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Design thinking in action: a quantitative study of design thinking practices in innovation projects

Claudio Dell'Era, Stefano Magistretti, Marina Candi, Mattia Bianchi, Giulia Calabretta, Ileana Stigliani and Roberto Verganti

(Information about the authors can be found at the end of this article.)

Abstract

Purpose – *Design thinking is widely recognized as an effective problem-solving approach in the professional and academic world, albeit with varying interpretations. It has been studied in multiple forms – as a tool, a practice, a skill and a mindset – leading to ongoing debates about its fundamental nature. This study aims to explore the use of design thinking in practice and determine how its application varies depending on the characteristics of the innovation projects, namely, the types of goals pursued and the level of uncertainty involved.*

Design/methodology/approach – *Using a survey methodology and a knowledge-intensive empirical setting, this study analyzes a data set of 221 innovation consulting projects based on design thinking conducted by European consulting firms and design agencies.*

Findings – *By analyzing the survey data, the authors identify six distinct sets of design thinking practices: discovering user needs, understanding the problem addressed, challenging existing assumptions, navigating the problem-solution pair, ideating through visualizations and learning through prototypes. The authors also identify configurations of these design thinking practices that are used to address different innovation project goals and levels of uncertainty.*

Practical implications – *The study draws attention to the need for design thinking practitioners to be aware of how different innovation project goals and levels of uncertainty can be pursued/addressed through the use of alternative configurations of design thinking practices.*

Originality/value – *To the best of the authors knowledge, this study is one of the first large-scale quantitative analyses of the nature of design thinking in action, providing a solid foundation for future research on design thinking.*

Keywords *Design thinking, Design thinking practice, Innovation, Consulting projects*

Paper type *Research paper*

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Introduction

The term "design thinking" has been discussed since the 1980s (Rowe, 1987) and has gained significant popularity since the turn of the millennium. The 1999 ABC News *Nightline* episode about the creation of a new shopping cart concept by IDEO, a major Silicon Valley design agency, has been viewed millions of times on YouTube. Auernhammer and Roth (2021) describe the evolution of the design philosophy and related practices that were developed at Stanford University from 1957 to 2005: from creativity to problem definition, from need-finding to imagining, from visualizing to experimenting. According to the Financial Times, current MBA and executive programs at prestigious business schools offer courses on design thinking [1]. Leading organizations across industries, including Siemens, P&G, SAP and PepsiCo, have created C-suite roles such as chief design officers (Leavy, 2011; Liedtka, 2018; Ignatius, 2015; Appleyard *et al.*, 2020). Others, such as Intuit, have

trained and deployed a growing number of design evangelists to spread the design thinking mindset and principles throughout the organization (Martin, 2011). Nearly all the consulting giants have recently acquired design agencies to update their skill sets and toolkits, especially as pervasive digital transformation requires new competencies to develop superior user experiences (Dell'Era *et al.*, 2020; Magistretti *et al.*, 2022a).

Design thinking is also the subject of a lively academic debate. According to literature reviews by Micheli *et al.* (2019) and Magistretti *et al.* (2021b), the number of articles on design thinking published in academic journals is steadily increasing. *California Management Review* published a special issue on the topic in 2020 [2] and the *Journal of Product Innovation Management* in 2021/22 [3]. Most of these studies, both conceptual and empirical, report benefits from using design thinking in business innovation processes (Nakata and Hwang, 2020; Nagaraj *et al.*, 2020; Magistretti *et al.*, 2021a; Robbins and Fu, 2022; Kamble *et al*, 2023). However, critics, particularly from the design community, see design thinking as an oversimplified version of design for the layperson (Iskander, 2018) or a management fad (Abrahamson, 1991).

Despite a broad understanding of the concept of design thinking, the literature does not provide a clear and unambiguous view of the practices involved nor comprehensive quantitative studies. Several conceptualizations of design thinking have been proposed, largely overlapping but with nuanced differences (Carlgren *et al.*, 2016; Micheli *et al.*, 2019; Magistretti *et al.*, 2022a). We, therefore, attempt to reduce the fragmentation in the literature regarding the components of this approach as principles (Nagaraj *et al.*, 2020), capabilities (Magistretti *et al.*, 2022a), methods (Seidel and Fixson, 2013), attributes (Micheli *et al.*, 2019), process steps (Appleyard *et al.*, 2020), tools (Liedtka, 2015) or a mix thereof (Nakata and Hwang, 2020; Carlgren *et al.*, 2016). Despite these different interpretations, scholars agree that design thinking is something that practitioners do (Micheli *et al.*, 2019), and the more they practice it, the more they know how it really works (Elsbach and Stigliani, 2018). Regardless of the tools, frameworks or methods used, design thinking is a set of practices that are enacted in a specific context and situation to address a problem. The practice turn in management studies is growing in many fields, from strategy (Whittington, 2006) to entrepreneurship (Thompson *et al.*, 2020) and innovation (Kohtamäki *et al.*, 2020). Therefore, a practice-oriented study seems well suited to unpack the design thinking phenomenon. In particular, conceptualizing design thinking as a set of practices allows us to study how it unfolds in specific contexts, regardless of the framework or tools used, as well as its overarching, more generalizable aspects. The majority of studies on design thinking are conceptual or rely on qualitative or anecdotal evidence, and do not measure or quantitatively examine the nature of design thinking. Of the 104 articles reviewed by Micheli *et al.* (2019), 15% are conceptual, 38% are anecdotal and 44% are qualitative.

In this study, we examine the use of design thinking practices and how their use varies. Specifically, we conceptualize the practice of design thinking as a dependent variable and investigate how its use changes depending on the goals addressed by the innovation project and the level of uncertainty faced. An examination of the relationship between innovation project characteristics, such as goals and level of uncertainty, and the adoption of design thinking practices is lacking in previous studies, which tend to treat design thinking as a context-invariant set of attributes. These studies typically focus on the performance effects of design thinking, hence, treated as a single independent variable – the few exceptions include Nakata and Hwang (2020) and Magistretti *et al.* (2022a). We differ from these studies by modeling design thinking as a dependent variable and examining how its use varies with the goals of the innovation project and the level of uncertainty.

To do so, we analyze a data set collected through a survey of 221 innovation consulting projects based on design thinking, a knowledge-intensive empirical setting. This is one of the first managerial surveys on design thinking and differs from others (e.g. Nakata and Hwang, 2020;

Nagaraj *et al.*, 2020) in its focus on consulting projects. There are several reasons for choosing this empirical setting. By the very nature of their business, consulting firms are early adopters of novel management approaches around which they design new services and methods for their clients to sustain growth (Armbrüster, 2006). The consulting industry has widely adopted design thinking practices in recent years to help clients address innovation challenges (Magistretti *et al.*, 2022a). Our empirical strategy not only provides a large enough population for quantitative investigation, but also allows for sufficient variance due to the heterogeneity of customers, suppliers and services offered, supporting the contextual perspective of this study. In line with Bettis *et al.* (2014) and Bianchi *et al.* (2020), our large-N research design is exploratory because existing theories provide arguments that are not sufficiently robust to formulate hypotheses.

Our findings point to the great diversity of design thinking in its local applications. The first contribution of this work is based on our adoption of a contingency perspective. We examine whether and how the use of design thinking practices varies depending on the project environment, specifically the primary goals of an innovation project and the level of uncertainty involved. As Nakata and Hwang (2020) show in their literature review, a contingency perspective is largely absent [Cai *et al.* (2023) is a notable exception], and most studies tend to present design thinking as a single set of attributes for creative problem solving. Given the growing evidence that design thinking is used for strategy development and organizational change (Dell'Era *et al.*, 2020; Botega and da Silva, 2020; Bellis *et al.*, 2023), our close examination of project goals and their association with design thinking practices allows us to explore the multifaceted nature of design thinking. This is important as innovation projects become more complex due to changes in the business environment, technology and society at large, and innovation managers may rely on alternative configurations of design thinking practices to meet the specific needs of each project.

The second contribution of this research is the identification of six sets of design thinking practices and the preliminary development of scales to measure them. The identified design thinking practices are *discovering user needs, understanding the problem addressed, challenging existing assumptions, navigating the problem-solution pair, ideating through visualizations* and *learning through prototypes.* This study is one of the first large-scale quantitative investigations of the multifaceted nature of the design thinking approach. Our granular yet comprehensive operationalization provides an important foundation for future research on design thinking (Micheli *et al.*, 2019; Carlgren *et al.*, 2016) and an empirical complement to the predominantly conceptual literature by supporting the proposed categorizations with real-world data.

Third, unlike most studies that investigate the organization-wide adoption and implementation of design thinking, we examine its practical application at the project level. A lower level of analysis offers a number of advantages: it supports our focus on the performative dimension of design thinking (i.e. the enactment of the idea), as opposed to the ostensive perspective that refers to the idea in theory (Latour, 1986). Another advantage is that the significant heterogeneity across innovation projects, for example, in terms of goals and uncertainty, supports the testing of the multifaceted nature of design thinking, which is a key goal of our study. As Carlgren *et al.* (2016) note, "Processes as well as the application of techniques are seen as project dependent" (p. 45). Therefore, we add to the few studies that have investigated design thinking at the project level (Micheli *et al.*, 2019; Nagaraj *et al.*, 2020; Magistretti *et al.*, 2022a).

Finally, we provide large-scale quantitative evidence on the use of design thinking in practice, which is still very scarce. With the exception of Nakata and Hwang (2020), Nagaraj *et al.* (2020) and Magistretti *et al.* (2022a), articles in this research stream are either conceptual (e.g. Liedtka, 2015), anecdotal (e.g. Brown, 2008; Martin, 2009), based

on qualitative methods (e.g. Dell'Era *et al.*, 2020) or experimental (e.g. Kurtmollaiev *et al.*, 2018).

Literature review

Although there are many definitions of design thinking, most scholars describe it as a human-centered, creative problem solving approach to innovation based on designers' principles and practices (Brown, 2008; Martin, 2009; Liedtka, 2015; Verganti *et al.*, 2021). The mainstream view of design thinking as creative problem solving is evident in the models that have been proposed to implement design thinking in innovation processes, such as the British Design Council's double diamond [4] and Stanford d.school's five hexagons (Liedtka, 2015). However, there is a growing body of work documenting alternative uses of design thinking, including strategy formulation (Gruber *et al.*, 2015; Liedtka and Kaplan, 2019; Knight *et al.*, 2020; Magistretti *et al.*, 2022a), long-term R&D projects (Magistretti *et al.*, 2022b; Robbins and Fu, 2022), leadership development (Verganti, 2017; Bason and Austin, 2019; Rylander *et al.*, 2021) and organizational change (Kelley and Kelley, 2013; Elsbach and Stigliani, 2018; Wrigley *et al.*, 2020; Carlgren and Ben Mahmoud-Jouini, 2022; Magistretti *et al.*, 2023). Dell'Era *et al.* (2020) identify four different types of design thinking based on a multiple case study of consulting firms in Italy. Verganti *et al.* (2021) discuss possible emerging transformations of design thinking, highlighting two paradigmatic shifts: from positivist (problem solving) to constructivist (sensemaking), from single users to multiple stakeholders.

In this section, we review the major studies that have used formal and systematic empirical methods to investigate the adoption of design thinking and its effects (see Table 1 for a summary). These studies provide conceptualizations of design thinking that are important ingredients for an adequate empirical investigation of the phenomenon. Drawing on 20 cases of innovation across industries, Beverland *et al.* (2015) find that design thinking promotes brand ambidexterity, defined as the ability to renew the brand in a way that is consistent with the past and maintains its relevance in the present and future. This effect of design thinking occurs through a three-step process (destabilize, define and develop and transform) involving eight distinctive designer practices (naive questioning, problem interrogation, contextual immersion, capability matching, problem scoping, solution development, mapping innovation to the brand and re-stabilizing). Carlgren *et al.* (2016) propose one of the first formal and systematic frameworks of design thinking based on an empirical, qualitative study. They clearly separate the elements of design thinking, both at the same level of granularity and across levels (themes vs practices). Considering both the theoretical (ostensive) and practical (performative) dimensions of design thinking, they provide a comprehensive but detailed view, identifying five themes as the foundations of design thinking. The first, *user focus*, emphasizes that design thinking positions user needs and desires at the forefront of any innovation initiative. Second, the *problem framing* theme emphasizes challenging the initial problem to redefine it from different perspectives and develop an original formulation. The third theme, *visualization*, is a defining characteristic of design work; designers seek to visually represent abstract ideas, no matter how early and rough they are. Fourth, the *experimentation* theme encompasses the notion of developing novel outputs through iterative, creative, trial-and-error cycles in which multiple ideas are generated, turned into prototypes and tested with proxy and real users. Finally, the fifth theme, *diversity*, emphasizes the importance of multidisciplinarity in design thinking and the integration of different perspectives from inside and outside the organization. In the context of sales management, Luotola *et al.* (2017) use 15 longitudinal cases to show that the increasingly wicked nature of customer problems requires an iterative, value-based, abductive selling approach consistent with a design thinking perspective and distinct from traditional deductive or inductive sales epistemologies. A single case study of Siemens' molecular imaging division (Appleyard *et al.*, 2020) shows that the application of design

Table 1 Principal studies that use formal and systematic empirical methods to investigate the adoption of design thinking and its effects

Authors (year)	*Method*	*Research topic*	*Conceptualization of design thinking [Operationalization]*	*Main findings*
Beverland *et al.* (2015)	Multiple case study	Effect of design thinking on brand innovation	Process stages: destabilization; definition and development; transformation Practices: naive questioning, problem interrogation, contextual immersion, capability matching, problem scoping, solution development, mapping innovation to the brand, re-stabilizing [n.a.]	Design thinking, implemented through three process stages and eight practices, supports the development of brand ambidexterity, i.e. the ability to innovate the brand while remaining consistent with the brand's tradition
Carlgren *et al.* (2016)	Multiple case study	Principles, practices and techniques that characterize design thinking	Design thinking framed around five themes: user focus, problem framing, visualization, experimentation, diversity [n.a.]	The proposed framework based on five themes presents opportunities to interpret design thinking as a specific paradigm into the design discipline and consequently identify commonalities and differences with other paradigms
Luotola *et al.* (2017)	Multiple case study	Design thinking as antecedent of value-based solution selling	Design thinking as a form of sensemaking, an approach used to manage the uncertainty related to value creation processes [n.a.]	The design thinking approach provides a good and novel means for practical and creative problem-solving and solution selling with the ultimate goal of creating added value for the customer
Appleyard *et al.* (2020)	Single case study of siemens molecular imaging group	Application of design thinking to R&D	Process steps: discovery, interpretation, ideation, implementation Methods: universe of possibilities; Innovation metric: value/cost, leapfrog conceptualization, prototyping [n.a.]	Design thinking supports the development of the "creative forbearance" dynamic capability, which in turn generates long-term profit and R&D leadership
Seidel and Fixson (2013)	Hybrid, qualitative and quantitative analysis of 14 product development projects by student teams	Performance effects of the use of formal design methods	Methods: needfinding, brainstorming, prototyping [Questions, both interview and survey, about the value that respondents attribute to formal design thinking methods]	High-performing teams make greater use of needfinding, brainstorming and prototyping Quality of brainstorming, not quantity, drives performance in the concept generation phase Higher reflexivity, i.e. more discussion and reflection in the team, increases performance in the concept generation phase but decreases it in concept selection phase
Meinel *et al.* (2020)	Experiment involving 53 innovation projects by student teams. Treatment: training and application of design thinking Control: training and application of QFD	Performance effects of the use of design thinking	Design thinking as a user experience driven approach: empathy, qualitative data, visualization, iteration [Experimental intervention (0/1) in the form of training]	New concept relevance, feasibility and specificity, but not novelty, are positively associated with the use of design thinking

(*continued*)

Table 1

Authors (year)	*Method*	*Research topic*	*Conceptualization of design thinking [Operationalization]*	*Main findings*
Kurtmollaiev *et al.* (2018)	Experiment involving 529 managers from a telecom company. Treatment: training and application of design thinking Control: no training	Effect of training in design thinking on capabilities and innovation output (dynamic capabilities perspective)	Set of tools including customer journey maps, personas, visual communication, experience prototyping, etc [Experimental intervention (0/1) in the form of training]	Training in design thinking leads to higher levels of sensing and seizing, in turn leading to superior transformational and operational capabilities and greater innovation output
Nakata and Hwang (2020)	Cross-sectional survey of 312 innovation professionals from different industries. Unit of analysis: business unit or firm	Relationship between design thinking mindsets, actions and performance	Mindsets (human-centeredness, abductive reasoning and learning by failing) and corresponding actions (discovery, ideation and experimentation) [Three to four survey items for each mindset/action]	Human-centeredness influences discovery, abductive reasoning influences ideation, learning by failing influences experimentation, discovery influences ideation, which influences experimentation, which influences new product performance
Nagaraj *et al.* (2020)	Cross-sectional survey of 247 innovation projects from different industries. Unit of analysis: project	Relationship between team design thinking and new product novelty and usefulness (dynamic capabilities perspective)	Principles: user empathy, collaborative abduction, iteration, collaborative representation (Three survey items per principle)	Team design thinking is positively associated with new product utility, regardless of team familiarity with the project Team design thinking is positively associated with new product novelty only in projects that are highly familiar to the team
Magistretti *et al.* (2022a)	Survey of 146 design thinking projects conducted by European consulting firms. Unit of analysis: Project	Relationship between design thinking practices and project market value for the client, distinguishing two innovation purposes (innovation of solution, innovation of direction)	Practices: capturing current user needs, envisioning future society, creating new ideas, challenging existing assumptions [Three to four survey items per practice]	Different innovation purposes require different practices For projects that aim to innovate solutions, market value is positively related to capturing current user needs and envisioning future society For projects that aim to innovate direction, market value is positively related to challenging current assumptions
Robbins and Fu (2022)	Survey completed by 127 member organizations of the Industry Research & Development Group (IRDG) Unit of analysis: business unit or firm	Influence of design thinking on organizational innovation performance in R&D	Practices: brainstorming and idea generation techniques, visualization of ideas and/or concepts, prototyping, field experiments, ethnographic user research, customer segmentation and customer persona's, journey maps, mind mapping and co-creating with customers	Design thinking practices applied in R&D help develop organizational innovation capability, which in turn increases organizational innovation performance
Kamble *et al.* (2023)	Survey completed by 291 platform-based start-ups in India Unit of analysis: startup	Effects of design thinking practices on decision-making logics (effectuation and causation)	Practices: human-centeredness, diversity, visualization, experimentation, (re)framing	The relationship between design thinking practices and decision-making logics (effectuation and causation) are significant and positive. The design thinking practices in technology ventures can be considered as significant estimators to predict effectuation and causation

Source: Authors' own work

thinking principles to R&D processes allowed the company to build a dynamic capability that the authors call "creative forbearance". This ability to think creatively about new features, even if not immediately feasible, and introduce them incrementally as they become feasible enabled Siemens to build an adaptable, continuously improving technology platform and regain market leadership.

Seidel and Fixson's (2013) study is, to the best of our knowledge, the first to provide quantitative, albeit descriptive, evidence of the performance effects of design thinking. Using data from 14 undergraduate product development projects, the authors find that compared to low-performing teams, high-performing teams make more extensive use of formal design methods, namely, needs assessment, brainstorming and prototyping, in both the concept generation and selection phases. They also show that team performance in the concept generation phase is associated with higher quality (not quantity) of brainstorming sessions, as well as more debate and reflection. Meinel *et al.* (2020) also use data from student innovation projects. In comparison to Seidel and Fixson (2013), they designed a rigorous experiment in which about half of the student teams were trained in design thinking, conceptualized as a user experience-driven approach, and the other half were trained in the more traditional user preference-driven approach of quality function deployment (QFD). They find that teams using design thinking produce innovative concepts that are more relevant, feasible and detailed. However, they find no significant difference in novelty between the teams using design thinking and those using QFD. Another study that uses a quasi-experimental method is that of Kurtmollaiev *et al.* (2018). By engaging experienced managers from a leading multinational telecommunications company as experimental participants, the authors address the validity issues inherent in using student samples. The study finds that managers trained in design thinking were able to develop superior sensing and seizing capabilities compared to a control group of managers who did not receive training. This capability advantage of trained professionals, in turn, led to higher levels of transformational and operational capabilities and, ultimately, innovation outcomes.

Recently, five quantitative studies (Nakata and Hwang, 2020; Nagaraj *et al.*, 2020; Magistretti *et al.*, 2022a; Robbins and Fu, 2022; Kamble *et al.*, 2023) have been published that contribute to the literature on design thinking practices in several ways. First, they provide evidence of the effects of design thinking practices in real-world contexts, such as innovation projects or processes implemented in organizations. Second, because they use survey methodologies, they provide a granular, multidimensional operationalization of design thinking concepts. Third, they adopt a contingency perspective, which has received little to no scholarly attention to date, to examine the role of contextual factors in influencing the effectiveness of design thinking. Nakata and Hwang (2020) conceptualize design thinking as consisting of three mindsets – human-centeredness, abductive reasoning and learning by failing – and three corresponding actions – discovery, ideation and experimentation. Based on data from 312 innovation professionals collected by a market research firm, they show that each mindset influences the corresponding action (e.g. human centeredness influences discovery). They find a positive impact of design thinking on new product performance through the action of experimentation. They also test whether this relationship is moderated by market turbulence, but the results do not support the hypothesis. In contrast to Nakata and Hwang's (2020) aggregate analysis at the firm or division level, Nagaraj *et al.* (2020) examine the relationship between design thinking and performance at the project level. Using structural equation modeling of survey data on 247 new product development projects collected through LinkedIn, the authors show that the teams' use of design thinking, as measured by 12 practices related to four principles (user empathy, collaborative abduction, iteration and collaborative representation), leads to more useful new products. In terms of product novelty, design thinking seems to be beneficial only in projects where the team is well acquainted with the problem to be addressed. The authors interpret these results through the lens of dynamic capabilities: design thinking can contribute to capability building by reducing inertia and expanding the team's knowledge

base. Magistretti *et al.* (2022a) examine how design thinking practices are applied differently when addressing different innovation purposes. Specifically, they compare two purposes: solution innovation, which encompasses traditional product and service development projects, and directional innovation, which encompasses strategic and organizational renewal projects. Based on data collected from 146 design thinking projects conducted by European consulting firms, they examine (i) the relationships between the design thinking practices used and the value generated by the projects, and (ii) how these relationships vary depending on the purpose of the innovation project. The results show that different purposes do indeed require different practices. In projects aimed at innovating solutions, market value is positively related to capturing current user needs and envisioning future society. Conversely, market value is positively related to challenging current assumptions in projects that aim to redirect innovation. Robbins and Fu (2022) explore the indirect performance impact of design thinking practices in R&D through a two-study approach. Study 1 explores the perceived performance impact of design thinking in a descriptive manner, and Study 2 investigates the mediating role of organizational innovation capability in the relationship between design thinking and organizational innovation performance. The results of these two studies provide additional evidence to support the contention that design thinking practices applied in R&D help develop organizational innovation capabilities, which in turn increase organizational innovation performance. Kamble *et al.* (2023) investigate whether design thinking practices lead to improved performance of high-tech ventures. Based on a survey of 291 platform-based start-ups in India, they show that design thinking practices are well integrated with effectuation and causation theories and facilitate the growth of platform-based ventures.

The studies described above focus on the performance effects of design thinking, which is often treated as a single independent variable. To the best of our knowledge, there is a lack of research that informs the use of different design thinking practices according to the specifics of the innovation projects – namely, a contingent view. Nakata and Hwang (2020) and Magistretti *et al.* (2022a) are exceptions in their consideration of contingent variables influencing the adoption of design thinking practices. Based on a contingency perspective, we consider innovation project goals (Magistretti *et al.*, 2022a) and level of uncertainty (Candi *et al.*, 2013) as key dimensions that may drive the adoption of different configurations of design thinking practices. Our work differs from most studies by considering design thinking practices as dependent variables and examining how their adoption varies with innovation project goals and level of uncertainty. This is important for assessing the kaleidoscopic nature of design thinking in practice, as suggested by a recent conceptual and qualitative study (Dell'Era *et al.*, 2020).

The next section describes the empirical methods we use in this study. The early stage of development of the design thinking literature, especially on the topic we address in this study, supports an exploratory research design. For this reason, we do not develop hypotheses about the expected relationships between design thinking practices, innovation project goals and level of uncertainty.

Research method

Operationalization of design thinking practices

Design thinking is generally used as a collective term that can be disaggregated into key practices related to design (Michlewski, 2008; Beverland *et al.*, 2015). Several authors have proposed multidimensional conceptualizations (Carlgren *et al.*, 2016; Seidel and Fixson, 2013; Micheli *et al.*, 2019; Magistretti *et al.*, 2021b). Although these conceptualizations overlap significantly, they differ in terminology, in the constituent elements of design thinking considered, and in their level of granularity. Drawing on the distinction between the ostensive and performative dimensions (the concept itself and the enactment of the concept) (Latour, 1986; Feldman and Pentland, 2003), design thinking can be seen as a

hierarchy of practices that fall under a set of themes; practices embed and enact themes in the innovation process (Nagaraj *et al.*, 2020). In line with Modig and Åhlström's (2012) conceptualization of lean, and based on the distinction between the ostensive and performative dimensions of a concept, design thinking can be seen as a hierarchy of elements. At high levels of abstraction, the principles, themes and/or mindsets describe the ostensible foundations of the approach, the orientation and mentality that guide actors' decisions in a variety of settings and application domains. At lower levels of granularity, the methods, tools and/or practices indicate the performative application of one or more overarching principles in a specific, concrete situation. As our focus is on design thinking in action, we operationalize design thinking at the level of practices [5].

To the best of our knowledge, there is no accepted and validated scale for design thinking practices in the literature [6]. Therefore, we used the iterative procedure suggested by Jaworski and Kohli (1993) to generate a list of potential survey items. First, we conducted a comprehensive literature review to create a large pool of preliminary items. Importantly, the analysis included scholarship that does not directly refer to design thinking but addresses phenomena related to each theme (e.g. customer orientation and latent user needs, job-to-be-done and analogical thinking, mapping and prototyping, creativity, lean and agile development, cross-functional teams and open innovation). Several discussions with designers and consultants complemented our literature review. The initial pool of items was refined through several rounds of feedback from academic experts and practitioners, who provided input on the scales' domain representativeness, item specificity and clarity of construction. Redundant items were removed to minimize survey length and, thus, non-response (Rogelberg and Stanton, 2007). A pilot test of the survey was conducted with 12 design professionals prior to data collection, where some concerns about wording were raised and addressed.

Table 2 lists the final set of survey items along with factor loadings. Items were retained if the corresponding factor loading exceeded 0.4 for a single factor and was below this threshold for the others (Hu and Bentler, 1999). Each factor in Table 2 is a latent reflective construct measured with multiple items that operationalize design thinking practices (Tabachnick and Fidell, 2007), as in Nagaraj *et al.* (2020). As shown in the table, the Cronbach alphas are 0.6 for the two variables consisting of two items, and range from 0.72 to 0.79 for the variables composed of three or more items, indicating good reliability (Nunnally and Bernstein, 1994). It is important to note that our operationalization of design thinking practices does not cover all the possible elements that scholars have proposed as components of design thinking. For example, we excluded some attributes that appear in Micheli *et al.* (2019), such as "blending analysis with intuition", which better characterizes a personal attitude than a project-level practice. Other attributes, such as "creativity and innovation" are not specific to design thinking, but rather general goals in innovation projects (Nagaraj *et al.*, 2020). Finally, some principles, such as "learning by failing" (Nakata and Hwang, 2020) can be found in several modern approaches to innovation, including lean start-up (Ries, 2011) and agile (Bianchi *et al.*, 2020), even if design thinking is not specifically applied. The survey asked respondents to name a specific project completed within the past year, which was then inserted into the question text where appropriate. Each item for design thinking practices was prefaced with the following: "Among the practices used extensively during [name of project] …". Possible responses ranged from 1 (strongly disagree) to 7 (strongly agree) (Jarvis *et al.*, 2003).

Operationalization of other variables

This study examines the relationship between design thinking practices, innovation project goals and level of uncertainty. The innovation, strategy and project management literature has identified families of project goals. The first group includes long-term strategic goals, such as formulating future scenarios and visions, spotting external trends, market and

Table 2 Survey items for design thinking practices with factor loadings

Survey items	*Correspondence with items proposed by existing research*	*Factor 1: Discovering user needs*	*Factor 2: Understanding the problem*	*Factor 3: Challenging assumptions*	*Factor 4: Navigating the problem-solution pair*	*Factor 5: Ideating through visualization*	*Factor 6: Learning through prototypes*
Interviewing users about their needs	Carlgren *et al.* (2016): user focus; Micheli *et al.* (2019): user centeredness and involvement; Nagaraj *et al.* (2020): user empathy; Nakata and Hwang (2020): human centeredness; discovery; Seidel and Fixson (2013): need-finding	0.69					
Identifying hidden, unexpressed user needs	Carlgren *et al.* (2016): user focus; Micheli *et al.* (2019): user centeredness and involvement; Nagaraj *et al.* (2020): user empathy; Nakata and Hwang (2020): human centeredness; discovery; Seidel and Fixson (2013): need-finding	0.49					
Addressing new, unmet user needs	Carlgren *et al.* (2016): user focus; Micheli *et al.* (2019): user centeredness and involvement; Nagaraj *et al.* (2020): user empathy; Nakata and Hwang (2020): human centeredness; discovery; Seidel and Fixson (2013): need-finding	0.43					
Directly observing what happens in real use environments	Carlgren *et al.* (2016): user focus; Micheli *et al.* (2019): user centeredness and involvement; Nagaraj *et al.* (2020): user empathy; Nakata and Hwang (2020): human centeredness; discovery; Seidel and Fixson (2013): need-finding	0.42					
Tuning into user feelings	Carlgren *et al.* (2016): user focus; Micheli *et al.* (2019): user centeredness and involvement; Nagaraj *et al.* (2020): user empathy; Nakata and Hwang (2020): human centeredness; discovery; Seidel and Fixson (2013): need-finding	0.41					
Spending time trying to understand the deep nature of the problem	Carlgren *et al.* (2016): problem framing; Micheli *et al.* (2019): problem-solving, Gestalt view, abductive reasoning; Nagaraj *et al.* (2020): collaborative abduction; Nakata and Hwang (2020): abductive reasoning, ideation; Seidel and Fixson (2013): brainstorming, debating		0.57				

(*continued*)

Table 2

Survey items	*Correspondence with items proposed by existing research*	*Factor 1: Discovering user needs*	*Factor 2: Understanding the problem*	*Factor 3: Challenging assumptions*	*Factor 4: Navigating the problem-solution pair*	*Factor 5: Ideating through visualization*	*Factor 6: Learning through prototypes*
Deconstructing the problem into smaller parts	Carlgren *et al.* (2016): problem framing; Micheli *et al.* (2019): problem-solving, Gestalt view, abductive reasoning; Nagaraj *et al.* (2020): collaborative abduction; Nakata and Hwang (2020): abductive reasoning, ideation; Seidel and Fixson (2013): brainstorming, debating		0.54				
Asking questions that challenge the status quo	Carlgren *et al.* (2016): problem framing; Micheli *et al.* (2019): problem-solving, Gestalt view, abductive reasoning; Nagaraj *et al.* (2020): collaborative abduction; Nakata and Hwang (2020): abductive reasoning, ideation; Seidel and Fixson (2013): brainstorming, debating			0.60			
Repeatedly asking questions to unearth and challenge inherent assumptions	Carlgren *et al.* (2016): problem framing; Micheli *et al.* (2019): problem-solving, Gestalt view, abductive reasoning; Nagaraj *et al.* (2020): collaborative abduction; Nakata and Hwang (2020): abductive reasoning, ideation; Seidel and Fixson (2013): brainstorming, debating			0.58			
Stimulating people to rethink the way they solve problems	Carlgren *et al.* (2016): problem framing; Micheli *et al.* (2019): problem-solving, Gestalt view, abductive reasoning; Nagaraj *et al.* (2020): collaborative abduction; Nakata and Hwang (2020): abductive reasoning, ideation; Seidel and Fixson (2013): brainstorming, debating			0.56			
Thinking in a divergent way	Carlgren *et al.* (2016): experimentation; Micheli *et al.* (2019): iteration and experimentation, tolerance of ambiguity and failure; Nagaraj *et al.* (2020): iteration; Nakata and Hwang (2020): learning by failing, experimentation; Seidel and Fixson (2013): prototyping				0.68		
Combining seemingly unrelated ideas to create new possibilities	Carlgren *et al.* (2016): diversity; Micheli *et al.* (2019): interdisciplinary collaboration, balancing rationality and intuition; Nagaraj *et al.* (2020): collaborative representation				0.59		

(*continued*)

Table 2

Survey items	*Correspondence with items proposed by existing research*	*Factor 1: Discovering user needs*	*Factor 2: Understanding the problem*	*Factor 3: Challenging assumptions*	*Factor 4: Navigating the problem-solution pair*	*Factor 5: Ideating through visualization*	*Factor 6: Learning through prototypes*
Thinking about the problem from multiple perspectives	Carlgren *et al.* (2016): diversity; Micheli *et al.* (2019): interdisciplinary collaboration, balancing rationality and intuition; Nagaraj *et al.* (2020): collaborative representation				0.54		
Defining the problem more broadly	Carlgren *et al.* (2016): problem framing; Micheli *et al.* (2019): problem-solving, Gestalt view, abductive reasoning; Nagaraj *et al.* (2020): collaborative abduction; Nakata and Hwang (2020): abductive reasoning, ideation; Seidel and Fixson (2013): brainstorming, debating				0.50		
Always looking for original solutions to the problem	Carlgren *et al.* (2016): experimentation; Micheli *et al.* (2019): iteration and experimentation, tolerance of ambiguity and failure; Nagaraj *et al.* (2020): iteration; Nakata and Hwang (2020): learning by failing, experimentation; Seidel and Fixson (2013): prototyping				0.49		
Communicating information in a visual manner	Carlgren *et al.* (2016): visualization; Micheli *et al.* (2019): ability to visualize; Nagaraj *et al.* (2020): collaborative representation					0.55	
Sketching ideas in a visual form, even if incomplete	Carlgren *et al.* (2016): visualization; Micheli *et al.* (2019): ability to visualize; Nagaraj *et al.* (2020): collaborative representation					0.52	
Frequently creating and releasing mock-ups and beta versions of the solution to real users	Carlgren *et al.* (2016): experimentation; Micheli *et al.* (2019): iteration and experimentation, tolerance of ambiguity and failure; Nagaraj *et al.* (2020): iteration; Nakata and Hwang (2020): learning by failing, experimentation; Seidel and Fixson (2013): prototyping						0.81
Concretely representing solution ideas through prototypes	Carlgren *et al.* (2016): visualization; Micheli *et al.* (2019): ability to visualize; Nagaraj *et al.* (2020): collaborative representation						0.73

(*continued*)

Table 2

Survey items	*Correspondence with items proposed by existing research*	*Factor 1: Discovering user needs*	*Factor 2: Understanding the problem*	*Factor 3: Challenging assumptions*	*Factor 4: Navigating the problem-solution pair*	*Factor 5: Ideating through visualization*	*Factor 6: Learning through prototypes*
Trying out early, rough versions of the solution to see what happens	Carlgren *et al.* (2016): experimentation; Micheli *et al.* (2019): iteration and experimentation, tolerance of ambiguity and failure; Nagaraj *et al.* (2020): iteration; Nakata and Hwang (2020): learning by failing, experimentation; Seidel and Fixson (2013): prototyping						0.69
Using 3D printing and other rapid prototyping technologies	Carlgren *et al.* (2016): experimentation; Micheli *et al.* (2019): iteration and experimentation, tolerance of ambiguity and failure; Nagaraj *et al.* (2020): iteration; Nakata and Hwang (2020): learning by failing, experimentation; Seidel and Fixson (2013): prototyping						0.51
Seeking feedback on ideas as early as possible, even if the ideas are very rough	Carlgren *et al.* (2016): experimentation; Micheli *et al.* (2019): iteration and experimentation, tolerance of ambiguity and failure; Nagaraj *et al.* (2020): iteration; Nakata and Hwang (2020): learning by failing, experimentation; Seidel and Fixson (2013): prototyping						0.48
	Cronbach's alphas	*0.73*	*0.60*	*0.72*	*0.76*	*0.60*	*0.79*

Source: Authors' own work

technology dynamics. We refer to this group as *scenario development* and measure it with items based on Cooper *et al.* (2009), Verganti (2017). Second, we group goals related to *organizational change*. Innovation projects may focus on transforming an organization's culture, structure or the attitudes and behaviors of its employees (Micheli *et al.*, 2019; Elsbach and Stigliani, 2018). The third group includes items that reflect the goal of introducing novelty in various forms, whether in products, services, business models, brands or markets. We refer to this group as *market transformation* (Kumar and Holloway, 2009; Mansoori and Lackeus, 2019). The fourth group, *user experience design*, focuses on users and includes goals that consist of solving user problems and needs (Thomke and Von Hippel, 2002; Norman, 2005). The uncertainty level items are based on the scales of Chen *et al.* (2005), Lynn and Akgün (2001), Floricel *et al.* (2016), Brettel *et al.* (2011) and Calantone *et al.* (2003). Table 3 provides a summary of the survey items used to measure project goals and project uncertainty. As with the design thinking practice items, possible responses ranged from 1 to 7. The Cronbach alphas ranged from 0.70 to 0.79.

Data collection

The survey was administered to professionals (chief design officers, software engineers, project managers, R&D directors and similar others) who led, managed or were involved in development projects based on design thinking and were employed in consulting organizations (strategic consulting firms, design agencies and digital studios) in the UK, Italy, Sweden and The Netherlands. We chose the consulting industry as our empirical setting because of its advanced but heterogeneous adoption of design thinking practices.

Table 3 Survey items for innovation project goals and innovation project uncertainty

Variables	*Items*
Scenario development	*One of the primary goals of [name of project] was . . .*
	Predicting technological trends
	Predicting market trends
	Identifying emerging scenarios
Organizational change	*One of the primary goals of [name of project] was . . .*
	Changing corporate culture
	Improving organizational structure
	Fostering new values, attitudes, behaviors
	Engaging and motivating employees
Market transformation	*One of the primary goals of [name of project] was . . .*
	Developing a new product or service
	Creating a new business model
	Introducing new product/service lines
	Developing a new brand
User experience design	*One of the primary goals of [name of project] was . . .*
	Solving a specific problem
	Addressing a specific user need
	Designing new user experiences
Innovation project uncertainty	*In relation to [name of project], to what extent do you agree or disagree with the following statements?*
	Most functionalities of the solution being developed in the project required knowledge that was new to our organization
	Our organization was lacking appropriate technological knowledge in the beginning of the project
	Through the project, our client was targeting customers outside its traditional customer base
	The project output targeted a market whose emergence and growth were still uncertain
	The project intended to satisfy completely new market demands

Source: Authors' own work

The unit of analysis is the innovation project that consulting organizations undertook for a client. At the beginning of the survey, respondents were asked to answer the questions based on their own understanding of design thinking and their experience as design thinkers. The survey was intentionally designed to allow for a broad, inclusive interpretation of design thinking as an approach to innovation based on the principles and practices of designers that balance people's needs with what is technologically feasible and commercially viable. Participants were also asked to identify a specific consulting project using design thinking that they had completed in the past year that they were familiar with and then answer questions related to that project. The average size of the firms represented in the data set was 304 employees and the average annual revenue was 223 million euros. The firms had an average of 5.8 years of experience in using design thinking. As described above, each respondent answered the survey for a specific, recently completed project. The average duration of the projects was 7.6 months, the average number of employees involved in each project was 5.7 and the average size of client firms was 683 employees. The distribution of client firms by industry sectors is shown in Table 4.

We collected usable data on 221 consulting projects, representing a response rate of 12%, which is consistent with similar studies (Nakata and Hwang, 2020). In addition to the usual strategies for addressing the risk of common method bias (Podsakoff *et al.*, 2003), namely reviewing and pilot testing the survey and reminding respondents of their guaranteed anonymity, we also conducted a marker variable test (Bagozzi, 2011; Lindell and Whitney, 2001). This involved including items to measure a variable unrelated to our research in the factor analysis, namely value delivered to customers. These items loaded on one variable and did not have significant cross-loadings with other variables, reducing common method bias concerns. All analyses were conducted using Stata version 17.

Findings

To analyze how innovation project goals and uncertainty influence the selection of design thinking practices, we conducted a multivariate path analysis. In this analysis, each set of design thinking practices (i.e. *discovering user needs*, *understanding the addressed problem*, *challenging existing assumptions*, *navigating the problem-solution pair*, *ideating through visualizations* and *learning through prototypes*) was treated as a dependent

Table 4 Distribution of client firms' industries

Industry	*Proportion of sample (%)*
Agriculture	1
Arts, entertainment and recreation	1
Automotive	6
Consulting	2
Education	3
Energy	8
Engineering	4
Finance and insurance	17
Food and beverage	5
Forestry and fishing	1
Healthcare	12
Information and communication	7
Manufacturing	6
Public administration	7
Real estate	1
Retail	6
Transportation and logistics	4
Other	10

Source: Authors' own work

variable. The independent variables included the four innovation project goals previously discussed (i.e. *scenario development*, *organizational change*, *market transformation* and *user experience design*), as well as the level of uncertainty in the innovation project. The findings are detailed in Table 5.

Table 5 Results of multivariate path analysis relating design thinking practices to innovation project goals and uncertainty

	Coef.	*Std. err.*	z	p > z	
Discovering user needs <					
Innovation project goals					
Scenario development	−0.06	0.07	−0.87	0.38	
Organizational change	0.17	0.06	2.75	0.01	***
Market transformation	0.15	0.07	2.07	0.04	**
User experience design	0.40	0.05	7.38	0.00	***
Innovation project uncertainty					
Innovation project uncertainty	0.13	0.07	1.75	0.08	*
Understanding the problem <					
Innovation project goals					
Scenario development	−0.06	0.08	−0.79	0.43	
Organizational change	0.09	0.07	1.34	0.18	
Market transformation	0.10	0.08	1.27	0.20	
User experience design	0.36	0.06	6.08	0.00	***
Innovation project uncertainty					
Innovation project uncertainty	−0.07	0.08	−0.95	0.34	
Challenging assumptions <					
Innovation project goals					
Scenario development	−0.04	0.08	−0.59	0.56	
Organizational change	0.30	0.06	4.93	0.00	***
Market transformation	0.18	0.08	2.24	0.03	**
User experience design	0.10	0.06	1.54	0.12	
Innovation project uncertainty					
Innovation project uncertainty	0.11	0.08	1.45	0.15	
Navigating the problem-solution pair <					
Innovation project goals					
Scenario development	0.16	0.07	2.22	0.03	**
Organizational change	0.28	0.06	4.68	0.00	***
Market transformation	0.16	0.08	2.13	0.03	**
User experience design	0.09	0.06	1.47	0.14	
Innovation project uncertainty					
Innovation project uncertainty	0.10	0.07	1.32	0.19	
Ideating through visualizations <					
Innovation project goals					
Scenario development	0.01	0.08	0.11	0.91	
Organizational change	0.01	0.07	0.08	0.94	
Market transformation	−0.05	0.09	−0.55	0.59	
User experience design	0.22	0.07	3.33	0.00	***
Innovation project uncertainty					
Innovation project uncertainty	0.17	0.08	2.06	0.04	**
Learning through prototypes <					
Innovation project goals					
Scenario development	−0.05	0.08	−0.62	0.53	
Organizational change	0.04	0.06	0.64	0.52	
Market transformation	0.08	0.08	0.96	0.34	
User experience design	0.34	0.06	5.90	0.00	***
Innovation project uncertainty					
Innovation project uncertainty	0.21	0.08	2.79	0.01	***

Notes: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: Authors' own work

The use of design thinking practices focused on *discovering user needs* is positively correlated with user experience design goals, organizational change, market transformation and innovation project uncertainty, all at statistically significant levels. These design thinking practices range from the overt, such as interviewing users about their needs and observing them, to the more covert, such as identifying and addressing unexpressed needs and tuning into user feelings. All these practices are intuitively consistent with the user experience design goals. As for organizational change goals, in this case, users are likely to be internal (e.g. employees and managers), so it makes sense to identify their needs. For market transformation goals, the focus is on the market (i.e. customers/users), and so discovering their needs is also relevant. Finally, one of the fundamental practices for dealing with uncertainty is a deep understanding of user needs. The design thinking practices of *understanding the problem addressed* are positively related to user experience design goals. This is consistent with the view that designing user experiences requires understanding their problems (e.g. by deconstructing them into their constituent parts or making efforts to understand them deeply).

The *challenging existing assumptions* design thinking practices are positively related to the organizational change and market transformation goals. These practices involve asking questions that challenge the status quo, uncovering and challenging inherent assumptions and rethinking how to reframe problems. This is consistent with organizational change goals, which often require radical inward rethinking, and market transformation goals, which also require radical rethinking, but outward.

The *navigating the problem-solution pair* design thinking practices are positively related to scenario development, organizational change and market transformation goals. These practices deal with ambiguous, complex and multifaceted challenges to the point where they cannot assume the existence of a problem to be understood and then solved. Conversely, these practices make sense of the problem by imagining possible solutions in an iterative way.

The *ideating through visualizations* design thinking practices are positively related to user experience design goals and innovation project uncertainty. The relationship with the user experience design goals may signal an implicit association between users (people) and the visual representation of things. The relationship with project uncertainty makes intuitive sense since visualization practices, such as sketching, are a form of (often iterative) experimentation that serves to reduce uncertainty.

The *learning by prototyping* design thinking practices are also positively related to user experience design goals and innovation project uncertainty. These practices include experimenting with and soliciting feedback on prototypes, mock-ups and beta versions of solutions, as well as using rapid prototyping technologies such as 3D printing. Interestingly, consulting firms appear to use prototyping practices in response to user experience goals. This likely reflects the notion that prototyping is an efficient and effective way to gauge user reactions to products and services (i.e. their experiences). In terms of the relationship with project uncertainty, prototyping is often used under conditions of high uncertainty to reduce the risk of proceeding with development before a certain level of validation has been achieved.

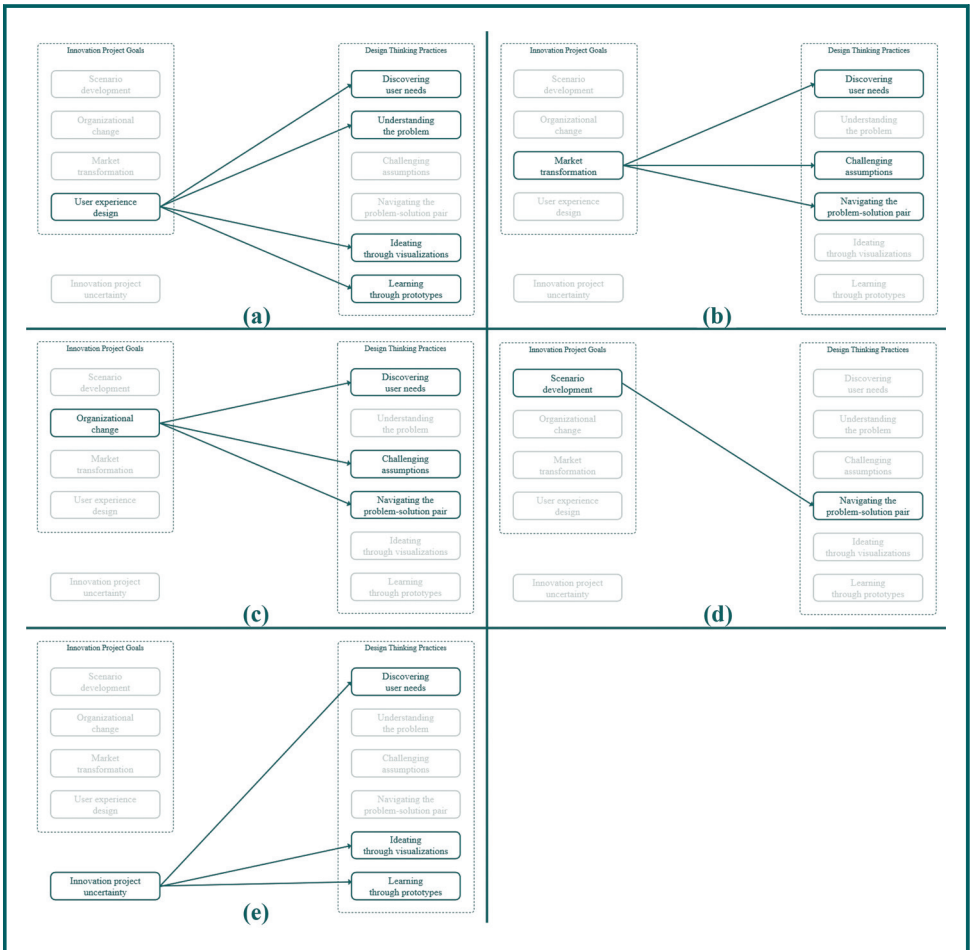
Discussion

Design thinking was initially conceptualized as a creative problem solving approach, mainly applied in the field of product and service innovation (Brown 2008, 2009; Martin, 2009; Liedtka *et al.*, 2013; Liedtka, 2015). As Auernhammer and Roth (2021) highlight, the diffusion of design thinking in the field of innovation management emerged around the mid-2000s, mainly stimulated by the initiatives of IDEO and Roger Martin, who proposed it as an umbrella construct (Dunne and Martin, 2006; Micheli *et al.*, 2019). Over time, design thinking has been increasingly used to address innovation challenges beyond product/service development,

such as market transformation, organizational change and scenario development (Carlgren and Ben Mahmoud-Jouini, 2022; Dell'Era *et al.*, 2020; Elsbach and Stigliani, 2018; Liedtka, 2020; Rylander *et al.*, 2021; Verganti, 2017; Wrigley *et al.*, 2020). Identifying new markets, reshaping the organizational culture, facilitating radical transformations and envisioning potential futures are some of the reasons for the increasing adoption of design thinking (Gloppen, 2009; Sato *et al.*, 2010; Kelley and Kelley, 2013; Norman and Verganti, 2013). Knight *et al.* (2020) emphasize that design thinking can support managers in strategic planning activities, describing a progressive integration between design thinking and strategic management. Micheli *et al.* (2019) discuss the possibility of elevating design to a strategic level to identify innovative directions for brand positioning and potential new markets. Dell'Era *et al.* (2020) confirm that, in addition to product and service innovation, the design thinking approach is increasingly used to define new strategic directions, propose radically new customer experiences, enter new markets and reposition brands. Like any other paradigm, design thinking requires adaptations or even variations to be effectively practiced and applied to different innovation challenges (Dell'Era *et al.*, 2020).

Our findings are summarized in Figure 1, which shows the configurations of design thinking practices intended to address specific innovation project goals and uncertainty. These

Figure 1 Configurations of design thinking practices aimed at facing innovation project goals and uncertainty



Source: Authors' own work

configurations highlight the importance of combining different design thinking practices, as described in more detail below.

Our empirical results show that innovation challenges aimed at designing new user experiences are usually addressed with practices that reflect the "problem solving" approach embedded in one of the most widely used design thinking frameworks: the double diamond (see configuration (a) in Figure 1). Although this conceptualization originated in the practitioner world, it has been adopted in the academic world as a design perspective of the innovation development process (Da Silva *et al.*, 2020; Gruber *et al.*, 2015; Verganti *et al.*, 2020), representing the transition between divergent and convergent ways of thinking. The double diamond is characterized by the alternation between a divergent phase aimed at exploring possible alternatives, called the problem space, and a convergent phase aimed at identifying the dominant alternative, often called the solution space. Specifically, the empirical results underline that four design thinking practices are typically adopted in innovation projects aimed at designing new user experiences: two practices operate in the problem space (i.e. *discovering user needs* and *understanding the problem addressed*) and the other two in the solution space (i.e. *ideating through visualizations* and *learning through prototypes*). In other words, problems must first be framed, and then solutions can be creatively conceived to properly address those problems. Similar design thinking practices (i.e. *discovering user needs*, *ideating through visualizations* and *learning through prototypes*) are used to address the uncertainty of innovation projects (see configuration (e) in Figure 1): in particular, the first and third practices aim to gather new knowledge to reduce the uncertainty that accompanies any innovation project.

Innovation projects aimed at achieving market transformation and organizational change are characterized by the adoption of a different set of design thinking practices (see configurations (b) and (c) in Figure 1). Whereas *discovering user needs* appears to be intensively adopted to address such innovation project goals, two distinct practices emerge in organizational change and market transformation projects: *challenging existing assumptions* and *navigating problem-solution pairs*. Market transformation and organizational change require not only the observation of users, but also the codification of the multitude of weak signals that emerge in society, implying the need for interpretation. The socio-cultural context in which users are immersed tends to lead them to interpret in accordance with what is happening at the time, while market transformations and organizational changes are often based on new interpretations of the competitive arena, thus, challenging established and shared beliefs, and creating a common sense of purpose that inspires new actions (Beltagui *et al.*, 2017; Elsbach and Stigliani, 2018; Wrigley *et al.*, 2020). The practices of challenging current cognitive frames and questioning how people make sense of their environment are grounded in criticism (Verganti and Norman, 2019; Beckman, 2020; Curhan *et al.*, 2021). The ability to question the status quo stimulates curiosity and new interpretations (Drews, 2009). Challenging current assumptions requires a deep understanding of current mental models and the generation of alternative models (Senge, 1991). Inquiry encourages individuals to discuss assumptions and recognize the limitations of their perspectives (Schein, 1999). As von Hippel and von Krogh (2016) note, the formal problem solving practice begins with the assumption that a problem has been identified. According to Emirbayer and Mische (1998), in-depth exploration in search of root causes is routine in many fields. Problem formulation is a practice that requires not only problem finding but also in-depth exploration of the underlying causes of the observed problem (Schwenk and Thomas, 1983). Very often, market transformation and organizational change projects deal with open and ill-defined challenges that need to be explored; they require finding or even creating the problem (Unsworth, 2001; Getzels, 1975) before being able to solve it. Such challenges are often characterized by the lack of a clear path to a solution because they do not specify the problem solving goals, information, assumptions or boundaries (Abdulla *et al.*, 2020). They are ambiguous and contain

conflicting assumptions and information that can lead to different solutions (Reiter-Palmon, 2017). The practice of *navigating problem-solution pairs* is a way to iteratively reframe the problem, which requires intense engagement in sensemaking to develop a deep understanding of the problem, and dialogue involving inquiry, divergence and convergence (Fairhurst, 2005; Senge, 1991). In other words, innovation challenges characterized by higher ambiguity and complexity, such as market transformation and organizational change, typically require the adoption of practices based on sensemaking rather than problem solving (Verganti *et al.*, 2021).

The intense and isolated adoption of *navigating problem-solution pairs* is even more evident in the case of innovation projects aimed at developing new scenarios [see configuration (d) in Figure 1]. The ambiguity and complexity of the challenge faced suggests that consulting firms rely intensively on practices in which the problem and solution co-evolve through sensemaking iteration (Verganti, 2017; Magistretti *et al.*, 2022a).

Theoretical implications

The theoretical implications of our study are twofold. First, we build on the idea of design thinking as a multifaceted approach (Magistretti *et al.*, 2022a) rather than a single oversimplified perspective. Second, our paper contributes to the growing understanding of design thinking as a complex phenomenon (Liedtka, 2015), suggesting the emergence of different configurations of practices within it.

Our study shows that different design thinking practices can pursue different innovation goals. This practice-oriented view of design aligns with the "doing" perspective of design thinking (Micheli *et al.*, 2019), while also incorporating the notion that these design thinking practices co-occur for specific reasons and may not always be present simultaneously. Our findings also advance current scholarly understanding by emphasizing the need to study design thinking as a practice (Liedtka, 2000), moving beyond its characterization as merely a set of tools, processes or artifacts (Rösch *et al.*, 2023). In fact, adopting a more practical perspective (Feldman, 2021) can provide deeper insights into the actual nature of design and expand its potential impact in management. Design thinking is more than a process (Seidel and Fixson, 2013); it is a far more complex approach to innovation (Verganti *et al.*, 2021) that requires a variety of practices and approaches. Our research shows that design thinking is context-specific and supports a more dynamic view (Magistretti *et al.*, 2021b) rather than a static, one-size-fits-all approach. This informs scholars that, beyond an understanding of the process, the study of design thinking also requires considering its dynamic and complex dimensions (Klenner *et al.*, 2022).

Second, our study contributes to theory by explaining how different configurations emerge within design thinking, viewed as a set of practices (Furnari *et al.*, 2021). This configuration-based view is novel, highlighting the complexity of design thinking (Liedtka, 2015) and the need for a new unit of analysis that goes beyond the processes, steps, tools and activities, shifting the focus to the project level. Indeed, studying design thinking at the project level allows for a broader exploration of the phenomenon and a clearer understanding of the power of this approach (Elsbach and Stigliani, 2018) at the organizational level.

Practical implications

In addition to the theoretical contributions, our study offers three key implications for practice. First, our research highlights the importance for design thinking practitioners to recognize the different innovation goals that can be achieved through different design thinking practices. Specifically, innovation challenges aimed at designing new user experiences are typically addressed with practices that reflect the "problem solving" approach, whereas market transformation, organizational change and scenario development projects require design thinking practices that are largely based on reframing

and criticism. Second, managers can benefit from understanding the importance of interrelated practices. In particular, three of the four configurations illustrate the coexistence of multiple design thinking practices, highlighting the value of investing in a broader range of design thinking aspects to achieve the desired goals, rather than striving for expertise in just one area. Third, design thinkers can learn from our study that while many practices are relevant and valuable, the most recurring practices among the three configurations are *discovering user needs* and *navigating problem-solution pairs*. While discovering user needs is essential and widely acknowledged in design thinking, *navigating problem-solution pairs* is less often recognized as relevant. Therefore, practitioners may want to place more emphasis on this practice.

Conclusions

This study explores and identifies design thinking practices and how their use varies depending on the project environment, specifically the types of goals an innovation project pursues and the level of uncertainty. Our findings suggest that design thinking is highly diverse in its local applications. As organizations adopt this approach, it takes on different forms through its situated use and adaptation to the innovation project goals and level of uncertainty (Ansari *et al.*, 2010), thus, becoming multiple versions of itself. The empirical results show that innovation challenges aimed at designing new user experiences are usually met by practices that reflect the "problem solving" approach embedded in the most popular design thinking frameworks, such as the double diamond: *discovering user needs*, *understanding the problem addressed*, *ideating through visualizations* and *learning through prototypes*. Innovation projects aimed at achieving market transformation and organizational change are characterized by the adoption of a different set of design thinking practices: while *discovering user needs* also seems to be adopted to achieve such innovation project goals, two distinct practices emerge in organizational change and market transformation projects: *challenging existing assumptions* and *navigating problem-solution pairs*. The adoption of practices for *navigating problem-solution pairs* is evident in the case of innovation projects aimed at developing new scenarios. Our findings highlight the kaleidoscopic nature of design thinking and the need to take a contingent approach to its practice, considering the goals pursued and the uncertainty faced. Indeed, design thinking practices can be combined and executed differently depending on the context, contributing to a broader conceptualization of design thinking by providing a more granular interpretation of the practices. This enriches current knowledge by highlighting the diverse set of practices that underpin design thinking, which is becoming increasingly pervasive in today's society.

Limitations and future research

Our study has some limitations that point to potential avenues for future research. First, because our data were all drawn from European countries, some of the results may be biased by cultural idiosyncrasies. Therefore, future research should test the model in a wider range of countries. Second, as the analysis of a single project in each consulting firm may be another limitation, future research could examine portfolios of projects within firms. Third, the lack of a clear scale for measuring design thinking led us to rely on existing publications on the subject, with all the limitations associated with the trustworthiness of such items and measures. Therefore, developing an appropriate scale for measuring design thinking practices could add to the literature and contribute to a better understanding of these practices. Fourth, we did not test the identified configurations of practices for their strategic or economic performance. Thus, future studies could build on our findings to enrich the value and reliability of the configurations we identified. Finally, these are just some of the potential future research avenues that scholars in the field of design thinking research could explore by drawing on our work.

Notes

1. Web article published on 22 June 2017: www.ft.com/content/cbf70424-422a-11e7-82b6-896b95f30f58.
2. California Management Review (2020): Special Issue on "Design Thinking", Guest Editors: T.S. Pitsis, S.L. Beckman, M. Steinert, L. Oviedo and B. Maisch, https://cmr.berkeley.edu/browse/issues/62_2/
3. Journal of Product Innovation Management (2021/2022): Special Issue on "Design Thinking and Innovation Management: Matches, Mismatches and Future Avenues", Guest Editors: R. Verganti, C. Dell'Era and K.S. Swan (Part 1: https://onlinelibrary.wiley.com/toc/15405885/2021/38/6; Part 2: https://onlinelibrary.wiley.com/toc/15405885/2022/39/1).
4. Design Council – Double Diamond: www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond
5. To avoid confusion, we use the term "practices" broadly to encompass elements at lower levels of granularity that other authors might refer to as methods, tools, or artifacts.
6. A recent study by Nagaraj *et al.* (2020), published a year after we completed our data collection, provides a set of survey items to measure design thinking practices at the project level. They consist of 12 items grouped into four factors. The authors define their measures as preliminary and among many possible. We argue that our scales, based on different themes, are an addition and complement to those proposed by Nagaraj *et al.* (2020).

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Author affiliations

Claudio Dell'Era and Stefano Magistretti are both based at the Department of Management, Economics and Industrial Engineering, Politecnico di Milano, Milan, Italy.

Marina Candi is based at the Center for Research on Innovation and Entrepreneurship, Reykjavik University, Reykjavik, Iceland.

Mattia Bianchi is based at the House of Innovation, Stockholm School of Economics, Stockholm, Sweden.

Giulia Calabretta is based at TU Delft, Delft, The Netherlands.

Ileana Stigliani is based at Imperial College Business School, London, UK.

Roberto Verganti is based at House of Innovation, Stockholm School of Economics, Stockholm, Sweden and Department of Management, Economics and Industrial Engineering, Politecnico di Milano, Milan, Italy.

Corresponding author

Claudio Dell'Era can be contacted at: claudio.dellera@polimi.it