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DESIGN THINKING IN DIGITAL ENVIRONMENTS

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Research in Progress

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Abstract

Design thinking (DT) as an innovation method has gained increasing importance in recent years, both for traditional and digital products. However, the rapid acceleration of digitalization across all domains of the modern working world has changed the way innovation management and DT are conducted. As a result, highly interactive offline workshops have been replaced by remote online workshops, which are supported by digital tools. This radical shift warrants a reconsideration of the potentially socio-psychological dynamics within DT workshops. To address this, we conducted 16 qualitative in-depth interviews with DT experts from different backgrounds and contextualized our interview findings with construal level theory and embodied cognition. Thus, we show how the DT process is affected by the changing socio-psychological dynamics created by the shift to digital environments. In sum, we identify both chances and challenges of DT in digital environments and derive implications for future research and practice in this area.

Keywords: Design Thinking, Digital Innovation, Innovation Management, Digital Transformation.

1 Introduction

For quite some time now, design thinking (DT) has become a widely used approach for structuring innovation processes for traditional products and, more recently, also increasingly for digital products (e.g., Brown, 2008; Hehn et al., 2018; Rai, 2017; Wang, 2021). As a human-centered approach to innovation with an empathetic stance, each step in the DT process is characterized by high degrees of personal interaction and exchange between future end-users and DT team members (Kolko, 2015).

So far, DT has mainly been conducted in offline environments such as design studios, innovation labs, or natural user environments allowing for interactive experiences for all participants (Plattner et al., 2011). However, digitalization is rapidly gaining momentum across all domains of the modern working world which has also changed the way innovation management (Appio et al., 2021; Verganti et al., 2020) and DT, in particular, are conducted (Redlich et al., 2018). That is, highly interactive offline DT workshops are ever more often becoming (semi-) virtual or are supported by all kinds of software tools (Schoormann et al., 2020). COVID-19 work-from-home regulations have further fueled this development. Workshops had to be performed entirely remotely which brought about a radical change both in how teams collaborate (Waizenegger et al., 2020) and, in particular, in how the DT innovation process is carried out. Also, in the long term, in times of radically changing work environments as well as advancing technological possibilities, many companies are striving for a permanent shift of innovation workshops to the virtual world (Nambisan et al., 2017). As a result, workshop participants no longer meet in person to interact, brainstorm, and prototype together, but spatially move away from

each other, only meeting online. Thus, the radical shift from an offline to an online innovation environment also requires a rethinking of the potentially changing socio-psychological dynamics and the resulting impact on the phases and outcomes of the DT process.

Although previous studies have analyzed the implications of digitalization in work environments on (distributed) teams (e.g., Hinds and Mortensen, 2005; Karis et al., 2015; Wilson et al., 2013), these insights are not sufficiently applicable to DT teams conducting complete, complex DT processes, as they often involve a high degree of uncertainty and ambiguity (Luchs et al., 2016). As such, each stage of the process establishes the foundation for the following, and a failure in one stage indicates the likelihood of issues in the subsequent (Jaskyte and Liedtka, 2021). Moreover, DT stands apart from other innovation practices, such as lean startup (Ries, 2011), through its human-centered approach to hypothesis generation and problem-solving (Meinel et al., 2020). This involves unique behavioral principles such as empathic data collection to understand the context of the problem, closely engaging with internal and external stakeholders, and embracing an open and creative mindset (Carlgren et al., 2016).

Further, there is a growing body of cross-disciplinary research that links DT to theories in social psychology, innovation management, and information systems (IS) (e.g., Avdiji et al., 2020; Klenner et al., 2021; Thompson and Schonthal, 2020), however, there is yet no research that addresses the potential changes in socio-psychological dynamics for DT in digital environments. In this paper, we address this gap. Given the exploratory nature of our research endeavor, we pursue a qualitative study. In specific, we first identified two psychological concepts, namely construal level theory (CLT) and embodied cognition (EC), that serve as a foundation for understanding the differences in participants' experience across the two forms of DT formats (online vs. offline). By drawing on previous research on these two theories, we then seek to inductively explore how these experiences may vary within the specific DT phases. While CLT explains how individuals form cognitive structures of situations that are not directly experienceable and are thus distant on a social or spatial dimension (Trope and Liberman, 2010), EC sheds light on how individuals' cognitive experiences are influenced by their physical experiences (Barsalou, 2008). Our study is thus guided by the following research question:

RQ: *How does the change in the environment (from offline to online) affect the phases and outcomes of the DT process?*

To answer our research question, to date 16 interviews have been conducted with renowned DT experts from research and practice. Since this work is part of a larger research project that is still ongoing, the results presented in this paper represent only a provisional state of research. However, as a preliminary result, we could already identify important chances and challenges of DT in digital environments. In this sense, our research has implications for both current managerial and technological developments (Eling and Herstatt, 2017) and contributes to recent calls to incorporate DT into a broader theoretical discussion (Dell'Era et al., 2020). At a deeper level, our findings contribute to understanding how to better structure innovation activities in the digital era (Rindfleisch et al., 2020) to improve the quality of innovation (Fichman, 2004). In addition, we have developed propositions for each phase of the DT process that may drive future research endeavors.

2 Theoretical Background

Recently, design thinking (DT) has become a popular term in practice and academia, although a common definition of DT is still lacking. Scholars often describe DT as an innovation method to generate creative ideas and solve complex, "wicked" problems (Liedtka, 2015). In general, the DT approach is also a means of dealing with the increasing complexity of digital-age technologies (Kolko, 2015). In the IS field, research on DT is still emerging (Rai, 2017) but has already been studied in the context of health technologies (Przybilla et al., 2018) or smart transportation (Azab et al., 2016).

Through a human-centered approach, DT can help to overcome this complexity by adopting an open mindset and developing deep empathy for users' latent needs (Carlgren et al., 2016). Hereby, design thinkers work in multidisciplinary teams, use variable rooms that support creative work, and follow a

structured process (Plattner et al., 2011). According to the Hasso Plattner Institute (HPI) Stanford, this iterative process consists of 5 phases: *empathize*, *define*, *ideate*, *prototype*, and *test* (Micheli et al., 2019). Within this process, DT makes use of various tools such as brainstorming techniques, experimentation with prototypes, and visualization to overcome the ambiguity of abstract, verbal explanations (Micheli et al., 2019). DT thus requires some degree of physical interaction with the environment to stimulate the mind for new ideas (Plattner et al., 2011). Hence, DT combines intuitive, and spontaneous with analytical thinking as well as convergent with divergent thinking. The mindset to be adopted in DT is therefore seen as a crucial component (Leavy, 2010). When the innovation environment changes (e.g., from offline to online), it can be assumed that the mindset is also influenced. Theories from social psychology such as construal level theory (CLT) and embodied cognition (EC) can help to explain socio-psychological phenomena that arise from such change.

According to CLT, the psychological distance to objects or events alters the level of abstraction of their mental representation. Thus, individuals will represent psychologically near events or objects with concrete and detailed low-level construals and distant events with abstract high-level construals. Hereby, psychological distance could be explained through objective distance such as spatial, temporal, social, or hypothetical dimensions (Trope and Liberman, 2010). The construal level (CL) again influences the judgment and prediction in social situations, hence a high (low) CL leads to a stronger focus on global, dispositional (local, situational) aspects of a problem (Henderson et al., 2006). CL also determines whether decision-making is driven by more holistic, goal-oriented, or by specific, peripheral details (Smith and Trope, 2006). Previous research has made propositions about how communication and collaboration among geographically distant teams affect psychological distance (Norman et al. 2016; Wilson et al., 2013). In the context of creativity, studies have shown that temporal and spatial distances have led to more abstract solutions (Jia et al., 2009). However, it was not considered if, and how the bodily movement limitation on a physical level also influences cognitive processes.

EC can provide clarity, as it assumes a bidirectional interaction between sensory, motoric, and cognitive processes (Barsalou, 2008; Markman and Brendl, 2005). Thus, a human's way of thinking and feeling is strongly influenced by the experience of the physical environment and its resulting continuous flow of information. Consequently, bodily movements and physical sensations play a central role in shaping the mindset and impacting emotional states. In particular, the spatial distance between individuals may influence the perceived emotional connection between themselves and other psychologically relevant entities (Williams and Bargh, 2008). Studies have also connected EC with CLT, as, for example, looking down (vs. looking up) serves a nearby (vs. distant) stimuli leading to more concrete (vs. abstract) processing (Van Kerckhove et al., 2015).

Building on these theoretical foundations, we expect that the change of the DT environment from offline (spatial proximity) to online (spatial distance), and the associated restricted physical movement in space, will have a compelling effect on DT participants' cognitive processing of information, and thus also affect outcomes in the DT process.

3 Methodology

Since this study is one of the first to explore the connection between DT and the theoretical concepts of CLT and EC, an exploratory qualitative approach was chosen (Eisenhardt, 1989; Yin, 2003). To date, 16 semi-structured interviews with DT experts have been conducted between March and June 2021, aiming to understand how the shift from an offline to an online DT innovation environment was perceived. All experts regularly take on leading roles in DT workshops, and come from industry (e.g., Ford, IBM, Siemens), design agencies (e.g., HYVE), and academia (e.g., HPI Stanford University, University of St. Gallen). The semi-structured interview revolved around questions about whether, and how the change to an online DT environment changed a) the way the process was conducted, b) teamwork, and c) individual attitudes. In addition, questions were asked about which steps in the process were perceived as most challenging, and potential solutions to the challenges were mentioned. This approach allowed us to gain deep insights into interviewees' individual experiences, capture personal

learnings, and learn about their troubleshooting. Recordings of the interviews totaled 19 hours, with an average of 71.4 minutes per interview. The audio recordings were transcribed, resulting in a total of 371 single-spaced pages. To structure the data analysis, an iterative procedure was followed, providing three main steps (Gioia et al., 2013). In this process, the data material was first read several times, then the first round of data analysis was performed with pen and paper, and the MAXQDA software was used in the following rounds. Initially, the first author coded the data and the resulting codes were then discussed, rephrased, and reinterpreted by the research team by using multiple example quotes. This collaborative approach was followed to ensure a rigorous and reliable analysis. The initial first-order codes were hereby generated in-vivo, which purely picked up the terminology of the interviewees and reflect a shift in DT, when changing the environment from offline to online. Next, the codes were combined into second-order codes, and an initial link to the CLT and EC literature was created in order to explain the changes by theory. In the next step, these second-order codes were aggregated and assigned to the central stages of the DT process and core implications for each phase were developed. Table 1 illustrates our data analysis process and shows a complete list of the coding structure.

First-order Code (data-based)	**Second-order Code (theory-based)**	**Aggregate Dimension**
• Loss of information concerning user insights • Loss of quality in communication with users	Broader and fewer insights (level of details) (CLT)	More abstract insights and less emotional immersion in **Empathize**
• Restricted emotional immersion into user's situation • Limited possibility to grasp the atmosphere in the environment	Different experience of the environment (EC)	
• Loss of bodily and non-verbal signals of users • Greater dependency on specific statements of the user • Naturality of setting as an impact on openness	Sensomotoric processes impact cognitive processing (EC)	
• Improved documentation of the whole learning experience • Faster and more efficient problem framing through structured working processes	Focus on the big picture and goal orientation (CLT)	Efficiency increase in **Define**
• Lack of serendipitous conversation • Changes in group dynamics while brainstorming • Difficulties in building trust and psychological safety in workshops • Missing spark of collaboration and increased social distance in ideation sessions	Ideation environment becomes more rigid and structured (CLT/ EC)	Decrease in creativity and more abstract ideas in **Ideate**
• Lower quantity of ideas • Higher level of abstraction of ideas	Impact on quality/ quantity in idea generation (CLT)	
• Less playfulness and event character in workshops • Creativity is based on motoric actions • Missing sensory factors of digital tools • Impact of the environment on energy levels	Sensory and motoric processes influence the mindset (openness and creativity) (EC)	
• Limited acting and exploring by using hands while prototyping • Product/project dependency on the fit of setting • Limitations in the power of imagination	Touching and thinking with hands (interaction with elements of the environment) (EC)	Lack of physical exploration in **Prototype**
• Subjectivity vs. objectivity in evaluation • Selling prototypes instead of gathering feedback	Focus on desirability of the end status (CLT)	More objective-driven evaluation in **Test**
• Limitations in information through missing contextual framework	Loss of feedback and information (EC)	

Table 1. Coding schema.

4 Findings

In the following, some of the most significant findings for each DT phase are outlined, contextualized with CLT and EC, and supported by anecdotal statements from the interviewees. Further, propositions are derived from the aggregate dimension of each phase.

4.1 Empathize

The *empathize* phase revolves around conducting observations and building a rich and comprehensive understanding of the user and his situational problems. However, interviewees reported that due to the spatial distance in a digital environment, the understandings gained from this phase often remain on an abstract, superficial level. In addition, many important details that are necessary for identifying deeper needs and new insights remain hidden. This effect can be explained by CLT, as increasing spatial and thus psychological distance is accompanied by abstract construals, which is reflected, for example, in more abstract language usage (Fujita et al., 2006). But especially in the empathize phase, the details captured between users and the innovation team are essential, as one interviewee stated:

"With that [empathizing online], we might never get to new observations, and that will prevent us from insights that we haven't had before. That's a risk or high risk." (Interviewee (I)1)

Furthermore, according to EC, abstract cognitive processes are often based on sensory and motoric processes, meaning that body postures, for example, have an impact on cognition (Wilson, 2002). However, the circumstances of the online setting diminish the possibility of experiencing the environmental situation holistically by being dependent on pure verbal statements. This carries the risk of losing personal physical exploration and perception of body language and important insights get lost. This is summarized by another interviewee:

"It's so much harder to be insightful about the actual usage situation in a digital setting. You're much more dependent on what the user tells you and shows you, in comparison that you can perceive stuff yourself and ask through on it." (I2)

Additionally, EC theory states that cognitive activities, such as emotional connection to individuals and other psychologically relevant entities, are influenced and shaped by the environment (Williams and Bargh, 2008). Especially in the first phase of the DT process, the development of empathy is essential for building a deep understanding of the users' needs. One interviewee expressed the following concerns in this regard:

"The first step in empathize, we are not in each other's context only partially. That's a very big difference. […] it's really difficult to see others' perspectives fully. Empathy means that you should be able to immerse in someone else's situation. How can you immerse fully if there's just a digital screen in front of you and you can't sense, smell or see the full person? You lack communication about emotions and stuff." (I3)

By contextualizing these findings with CLT and EC, we derive the following proposition:

Proposition (P)1: The digital environment increases the spatial and thus psychological distance to users and thus leads to more abstract insights and less emotional immersion in the empathize phase.

4.2 Define

The *define* phase comprises the synthesis, preparation, and definition of the problem space. The digital environment was considered particularly positive by the interviewees, as all the information collected in the previous phase could be directly digitized, thus mapping the entire problem journey. Participants reported that the focus in the digital environment was increasingly directed at a holistic big picture, as the whole learning experience is recorded and visible on boards such as Miro or Mural. Thus, this phase was perceived to be more efficient compared to the offline environment, as one interviewee pointed out:

"In this respect, to be honest, the togetherness there [online] is perhaps even more effective or efficient in that sense, because with good project management, you actually distribute the work packages, meet, compile things, discuss, and everyone does their thing and derives conclusions from it." (I4)

Since the interviewees particularly focused on efficiency when describing this phase, CLT suggests that actions are identified rather as ends than as means (Fujita et al., 2006) and thus, evaluated based on centralized, goal-oriented, and analytical schemas (Trope and Liberman, 2010). By viewing the entire journey and the information gathered from a psychologically distant perspective, participants perceive the problem space more holistically. Hence, we derive the following proposition:

P2: Conducting DT online increases the psychological distance to the information gathered and leads to a more efficient workflow by focusing on the big picture.

4.3 Ideate

The *ideate* phase is about generating new innovative ideas. In this phase, DT offers a wide range of playful tools that enable creative and open thinking. However, the variety of methods, for instance, different brainstorming techniques, is limited in the online format by the lack of spatiality. In addition, the energy released offline, which can be felt through emotional contagion between the team members, influences cognitive processing in the development of ideas, as one interviewee expressed:

"In offline formats, we've always used certain tricks - and that's what I meant a little bit by the event character of innovation, […] which definitely has a lasting impact on the participants, that they somehow do open up and think more in a different way." (I4)

In contrast, an online idea generation phase is perceived as much more energy-consuming. This phenomenon can be explained with the help of EC. Since humans' cognitive capacities are limited, they use their environment to shift cognitive tasks (Wilson, 2002). In addition, the interviewees found that the quantity of ideas decreases as the creative flow stagnates and becomes more rigid in a digital environment and ideas remain at a higher abstraction level:

"Even if you encourage people to go into quantity, [...][ideas] at least are noticeably more high-level, more abstract, less detailed compared to on-site formats." (I4)

Furthermore, interviewees felt that pure creative thinking is limited by the digital space, the digital communication medium, and the loss of the spark that collaboration in a physical space provides to participants. Interviewees emphasized that the sense of connectedness reinforced by physical ideations in an offline environment is critical to developing a fruitful team dynamic. Thus, the online ideation environment becomes much more structured and goal-oriented:

"All of that [interpersonal interaction] is lost, and all of that is certainly valuable in order to get the smallest bit out of the ideas or to set innovative impulses because a lot is controlled head-on by whoever is moderating and whoever has prepared and steered the process. Because this group dynamic doesn't happen on its own, as it would in an offline setup, but rather everything […] runs on tracks." (I4)

In sum, this leads us to the following proposition:

P3: The shift to a digital environment increases the psychological distance to a problem domain and leads to a higher level of abstraction in idea generation. Additionally, the loss of playfulness due to limited physical interaction negatively affects cognitive processing and thus creativity in generating ideas.

4.4 Prototype

This phase is about creating prototypes for the developed ideas. Interviewees described that especially the physical interaction in an offline environment and thus the haptic exploration stimulated cognitive assimilation, as people stop thinking and start acting and thinking using their hands:

"Feedback from people I've worked with and my own as well is though, the whole notion of rapid prototyping, having something tangible, and now handing something tangible over to you. Not talking about it, but you exploring it, speaking out loud so I capture that data is limited because you just can't give it to them in that space, which is so crucial to prototyping [...]." (I1)

This can be contextualized with previous findings from EC that bodily movements play a central role in shaping the mindset (Wilson, 2002), leading us to the following proposition:

P4: Conducting DT online limits physical (sensory and motoric) exploration of prototypes, reduces the ability to visualize and process information, and leads to more superficial prototypes.

4.5 Test

In the *test* phase, the prototypes are tested for their practical suitability. We found that the testing phase in a digital environment tends to be more rational, technical, and objective. Studies using CLT have shown that the spatial distance of events produces judgments that are reflected in abstract schematic representations and behavior is based on enduring dispositions rather than situational and spontaneous conditions (Henderson et al., 2006). Here, one interviewee pointed out that presenting an innovative product or service and getting feedback on it, is less influenced by situational and subjective factors:

"Maybe people are even more neutral online. [...] Because if you invite the customer, then, of course, you may have someone who presents it [prototype] extremely convincingly or something. And then they might think, oh, really cool. Of course, that's a little bit "quieter" online." (I5)

Obtaining feedback in this phase is considered to be essential for the further development of products or services. Therefore, it may be beneficial to establish a psychological distance to obtain feedback that is free of situational factors and focuses on the objective desirability and advantageousness of the pure product. We derive the following proposition:

P5: Conducting DT online increases the psychological distance to products and leads to a more rational testing process based on objective evaluation factors.

4.6 Contextual Factors

In addition to the findings above, the experts' diverse backgrounds (e.g., across various industries with different technological focus areas) have allowed for the identification of certain situational and contextual factors that can affect the appropriateness of the environment for conducting the entire process and were found to have a strengthening or weakening impact on the effects described. Interviewees highlighted, for example, the important role of the technology and digital maturity of the participants used to conduct the DT process in the online setting. Therefore, choosing an appropriate software tool (e.g., Miro as an online collaboration board) that is familiar and thus allows for intuitive use can reduce the perceived psychological distance during online DT. In addition, based on their different project experiences, interviewees shared that some product dependency influences outcomes in the process. The more software-heavy a driven innovation is, the easier it is to generate it in the online setting, as the current digital tools seem to fit the product purpose and already allow for valuable prototyping, experimentation, and testing. In addition, the home setup, achieved for example through meetings via Zoom, was seen as beneficial in reducing the perceived distance to users as they were met in their home and safe environment, and could therefore communicate more openly.

5 Discussion and Implications

Based on a preliminary set of 16 in-depth expert interviews, we explored how the phases and outcomes of the DT process are affected by the changing socio-psychological dynamics created by the shift from an offline to an online innovation environment. Since our research is still ongoing, the results presented in this paper represent only a snapshot. However, as a preliminary result, we could already identify

important chances and challenges of DT in digital environments. In our next research steps, we will conduct additional interviews to increase the robustness of our findings. Moreover, following a mixed-methods paradigm, we will conduct deductive quantitative studies to validate the results of our qualitative research (Venkatesh et al., 2013). Overall, we believe that our research can stimulate the current scientific discourse by contributing in multiple ways.

First, in a broader context, our research adds to the literature on digitalization in innovation (e.g., Huesig and Endres, 2018; Nambisan et al., 2017; Yoo, 2012). That is, we show that while digitalization can be beneficial at many points in the DT process, it is not a general-purpose weapon and always requires specific evaluation according to the application domain.

Second, and more specifically, we contribute to the emerging literature body on design thinking in IS and innovation management (e.g., Hehn et al., 2018; Rai, 2017; Wang, 2021) by providing an understanding of the socio-psychological dynamics in online DT environments. By contextualizing our findings with research on CLT and EC, it was shown that conducting the DT process in a digital environment resembles a spatially distant context. That is, the psychological distance to each objective in the DT process is increased, which in turn increases the construal level. Consequently, individuals participating in an online DT process tend to think in a more abstract and goal-oriented manner. This has important implications for the DT practice: In the define phase, more abstract thinking proves helpful, as the information must be condensed into a holistic picture and a clear goal must be established. However, the missing exploration of the physical environment affects cognitive processing resulting in less detailed insights in the empathize phase. In addition, the perceived lack of playfulness and tangibility in a digital environment leads to more abstract and less creative ideas in the ideate phase.

Last, our research contributes by integrating research from different disciplines such as information systems, innovation management, and social psychology (Tarafdar and Davison, 2018). This allows us on the one hand to connect with the intellectual core of IS research such as digital innovation, but on the other hand also to bring in enriching perspectives from other disciplines (e.g., cognition and social psychology) to create a more holistic understanding of the digitalization of the DT process and underlying dynamics.

Moreover, our findings contribute to DT practice. In fact, moving DT workshops completely to digital environments is a double-edged sword. Thus, for some parts of the DT process that require a more goal-oriented approach, it may be advisable to perform them online. On the other hand, process steps that require a high degree of interaction with the environment and for which a detailed and specific mental representation is necessary should better be performed offline. In addition, when choosing the DT innovation environment, contextual factors should also be considered, as they may influence the perceived psychological distance to the tasks in the DT phases. These include, among others, the choice of suitable software tools and the innovation domain (e.g., hardware-based or digital products and services).

In summary, we believe that this work has taken an important first step in exploring the socio-psychological dynamics of DT in digital environments, as well as shedding light on the chances and challenges that arise. There are several points of departure for future research. For example, since prior research has found that digital innovation also challenges established product innovation practices (e.g., Hylving et al., 2012), future research could more closely examine how the innovation domain, i.e., traditional versus digital product innovation, may moderate the mechanisms we identified. Moreover, we believe that our propositions can be fruitful starting points for future research endeavors to complement our study with quantitative data, for example by designing employee surveys for DT teams. Furthermore, each of the propositions could be tested through multiple experiments. For instance, by comparing results in idea generation when using a digital whiteboard like Miro, as opposed to an offline session utilizing physical materials. Additionally, future research may examine the contextual factors as moderators in more detail. For example, if the results in developing prototypes are dependent on the type of product (tangible or digital components) and/ or the tools used.

References

Appio, F.P., Frattini, F., Petruzzelli, A.M., and Neirotti, P. (2021). "Digital Transformation and Innovation Management: A Synthesis of Existing Research and an Agenda for Future Studies," *Journal of Product Innovation Management* 38 (1), 4-20.

Avdiji, H., Elikan, D., Missonier, S., and Pigneur, Y. (2020). "A Design Theory for Visual Inquiry Tools," *Journal of the Association for Information Systems* 21 (3), 695-734.

Azab, A., Mostafa, N., and Park, J. (2016). "OnTimeCargo: A Smart Transportation System Development in Logistics Management by a Design Thinking Approach," in: *Proceedings of the 2nd Pacific Asia Conference on Information Systems*, Chiayi, 44-55.

Barsalou, L.W. (2008). "Grounded Cognition," *Annual Review of Psychology* 59 (1), 617-645.

Brown, T., and Martin, R. (2015). "Design Thinking for Action. How to Use Design Thinking to Make Great Things Actually Happen," *Harvard Business Review* 93 (9), 57–64.

Carlgren, L., Rauth, I., and Elmqusit, M. (2016). "Framing Design Thinking. The Concept in Idea and Enactment," *Creativity and Innovation Management* 25 (1), 38–57.

Dell'Era, C., Magistretti, S., Cautela, C., Verganti, R., and Zurlo, F. (2020). "Four Kinds of Design Thinking: From Ideating to Making, Engaging, and Criticizing," *Creativity and Innovation Management* 29 (2), 324-344.

Eisenhardt, K.M. (1989). "Building Theories From Case Study Research," *Academy of Management Review* 14 (4), 532-538.

Eling, K., and Herstatt, C. (2017). "Managing the Front End of Innovation – Less Fuzzy, Yet Still Not Fully Understood," *Journal of Product Innovation Management* 34 (6), 864-874.

Fichman, R.G. (2004). "Going Beyond the Dominant Paradigm for Information Technology Innovation Research: Emerging Concepts and Methods," *Journal of the Association for Information Systems* 5 (8), 1.

Fujita, K., Henderson, M.D., Eng, J., Trope, Y., and Liberman, N. (2006). "Spatial Distance and Mental Construal of Social Events," *Psychological Science* 17 (4), 278-282.

Gioia, D., Kevin, G.C., and Aimee, L.H. (2013). "Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology," *Organizational Research Methods* 16 (1), 15-31.

Hehn, J., Uebernickel, F., Stoeckli, E., and Brenner, W. (2018). "Designing Human-Centric Information Systems: Towards an Understanding of Challenges in Specifying Requirements Within Design Thinking Projects," in: *Multikonferenz Wirtschaftsinformatik*, Lüneburg, 1051–1062.

Henderson, M.D., Fujita, K., Trope, Y., and Liberman, N. (2006). "Transcending the "Here": The Effect of Spatial Distance on Social Judgement," *Journal of Personality and Social Psychology* 91 (5), 845-856.

Hinds, P.J., and Mortensen, M. (2005). "Understanding Conflict in Geographically Distributed Teams: The Moderating Effects of Shared Identity, Shared Context, and Spontaneous Communication," *Organization Science* 16 (3), 290-307.

Huesig, S., and Endres, H. (2018). "Exploring the Digital Innovation Process: The Role of Functionality for the Adoption of Innovation Management Software by Innovation Managers," *European Journal of Innovation Management* 22 (2), 302-314.

Hylving, L., Henfridsson, O., and Selander, L. (2012). "The Role of Dominant Design in a Product Developing Firm's Digital Innovation," *Journal of Information Technology Theory and Application* 13 (2), 5.

Jaskyte, K., and Liedtka, J. (2022). "Design Thinking for Innovation: Practices and Intermediate Outcomes," *Nonprofit Management and Leadership* 32 (4), 555-575.

Jia, L., Hirt, E.R., and Karpen, S.C. (2009). "Lessons From a Faraway Land: The Effect of Spatial Distance on Creative Cognition," *Journal of Experimental Social Psychology* 45 (5), 1127-1131.

Karis, D., Wildman, D., and Mané, A. (2015): "Improving Remote Collaboration with Video Conferencing and Video Portals," *Human-Computer Interaction* 31 (1), 1-58.

Klenner, N.F., Gemser, G., and Karpen, I.O. (2022). "Entrepreneurial Ways of Designing and Designerly Ways of Entrepreneuring: Exploring the Relationship Between Design Thinking and Effectuation Theory," *Journal of Product Innovation Management* 39 (1), 66-94.

Kolko, J. (2015). "Design Thinking Comes of Age," *Harvard Business Review* 93 (9), 66–71.
Leavy, B. (2010). "Design Thinking – A New Mental Model of Value Innovation," *Strategy & Leadership* 38 (3), 5-14.
Liedtka, J. (2015). "Perspective. Linking Design Thinking With Innovation Outcomes Through Cognitive Bias Reduction," *Journal of Product Innovation Management* 32 (6), 925–938.
Luchs, M.G., Swan, K.S., and Creusen, M.E. (2016). "Perspective: A Review of Marketing Research on Product Design With Directions for Future Research," *Journal of Product Innovation Management 33* (3), 320-341.
Markman, A.B., and Brendl, C.M. (2005). "Constraining Theories of Embodied Cognition," *Psychology Science* (16:1), 6-10.
Meinel, M., Eismann, T.T., Baccarella, C.V., Fixson, S.K., and Voigt, K.I. (2020). "Does Applying Design Thinking Result in Better New Product Concepts Than a Traditional Innovation Approach? An Experimental Comparison Study," *European Management Journal* 38 (4), 661-671.
Micheli, P., Wilner, S.J.S., Bhatti, S.H., Mura, M., and Beverland, M.B. (2019). "Doing Design Thinking: Conceptual Review, Synthesis and Research Agenda," *Journal of Product Innovation Management* 36 (2), 124–148.
Nambisan, S., Lyytinen, K., Majchrzak, A., and Song, M. (2017). "Digital Innovation Management: Reinventing Innovation Management Research in a Digital World," *MIS quarterly* 41 (1), 223-238.
Norman, E., Tjomsland, H.E., and Huegel, D. (2016). "The Distance Between Us: Using Construal Level Theory to Understand Interpersonal Distance in a Digital Age," *Frontiers in Digital Humanities* 3 (5), 1-6.
Plattner, H., Meinel, C., and Leifer, L. (2011). *Design Thinking. Understand – Improve – Apply*, Berlin, Heidelberg: Springer.
Przybilla, L., Klinker, K., Wiesche, M., and Krcmar, H. (2018). "A Human-Centric Approach to Digital Innovation Projects in Health Care: Learnings From Applying Design Thinking," in: *Proceedings of the 22nd Pacific Asia Conference on Information Systems*, Yokohama.
Rai, A. (2017). "Editor's Comments: Diversity of Design Science Research," *MIS Quarterly* 41 (1), 3-18.
Redlich, B., Dorawa, D., Siemon, D., and Lattemann, C. (2018). "Towards Semi-virtual Design Thinking-Creativity in Dispersed Multicultural and Multidisciplinary Innovation Project Teams," in: *Proceedings of the 51st Hawaii International Conference on System Sciences*, Hawaii, 717-726.
Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*, New York, NY: Crown Business Publishing.
Rindfleisch, A., Mehta, R., Sachdev, V., and Danienta, N. (2020). "Innovation Research Themes for Our Changing Environment: Insights From the 2019 PDMA Doctoral Consortium," *Journal of Product Innovation Management* 37 (2), 126-137.
Schoormann, T., Hofer, J., and Knackstedt, R. (2020). "Software Tools for Supporting Reflection in Design Thinking Projects," in: *Proceedings of the 53rd Hawaii International Conference on System Sciences*, Hawaii, 407-416.
Smith, P.K., and Trope, Y. (2006). "You Focus on the Forest When You're in Charge of the Trees: Power Priming and Abstract Information Processing," *Journal of Personality and Social Psychology* 90 (4), 578-596.
Tarafdar, M., and Davison, R. M. (2018). "Research in Information Systems: Intra-disciplinary and Inter-disciplinary Approaches," *Journal of the Association for Information Systems* 19 (6), 2.
Thompson, L., and Schonthal, D. (2020). "The Social Psychology of Design Thinking," *California Management Review* 62 (2), 84-99.
Trope, Y., and Liberman, N. (2010). "Construal-Level Theory of Psychological Distance," *Psychology Review* 117 (2), 440–463.
Van Kerckhove, A., Geuens, M., and Vermeir, I. (2015). "The Floor Is Nearer Than the Sky: How Looking Up or Down Affects Construal Level," *Journal of Consumer Research* 41 (6), 1358-1371.
Venkatesh, V., Brown, S.A., and Bala, H. (2013). "Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems," *MIS Quarterly* 37 (1), 21-54.

Verganti, R. (2009). *Design-Driven Innovation. Changing the Rules of Competition by Radically Innovating What Things Mean*, Boston: Harvard Business Press.

Wang, G. (2021). "Digital Reframing: The Design Thinking of Redesigning Traditional Products Into Innovative Digital Products," *Journal of Product Innovation Management* 39 (1), 95–118.

Weizenegger, L., McKenna, B., Cai, W., and Bendz, T. (2020). "An Affordance Perspective of Team Collaboration and Enforced Working From Home During COVID-19," *European Journal of Information Systems* 29 (4), 429-442.

Williams, L.E., and Barg, J.A. (2008). "Keeping One's Distance: The Influence of Spatial Distance Cues on Affect and Evaluation," *Psychological Science* 19 (3), 302-308.

Wilson, J., Crisp, C.B., and Mortensen, M. (2013). "Extending Construal-Level Theory to Distributed Groups: Understanding the Effects of Virtuality," *Organization Science* 24 (2), 629-644.

Wilson, M. (2002). "Six Views of Embodied Cognition," *Psychonomic Bulletin & Review* 9 (4), 625-636.

Yin, R.K. (2003). "Designing Case Studies," *Qualitative Research Methods* 5 (14), 359-386.

Yoo, Y. (2012). "The Tables Have Turned: How Can the Information Systems Field Contribute to Technology and Innovation Management Research?," *Journal of the Association for Information Systems* 14 (5), 227-236.