Design Thinking in Leading European Companies - Organizational and Spatial Issues

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Abstract. In the last decade, design thinking has been discussed as a new paradigm for dealing with complex business problems. The implementation of design thinking is linked with substantial changes in the organizational culture and becomes visible in new approaches to designing office and learning spaces. To analyze proponents' perspectives on the implementation process, we adapted Schein's (1990, 2017) approach of different layers of an organizational culture. In general, two layers in an organization are addressed, namely visible artifacts and behaviors, as well as basic principles to think about approaches to deal with business problems (mindset). In total, eight semi-structured expert interviews were conducted with proponents to learn more about the implementation of design thinking and the architecture of related office spaces. The findings suggest that design thinking addresses both aspects—the provision and inner design of physical space as well as a change of mindset.

Keywords. Design Thinking, Designerly Thinking, Office Space, Innovation.

1   Introduction

Design thinking is seen as a new paradigm and strategic tool for dealing with complex (business) problems (Kotler and Rath, 1984; Brown, 2008, 2009; Camillus, 2008; Cooper et al., 2009; Johansson and Woodilla, 2009; Dorst, 2011; Wattanasupachoke, 2012; Johansson-Sköldberg et al., 2013; Liedtka, 2015; Carlgren et al., 2016a, 2016b; Elsbach and Stigliani, 2018). It is outlined as a required skill for management executives and therefore relevant for management education (Dunne and Martin, 2006). Scholars recommend the use of design thinking in different fields such as health care (Uehira and Kay, 2009), the law (Szabo, 2010), and human resources (Birchall-Spencer, 2010). With a special focus on service organizations, service design thinking represents a different body of research (Holmlid and Evenson, 2008; Kimbell, 2011, 2012; Stickdorn and Schneider, 2011). In management, design thinking influences the work in strategic management (Fraser, 2007) and organizational development (Sato et al., 2010), and it offers a toolbox for managers (Liedtka and Ogilvie, 2011; Stickdorn and Schneider, 2011). Nowadays, design thinking has been implemented in many large organizations, but of course it is not a "miracle cure," and more research on design thinking in organizational settings is needed (Carlgren et al., 2016b, p.39).

In its essence, design thinking refers to a reflective practice, a problem-solving activity, and a practice-based activity toward design as the creation of meaning (Buchanan, 1992; Kimbell, 2011, 2012; Johansson-Sköldberg et al., 2013; Carlgren et al., 2016a; 2016b; Prud'homme van Reine, 2017). The idea is to bring design practice and competence into the managerial and/or learning context and find new ways to deal with a complex reality (Johansson-Sköldberg et al., 2013). Hereby, human-centeredness is a core issue. This is reflected in the concept of human-centered design, which "has gradually developed into a field of expertise of its own" (van der Bijl-Brouwer and Dorst, 2017, p.1).

Carlgren and her colleagues (2016a, 2016b) identified five core elements of design thinking, namely user focus, problem framing, visualization, experimentation, and diversity. Innovation and design thinking are closely intertwined so that enterprises use the design thinking approach as a key lever for improvement (Brown, 2008). Successful design thinking implementations come along with substantial organizational changes. To implement design thinking successfully, organizations have not only to provide settings and working spaces that fit the design thinking purpose, but also have to rethink their traditional values and norms. Against this background, the objective of this paper is to learn more about the implementation of design thinking in general and the role of spatial issues in particular. To do this, we adapted Schein's (1990, 2017) approach of different layers of an organizational culture (artifacts and behaviors, observable values, and basic assumptions).[1] In a rough outline, the implementation of design thinking addresses two layers: visible artifacts and behaviors (office spaces, design thinking activities such as prototyping), and basic principles to think about business problems (design thinking as a change of mindset) (Hassi and Laakso, 2011; Carlgren et al., 2016a, 2016b). This paper addresses both—the design of office spaces as well as the need to change the mindset while implementing design thinking.

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[1]   In alignment with this, Argyris and Schön (1996) stated that the visibility of a culture can be assigned to two different theories of action: the espoused theory and the theory-in-use.

The paper is structured as follows: First, we give a brief overview of the research on design thinking (Chapter 2.1). Next, spatial issues are outlined (Chapter 2.2). The research question and method are addressed in Chapter 3; we focus on the identification of spatial and organizational issues while implementing design thinking. For that reason, expert interviews with design thinking experts (managers in large multi-business organizations) were conducted. The findings of the interview study are reported in Chapter 4. Finally, implications and limitations of the research are discussed (Chapter 5).

2 Design thinking

2.1 Designerly thinking and design thinking

There is an extensive body of literature on design thinking. Kimbell (2011) reviewed the origins of the term "design thinking" and identified three main accounts, namely design thinking as (1) a cognitive style (the focus is on experts and their problem-solving activities in traditional design disciplines; design problems are ill-structured); (2) a general theory of design (the focus is on design as a discipline; design's purpose is taming wicked problems); and (3) a resource for organizations (the focus is on innovation; organizational problems are design problems). More generally, Johansson-Sköldberg et al. (2013; see also Carlgren et al., 2016b, and Elsbach and Stigliani, 2018) identified two strands, namely an academic and a practitioner-oriented perspective: designerly thinking and design thinking.

Designerly thinking is rooted in design and closely related to disciplines such as architecture, planning, art, or design history. It aims at understanding students' education, e.g., in mechanical engineering, and refers to the "academic construction of the professional designer's practice (practical skills and competence) and theoretical reflections around how to interpret and characterize this non-verbal competence of the designers" (Johansson-Sköldberg et al., 2013, p.123). Johansson-Sköldberg et al. (2013) identified five strands of the designerly way of thinking, namely design and designerly thinking as (1) the creation of artifacts (Simon, 1969), (2) reflexive practice (Schön, 1983), (3) problem-solving activity (Buchanan, 1992), (4) practice-based activity and way of making (Cross, 2006; Lawson, 2006), and (5) the creation of meaning (Krippendorff, 2006) and innovation (Verganti, 2009). Against this background, one can state that there is a rich, theoretically underpinned discussion on the nature of designerly thinking (Carlgren et al., 2016b). However, this is not fully true for the discussion on design thinking within the management discourse—it is "less thoughtful and robust than contributions to the designerly thinking discourse" (Johansson-Sköldberg et al., 2013, p.127). Design thinking refers to the use of design practice and competence in the managerial context. It can be seen as (1) a way of working, (2) a way of dealing with organizational problems and therefore a crucial skill for managers, or (3) a part of management theory. The starting point was the need to think about creativity to be successful in saturated markets (Ward et al., 2009; Stevens and Moultrie, 2011), and design thinking has become a strategic tool (Kotler and Rath, 1984). The need for innovation and creativity as well as new ways to think about complex business problems are the main reasons for the popularity of design thinking in management (Johansson and Woodilla, 2009; Johansson-Sköldberg et al., 2013).

While discussing the relationship between design and designerly thinking, Johansson-Sköldberg et al. (2013, p.131) stated that "design thinking can be seen as a translation of designerly thinking into a popularized, management version" (for differences between business thinking and design thinking see Liedtka, 2010). Meinel and Leifer (2010, p.xiv) postulated that design thinking "creates a vibrant interactive environment that promotes learning through rapid conceptual prototyping." By analyzing common approaches, definitions, and toolboxes of design thinking, the following key issues of design thinking seem to be noteworthy (Carlgren et al., 2016a, 2016b; Matthews and Wrigley, 2017):

Innovation and *customer centricity* are seen as central factors behind the implementation of design thinking. The induction of design competence into the management context has an effect on innovation and can lead to competitive advantages (Brown, 2008; Johansson-Sköldberg et al., 2013; Carlgren et al., 2016b; Prud'homme van Reine, 2017). Martin (2009, p.38) argued that design thinking "enables leaders to innovate along the path of the knowledge funnel (mystery, heuristic, algorithm) and the firms that master it can gain long-term business advantages." Innovations should meet customer needs and therefore be user-centered. Furthermore, Elsbach and Stigliani (2018) highlighted the relevance of empathy with users. In this context, approaches such as user-centered or human-centered design are discussed; both are closely related to design thinking. Norman and Verganti (2014) discussed the potentials of human-centered design for creating innovations critically. They stated that companies have to overcome the traditional methods of human-centered design (observations, ideation, rapid prototype, and testing; for an overview on methods to support human-centered design see Maguiere, 2001). In fact, companies have to think about fundamental changes of technology and meaning (e.g., by motivating design teams to work simultaneously in multiple directions) when they want to create radical and not just incremental innovation (Norman and Verganti, 2014). In response to this criticism, van der Bijl-Brouwer and Dorst (2017) emphasized the importance of human-centered design. They stated that nowadays human-centered design provides deeper insights about human beings' needs and aspirations, and simultaneously design innovation is becoming more human-centric. They introduced a transdisciplinary four-layer model of human needs and aspirations for application in a design and innovation process (NADI) and distinguished four levels of needs and aspirations: (1) solutions: what people want and need; (2) scenarios: how people want to interact with a solution in a specific context of use; (3) goals: what people want to achieve within the context of a certain design problem; and (4) themes: the underlying structures, meanings, and values outside the direct context of the problem.

Furthermore, design thinking is related to *problem solving*. Buchanan (1992; see also Kimbell, 2011) described design thinking as a general approach to deal with wicked problems, and Kimbell (2011, p.287), as well as Carlgren et al. (2016b, p.39), defined design thinking as a "human-centered approach to problem solving." In this sense, design thinking activities are often described as problem-solving processes. Liedtka (2015) named three phases of the design thinking process, namely (1) data gathering to identify user needs and define the problem to be solved, (2) idea generation, and (3) prototyping and testing. Elsbach and Stigliani (2018) identified—based on the framework of Seidel and Fixson (2013)—three categories of design thinking tools: (1) need-finding tools (i.e., ethnographic observations, in-depth contextual interviews, and customer journeys used to empathize with and understand customers' needs), (2) idea-generation tools

(i.e., brainstorming, cocreation/codesign), and (3) idea-testing tools (i.e., rapid prototyping and experimentation). Dorst (2011; see also Lawson and Dorst, 2009, or Paton and Dorst, 2011) identified two paradigms to describe design thinking, namely the 'rational problem-solving' (Simon) and the 'reflection-in-action' (Schön) approach (see above). Based on the work of Peirce (1931-35) on the logic of reasoning, the need of abduction-2 to deal with complex problems is highlighted. This means that designers have to create a product or a service *and* in parallel have to develop new ways of working to create value for the customers. He suggested working backwards, starting with the value the designer wants to create, then developing or adopting a standpoint from which the problem can be tackled, and finally moving to abduction-1 and creating the product or service. Furthermore, barriers or cognitive biases hindering the problem-solving process were outlined. Liedtka (2015) identified cognitive biases (e.g., the hypothesis confirmation bias or the gap between saying and doing) that are linked with negative consequences in decision making. Paton and Dorst (2011) also depicted enablers (using metaphors and analogies, contextual engagement through research, conjecture) and barriers (fixation on initial ideas, unfavorable mental models of design, resistance to journey) to reframe a given situation in a new one (for the impact of team cognition on problem reframing see also Kress and Sadler, 2014).

Creativity is derived as an essential objective for design thinking implementations (Dorst, 2011). Creativity and knowledge resources are positively associated with newly designed products (Jiang and Zhang, 2014). Design thinking is characterized as "an analytic and creative process" that generates opportunities to experiment, to prototype, and to gather feedback for redesign (Razzouk and Shute, 2012, p.330). This notion can also be found in the work of Meinel and Leifer (2010, p.xiv), by describing design thinking as the "creation of, as well as adaptive use of a body of behaviors and values."

Change issues are also part of design thinking. Against this background, it is obvious that the discussion on design thinking is intertwined with organizational culture issues. We follow the understanding of culture as "beliefs, ideologies, and values, and the ways these are transmitted through symbols, languages, narratives, and practices" (Schneider et al., 2011, p.373). In summary, culture can be defined as (group) patterns of behavior and actions learned during a specific time period to achieve external adaptation and resolve internal integration problems (Schein, 1990, 2017).[2] Hassi and Laakso (2011) evaluated how design thinking skills can be beneficial for dealing with continuous change, while Burdick and Willis (2011) investigated the bias toward action as a major change enabler for organizational development.

Finally, a comprehensive *evaluation* of the success of design thinking initiatives is needed in order to derive change measures for improvement. This could be done in various ways (i.e., number of prototypes, satisfaction of customers, product usability).

2.2 Spatial issues: Learning environments and working spaces

A learning environment is seen as "a place where people can draw upon resources to make sense

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[2] Sometimes culture and climate are seen as equivalents. In brief, one can state that climate researchers focus more on practices, procedures, and behaviors, whereas research on culture is more on a macro level and targets values and beliefs (for a differentiation between organizational culture and organizational climate see Schneider et al., 2011).

out of things and construct meaningful solutions to problems" (Wilson 1996, p. 4); it is a setting "wherein the learner acts, using tools and devices, collecting and interpreting information, interacting perhaps with others" (Wilson, 1996, p.6). Physical proximity and face-to-face communication foster learning and knowledge transfer in enterprises (Nonaka and Takeuchi, 1995; Cook and Brown, 1999) as well as in universities (Cox, 2018; Thoring et al., 2018). A learning environment is characterized by the particular quality of the current learning situation in terms of time, space, and social and cultural context. The terms "space" (locations without social connections for employees) and "place" (locations with meaning and values created by human experiences; see Saar and Palang, 2009) are of importance in describing an environment (for the architecture of university buildings see Cox, 2018). With regard to workplaces, Lindahl (2004) also differentiated between space and place and highlighted the relationship between spatial and organizational issues of workplaces for the development of organizations. Leifer and Steinert (2011, p.157) also emphasized the design of working spaces as a key factor for performing change: by adapting the physical environment, "organizations are able to lower hierarchical boundaries, enhance ideation and creativity, foster and accelerate prototyping and generally increase the rate of learning and change." Flexibility in terms of adaptive as well as agile working places is outlined as a crucial component of the spatial setting.

Thoring et al. (2018) presented a typology of creative-learning spaces with regard to the working and learning processes of designers. Based on an extensive literature review, they distinguished among five types of creative spaces: (1) personal space for working alone, (2) collaboration space for working together with others, (3) presentation space for giving presentations, (4) making space in which people experiment and try things out, and (5) an intermission space for transition and recreation (e.g., cafeterias). They further distinguished among five different spatial qualities (each space type comprises all spatial qualities): space can (a) be a knowledge processor (e.g., provides access to knowledge); (b) be an indicator of organizational culture (e.g., indicates privacy); (c) be a process enabler (by providing an appropriate infrastructure); (d) have a social dimension (e.g., reduces or facilitates social interactions); and (e) be a source of stimulation (e.g., provides external stimulation). By linking the space types with the spatial qualities, they were able to describe spatial concepts in organizations and universities.

In design thinking research, flexibility in terms of adaptive as well as agile working places is outlined as a crucial component of the spatial setting. The space makes allowance for and even can arouse ideation and prototyping actions. Stanford's Center for Design Research (d.school) identified some important issues: (1) flexible room separators instead of fixed walls, (2) movable and modular furniture, (3) furniture should enhance creativity and lower barriers to ideation, (4) the use of minimum commitment prototypes to facilitate rapid redesign and learning, and (5) furniture and support infrastructure should be customized for the needs of project teams (Leifer and Steinert, 2011). Against this background and with regard to the learning theories based on the context of situated learning (Brown et al., 1989; Collins et al., 1989), the following elements of physical spaces are discussed to foster design thinking activities (e.g., Herrington and Oliver, 2000):

- Design thinking requires physical space that is different from the usual offices, and a physical environment that fosters creative thinking. The space should enable a thorough investigation from different perspectives. Among other aspects, this includes a prototyping

environment that reflects the usage of knowledge in real-world scenarios (making space). Writable walls and easily movable furniture are also often mentioned. Moreover, spaces should provide possibilities for transition and recreation (intermission space) to facilitate social interactions.

- Design thinking needs room for teamwork (collaboration space). Collaboration and cocreation refer to core elements of design thinking. Ill-defined problems are tackled by a project team, and complex tasks are better addressed within a group than by individuals (Resnick, 1987; Collins et al., 1989; Hooper, 1992) in order to get an all-embracing perception of a problem. Furthermore, the exploration of problem settings from various perspectives is of importance (Collins et al., 1989; Lave and Wenger, 1991).

- Finally, spaces should provide access to knowledge and expertise. Ways to make tacit knowledge explicit and to get access to expert knowledge are needed. Access to expert thinking is necessary to deepen the knowledge in ill-defined problem areas. This is particularly true for the initial project phase in which the team has to immerse itself in the subject matter to deeply understand the problem field.

3 Interview study

The main objective of the interview study was to explicate spatial issues (the design of office spaces) and organizational issues (design thinking in relation to changing the mindset) in design thinking initiatives in selected European companies. In doing so, we conducted an interview study. Eight interviewees (proponents who are entrusted with design thinking in their companies) were identified and addressed for scheduling the interviews. During the correspondence for the appointments, the interviewees confirmed the challenge of implementing design thinking initiatives in the last few years as well as the relevance and the challenges associated with designing an appropriate office space. The interviews were conducted to explore the firm-specific conditions of implementing design thinking and to learn more about the office space. In this context, we were particularly interested in the relationship between spatial aspects and the understanding of design thinking as a change of mindset (in the sense of a change of the organizational culture). In other words: Are design thinking tools and workspaces seen as a trigger to change the mindset or has a change of mindset influenced the design of office spaces according to the principles of design thinking? With regard to Schein's (1990, 2017) layers: Do the interviewees stress the underlying norms, values, and assumptions more or do they highlight visible artifacts and behaviors? We asked questions on the following aspects: (1) What was the main reason for implementing design thinking? (2) How did the introduction of design thinking take place? (3) How are the design thinking offices designed? (4) How is the success of design thinking measured? (5) Finally, we wanted to learn more about the understanding of design thinking (is design thinking seen as a tool/method or is it more about a change of mindset?). After running a content analysis of the individual interview transcripts, a cross-organizational analysis was used to find patterns in the collected data.

By using the criteria of organization size (defined in terms of sales volume and number of employees) and industry segments, eight interviewees were selected with a theoretical sampling

strategy (Eisenhardt, 1989). Enterprises with different characteristics were incorporated (from different industries) to cover different perspectives. Each of them faces serious competition with regard to quality—cost leadership is not an option. Consequently, there is a strong need for innovation, creativity, and change. The consideration of different organizations with diverse industry backgrounds offers a more holistic view of design thinking. The organizational culture and the business models differ considerably among the companies, and design thinking initiatives are deployed in different corporate functions such as innovation management, research and development, corporate venturing, information technology, and consulting. This ambiguity is also reflected in the job descriptions of the interviewees.

We used a semi-structured interview guideline, and the interviews were conducted in April and May 2016 in person or via phone. The interviews lasted between 22 and 59 minutes. In order to retain the data from the interviews, the interviews were recorded. After the interview sessions, the interview transcripts were submitted to the interviewees for control and approval. The final interview reports were used for the analysis. In order to generate a holistic view of the interviewed organization, the interview results were linked with publicly available information from corporate websites and information service providers such as Bloomberg. Table 1 shows the profiles of the interviewees.

Table 1. Profiles of the interviewees

Case	Sector	Employees > 20k	Turnover € > 20 billion	Interviewee	Interviews
ALPHA	Industrial	√	√	Manager, Innovation	1
BETA	Technology	√	√	Senior Consultant	1
GAMMA	Utilities	√	√	Director, Corporate Ventures / Senior Vice President, Technology	2
DELTA	Health Care	√	√	Director, Innovation	1
EPSILON	Industrial	√	---	Director, Technology	1
ZETA	Industrial	√	√	Manager, Innovation	1
ETA	Consulting	---	---	Senior Consultant	1

4 Findings

4.1 Design thinking in different organizations

To contextualize the findings, we first present brief information on the companies that outlines different ways of implementing and using design thinking. Table 2 gives an overview of the key findings of the interviews.

4.1.1 ALPHA

Context information: ALPHA is a multinational industrial company with corporate headquarters in Europe. The product, service, and solution portfolio covers a broad range of technologies, and ALPHA is the market leader in different markets. Key markets are located abroad, while product development and design reside in Europe. Novel products, services, and solutions are rolled out globally without specific tailoring to customers' demands or cultures. One key issue is that ALPHA's products are very complex and often do not meet customers' needs. The main challenges are dealing with market dynamics and innovative, customer-tailored solutions.

Design thinking in the organization: A few years ago, design thinking was implemented as a method for topics burdened with wicked problems (especially to develop more innovative products). At ALPHA, design thinking is primarily seen as one instrument (among others) designed to support innovation and to find out what the customer needs. The interviewee also mentioned the relevance of design thinking as a tool to support the change of mindset, but top management support is not strongly noticeable. ALPHA's design thinking comprises recursive loops in the ideation phase using arts and crafts materials. In this context, the aim is to find a solution that works on the basis of a prototype and delivers value to the customers. The interviewee stated that "design thinking revealed that users actually had very different needs than originally anticipated by the business unit and engineers." While implementing the design thinking method, the implementation team cooperated, among others, with IDEO (a global design company), and members were trained and coached through external consultants. At ALPHA, no specific measurement tools to assess the success of design thinking have been established. Qualitative indicators such as the perceived benefit of projects have been used instead.

Office space: For ALPHA's design thinking initiative, rooms and labs were set up in order to be flexible. The rooms were equipped with movable furniture, and foamboards were used (e.g., as visualization platform and prototyping space). An advanced machine shop with additive manufacturing technologies (e.g., 3D printing devices), as well as a computerized numerical control laser cutter, both of which make prototyping more professional, were deployed. The interviewees highlighted that new spaces do not automatically solve the problems of ALPHA but help to break up certain rules and assumptions. In this sense, the design thinking office spaces were seen as a tool to support the change of mindset.

4.1.2 BETA

Context information: BETA is a large technology and software vendor that supplies all relevant markets in the support and automation of customer resource planning, manufacturing execution, customer relationship management, supply chain and supplier management, and business analytics. BETA is headquartered in Europe but has worldwide user designs, research and development, and sales offices. After years of organic growth, BETA now tends to focus on acquisitions more to attract new customer segments and to come up with innovations. Technological disruptions in this branch are currently initiated by other market players (e.g., Silicon Valley start-ups).

Design thinking in the organization: BETA has had a long tradition of design thinking practices for more than twenty years. In recent years, design thinking has been rolled out and established

on a global scale. Design thinking is understood as a global mindset, and it is supported by top management in many ways. In daily operations, the processes and routines focus on the methodical point of view of design thinking. While implementing design thinking, BETA utilized different steps, namely the use of (1) external design thinking coaches, (2) qualifying internal coaches, and (3) project-based development of design thinking skills. Often employees with design thinking expertise perform an ambivalent role in the project team. They are both coaches and project workers. Balancing these needs turns out to be challenging. Another challenge is to balance creativity and large-scale project requirements. The approach is to cooperate with partners that provide physical space and infrastructure to take the team out of its daily business and enable cooperation and co-creation across organizational boundaries. The interviewee stated that BETA has managed the design thinking institutionalization successfully. Drivers were the support of the board of directors as well as the intrinsic motivation of employees to spread design thinking within the organization. Customer feedback is used to assess the success of design thinking.

Office space: The physical learning environment constitutes both internal and external locations. For external locations, BETA uses facilities with a craftsmanship background or loft buildings that are located nearby. Temporarily moving to external locations helps to get out of the daily work routine and to rethink traditional views. Each of BETA's internal buildings incorporates at least one design thinking space in proximity to break rooms and restrooms to ensure convenient access. All rooms have been designed individually. The furniture, sofas, movable walls, bar chairs, and bar tables are equipped with casters so that the room becomes flexible and can be tailored to different needs. Tools and materials for prototyping such as polystyrene beads, cardboard boxes, construction paper, glue, LEGO bricks, and modeling clay are available. Most of the design thinking spaces are based on redesigned meeting rooms. Walls have been repositioned to create spacious and light-filled rooms. The comfortable furniture and colored design items offer cozy corners and seating areas that make people stay in the office after work. As the interviewee stated, the well-equipped office spaces can be seen as an indicator of how much the top management supports the implementation of design thinking as a mindset.

4.1.3 GAMMA

Context information: GAMMA is one of the major European enterprises in the untility industry. In recent years, the organization has been restructured and has suffered from governmental-initiated turnaround in energy policy. The organization is split into two parts: a more conventional large-scale system provisioning business and a new business unit that designs and implements decentralized and customer-tailored energy solutions. Two company representatives were interviewed to reflect both views.

Design thinking in the organization: Against the background of game-changing market dynamics in the energy crisis, GAMMA's management decided to give strategic significance to innovation and new business models. In this context, design thinking found its way into GAMMA. First, external coaches conducted workshops with the entire senior management team. As articulated by one of the interviewees, GAMMA wants "to realize more innovation and a change in the enterprise culture. A lean and rapid approach of testing new business models in the market is preferable toward thoroughness and perfectionism." Following this notion, an innovation hub was

launched. The innovation hub is organized in several sections that present the current topics of interest (e.g., smart home, big-data management, and digitalization). Design thinking, so far seen more as a tool, plays an essential role in transforming the traditional mindset nowadays, and several corporate initiatives have been started to overcome risk aversion and to open up for new ideas. To learn more about the success of design thinking, GAMMA analyzed a number of projects that found their way to the market.

Office space: In the past, more and more rooms were designed especially for design thinking. Movable furniture and writable walls were key requirements for the interior design as well as sticky notes and movable walls. The aim was to create an entirely agile environment to support the changing needs in a project. Being a pioneer for GAMMA, this trend was adopted rapidly by other business units. After some initial resistance, people recognized the advantages of such an environment, in terms of a contrast to the usual office spaces. In this sense, the new designed office spaces trigger the change of mindset. As described by the innovation manager after facilitating some design thinking workshops, "if you look at someone working in the finance area, and drop him in a design thinking room for the first time, where you can write on walls and have LEGO bricks for prototyping, he probably thinks he is in pre-school. But after going through the design thinking process and looking at tangible prototypes, they quickly are convinced."

4.1.4 DELTA

Context information: DELTA is a multinational health-care company, and innovation plays a key role. The company opened an innovation center to give employees the possibility to work on new ideas and projects in a creativity-enabling environment. An important element of the innovation center is an "Innovator Academy," where employees have access to trainings or workshops including topics such as design thinking, user-centered design, and creativity techniques.

Design thinking in the organization: To push cross-divisional innovations, design thinking is a tool to foster collaboration within the company. In the past, things were explored in one area, mostly in laboratories, and in this area they were brought to market maturity without a prototyping phase or a customer requirement analysis. Design thinking should help to overcome this problem. The innovation center is seen as a melting pot of ideas and offers space for working in interdisciplinary teams, and the building complex has been constructed to represent the management's cultural change of mindset. While implementing design thinking, external coaches were hired. The success of design thinking is analyzed by indicators such as participation rates at design thinking events.

Office space: Openness is the main guiding principle behind the architecture of the innovation center. It is divided into two areas: one where staff and visitors have access and a second one that is reserved for project teams. Here, employees and external partners work together in interdisciplinary projects. There are no fixed office rooms but flexible working spaces instead, and everything is easily movable. The finished modules as part of the building are grouped around a spacious courtyard. For the manager of the innovation center, a key factor for productive work is the atmosphere. For a feel-good factor, a kitchen was incorporated into the work area. As the innovation center has been built to represent the management's cultural change of mindset, visible artifacts can be seen as a tool to change the values and norms.

4.1.5 EPSILON

Context information: EPSILON is a leading industrial provider of maintenance services for the transportation sector. EPSILON faces some serious challenges that can be traced to game-changing market shifts. Original equipment manufacturers are looking for new business models since they are suffering from shrinking margins, international competition, and service-demanding customers. Another challenge is the intense competition for EPSILON's customers. Both factors weaken the market position and lead to considerable cost pressure for EPSILON.

Design thinking in the organization: Design thinking was brought to EPSILON a few years ago and is seen as a tool to promote innovation. Until then, there had been no internal trainings available, but when an employee now wishes to gain experience, this is seen in line with his or her personnel development and thus is supported by EPSILON. Against this background, the implementation of design thinking is still in a rather early stage. The interviewee reported being quite satisfied with the result of the new way to work after EPSILON implemented a structural reorganization of the IT department. Along with some other units, his team is seen as one area for change and the usage of innovative and creative methods for their daily work. Particularly in the IT sector, rapid prototyping and other agile approaches are of importance. Through the reorganization, his team had the chance to rethink the established processes and culture. They became a grass root movement, and slowly more and more units explored the advantages of design thinking. In this sense, the new designed office spaces are seen as a measure to support change. After initial hesitation, the support of the top management is also emerging now. To learn more about the effects of design thinking, EPSILON used data from employee surveys.

Office space: At EPSILON, employees can create flexible working spaces for design thinking issues. These rooms have writable walls, and while some are furnished with couches, others have high tables and stools. Moreover, conference rooms and libraries are provided for the team, if the employees want to work in concentrated silence. Before the implementation, employee surveys showed the need for this. But the libraries were not frequented as expected, and therefore the library space has already been transformed into a team room. The rooms are supplemented by a "market place," which is an open, cozy area with sofas, tables, and comfortable chairs. Further, EPSILON's manager clearly emphasized the benefits of writable and accessible glass partitions in meeting rooms and office spaces. However, he acknowledged budget restrictions. Especially for the prototyping phase, serious LEGO play is of importance. A 3D printing lab was also installed to create prototypes quickly. Especially for the manufacturing unit, this device is seen as advantageous.

4.1.6 ZETA

Context information: ZETA is a traditional engineering-minded European organization and constructs resource-, knowledge-, and capital-intensive investment goods. As the final assembler that brings complex systems together, ZETA heads a large production network. One of the main challenges lies in the consolidation of ZETA's business customers. As a consequence, ZETA started extensive cost-saving programs that look for all costs in the business and accordingly

approach suppliers to renegotiate prior agreements to reduce the product price. Due to financial constraints, the equipment operators cannot afford the huge investments anymore.

Design thinking in the organization: Design thinking started a few years ago. Several managers attended workshops and brought the notion into the company. Nowadays, design thinking is part of the corporate innovation program. There are awareness workshops to inform ZETA's technicians and engineers about the design thinking paradigm. However, the management has understood that the benefits of design thinking go far beyond a collaborative working mode in workshops. The corporate innovation team aims at developing user-centered innovations and thereby altering the maturity of design thinking usage. The idea today is to implement design thinking extensively as an innovation method. However, the spread of design thinking within the company is still limited. There is no top management support that drives a design thinking program, provides budget, or controls the success of design thinking. At ZETA, currently, no specific measurement tools/key performance indicators have been established to measure the success of design thinking.

Office space: There are physical rooms that have been tailored for innovation projects, but ZETA has no dedicated room for the exclusive use of teaching or applying design thinking. The interviewee explained that "the needs of such a room differ considerably." At ZETA, there are pop-up spaces to bring internationally distributed teams physically together. Moreover, the design thinking space has to facilitate the prototyping activities. This includes prototyping on paper, but also an environment for testing the prototypes. For a pop-up space, the team can use existing spaces and reshape them. The basic notion is to make those spaces flexible and scalable. This includes modular walls and different zones, such as meeting zones and focus zones. The resources that are still required are projection spaces, interaction spaces with projectors and smartboards, and a videoconference system for remote collaboration.

4.1.7 ETA

Context information: The interviewee is a management consultant with eight years of experience in design thinking. He consults, among others, with clients in the financial service industry. This industry faces different game-changing problems and is characterized by hierarchical grown structures and thinking in terms of status.

Design thinking in the organization: The interviewee's bank client has started with a bottom-up approach. The middle management, responsible for aligning business and technology strategy, wanted to improve the cooperation mode. A program was set up to initiate design thinking projects on the operative level. At this time, the operative project managers realized that customer solutions (e.g., banking apps, online banking) were outdated. So design thinking was used to get access to customer needs in direct interaction with customers. They started with small project teams that were coached by external consultants. Further, they built an innovation community that diffuses design thinking within the corporation. This had an enabling effect on the working culture. Nevertheless, the implementation teaches management executives that the learning curve cannot be shortened. As outlined by the interviewee, "although design thinking is simple and feasible, this does not imply that it can be implemented at once. All organizations have to pass the hermeneutic circle of learning." For the implementation of design thinking,

support by top management is advantageous. Even a sound bottom-up strategy that supports the needs of project teams is essential. Against sceptics and doubters, this is the best solution when both parties are aligned and cooperate. When it comes to approaches to measure the success of design thinking, the interviewee stated that the deployment of adequate controlling instruments and key performance indicators will take a long time and is a challenging task.

Office space: The learning environment starts with the appropriate physical location. Lessons learned from the financial service provider refer to a hosting role for the design space. This person ensures usage in terms of the intended purpose and takes care that the required material is available and stocked. The room should be located centrally to enable good access and allow drop-by situations from other curious employees. Openness, transparency, and daylight offer further features. Comfortable and cozy furniture as well as writable and flexible walls, all equipped with "movable casters", complement the interior of the design space. By referring to one of his previous mentors from Stanford University, the management consultant stated that "each point in the room has to be accessible within a seven-second reach, since this is precisely the time period that a person can keep a prototyping idea in mind." This presents an appropriate size indication without mentioning a number in square meters. In addition, the atmosphere should be inviting and cozy to make people stay in the room, even for leisure activities. Further, the behavioral rules should allow making results visible and exposing prototypes for several days or weeks. For instance, there is a well-recognized best practice to preserve stakeholders' profiles such as personas for the entire design thinking project along all phases. This measure helps to keep the assessment of all project ideas and outputs against the desired customer and user centricity criteria in mind.

4.2 Summary of the findings of the interviews

4.2.1 Implementing design thinking

First of all, it is of interest to know whether design thinking is merely seen as a method/toolbox or as a way of thinking about business problems. BETA shows the highest maturity in this concern: design thinking is implemented comprehensively, and it is understood as a mindset. At GAMMA, the interviewee also reported that nowadays there is a more comprehensive understanding and the shift from the tool to the mindset perspective is noticeable. The interviewees from ALPHA, DELTA, EPSILON, and ZETA merely stressed the tool perspective. Particularly in these cases, the crucial success factor to implement design thinking is the strategic alignment of design thinking within the company. The findings from the interviews indicate that a bottom-up movement as well as top management support are both of importance. In the interviews, different positions were mentioned. BETA and DELTA both have top management support, budget for buildings, design rooms, and training programs. At ALPHA and ZETA, design thinking is a supportive staff division. At EPSILON, the IT division design team came up with an initiative due to its understanding of the need for prototyping—and the efforts of the employees let the design initiative grow. The interviewed consultant (ETA) additionally stated that "top management support is an evergreen. But that's not the only possibility. You also need people from bottom-up who have pressure; when they are supported by the management, that's the best

case. Once there is a main unit that is convinced and also top management support is given, then a cultural change can occur."

Furthermore, the interviewees mentioned the important role of design thinking coaches. But in the end, the key issue is that the organizational culture fits design thinking. This is especially relevant in the prototyping phase when all restrictions and limitations are set aside and possible prototypes occur that are not aligned with the business strategy or company portfolio. At ALPHA and ZETA, design thinking initiatives don't integrate well with the traditional organizational structure and management leadership style. Accordingly, their impact remains limited to the administrative departments they report to, e.g., ALPHA's corporate innovation department. Similar thinking applies to ZETA, where the innovation manager emphasized that the product divisions have to be convinced by his unit to allow active participation and coaching. ETA's senior consultant brought forward organizational readiness as one of the key differentiators between those organizations that formally pretend to conduct design thinking and those that have achieved the readiness to take radical innovation ideas seriously (as done for example in BETA).

Closely linked to the implementation of design thinking is the question of how the success of design thinking is evaluated. Currently, the companies did not have customized key indicators at hand, but the development and establishment of measurement tools is seen as an important task for the future. ALPHA's innovation manager stated that "if you measure design thinking projects in terms of market entry as part of a strict definition of innovation, then we have not succeeded." BETA used customer feedback in some cases, but BETA's senior consultant acknowledged that the opportunity costs of not having used design thinking for ideation to innovate product development cannot be calculated. GAMMA analyzed the funnel from the project idea to the market, but the interviewee stressed that it is hard to identify the crucial triggers for market success. At DELTA, an evaluation based on key performance indicators is also quite difficult. DELTA offers voluntary participation events with design themes in the evenings and measures the participation rate as an indicator for the acceptance of design thinking. EPSILON does not apply specific measures for design thinking projects, and at ZETA the conception is prevalent that classical quantitative measuring instruments do not fit the design thinking approach. One can state that the success of design thinking is not measured based on hard facts on a regular basis. The companies used mostly weak indicators such as employee participation in design thinking projects or employee satisfaction with regard to design thinking. ETA's senior consultant acknowledged that the deployment of adequate controlling instruments will take a long time, but he saw the potential for the following performance indicators: employees using the method, diversity and interdisciplinary representation in the design team, number of generated prototypes, and number of ideas that achieved market readiness.

4.2.2 Office space and architecture

All interviewees highlighted the relevance of the architecture of office space. BETA's senior consultant outlined that the architectural style is crucial for learning and innovation. The interviewee differentiated between the reuse of existing office space and the acquisition of external buildings that serve exclusively as design space. Small changes, e.g., different routes to external locations, can make a first contribution to getting the employees out of their daily routines.

However, both types of space share specific design features, i.e., writable glass walls or movable furniture. As reported by the interviewee from GAMMA, it is very advantageous to have a space that can be perfectly transformed to individual needs. ZETA's innovation manager thought that an appropriate workshop room needs one thing above all: flexible walls with space. The design space creates an enabling role for the selected collaboration mode within the team but should also serve as separated units for breakout sessions. Besides this, all interviewees declared themselves in favor of having a spacious room equipped with writable walls, easily movable furniture, and all sorts of prototyping materials. ALPHA's favorite tools to document results were foamboards with sticky notes because they are easily storable between creative sessions. Flexible walls with sticky notes were the preferred alternative for BETA, DELTA, and GAMMA. There, the results are secured through smartphone pictures if they can't remain on the wall until the next meeting. The director of corporate ventures of GAMMA outlined that an effective learning environment for design thinking "cannot be drawn back to a singular board or a glass panel; instead, the opportunity for self-expressionism should be given. The space in which you can let your ideas flow is important."

Another strand addressed the atmosphere of the environment. GAMMA's director of corporate ventures postulated that the office spaces for design thinking "should be so spacious and inviting that people say, let's stay for a group session." For him, it was essential that people feel comfortable and that everything is located next to the room or in the room so that a "bonfire atmosphere" can arise. The senior vice president for technology at GAMMA supplemented this with the following statement: "An indirect effect is caused by a different environment. If the environment changes, the people have to change." He continued by saying that "through furnishings and equipment, a controversial, but nice atmosphere, as compared to the corporate standard environment, should be created." The senior consultant at BETA said that the aim is "pulling someone into another world". DELTA's director was sure that the "atmosphere is always transferred to people," while ZETA's innovation manager outlined that he wants to support a start-up-like atmosphere. GAMMA's senior director for corporate ventures said that the design space refers to a place that people enjoy with bright and flexible rooms. This forms an atmosphere that encourages employees to stay and ensures that creativity flows. The investment for large organizations such as GAMMA pays off if the project team spends more time on the project than in the usual office spaces. In the evening, the company occasionally organizes public viewings for sport events and includes drinks and food to make employees feel comfortable. At the same time, those employees are still engaged and can discuss projects after work.

To sum up, all the interviewees emphasized the meaning of design thinking in the sense of changing the mindset and with regard to architecture and office space issues. All interviewees addressed the importance of organizational readiness. Especially at ALPHA and ZETA, the design thinking approach does not integrate well with the traditional organizational structure and management leadership style. When it comes to the measurement of the success of design thinking, all interviewees stressed that prevailing instruments and key performance indicators are not appropriate and have to be adapted.

4.3 Discussion of the findings

As Lindahl (2004, p.253) stated: "Often in situations when changes of work and the organi-

Table 2. Overview of the findings of the interviews

Case	Cue to implement design thinking	Implementation of design thinking	Design of office spaces	Performance measurement	Design thinking as a change of mindset
ALPHA	Competitive markets, need to identify customer requirements, and develop product and process innovations	In the last few years, in cooperation with IDEO, external consultants acted as coaches	Flexible space concepts, movable furniture, foamboards, as well as 3D printers, and other devices used for prototyping	No specific measurement tools/key performance indicators established; approaches to measure the benefit of projects for internal customers are used	DT as an instrument designed to support innovation, furthermore as a tool to trigger the change of mindset, and new office spaces serve as an indicator for the new way of thinking (and to break up traditional rules)
BETA	Competitive markets, growth by own success (and not only by acquisitions), product and process innovations	For more than 20 years; in the last years DT has been rolled out globally, in steps: (1) hiring external coaches, (2) qualifying internal coaches, and (3) developing DT skills	Internal and external locations, facilities with craftsmanship backgrounds, loft buildings; external locations to break daily routines; lounge/bar atmosphere, movable walls and furniture; LEGO and other materials for prototyping	No specific measurement tools/key performance indicators established; customer feedback is used to learn more about the effects of DT	DT as a global mindset for the whole company; DT office spaces are seen as an investment to support new ways of working and to show the top management support
GAMMA	Competitive and highly regulated dynamic markets, innovation, and new business models	In the last few years, launch of an "innovation hub"	Movable furniture, writable walls, movable walls; different materials for prototyping	No specific measurement tools/key performance indicators established; analyzing the number of projects that find their way to the market	DT as a tool to support innovation and an approach to transform the traditional mindset

Note. DT = Design thinking

Table 2. Overview of the findings of the interviews (cont.)

Case	Cue to implement design thinking	Implementation of design thinking	Design of office spaces	Performance measurement	Design thinking as a change of mindset
DELTA	Innovation through collaboration and interdisciplinary teams	In the last few years, hiring external coaches	Innovation center, flexible spaces, and movable furniture; different materials for prototyping	No specific measurement tools/key performance indicators established; analyzing participation rates at DT events	DT as a tool to foster collaboration within the company; cultural mindset change would be supported by design thinking tools
EPSILON	Game-changing market shifts, competitive markets, market power of customers	In the last few years, based on the initiative of individuals; no internal trainings, but development of DT skills as a result of individual engagement	Flexible working spaces, writable walls, lounge atmosphere, dismantling of rooms that are suitable for work in silence; LEGO play and 3D printers used for prototyping	No specific measurement tools/key performance indicators established; employee surveys are used to learn more about the effects of DT	DT as a grassroots movement to change the mindset
ZETA	Shrinking margins, cost-saving programs, price competition, innovation	In the last few years, based on the initiative of managers who brought DT knowledge into the company; currently no top management support	Some (pop-up) spaces with modular walls to meet DT needs, but no dedicated rooms for exclusive DT use; different materials for prototyping	No specific measurement tools/key performance indicators established	DT as an approach to implement user-centered innovations
ETA	Process and product innovation, competitive markets	Implementing DT in many different ways (e.g., bottom up); top management support as crucial factor	Spaces are essential; openness, transparency, daylight; writable and flexible walls, cozy atmosphere; comfortable furniture; inviting atmosphere; different materials for prototyping	Development of key performance indicators as a long-term undertaking, e.g., employees using DT, composition of DT teams, number of prototypes, number of ideas ready for market	DT as an approach to overcome traditional structures and thinking in terms of status; DT to foster creativity and innovation

Note. DT = Design thinking

sation of it are underway, workspace issues are discussed". But one question is which kind of workplace will support the implementation of design thinking in the most effective way. The more challenging question, however, is to what extent office space is seen as an instrument to support mindset change. Regarding the first question, all interviewees showed great agreement and mentioned the importance of key features of design thinking spaces (writable walls, movable walls and furniture, cozy atmosphere, and so on). Regarding the latter question, we found that the use of design thinking tools and new designed office spaces had an effect on the change of the mindset in the sense of the underlying norms, values, and assumptions (Schein, 1990, 2017). All interviewees indicated that this relationship exists. But a comprehensive alignment between the organizational culture and visible artifacts and behaviors (office spaces and design thinking tools) was only clearly visible at BETA. Against this background, one can assume that the openness and readiness to organizational change is of importance for a comprehensive implementation of design thinking.

Against this background, the results from our interview study are partly in line with key findings on design thinking. In their extensive literature review (86 empirical articles: 79 articles used case-study methodology, but only seven used survey or interview methods) on the relationship between design thinking and organizational culture, Elsbach and Stigliani (2018) showed that specific design thinking tools support the development of specific aspects of the organizational culture (33 articles) and vice versa (25 articles), and they stressed the idea that there is a recursive relationship between the tools and the culture. They also reported that the use of design thinking tools produced physical artifacts (e.g., drawings, prototypes, design spaces) as well as emotional experiences (e.g., the experience of empathy) (22 articles).

More specifically, our findings confirm the results from an interview study conducted by Carlgren and colleagues (2016a, 2016b). They interviewed 36 respondents from five large firms that all had had only a few years of experience of using design thinking to learn more about the common understanding of design thinking. They used a framework that included the categories of principles/mindset, practices, and techniques and identified different strands (user focus, problem framing, visualization, experimentation, and diversity). The main use of design thinking was often to foster innovation, and design thinking was mainly understood as a process or as a set of principles on an organizational level. Aims of using design thinking were the wish to develop innovative solutions and to effect cultural change/mindset change. Both perspectives were highlighted in our interviews as well. With regard to the integration of design thinking within the company, Carlgren and colleagues identified different approaches (e.g., integration in existing structures, use of workshop formats to support projects, the use of design thinking as a special innovation function). As main challenges linked to the use of design thinking, they named, among others, a misfit with existing processes and structures as well as with the existing organizational culture, and they highlighted the need for "balancing between doing things differently with not alienating people in the organization" (Carlgren et al., 2016a, p.353). This holds true for our study, too.

Furthermore, approaches to measure the success of design thinking were addressed in our study. All interviewees stated that they do not have customized key performance indicators but use common indicators instead. This could be seen as an indicator that design thinking is not yet fully integrated into the organizational culture. Based on Kirkpatrick's framework of evaluation

(Kirkpatrick, 1994; Kirkpatrick and Kaiser Kirkpatrick, 2016) one can state that a change of mindset can be measured on four levels, namely reaction (level 1: the degree to which employees perceive design thinking as favorable and relevant for their jobs), learning (level 2: the degree to which employees acquire design thinking knowledge, skills, attitudes, and so on), behavior (level 3: the degree to which employees apply design thinking knowledge and skills during their jobs), and results (level 4: outcomes for the organization). Usually, self-reports (surveying employees), surveys with customers and other stakeholders, as well as assessments and observations at the workplace, are used to measure the effects on levels 1 to 3. Since many factors can impact effects on level 4, it is hard to isolate the direct link to organizational cultural issues, and therefore it is understandable that companies do not have a sophisticated framework for measuring design thinking performance yet.

Our findings are in line with results from a survey done by Schmiedgen et al. (2016). They surveyed about 400 design thinking practitioners from mostly larger companies. The respondents stated—generally speaking—that it is not possible to measure design thinking as a single concept. Carlgren et al. (2016a) also mentioned the difficulty of assessing the success of design thinking initiatives. Besides this, Rauth et al. (2014) worked out some strategies to legitimize design thinking, e.g., demonstrating its usefulness. More generally, one can differentiate an input perspective (e.g., sum of costs), a process perspective (e.g., team engagement), and an output perspective (e.g., number of projects ready to market, number of prototypes), as well as an internal (e.g., employee satisfaction), and external (e.g., customer satisfaction) view, and create key performance indicators for the design thinking process as well as the outcomes. Liedtka (2017), for instance, described the design thinking impact on innovation outcomes as follows: design thinking leads to higher-quality solutions, helps to reduce the risk and cost of failure, improves the likelihood of implementation of ideas, improves organizational adaptability, and supports the creation of local skills and competencies. Based on these five assumptions, key performance indicators to measure the success of design thinking could be developed. It is evident that the usefulness of different key performance indicators depends on the organizational context (e.g., industry or the mature level in design thinking utilization) (Rauth et al., 2014; Björklund et al., 2018).

5 Conclusions

This study sought to analyze the implementation of design thinking in Europe-based companies. The starting point of the implementation of design thinking was that all of the companies wanted to have a better understanding of customers' needs and become more user-centric (see also the results from case studies done by Seidel and Fixson, 2013; Liedtka, 2014; or Rau et al., 2017), because all are players in global competitive markets. The interviewees were convinced that design thinking is about mindset change and that office space—in the sense of visible artifacts—is an important tool to push the new way to work on business problems. Based on the results from the expert interviews, we identified different issues that are crucial for design thinking in organizations, namely physical space (flexible office design and space equipment), atmosphere, organizational readiness (see Weiner et al., 2008, for an overview how organizational readiness for change can be defined and measured), and top management support. Most importantly, design thinking tools and artifacts have to be aligned with issues of organizational

culture. All interviewees pointed out that the development of customized measurement tools is a desideratum.

Our research addresses the empirical understanding of how design thinking is implemented and practiced in companies. Nowadays, there is a large body of empirical research on design thinking, and several review articles are available (for an overview see Elsbach and Stigliani, 2018), and—in sum—positive implications of design thinking were emphasized. All of our interviewees stated that it is not trivial to assess the success of design thinking. Most of them implemented design thinking successfully, but they could not calculate the opportunity costs of not using design thinking.

From a research perspective, it would be very interesting to compare entities with or without design thinking in comparable settings to learn more about the potential and the effects of design thinking (e.g., in an experimental setting using experimental and control groups). The development of a valid system of indicators is of interest from a research perspective as well as a managerial perspective. Furthermore, additional research on the potential of design thinking in small- and mid-sized companies is needed. Besides this, the relationship between the professional qualifications as well as the attitudes, beliefs, and emotions of the employees and the success of design thinking should be analyzed in greater detail. In this context, Elsbach and Stigliani (2018, p.2300) mentioned the important role of empathy (representing an important issue of design thinking; empathy can be interpreted as "an important signal of cultural values of collaboration and user focus in the organization") for a better understanding of the effectiveness of design thinking processes. Finally, research on the possibilities and constraints of the implementation of design thinking in higher education (e.g., linking design thinking to topics such as entrepreneurship; see Garbuio et al., 2018) is of interest.

Our study comes with several limitations. The use of interviews implies certain validity restrictions. We used a convenience sample but payed attention to the careful selection of the interviewees. The sample was limited to eight individual expert interviews from a certain number of organizations and selected industry sectors. Each expert represented an individual perspective, which may not necessarily have corresponded with the espoused theory of the company. The phenomenon of interest was initiated by different innovation stakeholders ranging from the cofounder to executive managers and departmental managers in technical development and IT to management consultants. In accordance with these different roles in the organization, the interviewees showed considerably different backgrounds, resided on different hierarchy levels, and belonged to different corporate functions. This, in turn, exposes another limitation for generalizing the cross-interview findings, as in most cases only a singular representative of the organization was interviewed. The given information reflects a specific perspective on design thinking implementation, e.g., from the corporate innovation department, IT, or a new-venture unit. Moreover, the data sampling relied on large and Europe-based companies. This imposed a traditional and engineering-focused culture but made those organizations that implement design thinking interesting subjects of investigation. Small- and mid-sized organizations do not have the resources to roll out design thinking in this way. Against this background, we have to be aware of selection bias (all interviewees were entrusted with design thinking issues and therefore could be biased) and we have to question whether the results are transferable to other organizations and/or industries. To increase the reliability, we compared the interviews with freely

accessible company information from the corporate websites and information service providers such as Bloomberg.

From a managerial perspective, the alignment of tools and organizational culture is the key issue to implement design thinking successfully. There are many barriers to the implementation of design thinking (Carlgren et al., 2016a), and top management support as well as highly qualified and motivated employees are of importance. However, the interviews also showed that the extent to which design thinking is integrated into organizational culture varies. It ranges from a rather early stage to a comprehensive implementation in the sense of linking design thinking tools and cultural values.

Besides this, key performance indicators with a focus on design thinking issues are needed. Research shows that companies lack appropriate tools, especially when it comes to effects on the organizational level. Furthermore, design thinking needs highly qualified and intrinsically motivated employees. This is closely linked to learning and education. Companies as well as universities should think about new ways to qualify professionals for the challenge of dealing with complex business problems. This is about collaborative knowledge construction in groups, multiple perspectives, coaching and scaffolding, and authentic assessment (Herrington and Oliver, 2000). Technical knowledge is of importance, but we have to "equip students with meta competences going beyond cognitive knowledge" (Scheer et al., 2012, p.8). Universities and other institutions often struggle with this challenge. Against this background, strong efforts to foster workplace learning are needed. Furthermore, managers should be aware that design thinking comes along with some limitations. If design thinking processes mainly focus on customer needs, companies run the risk of losing balance and failing to sufficiently take other perspectives and stakeholder needs into account. Finally, not all kinds of problems (e.g., routine tasks) are suitable for design thinking.

Acknowledgements

6 References

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