust findings. Moreover, the great outpouring of interest has rather simplified our current knowledge of Design Thinking, instead of deepening our understanding of its operative nature and possible applications. The purpose of this article is to take stock of Design Thinking by pinpointing a central feature that has been explicated, but not consistently developed further within current debates on the subject. I sense a great necessity to restate Design Thinking in ways that make it more future-oriented and less of a process that embraces today's immediate challenges. This key enhancement provides a basis upon which to build future research that can offer a wider scope of application of Design Thinking and direct attention to leadership required to embed Design Thinking in organizations, to create desired futures for business or society as a whole.

Keywords Design thinking • Design dialogue • Social construction • Sensemaking

Introduction

In the last decade, design methodologies gained extensive attention beyond the disciplinary boundaries of the field. In particular there has been a great outpouring of interest on the part of corporate executives and management scholars who see in the designer's creative-analytical mode of operation, in his or her way of thinking, a strong and even unique potential for business innovation. As a matter of fact, Design Thinking has been viewed as the next competitive advantage (Martin 2009a). Beyond its well-known capacity in the process of envisioning new opportunities to unleash collective imagination (e.g., Lockwood 2010; Roam 2009;

M. Shamiyeh (✉)
Design-Organization-Media (DOM) Research Lab, University of Arts and Design Linz, Hauptplatz 8, P.O. Box 6, 4010 Linz, Austria
e-mail: m.shamiyeh@domresearchlab.com

W. Brenner, F. Uebernickel (eds.), *Design Thinking for Innovation*,
DOI 10.1007/978-3-319-26100-3_14

Ware 2010), scholars particularly consider Design Thinking as a powerful tool to boost innovation (e.g., Brown 2008, 2009; Kelley 2004; Kelley and Littman 2005; Shamiyeh 2007b, 2010, 2014; Verganti 2009) and to formulate business strategies (e.g., Boland and Collopy 2004; Liedtka 2000; Lockwood and Walton 2008; Shamiyeh 2007a).

Nevertheless, while the extensive literature contributes much to our understanding of possible applications of Design Thinking to achieve key business objectives, there remains an ambiguity about the nature of Design Thinking in the context of management. Contrary to debates in the design disciplines on the particular nature of design methodologies (e.g., Buchanan 1992; Cross 1993; Fuller and McHale 1963; Jones and Thornley 1963; Lawson 1980; Rowe 1991; Spillers 1974), in the field of management it is still not clear whether theory related to "Design Thinking"—a quite recent label—is grounded on the thorough examination of a designer's cognitive processes, his or her mode of reasoning and decision-making, or on a designer's actual mode of operation, the way of giving form to a particular problem. Significantly, despite this lack of clarity there seems to exist broad consensus about the key role of observation in the Design Thinking process (Brown 2009; Kelley 2004; Kelley and Littman 2005; Plattner et al. 2009): Viewed as an activity similar to that of an anthropologist who develops empathy for people by watching their actual experiences in the context of artifacts (physical spaces, products, etc.) and services, observation discerns what people really want rather than delivering quantitative data about known circumstances, as in conventional market research. It involves the Design Thinker in the immediate circumstances people encounter every day and thereby becomes a primary source for insights that inform the design process.

The benefit of Design Thinking's emphasis on observation in the creation of new business solutions is obvious. For a long time it was common in management practice and education to solve current problems, not by observation, but by inferring from the past. That is to say, on the basis of past experiences, the problem solver investigated and evaluated a series of alternatives with the support of scientific or empirical methods to finally come to a decision for further actions (Fink 2003). Such a problem-solving approach, management scholars have come to understand, entails a problematic limitation: It suggests that the analysis of past conditions will provide the perfect solution for a current prevailing condition (Boland and Collopy 2004; Martin 2009b; Shamiyeh 2007a).

On the contrary, observation—the study and embrace of immediate circumstances in the here and now—triggers a creation or "design" process of new and appropriate alternatives, rather than their discovery in the past. It is in this sense that men and woman running businesses have begun to understand that in the face of the increasingly diverse complexities of our world, Design Thinking in which observation takes center stage, can be a powerful tool for adapting businesses to actual market developments.

But it is the purpose of this paper to show that it is precisely today's overemphasis on observation that obscures the powerful capacity of Design Thinking to create futures that people truly desire, instead of creating solutions in

response to immediate circumstances people encounter today. IDEO's often-cited shopping cart project, first aired on July 13, 1999 on *ABC News*, is a case in point.

By observing customers' behavior in improvising to find their way through a supermarket, IDEO's design team drew a series of conclusions in regard to the design of a more convenient shopping experience (possible in the given context of a supermarket). The design firm's deep empathy for consumers—fueled particularly by watching what customers didn't do or by listening to what they didn't say—led to the design of a new shopping cart that invited customers to a new shopping experience. The design team matched need to demand. However, the case also exemplarily reveals that the approach failed to initiate a larger process of imagining and designing what consumers might truly value or desire beyond their immediate needs. For instance, and just to name one of infinite alternatives, one might envision a smart-fridge, which, every time it runs low on groceries, automatically orders electronically from the local supermarket and gets refilled from an externally accessible servicing door. To go shopping then assumes a completely different meaning, with an immense impact on the associated business opportunities.

Whether or not this alternative is desirable, the example aims to show that a strong emphasis on observation can be an impediment on two grounds: First, in today's common dissemination and application of Design Thinking, it is generally assumed that something radically new can be derived from observing the here and now. However, to focus on a given situation and to try to deduce or infer design solutions from what is being observed, necessarily frames the problem space; that is to say, by framing an existing context as a reference point for further development, the solution space for new alternatives is automatically limited (Cross 2006; Kuhn 1962; Simon 1969). And second, what is more important, it prevents the designer from initiating a larger process of creating—of designing—what people might truly desire or value and encourages a mode of thinking that proposes to match immediate need to demand. In short, it obscures the more fundamental question of "what desired future do we want to create?"

Many well-known business cases reveal the value of a design approach that "ignores" immediate circumstances in the here and now in favor of desired futures that designers seek to create. We find those approaches particularly in situations where products and services have reached their climax of performativity. For instance, one might think of Cirque de Soleil's response to increased popular opposition to the use of wild animals or BMW's *iDrive* automobile control unit, which quite quickly gained immense market acceptance despite its strange appearance and unseen mode of use. In none of these cases did an immediate circumstance or an urge to directly match a need to demand trigger the design process.

In architecture, efforts to capitalize on such a future-oriented design process are well known. Certainly, making use of this particular potential of Design Thinking goes back to the first creations of an ideal *civitas* or city-state, which in antiquity referred to both an urban and a socio-political organization (Eaton 2001). Whether it is Thomas More's conception of an ideal state of a republic on the *New Island of Utopia* from 1516, Claude Nicolas Ledoux's 1804 urban and social design for a

Cité ideal, Ebenezer Howard's late-nineteenth-century schemes for *Cities of Tomorrow*, or more recent projections (and realizations) for ideal cities by Norman Foster, e.g., *Masdar City*—these are just a few examples of the many endeavors in which architects have tried or are trying to translate conjectures of an anticipated ideal state of urbanization into reality, rather than to observe, study, and embrace the here and now. Of course, it should be noted, not all such developments were desirable from the point of view of those concerned.

Furthermore, attaching great importance to observation blocks a Design Thinking approach that would embrace a larger process of imagining and creating what people truly desire. For good reasons, however, this later approach is generally ignored in managerial practice and scholarly research, despite its potential value for innovating business or society as a whole. Indeed, and as will be shown in detail, to study the actual circumstances that people (or customers) encounter and the possibility to build upon real and given situations, strongly supports the proof of newly conceived solutions. By contrast, to step outside the immediate problem space and to design what one truly desires—regardless of the immediate challenges at hand—certainly renders such proof difficult, due to the innumerably large range of possible hypothetical entities the design process rests upon. Legitimacy, in this case, cannot be acquired by truth or accuracy. Instead, it is about continued redrafting of an anticipated future so that it becomes more plausible, uses many different sources of corroboration, and thus becomes more resilient in the face of criticism. Such an approach in the face of an actual problem certainly brings about a different form of reasoning: Whereas in the former approach the Design Thinker searches for opportunities by observing and analyzing people's behavior in the here and now in order to hypothesize about potential design solutions, in the latter case the design thinker starts by hypothesizing about a desired future, to then hypothesize about its grounding in the here and now. Whereas in the former approach the newly designed alternative quite naturally meets people's demand in a given situational challenge, in the latter people would be challenged by the need to adapt to an unknown (but not necessarily undesirable) situation.

It is the aim of this article, therefore, to start with addressing in detail Design Thinking's potential to become more future-oriented and less of a process that embraces immediate challenges people face. In order to do so, I will contrast various forms of reasoning in the design process. The elaboration will also help to clarify the richness of abductive reasoning in the context of the design process. I will then pinpoint the benefits of a future-oriented design process and outline particular limitations. Finally, I will direct attention to the larger implications for organizations in their effort to embed such a design process in a value-generating manner. Here I will particularly address the shortcomings of a two-step approach in Design Thinking, by separating the design process as such from communicating its results. I will conclude with recommendations for organizational embedding.

Forms of Reasoning in Designing Alternative Realities

I want to start with a definition of how design is understood in the following discussion. The understanding of design in general and its underlying process in particular varies significantly according to the disciplinary perspective taken. For the sake of parsimony, I therefore might propose to distinguish two basic and widely recognized perspectives: On the one hand, we might think of design as a material practice with a clear focus on making artifacts. Architects and designers exercise this activity every day. Christopher Alexander, one of the leading protagonists of a design science, convincingly argued that designing is a "process of inventing physical things, which display new physical order, organization, form, in response to function" (1964, p. I). Alexander's perspective certainly reflects the most commonly held view of design.

On the other hand, however, we might view design in its broadest sense as an activity aiming to transfer a given situation into a desired one, regardless of whether we think of making an artifact or strategically realigning a company. Proponents of the Information Processing Theory, notable Hayes (1978), Newell et al. (1959), who called for cognitive-based explanations of creative thinking, showed that the intellectual activity taking place in the design of material artifacts does not fundamentally differ from that involved in developing a new business model for a company or an economic incentive program for a nation (Simon 1969). So construed, the process of design can be identified in many professions far removed from the "core" design disciplines, including business, education, law, and medicine among many others. I will build upon this latter view of design.

Following up on the view that design is not exclusively concerned with artificial objects, but also with all kinds of man-made phenomena (as opposed to natural phenomena), it is important to briefly explain my recurring phrase "desired futures" or its more abstract notation of "alternative realities." This allows me to show how a changing focus on a given or future situation induces varying forms of reasoning. The use of the adjective "alternative" in combination with the plural "realities" implies the existence of more than one reality; moreover, I seem to suggest that the design of alternative realities may lead to the application of different logics.

Let me take up these thoughts step by step. In his elaboration of the science of design, Herbert Simon showed that design "is concerned with how things ought to be," unlike science, which is all about "how things are" (1969, p. 144). Although this may seem to be an insignificant difference, its larger implications for the design process and the applied forms of reasoning are significant. First, an immediate implication is that by nature, design has an open-ended context within which a hypothetical alternative can be generated and tested. In other words, for designers who devise artifacts (or artificial phenomena) with the aim of transforming a given situation into a desired one, the generated alternative is dependent on how the situation is framed and how one thinks the situation "should" be changed. Certainly such a process is strongly guided by individual experience, creativity, and cultural background, among many other aspects of design behavior (Lawson 1980; Rowe

1991). Furthermore, situational problems that designers address are seldom simply structured, but are "wicked" in the sense that they reveal complex interdependencies (Rittel and Webber 1984). Efforts to solve such problems usually generate additional problems. Given these circumstances and coupled with the resource constraints designers face, it is not possible to find one and only one optimal solution that can satisfy all conditions and attain all goals (Simon 1969); rather, design is necessarily about multiple possible alternatives that ought to be justified individually vis-à-vis a particular situation.

I shall now explain my use of the plural form of "realities" before turning to the core of my argument. I could, of course, shield myself behind the epistemological implications implied by the use of the plural form in the phrase "realities" (or "futures") and simply suggest that design transforms "the" reality. In fact, there is a deep hiatus between philosophical schools that address the intrinsic features of the world (or reality, or the universe) that exists independently of our representations of it, and those that address the social constructions of the world and therefore investigate the relationship between the mind and reality. However, for good reasons, I prefer to speak in the plural of realities.

Much of what we consider to be reality depends on our concept of objectivity and the contrast between the objective and the subjective. Searle (1995) convincingly showed that proportions of our real world, objective facts of the world, exist only by human agreement; that is to say, in contrast to brute and objective facts such as mountains or molecules, which exist independently of our representations of them, reality is also made up of objective facts that exist only because we believe them to exist. Things such as money, marriage, or government are objective or observer-independent facts in the sense that they are not a matter of personal preference. The piece of paper that represents a five dollar bill should be the equivalent of five dollars for all of us who are acquainted with the human institution of money (Searle 1995). Hence, in contrast to brute facts, these "institutional" but objective facts depend on human agreement and acceptance of social constructions.

Given that design is not just a material practice but is generally concerned with the transformation of a current situation into a desired one, we may expect the design process to be capable of constructing institutional reality. Think of social innovations such as the Fair Trade System or the Emissions Trading System. These socially constructed (or designed) institutional realities barely manifest themselves as brute facts, but exist independently of our judgments or representations of them as objective facets of reality. However, in order to persist, these socially constructed facets of reality must be constantly reaffirmed by means of communication. This process introduces not just the opportunity for change, but also renders reality multi-faceted: on the one hand, because accepting and reaffirming socially constructed facets of reality necessarily leads to the dismissal of a hitherto maintained reality; and on the other, in this process language becomes the most constitutive feature through which humans create, accept, and reaffirm alternative realities (Searle 1995). Without some form of language (which is shared within the boundaries of a system of social exchange) it is impossible to have institutional

facts, because it is words or other symbols that are constitutive for the facts. Hence, the existence of an institutional reality is dependent to the extent its constitutive language is shared among individuals. To be more concrete, organizations have their own languages, which has an impact on sensemaking in given situations or adapting to conjectured situations (Dubberly et al. 2002; Pondy 1978; Weick 1995). It is in this sense that we might speak of realities rather than one and only one reality. Later I will return to the issue in more detail in order to illuminate obstacles that organizations face in embedding a future-oriented Design Thinking process.

Finally, I turn to the third and central issue of my proposition—namely that there are multiple forms of reasoning possible in Design Thinking and that one of these forms has been explicated in current managerial debate, but has not been consistently developed further. In his seminal work *The Science of the Artificial*, Herbert A. Simon (1969) extensively elaborates the logic of design, and asks whether there are differences in the form of applied reasoning there in comparison to the natural sciences. Of interest here are his insights drawn from the observation of designers when they are being careful about their reasoning. He concludes that the logic at work in design practice can be sketched as being merely an adaption method, in which, in iterative cycles, the designer aims to adapt the organized nature of a possible solution to the surroundings in which it is intended to operate. He concludes that it is not about finding (or computing) the optimal solution, which is by and large impossible due to the complexity or ill-structured nature of the problems and resource constraints, but rather about finding "satisfactory" solutions. In building upon the general information-process model of individuals' problem-solving behavior, the process of design is then conceived as an activity in which the designer searches selectively through an environment in order to acquire information needed to solve the problem presented by the environment (Newell and Simon 1972; Simon 1969).

Significantly, Simon (1969) failed to address the particular locus of sources of information that help to assemble sequences of actions that fuel a design process in generating a satisfying alternative; that is to say, he was clear about the role of memory as a repository of stored "information about states of the world" and how it might affect the interpretation and processing of newly gathered information (p. 121); however, he remained vague about the specific locus of the search activities. To put it in pragmatic terms, in aiming to transform a given situation into a desired situation, he did not specify whether designers generate new alternatives on the premises of gathered information observed in the here and now, or, for instance, based on information underlying an anticipated future. Based on his approach from the perspective of human behavior in problem-solving, we might infer that the search environment he considered is congruent with the environment affected by the very problem in question.

It is interesting to observe that this important issue was not consistently developed further within the design discourse—regardless of the particular disciplinary context. The various propositions outlined in scholarly work suggest that there are multiple loci of sources of information possible: in the past, the present, and the

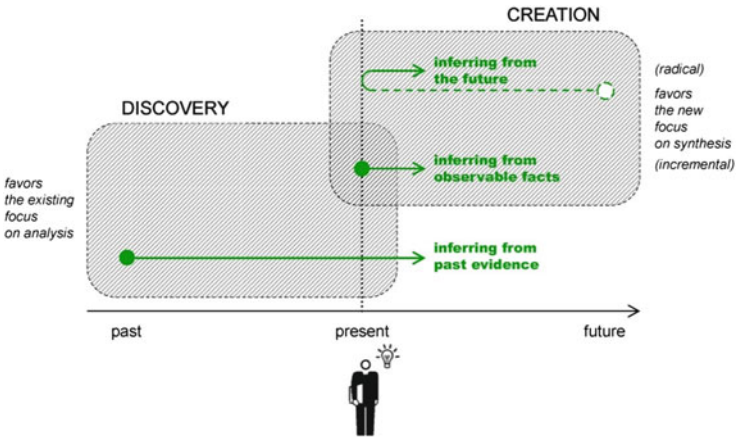

Fig. 1 Loci of information fueling the design process

future (see Figs. 1 and 2). For instance, Akin (1986), who applied Simon's (1969) information-processing model to explore cognition in architectural design, almost takes for granted that designers rely on long-term memory; that is to say, in the first instance architects refer to past solutions stored in their memory. Only when this is inadequate, he asserts, do architects "try books, drawings, on-site observations, interviews, documents and other survey methods to gather the relevant information" (Akin 1986, p. 64). Schön (1983), who also looked at architectural design to derive his conclusions about how professionals think and reflect while in action, sees architects, designers, engineers, etc. as attending to the "peculiarities of the situation at hand" (p. 129). Thus, his observations clearly direct attention to the present as a source of information fueling the design process. And finally, Buckminster Fuller, one of the most prominent pioneers of a design science in the 1960s, argued in favor of an anticipated future as a key source of information. "You never change things by fighting the existing reality," he contended. "To change something, build a new model that makes the existing model obsolete." Hence, for Fuller neither the past nor the here and now provided a reference point for design actions. It is important to note that these three fundamental approaches correspond to practical realizations and can be identified throughout the historical development of the environment we have constructed. However, for the sake of parsimony, I won't go into details here.

Significantly, approaches in the context of business reveal no substantial difference. Here too, perspectives on the loci of sources of information oscillate between the past and the future, although approaches with a future orientation have remained modest or marginal: Throughout the 1980s and 1990s, Tom Peters media effectively directed attention to management's obsession with "polishing yesterday's paradigms" and thus risked being a useful discipline (1997, p. 25). In his earlier book *In Search of Excellence* from 1982, he elaborates this point and there is no need to discuss this backwards-looking approach in more detail. Today, major

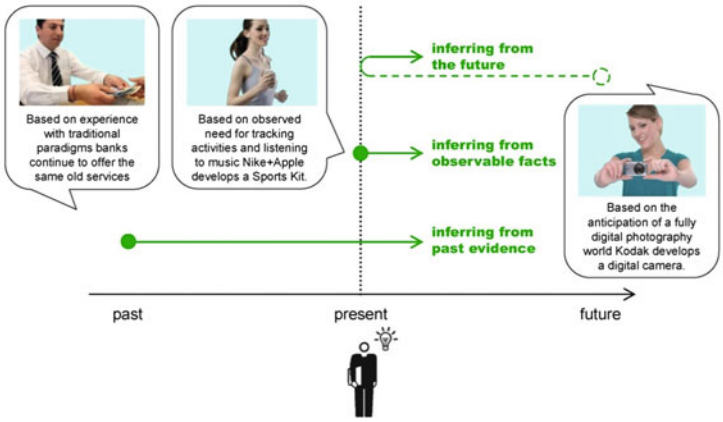

Fig. 2 Varying forms of reasoning to infer solutions

management schools and leading corporate executives have come to the conclusion that no business success can been achieved without focusing on the customer in the here and now (see, e.g., Huff et al. 2008, Chapter "Why is the Costumer Relationship Increasingly Critical?"). "All these bright people with Ph.D.s have to do," IDEO founder Tom Kelley wrote, "is to watch people" (Kelley and Littman 2005, p. 16). "Figure out what people want and then give it to them" (Brown 2009, p. 39). An emphasis on a truly distinct and desired future, however, is barely considered. Management scholar Russell Ackhoff, who was also educated in architecture, may be named as one of the few exceptions. Ackhoff (1981) sees in an ideal state of a particular circumstance the sources of information guiding the change (or design) process of organizations and society as a whole. The procedure for determining what actions are to be taken to change organizations from a current situation into a preferred one, he argues, "begins with the specification of ideals and works backward through objectives and goals" (p. 104). "This ensures," he states more precisely elsewhere, "that you do not erect imaginary obstacles before you even know what the ideal is" (Ackhoff et al. 2006, p. xxxiii). However, for probable reasons discussed later, this approach has remained underdeveloped in current debates.

In the following, therefore, I will show how these theoretical propositions correspond with practical realizations. The main reason for citing the subsequent case studies is to show how a commonly accepted Design Thinking method may resort to different forms of reasoning and thus lead to various degrees of newness. Later I will address the relevance of this fine-grained view of Design Thinking. For the sake of parsimony, I will focus primarily on business cases, although there are plenty in the fields of architecture and design.

The Past as a Point of Reference

The circumstances of the global financial crisis clearly showed that recourse to old rationales or past evidence created a massive mismatch between financial markets and the real economy for two reasons: Paradigms or shared beliefs that had been maintained for a long time suddenly ceased to become useful. The approach of proceeding from general principles or old premises to derive particular actions transforming a given situation in the here and now sooner or later had to lead to inadequate outcomes—simply because deductive reasoning, the logic at work in applying general principles, is not synthetic (or insight enlarging). It does not provide any new insights, because the information content of the conclusion must already be implicitly contained in the premises (Hurley 2002; Peirce 1965). Secondly, the chances are limited to developing suitable rationales to be applied to present circumstances by gathering and analyzing information from the past. This too leads to imposing solutions from the past or falling victim to the erroneous belief that the future continues to exist under the same paradigms that ruled the past.

Thus, a backwards-oriented search strategy for gathering information from the past generally tends to discover what has previously existed rather than to create "new" alternative realities. The application of such information in a design process is certainly possible, but it raises a question concerning the validity of such actions. One might think of current models of a sharing economy that partly take up the old barter systems of exchange (Weitzman 1984). In the field of architecture, one might refer to Prince Charles' advocated county town "Poundbury," which was designed according to medieval urban design principles.

The Present as a Point of Reference

Nike's and Apple's collaborative design of a "Nike + iPod" *Sports Kit* suggests a close observation of their customers in the here and now. In 2006 the two companies jointly developed a device that tracked the distance and pace of runners. The lightweight tracking module, which included a transmitter, was to be placed in a recess of the inner sole of a Nike shoe. The transmitter communicated with either a receiver connected to an Apple iPod or a Nike + *Sportsband*. The use with an iPod allowed viewing and sharing tracked activities with friends via social networks (see Fig. 3).

By introducing this sports equipment, both companies successfully converted a need into demand: "Runners always want to know how far they have gone, how fast they are going, and how many calories they are burning" (Michael Tchao, General Manager Nike Techlab/Nike+, video interview in Meur 2008). By offering a technology to amass data and to share it, Nike managed to build the world's largest community of runners; in less than 5 years, between 2009 and 2014, Nike's community grew from 1.2 million to 18 million members tracking their exercise

(McClusky 2009; Nike 2013). "40 % of community members who didn't own Nike + ended up buying" (Roberto Tagliabue, Director of Digital Innovation at Nike and project leader of the Nike + Apple Project, cited in Lawrence 2008).

In an interview, Roberto Tagliabue (cited in Lawrence 2008), vividly explains the approach in developing the tracking device:

> We noticed that something interesting was happening in the world of running: more and more people were running with music and a good majority were running with an iPod. We thought that we could add a little extra that could enrich the experience of running. So we made a sensor that tucks into the shoe. We worked with Apple to have the sensor talk to your iPod and reveal your running data while you are listening to music. The big learning? Enrich an existing behavior and make it simpler: press a button and start running. We will do the rest. Do not disrupt something very basic and liberating like going for a run with tons of complex features.

Nike's approach to identifying consumer needs by observing their behavior clearly suggests the use of induction as a primary form of reasoning, because it aimed to examine specific information, perhaps many pieces of specific information, to derive a general principle. Unlike deductive reasoning, which applies general principles to reach specific conclusions, inductive reasoning, where the conclusion is likely to follow from the given evidence, provides the ability to learn new things that are not obvious from the evidence (Hurley 2002; Peirce 1965). At Nike the "big learning" was that there is a need to enrich, but equally to simplify existing running behavior.

What is of interest here is that the stimuli that triggered Nike's design process arose exogenously from a specific circumstance or market imperfection—in our case, from certain consumer behavior. Based on the particular needs that Nike identified in observing runners, the designers generated several hypothetical solutions for the problem at hand. The emphasis on exogenous stimuli forming the premises for a design process has several important implications. It suggests that the design process is based on realistic assumptions. In their case, the basis for the design process exists as a real and objective phenomenon, independent of the actions or perceptions of the designer. This is a decisive criterion for legitimizing additional design actions. Consider designers concerned with the truth of a hypothesis that predicts an alternative reality. An immediate implication of being confronted with a given situation is that the boundaries of the context within which to test the hypothesis are already set. This entices one to direct attention and to respond to things and relations discovered in the given problem space.

Committed to an exogenous circumstance, design ultimately becomes a "reflective conversation with the situation" in which the designer "shapes the situation, in accordance with his [or her] initial appreciation of it, the situation "talks back," and he [or she] responds to the situation's back-talk" (Schön 1983, p. 79). Such a design approach entails a problematic limitation. It assumes that the analysis of a prevailing condition equally entails the perfect solution. Moreover, it presupposes that a prevailing condition can be transformed into a perfect one. Remember the shopping cart example I referred to in the introduction. The focus on an enhanced shopping experience in the supermarket guided designers to come up with a better

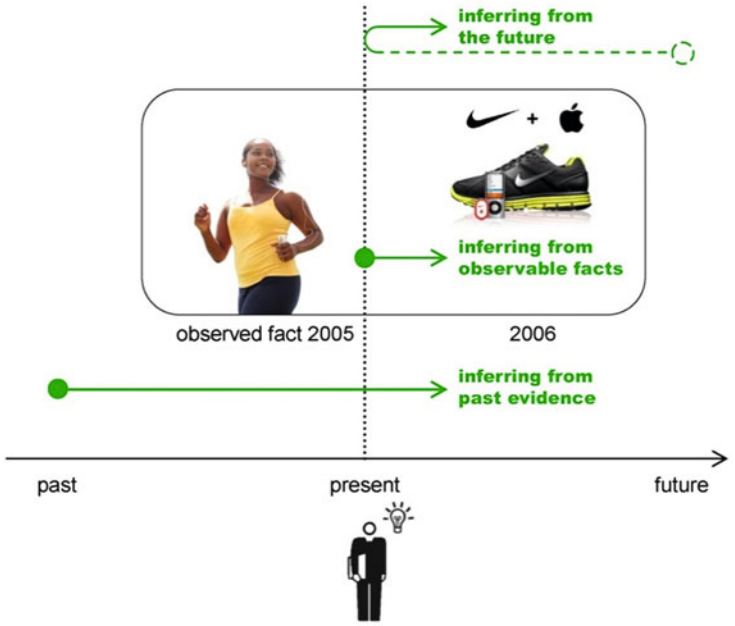

Fig. 3 Reasoning applied in designing Nike + Apple Sports Kit

shopping cart; they did not call into question the very existence of the supermarket as such.

Hence, Design Thinking as a response to exogenous stimuli can become an impediment. Rather than initiating a larger process of creating—designing—what one truly values or what might be ideal for a given situation, it suggests a way of thinking that proposes to fix something that is broken. Framing a given situation does not necessarily mean that it is impossible to reframe it, as many scholars concerned with problems-solving behavior or design have suggested (Lloyd and Scott 1995; Valkenburg and Dorst 1998); however, due to constraints such as available resources, clients, or targeted customers, reframing takes place within the boundaries of a given problem space. Besides, to identify self-imposed constraints is usually difficult, because we are generally unaware of them. It takes great effort to reset the boundaries of once-framed problems (Ackhoff 1981; De Bono 1970). The well-known nine-dot problem is a case in point.

The Future as a Point of Reference

In 1975, when the world's first digital camera was invented, there was no demand for such a device nor could anybody have made serious use of it. At that time, film-based point-and-shoot cameras became extremely popular. The idea of a personal

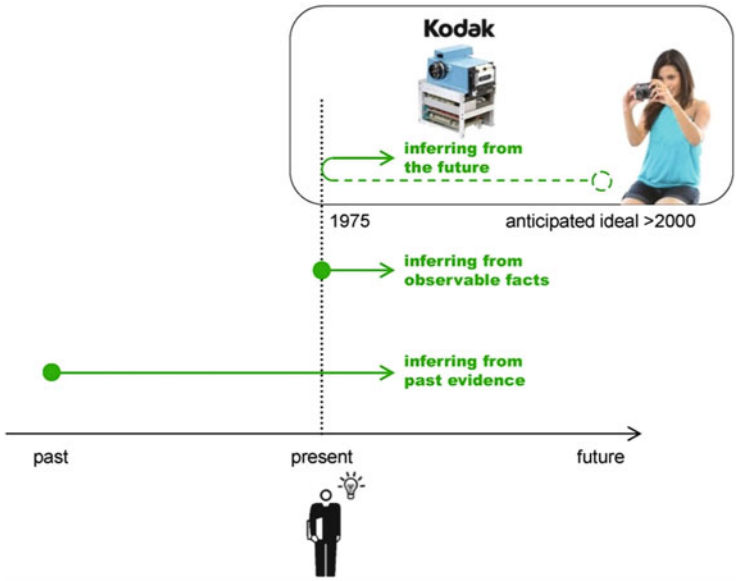

Fig. 4 Reasoning applied in designing the first digital camera

computer, which today finds its way into every household, allowing people to post photos on the web, was still dismissed in the computer industry as being totally absurd. Neither were there any electronic devices to print or store photos. In short, in the mid-1970s there was neither demand nor an ecosystem for cameras that could have captured images electronically. Steve Sasson (cited in Shamiyeh 2014, p. 114), who as a young engineer at Kodak invented the digital camera, described the events around its development as follows:

> I have to explain to you that no one asked me to build a camera. It was a filler project to look at this type of device [called a Charge Coupled Device, which could convert patterns of light into a pattern of electrons], but I simply thought that a good way to see how the device would perform would be by capturing an image, and then if we wanted to capture an image, wouldn't it be nice to put it in something portable that would capture images and store images? So it was really a desire on my part to just try to build this.

Less than a year later, Sasson was able to present the world's first digital camera, which looked more like a toaster than a camera and weighed about 8-1/2 pounds (see Fig. 4). He did so without being guided by any consumer needs or prevailing technologies. "Nobody knew how to do this stuff and at the time he had to come up with solutions to all of his problems really almost single-handedly" (Brad Paxton, back then director of Electronic Imaging Research Laboratories at Kodak and Steve's supervisor cited in Shamiyeh 2014). The camera was created endogenously, by the actions and reactions of Steve Sasson, exploring ways to produce a new imaging device. In contrast to the design of the "Nike + iPod" *Sports Kit*, which evolved out of search activities to discover valuable sources of information in the

existing world of runners, for Sasson the term "search" had little or no meaning—precisely because it implies an attempt to discover facts, like the behavior of runners, that already exist. In Sasson's design process, the context for his prediction of a desired future was purely hypothetical and thus non-existent. In other words, whereas Nike and Apple could ground their hypothetical new reality—a runner with a sensor in his or her shoe that talks to the iPod and reveals running data while the runner listens to music—upon information evident in the real world, in the case of Sasson, both the design context and the prediction of an alternative reality were hypothetical. As mentioned above, in the early 1970s there existed neither consumer demand nor technologies that could have rendered the capture of digital images feasible. This aspect seems to be insignificant; however, its implications for the design process, the newness of outcomes, and its legitimacy are significant. To address these issues, it is necessary to look more closely at the different forms of reasoning applied in both cases:

As discussed above, Nike and Apple examined specific information gathered from the real world in order to discover and assemble solutions transforming the given situation of runners to a preferred one—one in which technology assists runners. The form of reasoning applied to frame the design context was essentially inductive. The creation of the alternative reality, to add a little extra that could enrich the experience of running, however, was abductive.

Abduction "merely suggests that something may be," as opposed to deduction, which "proves that something must be," or induction, which "shows that something actually is operative" (Peirce 1965, CP 5.171). More commonly, abduction is understood as inferring backwards from a set of data to a hypothetical situation that would best explain the data (Harman 1965; Walton 2004). It is a process "where we find some very curious circumstance, which would be explained by the supposition that it was the case of a certain general rule, and thereupon adopt that supposition" (Peirce 1965, CP 2.624). The creative assertion or invention of a cause, also known as a "What-if and Then" statement, therefore, becomes preliminary to abductive reasoning (Nagl 1992). It is for this reason that Peirce (1965) argued that abduction is the only logical process that fosters initiative and thereby actually creates anything new.

Johannes Kepler's reasoning, in drawing his conclusions about the observed configuration of the planets so as to exemplify their interplay, can be taken as an instance of abduction (Peirce 1965): After years of inquiry into the planetary configuration and dissatisfaction with the geocentric view of the world, Kepler went off to develop his own model for calculating planetary positions. At that time the Copernican or heliocentric view was merely a hypothetical model without proof. Moreover, there was no rigorous idea about the exact form of the planetary orbits. It was Kepler who hypothesized that Mars may orbit the sun in the form of an ellipse, which introduced a radical new paradigm about our world for several reasons. On the one hand, it questioned the prevailing worldview in which the Earth was considered to be at the center of the universe. On the other, it suggested that the forms of planetary orbits are not circular but elliptical. Kepler's abductive reasoning was grounded in a rich set of data about the movement of Mars, which he

had long tried in vain to fit within the possible limits of error of the observations. At first, his idea about planets moving in elliptical orbits around the sun was merely a suggestion. For this reason Kepler proceeded to test the hypothesis deductively, meaning he undertook the calculations of the latitudes from his elliptical theory without knowing whether the calculations would agree with the observations. In a final phase, he inductively verified his proposition.

In this regard, we might assert that the form of reasoning applied in generating an alternative reality in the cases of Nike/Apple and Kodak is of no different than the one used by Kepler; that is to say, the hypothetical proposition of a world in which runners are assisted by a new tracking technology or photographers are equipped with a new image-capturing technology is based on abduction, like Kepler's hypothesis on the planetary orbits.

However, the examples reveal differences in grounding the actual design process. Whereas Kepler and Nike/Apple could rely on inductive reasoning to gather data in the real world to guide the design process and supply strong evidence for the appropriateness of their design, in the case of Kodak, the context to ground a digital camera was purely conjectural or abductive. The context that Steve Sasson envisioned—a world in which the entire imaging process is digital, including capturing, storing, editing, processing, and sharing—was purely hypothetical and thus opened the door to the possibility of all kinds of future contexts yet to be determined. Hence, in this future-oriented design process, the act of framing the situation one intends to respond to and the act of designing the situation as such become a dialectic endeavor, forcing the designer not only to conceive of a possible situation, but also to think about how to contribute to or transform this situation.

Building upon this difference, we might distinguish between a Design (Thinking) process that rests on discovery of what already exists and one that rests on creation. The emphasis on discovery suggests that the design of an alternative reality is first and foremost about how searching exogenous stimuli provides design opportunities—systematically scanning the environment to discover opportunities to create new products or services. On the contrary, an emphasis on creation suggests that design opportunities are not assumed to be objective phenomena formed by exogenous stimuli; rather they are to be created, endogenously, by the actions of the designer, exploring ways to produce new products or services. In this sense, opportunities embraced in creation-driven designs are social constructions that do not exist independently of the designer's imagination (Aldrich and Kenworthy 1999; Berger and Luckmann 1966). It is important to note that this form of analysis is not unique to the design disciplines, but finds its equivalent in the literature on entrepreneurship, with its focus on opportunity discovery and opportunity creation (Aldrich and Kenworthy 1999; Aldrich and Ruef 1999; Alvarez and Barney 2007; Gaglio and Katz 2001; Gartner 1985; Shane 2003; Venkataraman 2003).

The Importance of a Future-Oriented Design Process

What could be the purpose of engaging in a future-oriented Design (Thinking) process? Why should one take the risk to create alternative realities that do not evolve out of existing situations? Why engage in a design process whose outcome cannot be understood until its hypothetical context exists? Think of Steve Sasson, who at Kodak designed a camera that was useless in the analog world of chemical-based photography back in the 1970s.

The work of Giovanni Dosi (1982), a renowned expert in the economics of innovation and technological change, is illustrative for answering these questions. By referring to the seminal work of Thomas Kuhn (1962), he proposed a perspective of technological change resting on the concepts of "paradigm" and "trajectory." "Technology," for Dosi (1982), is "a set of pieces of knowledge, both directly 'practical' (related to concrete problems and devices) and 'theoretical' (but practical, applicable although not necessarily already applied), know-how, methods, procedures, experience of successes and failures and also, of course, physical devices and equipment" (p. 151f.). The achievements of technology, according to this view, are "embodied," so to speak, in two parts: On the one hand, technology exists in a particular product or process, and on the other, it exists in a "disembodied" part that relates to the particular skills, experiences, and knowledge used in previous technological solutions. In this sense, technology is very much about design.

The point that is of interest here is Dosi's view about the limits of performativity of technology. He could show that every technological change follows a "trajectory," that is, a pattern of actions related to searching for and solving problems based on a particular logic or "paradigm" that is immanent to the very technology itself. This "technological paradigm" defines the relevant problems, the patterns of inquiry, and, consequently, the pattern of solutions for the selected problems. Thus, technological paradigms embody strong determinations in regard to the directions in which technology can change. Or, to formulate it differently, every technology has boundaries to possible technological variations and paths of progress. At a certain stage, the technological process becomes either too complex or the effort required too large. The only feasible way then to push the limits of performance is to redefine the technological paradigm altogether (Sahal 1981). The challenge to the design of wind-powered vessels from new technologies is a compelling case (Foster 1986). To compete against the new steam-powered vessels that had increasingly taken the cargo business away from sailing ships, designers had to improve traveling speed. But to gain swiftness, designers had to sacrifice maneuverability. As a consequence, ships became difficult to handle and unstable. Several reports of capsized ships finally brought about the end of commercial sailing, and steamships began to rule the seas. Attempts to design faster cargo-carrying sailing ships ended.

The case demonstrates that technology improvement or evolution along a given trajectory led to incremental changes—faster sailing ships—and also that the paradigm underlying the technology sets limits to its improvement. To overcome

the given limits, it was important to introduce a radical technological change by defining a new paradigm—steam technology. Thus, the case clearly reveals the need for different approaches in design. For centuries it was adequate to design better sailing ships by embracing the immediate challenge of "sailing"; that is to say, to focus on the given situation and to improve it. However, and as the case clearly shows, there are times when a technology reaches its limits in terms of performativity and can't be improved any further in an evolutionary manner. The Nike/Apple case versus the Kodak case exemplifies the two poles: evolution by embracing the present or revolution by anticipating the future.

Today, we may find many examples that may reveal the need for an approach that makes design more future-oriented and less of a process embracing the old paradigm. Elsewhere I have discussed the renewal of the business model of the traditional circus, which has been in crisis since the turn of the century (Shamiyeh 2007a). I showed that the "design" of the Cirque du Soleil, one of Canada's largest cultural exports, reveals strikingly the operative limits of design by evolution. But we may also broaden the scope and look at the future of the global economy:

Nowadays, there is a clear perception that the global economy can't continue as it is, given the planet's resources, its natural systems, and the population that is living in poverty (Meadows et al. 2004; Meadows et al. 1972). It has been extensively shown in research and best practices that the answer to the problem rests in a radical shift from the linear cradle-to-waste industrial-age systems to a circling cradle-to-cradle system following the logic of nature—the so-called "triple bottom line" (Ayres 2004; Ayres and Simonis 1994; Braungart et al. 2007; McDonough and Braungart 2002, 2010); that is to say, the global economy would need to change from continuing to improve its prevailing linear system in an evolutionary manner, to anticipating a future in which products and industrial systems are developed that maintain or enhance the quality and productivity of materials through subsequent life cycles. Strategies towards pollution prevention or energy efficiency certainly reduce the ecological impact (and are thus worthwhile), but given the point of damage to the earth's eco-system today, there is no point in being less bad.

Embedding a Future-Oriented Design Process

Design actions, or, to formulate it in business terms, entrepreneurial actions, that aim to transfer a given situation into a preferred one, generally take place within a system of social exchange, regardless of the scope of change. In the context of business, we may equate systems of social exchange with an organizational setting. For instance, there won't be a new shopping cart without someone who designs it and others who produce and commercialize it; but there also won't be a new shopping cart without a supermarket offering it for an enhanced shopping experience and consumers who are willing to use it. Consequently, ambitions to introduce an alternative reality are necessarily bound to an organizational setting that

provides support for the development and exploitation of the design (or business) opportunity. Without such a setting, propositions about alternative realities remain stuck at the level of the individual. For designs, which in the first instance are merely representations about a hypothetical alternative reality (Evans 1997), to become an organizational initiative in order to be realized, they have to move from a state of subjective reality that is only valid for the individual to one of objective reality that a group or organization agrees on (Floyd and Wooldridge 1999; Nonaka 1994; Nonaka and Takeuchi 1995).

But what is more important for organizations, alternative realities have to make sense so that actions are taken (Weick et al. 2005). Regardless of how small or large the change introduced by a new alternative reality will be, for better or worse, individuals within and outside the immediate organizational setting will be asked to comprehend the new stimuli and to make sense of them in order to determine future behavior. This holds true particularly in organizations as a specific form of systems of social exchange, because they are "goal directed, boundary-maintaining, and socially constructed systems of human activity" (Aldrich and Ruef 1999, p. 2). Unlike other groupings of humans (such as a family), social interactions in organizations are defined on the premises of particular roles people play, roles that entail certain expectations because they are associated with particular functions. As a consequence, members of an organization will "attempt to order the intrinsic flux of human action, to channel it toward certain ends, [and] to give it a particular shape, through generalizing and institutionalizing particular meanings and rules" (Tsoukas and Chia 2002, p. 570). It is particularly this transient nature of sensemaking that is central for informing and constraining future human behavior (Weick 1995). The events related to the presentation of a filmless camera at Kodak, which was then the world's largest film company, are illustrative for sensemaking in the context of alternative realities (Steve Sasson cited in Shamiyeh 2014, p. 240f.):

Shortly after Steve Sasson finished his prototype of a digital camera, he went to his supervisor, Gareth Lloyd, and told him that the camera was working and he had managed to take a picture. Lloyd immediately suggested bringing some people into the lab to present the camera. Because no one has been paying attention to his work, Sasson remembers, there was not even any awareness that the camera was a portable device. It could easily be taken to any conference room at Kodak or outside. Recalling the particular circumstances related to championing a filmless camera, he explained that he never finished a presentation because conversations started and people began to ask all kinds of "galactic" questions: "Why do you think this is going to work?" "Why do you think anybody would want to look at their picture on a television set?" "You've got all these things on magnetic tapes, how are you going to store all this stuff?" "What's this electronic photo album going to look like?" Or "Nobody would ever want to do that, they love prints—that's ridiculous." After having presented the camera several times, Kodak's management decided to stop further development and to keep it under wraps (until the new millennium).

The challenge in designing and integrating an alternative reality is therefore to establish mechanisms by which the probability of an interaction between a difference that introduces alternative reality and existing routines is increased. Only

when the alternative has proven itself in the practice of organizing, when it becomes meaningful for the organization, can it come into existence and reach its full potential as generating an added value. Indeed, such a process depends not only on the skills and abilities of the individuals in making sense of new alternatives, but also on the quality of social exchange within the organizational setting itself (Dess et al. 2003; Floyd and Lane 2000).

Weick (1995) showed that sensemaking is central because it serves as a springboard to action. When members of an organization are confronted with something unintelligible, they ask, "What's the story here?" Their question has the power of bringing a new stimuli into existence; and when they then continue to ask, "Now what should I do?" their questioning has the potential of bringing meaning to the event that they "hope is stable enough for them to act into the future" (Weick et al. 2005, p. 410). Sensemaking is therefore the circumstance whereby meanings emerge that constrain prevailing identities and inform future behavior (Mills 2003). It is an issue of language as well as communication, because a new alternative is talked into existence. And, importantly, organizations have their own languages and symbols that have important effects on sensemaking. As Pondy (1978) argued, vivid words draw attention to new possibilities, suggesting that organizations with access to more varied images will engage in sensemaking that is more adaptive than will organizations with more limited vocabularies.

While these descriptions may help to delimit sensemaking, they say little about the quality of social exchange within the organizational setting. The answer is that different approaches in design—discovery-driven design versus creation-driven design—constitute different forms of organizational embedding of the design process to promote sensemaking. This will be addressed in detail in the following.

Sensemaking in Discovery-Driven Design

The idea that design aims to change a given situation into a preferred one gives primacy to the search for meaning in the difference between the two. Thus, members of an organization engage in sensemaking whenever a proposed conjecture about an alternative reality is perceived to introduce a "difference" from the current state of reality. This means that sensemaking starts when a situation is experienced or perceived as introducing a difference. Experiencing or perceiving this difference certainly disrupts expectations about routine or maintained continuity (otherwise there would be no difference). Such a situation may be experienced as a circumstance of discrepancy, surprise, opportunity, or interruption (Weick et al. 2005). And regardless of how diverse the interpretations of the situation may be, people will try to make sense of it by trying to construct plausible explanations for what is being perceived or experienced in order to normalize the disruption, restore prevailing expectations, and ensure continuity. As Weick et al. (2005) put it, "[only] plausible stories keep things moving" (p. 415).

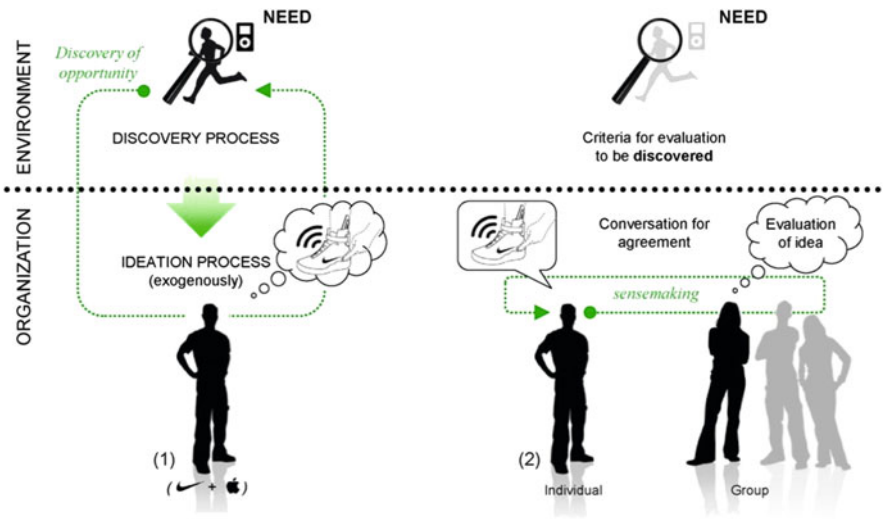

Fig. 5 Assessing truth in discovery-driven design

Significantly, sensemaking is not about truth; it is about an ongoing process of trying to comprehend a situation (or a conjecture about a future situation) so that it becomes plausible. Mills (2003) found that the plausibility judgment of situations may vary depending on group association. For instance, what managers might perceive as plausible might prove implausible for employees. Furthermore, Mills (2003) showed that a situation is usually rendered as plausible when it "taps into an ongoing sense" (e.g., low morale); "is consistent" (e.g., employee surveys); "facilitates, rather than disrupts, ongoing projects"; "reduces equivocality" (e.g., the reduction of problems); "references a sense of 'accuracy'"; and "offers a potentially exciting way forward" (p. 169). Weick (1989) is more precise in regard to the plausibility of conjectured situations, arguing that they are judged as plausible first and foremost when their statements are "believable" (that is what every reader's experience will corroborate), "real" (which invokes some combination of experience, practice, and convention, as opposed to ungrounded conjecture), and "obvious" or "beautiful" (which indicates that statements must be easily comprehensible and appealing for the reader). In the field of cognitive sciences, Connell and Keane (2006) found that a presented situation (whether real or conjectured) is viewed as plausible when it fits with prior knowledge (e.g., using many different sources of corroboration), minimizes the use of complex explanation (e.g., does not rely on extended or convoluted justifications), and uses minimal conjecture (e.g., avoids the introduction of hypothetical entities). Diverse as these findings may seem, they share the properties that in every case of discovery-driven design it is deemed that a situation that ought to be considered as plausible should rely on prior knowledge and avoid the introduction of hypothetical entities. Design ap-proaches vary significantly in this regard.

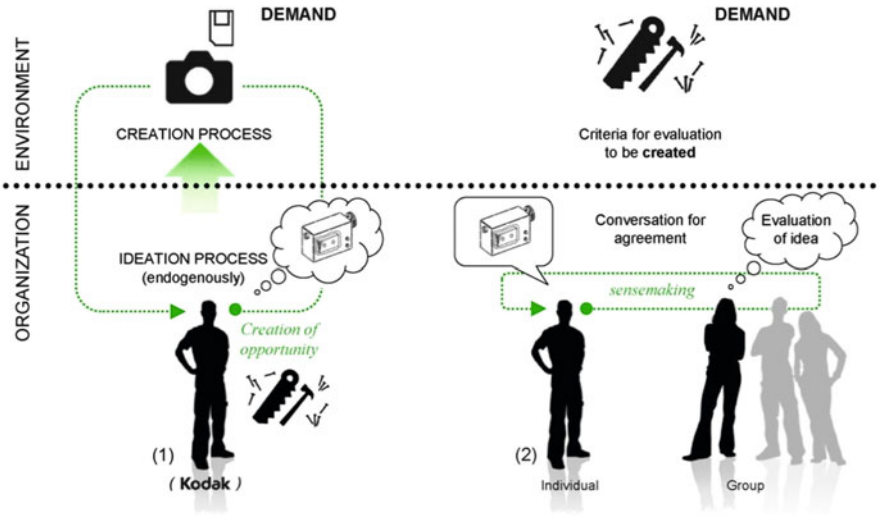

Fig. 6 Assessing plausibility in creation-driven design

In discovery-driven design—a design process that embraces an existing circumstance that people encounter (see Fig. 5)—members of an organization can make plausibility judgments about a conjectured future on the grounds of its verifiability or refutability by observation in the real world. Procedures applied in reaching conclusions "utilize evidence that can be ascertained intersubjectively" (Feigl 1964; cited in Floyd and Wooldridge 1999, p. 128). It is in this respect that a variety of analytical techniques can be applied to estimate the opportunities and risks associated with the particular design. For instance, Nike and Apple could have surveyed the market (and probably did so) of runners using Nike equipment while listening to iPods or estimated the number of runners wanting to get data about their performance. Moreover, in discovery-driven design it is possible to logically infer possible outcomes. Both the trajectory and duration of the search and development process to discover and exploit opportunities to produce new products or services can be deduced and are guarded just against either a more local search—where modest opportunities for discovery exist—or more global search (Gharajedaghi 1999; Levinthal 1997; Rasiel 1998; Rasiel and Friga 2001). The decision of whether an organizational initiative is to be pursued can be evaluated against likely outcomes, required resources, and most importantly, current organizational goals. It is in this sense that the current view of a two-step approach for designing the alternative reality and a subsequent phase concerned with implementing the design appears possible. In creation-driven design, the premises are completely different.

Sensemaking in Creation-Driven Design

In creation-driven design—a design process that embraces a hypothetical desired future, regardless of the circumstances people encounter at present (see Fig. 6)—validation and risked-based decision making becomes impossible because the design is not grounded yet in the real world. In creation-driven design, conjectures about a future situation do not necessarily evolve out of existing situations. As noted earlier, the term discovery or search has little meaning in this approach, because the designer is not looking for opportunities to ground his or her design upon, but rather to create those very conditions. Endogenously created designs are social constructions (Berger 1967; Berger and Luckmann 1966; Searle 1995). They do not exist independently of the designer's perception. The alternative reality—the desired future that one aims to bring into existence and to exploit—can only be understood after the creation process has unfolded completely. Only starting points and initial directions for actions can be known. These initial actions are determined either more intelligently or blindly (Campbell 1960). However, in creation-driven design, it will rarely be possible to perceive the final outcome, the conjectured future to be exploited, in its full scope from the beginning (Berger and Luckmann 1966; Weick 1969). In other words, the desired future and the applicability of endogenously created designs grounded in this reality cannot be tested until the formation process has come to an end. Intended outcomes—the actual crystallization of an idea into the form of a real artifact or service (Nonaka 1994)—must come into being, and they only come into being after they have been crafted in an iterative action-reaction process (Berger and Luckmann 1966; Weick 1969).

Thus, while in discovery-driven design, analytical methods can be used to generate and test hypothetical alternative situations against a given (and real) situation, in creation-driven design, the alternative situation (e.g., photographers with digital cameras) and the context to ground upon (e.g., full digital eco-system) remain hypothetical unless both are brought into being. Given the premise that sensemaking (and thus future behavior) relies on plausibility, this circumstance renders validations and acceptance of the creation-driven design approach in organizational settings difficult. To repeat, plausible situations rely on multiple sources of corroboration that affirm the potential of being real and avoid the introduction of hypothetical entities.

It is in this sense that any creation-driven design approach is destined to fail when pursued in the widely acknowledged two-step design approach of making a design and subsequently "carrying" it into the organization for the purpose of implementation. As a social construction that does not exist independently of the actor's perceptions, creation-driven designs require an evolving and commonly shared consciousness; that is to say, members of a system of social exchange can only make sense of the conjectured reality when actively and continuously involved in its construction. As Berger and Luckmann (1966, pp. 172–173) noted:

> the most important vehicle for reality-maintenance is conversation. . . . At the same time that the conversational apparatus ongoingly maintains reality, it ongoingly modifies it. . . .

> Thus the fundamental reality-maintaining fact is the continuous use of the same language to objectify unfolding biographical experiences. In the widest sense, all who employ this same language are reality-maintaining others.

The language shared in the organization is thus the enfolding of symbols and meanings that define the environment in which consciousness about a shared and anticipated future evolves. It provides the premises for those seeking to reach agreement in an organization and therefore the medium to generate thought and action (Dubberly et al. 2002). Only through discursive interactions in which the implicit nature of meaning is made explicit, is an opportunity created for those involved in the conversation to generate a common meaning through sharing and to refine a shared language (Jenlink and Banathy 2007).

Thus, I may conclude, given that creation-driven design is important, that there is a need for appropriate forms by which to embed such a design process in organizations. Rather than maintaining a two-step process of design and subsequent implementation, there is a need for leadership modelling of the design process as an ongoing process of "design conversation." Design conversation has been defined variously (Banathy 1996, 2000; Dubberly and Pangaro 2009; Jenlink and Carr 1996). Here, by design conversation I mean conversations that "serve as the medium for the reciprocal process that enables [participants] to construct meanings towards a common purpose" (Lambert 1995, p. 83). Understood in this way, conversation, as a medium, contributes to building language that allows members of a system of social exchange to gain access to more varied images and to make sense of collectively created constructions of reality (Pondy 1978; Weick 1995). It provides a "forum for exploring individual and collective concerns, examining common experiences, developing shared meaning, identifying core ideals, values, beliefs—what is sacred, constructing a change community language, and creating 'community of mind' essential to a design community" (Jenlink 2007, p. 7) Designing a desired future is then guided by the conscious awareness of what is desired and by actions essential to realizing that future.

Certainly such a process cannot take place outside the boundaries of organizations and also not in a clearly discernible design phase, which renders inadequate the current aspirations of design practices that seek to help organizations in their quest to design alternative realities from outside. Formulated in a different language and encompassing aspirations foreign to the organization, design and context to ground upon would meet lack of understanding. Nevertheless, design conversation may be thought of as a co-evolutionary process in which new meanings are collectively created through changing relationships, e.g., by responding to stimuli from outside, rather than by overtly confronting an organization's power structure.

References

Ackhoff RL (1981) Creating the corporate future: plan or be planned for. Wiley, New York
Ackhoff RL, Magidson J, Addison HJ (2006) Idealized design: creating an organization's future. Wharton, New Jersey, NJ
Akin Ö (1986) Psychology of architectural design. Pion, London
Aldrich HE, Kenworthy A (1999) The accidental entrepreneur: Campbellian antinomies and organizational foundings. In: Baum JAC, McKelvey B (eds) Variations in organization science: in honor of Donald Campbell. Sage, Newbury Park, CA, pp 19–33
Aldrich HE, Ruef M (1999) Organizations evolving, 2nd edn. Sage, London, 2007 edn
Alexander C (1964) Notes of the synthesis of form. Harvard University Press, Cambridge, MA
Alvarez SA, Barney JB (2007) Discovery and creation: alternative theories of entrepreneurial action. Strateg Entrep J 1(1–2):11–26
Ayres RU (2004) On the life cycle metaphor: where ecology and economics diverge. Ecol Econ 48 (4):425–438
Ayres RU, Simonis UE (1994) Industrial metabolism: restructuring for sustainable development. United Nations University Press, New York
Banathy BH (1996) Designing social systems in a changing world. Springer, New York
Banathy BH (2000) Guided evolution of society: a systems view. Kluwer Academic/Plenum Publishers, New York
Berger PL (1967) The sacred canopy: elements of a social theory of religion. Anchor Books, New York
Berger PL, Luckmann T (1966) The social construction of reality: a treatise in the sociology of knowledge. Anchor Books, New York
Boland RJ, Collopy F (2004) Managing as designing. Stanford University Press, Stanford
Braungart M, McDonough W, Bollinger A (2007) Cradle-to-cradle design: creating healthy emissions—a strategy for eco-effective product and system design. J Clean Prod 15 (13):1337–1348
Brown T (2008) Design thinking. Harv Bus Rev 86(6):84–92
Brown T (2009) Change by design: how design thinking transforms organizations and inspires innovation. Harper Collins, New York
Buchanan R (1992) Wicked problems in design thinking. Des Issues 8(2):5–21
Campbell DT (1960) Blind variation and selective retentions in creative thought as in other knowledge processes. Psychol Rev 67(6):380–400
Connell L, Keane MT (2006) A model of plausibility. Cognit Sci 30(1):95–120
Cross N (1993) Science and design methodology: a review. Res Eng Des 5(2):63–69
Cross N (2006) Designerly ways of knowing. Springer, London
De Bono E (1970) Lateral thinking. Penguin, London
Dess GG, Ireland RD, Zahra SA, Floyd SW, Janney JJ, Lane PJ (2003) Emerging issues in corporate entrepreneurship. J Manag 29(3):351–378
Dosi G (1982) Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. Res Policy 11(3):147–162
Dubberly H, Pangaro P (2009) What is conversation? How can we design for effective conversation. Interact Mag 16(4):22–28
Dubberly H, Esmonde P, Geoghegan M, Pangaro P (2002) Notes on the role of language and leadership in regenerating organizations. Sun Microsystems, Dubberly Design Office, San Francisco
Eaton R (2001) Die Ideale Stadt. Von der Antike bis zur Gegenwart. Nicolai, Berlin
Evans R (1997) Translations from drawing to building. MIT Press, Cambridge, MA
Feigl H (1964) Philosophy of science. In: Passmore J (ed) Philosophical scholarship in the United States 1930–1960. Prentice Hall, Lewood Cliffs, NJ

Fink D (2003) Die Grossen management consultants: Ihre Geschichte, Ihre Konzepte, Ihre Strategien [the famous management consultants: Their history, their concepts, their strategies]. Vahlen, München
Floyd SW, Lane PJ (2000) Strategizing throughout the organization: managing role conflict in strategic renewal. Acad Manag Rev 25(1):154–177
Floyd SW, Wooldridge B (1999) Knowledge creation and social networks in corporate entrepreneurship: the renewal of organizational capability. Entrepreneurship. Theory Pract 23(3): 123–143
Foster RN (1986) Innovation: the attacker's advantage. Summit Books, New York
Fuller RB, McHale J (1963) World design science decade, 1965–1975: world resources inventory. Southern Illinois University, Carbondale, IL
Gaglio CM, Katz JA (2001) The psychological basis of opportunity identification: entrepreneurial alertness. Small Bus Econ 16(2):95–111
Gartner WB (1985) A conceptual-framework for describing the phenomenon of new venture creation. Acad Manage Rev 10(4):696–706
Gharajedaghi J (1999) Systems thinking: managing chaos and complexity: a platform for designing business architecture: managing chaos and complexity—a platform for designing business architecture. Butterworth Heinemann, Boston
Harman G (1965) The inference to the best explanation. Philos Rev 74:88–95
Hayes HR (1978) Cognitive psychology and creating: thinking and creating. Dorsey, Homewood, IL
Huff AW, Floyd SW, Sherman HD, Terjesen SA (2008) Strategic management: thought and action. Jossey-Bass (Wiley), San Francisco
Hurley PJ (2002) Concise introduction to logic. Wadsworth, Boston
Jenlink PM (2007) Design conversation—future building and consciousness evolving. In: Jenlink PM, Banathy BH (eds) Dialogue as a collective means of design conversation. Springer, New York, pp 3–21
Jenlink PM, Banathy BH (2007) Dialogue and designing our future. In: Jenlink PM, Banathy BH (eds) Dialogue as a collective means of design conversation. Springer, New York, pp 159–168
Jenlink P, Carr AA (1996) Conversation as a medium for change in education. Educ Technol 36(1):31–38
Jones JC, Thornley DG (1963) Conference on design methods. Oxford University Press, Oxford
Kelley T (2004) The art of innovation: lessons in creativity from Ideo, America's leading design firm. Profile Books, London
Kelley T, Littman J (2005) The ten faces of innovation: Ideo's strategies for defeating the devil's advocate and driving creativity throughout your organization. Random House LLC, New York
Kuhn TS (1962) The structure of scientific revolutions, 3rd edn. The University of Chicago Press, Chicago, 1996 edn
Lambert L (1995) Leading the conversation. In: Lambert L, Walker D, Zimmerman DO, Cooper JE, Lambert MD, Gardner ME, Ford-Slack PF (eds) The constructivist leader. Teachers College Press, New York, pp 83–103
Lawrence S (2008) Nike + Community = Leadership, gba—go big always, vol. 2014: Interview with Roberto Tagliabue
Lawson B (1980) How designers think: the design process demystified, 4th edn. Elsevier, Amsterdam
Levinthal DA (1997) Adaptation on rugged landscapes. Manag Sci 43(7):934–950
Liedtka J (2000) In defense of strategy as design. Calif Manage Rev 42(3):8–30
Lloyd P, Scott P (1995) Difference in similarity: interpreting the architectural design process. Environ Plan B: Plann Des 22:383–406
Lockwood T (2010) Design thinking; integrating innovation, customer experience, and brand value. Allworth Press, New York
Lockwood T, Walton T (2008) Building design strategy. Allworth Press, New York

Martin R (2009a) The design of business: why design thinking is the next competitive advantage. Harvard Business Press, Boston
Martin RL (2009b) The opposable mind: winning through integrative thinking. Harvard Business Press, Boston
McClusky M (2009) The Nike experiment: how the shoe giant unleashed the power of personal metrics. Wired Magazine. Retrieved Nov 11, 2009, from http://www.wired.com/2009/06/lbnp-nike/
McDonough W, Braungart M (2002) Design for the triple top line: new tools for sustainable commerce. Corp Environ Strateg 9(3):251–258
McDonough W, Braungart M (2010) Cradle to cradle: remaking the way we make things. Macmillan, New York
Meadows DH, Meadows D, Randers J, Behrens W (1972) Limits to growth. The New American Library, New York
Meadows D, Randers J, Meadows D (2004) Limits to growth: the 30-year update. Chelsea Green Publishing, Vermont
Meur LL (2008) "Seesmic Du Jour 123: Nike + with Michael Tchao". https://www.youtube.com/watch?v=u4VkGs_pXm0. Accessed 27 Nov 2014
Mills JH (2003) Making sense of organizational change. Routledge, London
Nagl L (1992) Charles Sanders Peirce. Campus Verlag, Frankfurt am Main
Newell A, Simon HA (1972) Human problem solving. Prentice-Hall, Englewood Cliffs, NJ
Newell A, Shaw JC, Simon HA (1959) The processes of creative thinking. Rand Corporation, Santa Monica, CA
Nike I (2013) Nike redefines "just do it" with new campaign". http://news.nike.com/news/nike-evolves-just-do-it-with-new-campaign. Accessed 27 Nov 2014
Nonaka I (1994) A dynamic theory of organizational knowledge creation. Organ Sci 5(1):14–37
Nonaka I, Takeuchi H (1995) The knowledge-creating company: how Japanese companies create the dynamics of innovation. Oxford University Press, Oxford
Peirce CS (1965) Collected papers of Charles Sanders Peirce. Harvard University Press, Cambridge, MA
Peters T (1997) The circle of innovation: you can't shrink your way to greatness. Hodder & Stoughton, London
Peters T, Waterman RH (1982) In search of excellence. Harper and Row, New York
Plattner H, Meinel C, Weinberg U (2009) Design-thinking. Mi-Fachverlag, Landsberg am Lech
Pondy LR (1978) Leadership is a language game. In: McCall M, Lombardo M (eds) Leadership: where else can we go? Duke University Press, Durham, NC
Rasiel EM (1998) The Mckinsey way: using the techniques of the world's top strategic consultants to help you and your business. McGraw-Hill, New York
Rasiel EM, Friga PN (2001) The Mckinsey mind: understanding and implementing the problem-solving tools and management techniques of the world's top strategic consulting firm. McGraw-Hill, New York
Rittel HW, Webber MM (1984) Planning problems are wicked problems. Developments in design methodology. Wiley, New York, pp 135–144
Roam D (2009) The back of the napkin (expanded edition) solving problems and selling ideas with pictures. Penguin, London
Rowe PG (1991) Design thinking. MIT Press, Cambridge, MA
Sahal D (1981) Patterns of technological innovation. Addison-Wesley Publishing Company, Advanced Book Program/World Science Division, Boston
Schön DA (1983) The reflective practitioner: how professionals think in action. Basic Books, New York
Searle JR (1995) The construction of social reality. Penguin, New York
Shamiyeh M (2007a) Design new futures! Volume 14(4):14–19
Shamiyeh M (2007b) Organizing for change: integrating architectural thinking in other fields. Birkhaueser, Basel

Shamiyeh M (2010) Creating desired futures: how design innovates business. Birkhaueser, Basel
Shamiyeh M (2014) Driving desired futures: turning design thinking into real innovation. Birkhaueser, Basel
Shane SA (2003) A general theory of entrepreneurship: the individual-opportunity nexus. Edward Elgar Publishing, Cheltenham
Simon HA (1969) The science of the artificial, 3rd edn. MIT Press, Cambridge, MA, 1996 edn
Spillers WR (1974) Basic questions of design theory. North-Holland Publishing Company, Amsterdam
Tsoukas H, Chia R (2002) On organizational becoming: rethinking organizational change. Organ Sci 13(5):567–582
Valkenburg R, Dorst K (1998) The reflective practice of design teams. Des Stud 19(3):249–271
Venkataraman S (2003) Forword. In: Shane SA (ed) A general theory of entrepreneurship: the individual-opportunity Nexus. Edward Elgar Publishing, Cheltenham
Verganti R (2009) Design-driven innovation: changing the rules of competition by radically innovating what thing mean. Harvard Business Press, Boston
Walton D (2004) Abductive reasoning. The University of Alabama Press, Tuscaloosa
Ware C (2010) Visual thinking for design. Morgan Kaufmann, Burlington, MA
Weick KE (1969) The social psychology of organizing, 2nd edn. McGraw-Hill, New York, 1979 edn
Weick KE (1989) Theory construction as disciplined imagination. Acad Manag Rev 14(4): 516–531
Weick KE (1995) Sensmaking in organizations. Sage, Thousands Oaks, CA
Weick KE, Sutcliffe KM, Obstfeld D (2005) Organizing and the process of sensemaking. Organ Sci 16(4):409–421
Weitzman ML (1984) The share economy: conquering stagflation. Harvard University Press, Boston