Received: 25 February 2020 | Accepted: 9 July 2021

DOI: 10.1111/jpim.12592

JOURNAL OF PRODUCT INNOVATION MANAGEMENT pdma

ORIGINAL ARTICLE

Microfoundations of dynamic design capabilities: An empirical analysis of "excellent" Italian design firms

Cabirio Cautela[1] | **Michele Simoni**[2] | **Peter Moran**[3]

[1]Department of Design, Politecnico di Milano, Milano, Italy

[2]Management Studies and Quantitative Methods Department, Parthenope University of Naples, Naples, Italy

[3]China Europe International Business School (CEIBS), Shanghai, P.R. China

Correspondence
Cabirio Cautela, Department of Design, Politecnico di Milano, Via Durando 10, Milano 20158, Italy.
Email: cabirio.cautela@polimi.it

Funding Information
The authors do not have any funding to report.

Guest Editors: Roberto Verganti, Claudio Dell'Era, and K. Scott Swan

Abstract

This article investigates how managers of firms awarded for their design excellence build organizational-level design-related dynamic capabilities by selecting designers with specific individual capabilities and managing how and the extent to which users of the firms' products are actively involved in design activities. The following two types of dynamic capabilities were studied: user-centered design (UCD) and meaning innovation (MI). Data from a survey of managers of 106 Italian firms recognized for their products' "design excellence" during the 2011–2016 period were analyzed using a structural equation model (PLS-SEM). The results suggest that managers seeking to build dynamic UCD capabilities prefer designers with holistic thinking capabilities over those with ideation and envisioning capabilities and value user involvement throughout the design process. In contrast, managers seeking to build dynamic MI capabilities search for designers with holistic thinking and envisioning capabilities and avoid ideation capabilities. They also consider the value of involving users in the design process to be limited. This study is among the first to present the results of an empirical investigation of the microfoundations of dynamic design capabilities. Limitations of the research and prospects for future work are discussed. In particular, our findings point to the need for additional studies that further specify the routines and associated competencies that managers responsible for design employ to attract, nurture, integrate and exploit the micro-level capabilities required for UCD and MI. Given that some of these microfoundations were found to be differentially important, unimportant, or even detrimental to the development of either UCD or MI, an important remaining question is the extent to which, and how, a single firm can accommodate and effectively exploit both of these dynamic design capabilities.

KEYWORDS

designer capabilities, dynamic design capabilities, meaning innovation, microfoundations, user centered design

This article is part of the Special Issue on "Design Thinking and Innovation Management: Matches, Mismatches and Future Avenues".

1 | INTRODUCTION

Managers and entrepreneurs increasingly view design as an organizational capability that can enhance their firms' competitive advantage. Studies show that design-driven firms outperform competitors in the most dynamic fast-paced environments. The Design Value Index compiled by the Design Management Institute has been used to show that design-driven companies have maintained a significant stock-market advantage, outperforming the S&P 500 by 200 percent over the last decade (Rae, 2016). Similarly, companies with top-quartile McKinsey Design Index scores have performed twice as well as industry-benchmark growth (McKinsey & Company, 2018). Accordingly, scholars and practitioners are interested in how managers can equip their organizations with such a unique capability (Elsbach & Stigliani, 2018; Kolko, 2015).

Design studies have long identified a growing list of skills that individual designers should master (Cross, 2001, 2011; Dorst, 2011; Dorst & Cross, 2001; Kelley & Kelley, 2013; Michlewski, 2008; Morelli & Tollestrup, 2007; Swan et al., 2005; Topalian, 2002). Only recently, scholars have begun to aggregate these skills into specific organizational capabilities (Buchanan, 2008; Dong et al., 2016; Liedtka, 2020). However, with very few exceptions (Magistretti et al., 2021 is one such exception), even these studies do not consider the specific relationships between individual design skills and organizational level capabilities that point to the origins or microfoundations of organizational design capabilities (Barney & Felin, 2013). Moreover, none of these studies draw upon the perspectives of the design managers responsible for building dynamic design capabilities or investigate the topic through an empirical study based on a large sample of firms.

To address this gap, we surveyed 106 managers responsible for the design process in firms eligible for the Compasso D'Oro award provided by the Association of Industrial Design (ADI)[1] to study how these firms built organizational-level design capabilities. This study distinguishes between two fundamental types of organizational design capabilities that excellent firms appear to leverage and that can be framed according to the current design and innovation management literature. These are user-centered design (UCD) and meaning innovation (MI). A UCD capability facilitates the building, marshaling and engagement of the creative problem-solving competencies and skills required to design products that satisfy users' needs (Mattelmäki, 2006; Norman & Draper, 1986; Vredenburg et al., 2002; Wilson, 2000, 2014). The aim of UCD is to grasp new *"hows"* (Salvendy, 2012; Verganti, 2017), i.e., new working logics, to resolve specific user issues. A MI capability aims to change the *"reason-why"* one uses a product. This capability involves the ability to sense, reinterpret and reshape a product's meaning and a user's ability to make sense of this meaning (Verganti, 2008, 2009, 2017).

Practitioner Points

- To build dynamic design capabilities managers should select professional designers with specific skills and how users can be actively involved.
- Different designer skills are required to build meaning innovation (MI) or user-centered design (UCD) dynamic capabilities.
- A different active role of the user is helpful to build MI or UCD dynamic capabilities.
- Building simultaneously MI and UCD dynamic capabilities could be challenging for managers because some designer skills can be detrimental for the former and beneficial for the latter and viceversa.

Given these differences in the teleology (i.e., aims and goals) and ontology (i.e., nature and characteristics) of the key design activities associated with UCD and MI, we explore the extent to which these organizational capabilities differentially draw upon individual resources and competences. Specifically, we draw upon the notion of microfoundations as individual-level factors that aggregate through different forms of interaction into collective-level factors, thereby allowing us to explain higher-level units of analysis, such as organizational capabilities (Barney & Felin, 2013). Accordingly, we conceive individual designer skills and the active involvement of users as microfoundations that contribute to the emergence of two distinct dynamic design capabilities (i.e., UCD and MI) at a macro-organizational level.

This study is unique because it analyzes these microfoundations (Barney & Felin, 2013; Dong et al., 2016) from the perspective of the managers who are responsible for selecting designers, based on their capabilities (i.e., ideation, holistic thinking, and envisioning), and deciding the different roles that users play in the design process. The study is also among the few that draw upon a large sample, given that cases provide most of the empirical support on which studies to-date have relied. Since UCD and MI belong to that *"special category of organizational capabilities (...) [that facilitate] an organization's ongoing ability to address environmental change by continually reconfiguring competencies"* (Liedtka, 2020, p. 56), we refer to both as dynamic capabilities.

Our findings reveal that certain designer capabilities are important, unimportant, or even counterproductive to

the development of these two organizational capabilities. UCD requires designers with holistic thinking but not ideation or envisioning capabilities. It also must accommodate a broad role for involving users in the design process. In contrast, MI requires designers with holistic thinking and envisioning design capabilities but not ideation capabilities; the need for MI to involve users in the process is minimal.

The remainder of this article comprises five sections. The Theory development section is divided into two subsections. The first subsection defines UCD and MI as design-related dynamic organizational capabilities. The second subsection advances hypotheses that specify individual-level designer capabilities and user involvement (at the organizational level) and traces them as microfoundations of these two organizational capabilities. The Research methods section describes our sample of firms cited for design excellence, the operationalization of the indicator variables, the measurement scales, the data collection protocol, and the statistical methodology of the study. The Results section presents the tests applied to the measurement model and the findings. The Discussion section explains these findings, including their contributions to and implications for the literature and future research. The final section concludes by situating this study in the emerging literature and considering its limitations.

2 | THEORY DEVELOPMENT

2.1 | Design innovation approaches as dynamic organizational capabilities

Scholars have begun to view organizational design capabilities as dynamic to the extent they facilitate an organization's ability to sense and seize new business opportunities (Dong et al., 2016) and to reconfigure resources to exploit these opportunities (Liedtka, 2020). Because such sensing, seizing, and reconfiguring are key features of both UCD and MI, we refer to each as a dynamic capability.[2] The literature contrasts these capabilities as two distinct approaches to design (Norman & Verganti, 2014). As its name implies, UCD places users at the core of the experiential routines that enable an organization to renew and revise its repertoire of knowledge and understanding of users (Sanders, 2002; Sanders et al., 2010). These routines (Nelson & Winter, 1982) all share the aims of enhancing empathy (Chang-Arana et al., 2020; Gero & Kannengiesser, 2004; Kouprie & Visser, 2009) and expanding the organization's awareness of the needs of users and the "pains and gains" they encounter when using a product or service (Osterwalder et al., 2014). MI encourages consideration of the broader context in which a user is embedded and shifts attention to sensing emerging sociocultural models and signals derived from technology and evolving social pressures (Dell'Era & Verganti, 2007, 2011; Rindova et al., 2011; Verganti, 2017).

UCD and MI differ in how they employ *framing* and *abduction* (Dorst, 2011; Wu et al., 2009). While both capabilities involve the creation of new frames, UCD typically seeks "the attainment of a certain value" (Dorst, 2011, p. 523) and focuses on first finding a "working principle" that delivers the aspired value (i.e., the frame). Then, UCD facilitates the search for things that conform to the working principle (see Dorst [2011] for a clear example of UCD applied to "frame creation"). Abduction is used to advance the new hypotheses to be tested and explore the conditions under which the hypotheses appear to be true or need to be revised.

MI offers greater freedom in frame creation because the acceptable level of value (or meaning) is not fixed. This allows abduction to focus more on a user's environment and life and less on the multitude of details that describe the use of a product. Thus, in contrast to UCD's outside-in process (aiming to understand a user's pains and gains from using a product), MI is an inside-out process (aiming to find a compelling reason why a user should use a product and then convince the user). MI requires managers or entrepreneurs to be alert to the symptoms and malaises that mark the distance between the current product meanings in a given industry and meanings that may be more relevant in people's lives. In this way, managers and entrepreneurs (under the guidance of the design team) become the prime promoters of the search for novel meanings (Altuna et al., 2017; Verganti, 2017), and users are considered a group rather than as individuals. MI is a more "hermeneutic" activity based on "criticism" that aims to produce novel interpretations of the future of society in terms of desires, wishes, expectations or perceived malaises (Verganti, 2017).

Its goal is to develop robust visions allowing managers and designers to share a common direction template before generating ideas. This ability to reset direction is the core of MI as a dynamic capability. It is no coincidence that MI has recently become a theme that has gained the attention of the management community for its characteristics linked to market shaping and the reconfiguration of competitive rules (Anthony et al., 2016; Khaire & Wadhwani, 2010; Rindova & Courtney, 2020).

Anecdotal evidence suggests that firms base their strategy on their UCD or MI dynamic capabilities. For example, Philips Design's website implies a UCD focus. *"We bring human-centered innovation to the technologies we all rely on for healthcare and healthy living. The products, services and solutions we design touch the lives of millions every day. We shape experiences to improve lives."* In contrast, Alessi's

"Family Follows Fiction" collection, Nintendo's Wii video gaming console, Kartel's iconic plastic-based interior products and Technogym's Kinesis fitness equipment are all recognized as examples of meaning innovators that changed the deep "reason why" people buy and love their products (Norman & Verganti, 2014; Rindova et al., 2011; Verganti, 2009, 2017). The managers of these and other firms likely carefully assembled the microfoundations of their firms' dynamic design capabilities.

2.2 | Microfoundations of dynamic design capabilities

An examination of the microfoundations of dynamic capabilities can occur at the individual, organizational, and network levels of analysis (Eisenhardt & Martin, 2000; Rothaermel & Hess, 2007; Salvato & Vassolo, 2018; Teece et al., 1997; Verona & Ravasi, 2003). However, according to Barney and Felin (2013, pp. 140–141), few studies actually "explain the origins of the macro as the result of individuals and their interaction." These scholars argue that "various collective 'givens' (...) need to be unpacked to understand factors such as organizational capability (...) [and t]hese matters have not been addressed systematically in the literature on organizational capabilities (...) The first-order questions (...) should focus on the composition of the organization: Who—with what skills, abilities, capability, and knowledge—selects into (or leaves) organizations, with what aggregate effects? How is capability, in the aggregate, built? Where do firm-level expectations and information come from? How is information aggregated?" (p. 149). Our research questions and design allow us to open this black box to address some of these first-order questions and thereby systematically unpack how UCD and MI differ in the microfoundations that each dynamic design capability must effectively marshal.

Our cross-level design begins at the level of individuals and pertains to individual designers' capabilities. At the organizational level, we consider the role of users in the design activities of firms and include the capabilities needed to facilitate their involvement. Unpacking the design and innovation management literature to identify specific individual designer capabilities is complicated. First, a clear distinction among capabilities, skills and mindsets is lacking. Second, scholars have employed a plurality of units of analysis (from professional designers to design leaders or design managers, project teams, and the corporate dimension). Third, the anecdotal nature of the design literature often lacks any robust empirical analyses. Therefore, we limit our literature review to only a few studies with relevant contributions that shed light on the skills and capabilities of individual designers in an organizational setting.

2.2.1 | Ideation capabilities of designers as a microfoundation of UCD and MI

Managerial literature widely uses the term "creativity" defined as *"the production of novel and useful ideas by an individual or a small group of individuals working together"* (Amabile, 1988, p. 126). Creativity is strongly associated with problem solving (Basadur et al., 2000), and in the design literature specifically, it is considered to involve an iterative ability to pass back and forth between the "problem space" and "solution space" (Cross, 2001; Dorst & Cross, 2001). Iterating in this way makes it useful for expanding a problem's boundaries, which aids the search for novel solutions (Dorst & Cross, 2001).[3] Thus, creativity creates a conceptual bridge between the problem setting and various ways to "exit" the problem setting (Carbon, 2019; Gero & Kannengiesser, 2004). Gianpiero Di Gianvittorio, Director at PwC Italy Experience Centre Leader, noted the following: *"Ideas are not just the first attempt to solve the problem, they are a powerful tool to properly understand and redefine the problem itself. Ideating allows clarifying the boundaries and nature of the problem"* (Dell'Era et al., 2020, p. 330). Thus, ideation is an individual's ability to creatively translate various inputs into a large set of possible new solutions. As ideators, designers often act as brokers that combine technologies and product languages from other industry settings (Hargadon & Sutton, 1997).

As noted above, UCD involves an outside-in process that starts with a greater understanding of often ill-defined user problems, which may stem from apparent or even latent needs, and progresses to finding new *"hows"* to address them (Norman & Verganti, 2014; Verganti, 2017; Wilson, 2013). Therefore, the availability of a large set of potential new solutions to satisfy users may be of primary importance to companies that adopt an open-ended approach to seeking all possible internal or external sources of new ideas. Thus, we expect that designers with the ability to produce such a set of possible solutions are likely to be considered important by company managers for building organizational competences related to UCD.

In contrast, MI is more of an inside-out process that starts with the need to sense and make sense of the various signals pervading society and industries in order to build a robust vision that explains how people live and what they would love (Verganti, 2017). Verganti (2017, p. 14) explains it in this way: *"The process of getting to a novel meaningful interpretation (...) is totally different from the classic ideation process. A new meaning is not created through quantity, i.e., by generating as many ideas as possible and then selecting the best one. Instead, it is created through quality: by taking a few initial visions and making them clash: focusing on their differences in the search for a novel deeper interpretation that can explain what lies beyond each of them."*

Indeed, designers capable of providing many new and varied solutions and other possible sources of new ideas may even impede MI. Without new visions and directions, generating new ideas only overcrowds the organization without supplying new responses to emerging cultural and social demands. Therefore, we expect managers to view designers with ideation capabilities as unhelpful for building a dynamic capability for MI.

Hence, we advance the following two hypotheses:

Hypothesis 1a *The ideation capabilities of designers are positively associated with UCD.*

Hypothesis 1b *The ideation capabilities of designers are negatively associated with MI.*

2.2.2 | Holistic thinking capabilities of designers as a microfoundation of UCD and MI

Recent studies emphasize that critical thinking (Dell'Era et al., 2020; Magistretti et al., 2018; Martin & Martin, 2009) and systemic thinking (Cooper et al., 2009; Plattner et al., 2009) are key designer skills that facilitate leveraging the design process and particularly aid in exploring innovative trajectories in the search for novel ideas. The idea of critical thinking emphasizes its etymological roots, i.e., *"krino"* (κρίνω) refers to the practice of "judging", "valuing", or examining in depth when interpreting things (Verganti, 2017). Systemic thinking in the design literature dates back to the Gestalt theory of perception (Koffka, 1922) applied to design. According to this theory, the role of a product or the solution it provides must be interpreted and framed according to the contextual landscape (Behrens, 1998; Graham, 2008; Hollnagel, 1997; Jones, 2015), while embracing all aspects and relationships surrounding the object and the user-product relations.

Whereas critical thinking prompts designers to delve deeper into the design problem, systems thinking is required to expand the scope of the problem space and, thus, connect many elements and aspects related to users, users' context, and external social and cultural trends at different levels. In different ways, both skills can free designers from current constraints and facilitate new perspectives in the approach to designing new solutions. Critical thinking, in fact, allows designers to challenge the status quo at different levels and avoid the common tendency to fall in love with the first or easiest solution instead of reframing and delving deeper into the more controversial aspects of "wicked", ill-defined, or complex design problems (Buchanan, 1992). Systems thinking opens the door to considering and addressing interdependencies, prompting designers to extend beyond the usual constraints of the current context (Reynolds, 2011).

We refer to the combination of these two thinking skills, i.e., critical and systemic, as the designer's "holistic thinking capability," which invokes a common designer cognition dynamic that is associated with zoom-in and zoom-out activities (Ruttenberg & Maital, 2014). Designers with holistic thinking capabilities are likely to be important components of both UCD and MI capabilities because they enhance the organization's ability to identify a new "*how*" for UCD or a new "*why*" for MI.

Holistic thinking applied to UCD serves as an enabler of contextual inquiry (Beyer & Holtzblatt, 1999; Gero & Kannengiesser, 2004) that more easily connects contextual elements and makes it easier to grasp and make sense of system dimensions. It also promotes the critical search for insights and the ability to skim such insights and advance hypotheses regarding new innovation trajectories that match users' expressed or unexpressed needs.

Applied to MI, holistic thinking capabilities enable a deeper and wider understanding of the context that can justify and sustain the design of new meanings. According to Verganti (2017), "*[meaning innovation] is a process of clashing and fusing the different perspectives that we inevitably have inside ourselves. While brainstorming suggests deferring judgment, innovation of meaning creates through judgment. It's the art of criticism that enables us to discover the new, to turn the blurred internal hypotheses we start with into a final robust vision that people love.*" Hence, the search for new meanings requires a systemic view to grasp emerging sociocultural models, sense weak social behavior, and identify symptomatic gaps between the received view of the current meaning and people's lives.

Thus, the holistic thinking capabilities of designers are likely to be considered beneficial by managers seeking to build dynamic capabilities related to either UCD or MI.

Accordingly, we propose the following hypothesis:

Hypothesis 2 *The holistic thinking capabilities of designers are positively associated with both UCD and MI.*

2.2.3 | Envisioning capabilities of designers as a microfoundation of UCD and MI

The emerging domains of design leadership (Joziasse, 2011; Miller & Moultrie, 2013; Sherwin & Maguire, 2010; Turner, 2016) and design management (Acklin, 2013; Chiva & Alegre, 2007; Fernández-Mesa et al., 2013) have highlighted the importance of designers' ability to envision new scenarios that can guide design activities. This ability is rooted in the skills of imagining and visualizing (Miller & Moultrie, 2013). Imagining involves looking beyond the status quo and projecting a new possible future and courses of action. Visualizing relates to representing and translating ideas into visual artifacts to expedite sharing and gathering feedback.

By imagining and representing future scenarios, designers provide company management with insight into possible development paths that match design solutions with business constraints (Morelli & Tollestrup, 2007; Wrigley & Bucolo, 2012). For example, in the search for new solutions, the ability to envision scenarios based on new artifacts, experiences, user contexts, or activities can help support decisions regarding which innovation trajectory appears the most attractive to the business (Carlgren et al., 2016; Dell'Era et al., 2020; Krum, 2013; Magistretti et al., 2018; Micheli et al., 2019).

UCD and MI are likely to differ in the importance they assign to envisioning capabilities. In UCD, even when the value of designers visualizing new solutions is acknowledged, there is no expected role of projecting designers' vision or imagination into the future. Rather, all observational activities proposed in UCD settings tend to derive their insights from a *"hic et nunc"* situation involving the contextual inquiry of the user.[4] Even the UCD tool repertoire (Sanders, 2002) does not embrace scenario-building techniques or other visioning devices. Thus, the envisioning capabilities of designers appear not to be relevant for UCD, and managers are unlikely to consider them essential for this type of dynamic capability.

In contrast, envisioning is at the core of MI (Verganti, 2017). The dynamics of *"clashing and fusing"* are based on confrontation among new scenarios and visions of the future. Visions are contrasted and visualized in the form of "cultural probes" (Verganti, 2017) to understand what can be considered a desirable future for people. Moreover, the repertoire of tools of MI includes different scenario-building techniques (Verganti, 2017). Thus, the envisioning capabilities of designers can be considered fundamental for MI, and managers likely consider them important as they seek to build this type of dynamic capability.

Accordingly, we propose the following hypotheses:

Hypothesis 3a *The envisioning capabilities of designers are not associated with UCD.*

Hypothesis 3b *The envisioning capabilities of designers are positively associated with MI.*

2.2.4 | Active user involvement as a microfoundation of UCD and MI

Although Hekkert and Van Dijk (2001) argue that paying too much attention to end users can erode the role of the designer, whose vision and creativity are essential for innovation, design theory and practice have always assumed the relevance of involving users in the design of new solutions (Steen et al., 2007). This involvement has long been essentially passive, posing the user as an actor to be observed and studied in terms of biometric parameters and soft dimensions, such as cultural behaviors and habits (Barab et al., 2004; Salvador et al., 1999). Recently, the diffusion of digital technologies and the evolution of user culture (Schäfer, 2011) have allowed users to more actively participate in innovation processes managed by organizations. Thus, techniques aiming to merely identify user needs (Lindgaard et al., 2006) or the sets of pains and gains associated with the "job to be done" (Osterwalder et al., 2014) have been supplemented with techniques to actively involve users in the ideation, conceptualization, and testing phases of the design process (Celikoglu et al., 2017; Füller et al., 2014; Lettl, 2007). An entire repertoire of different techniques is available to support designers in understanding users (such as the ethnographic fieldwork or lead-user approach) or leverage users' creativity to secure their collaboration in finding new solutions (such as in contextual design, co-designing, and empathic design).

A passive involvement of the user does not imply specific organizational efforts since the designer can easily individually manage the study and analysis of the anthropometric and behavioral characteristics of users. In contrast, the active involvement of users presupposes the company's development of practices and tools able to engage users in different phases of the design process and accumulate and make available the knowledge obtained through their involvement. Thus, active user involvement requires managers to assess the relevance of this type of involvement for building dynamic UCD or MI capabilities and, consequently, organizing the firm.

As previously noted, UCD relies on the ability of the organization to develop multiple ideas able to address users' problems and design solutions that meet their needs. Therefore, active user engagement can be a valuable source for company designers to gain inspiration, codevelop solutions with end-user contributions and test prototypes of new products and services in advance. Thus, we expect managers to consider active user involvement at the organizational level relevant for building dynamic capabilities related to UCD.

In contrast to UCD, the MI approach does not require much user involvement during the design process. As highlighted above, this approach consists of an inside-out process that begins with management formulating new hypotheses regarding emerging sociocultural trends and new business assumptions and continues with designers developing scenarios for new product meanings (Verganti, 2017). The result of the process is a prototype that incorporates new cultural assumptions made tangible in the design of new meaningful experiences. Thus, users are only the terminal point in the entire design process and the recipients of the meanings that the product conveys.

Thus, active user involvement at an organizational level can be considered unimportant for MI, and managers are likely to consider user involvement unhelpful for building this type of dynamic capability.

Accordingly, we propose the following hypotheses:

Hypothesis 4a *Active user involvement at the organizational level is positively associated with UCD.*

Hypothesis 4b *Active user involvement at the organizational level is not associated with MI.*

3 | RESEARCH METHODS

3.1 | Sample and data collection

This study was based on a sample of companies included as eligible for the Compasso d'Oro Award by the Italian Association of Industrial Design (ADI)[5] during the 2011–2016 period. Only firms in the "design for living" category were included in the sample, allowing us to focus on design projects whose output was a specific product rather than a service or cultural initiative. This category includes companies that manufacture furniture and accessories for the home, lighting equipment, sanitary and bathroom accessories, kitchen furniture and appliances, televisions, computers, home automation control systems, outdoor furniture, equipment for gardening, street furniture, and public lighting.

The survey was conducted through a closed-ended questionnaire using a single respondent approach (Montabon et al., 2018). The targeted respondent was the manager that the ADI listed as officially responsible for the project development. This approach, supported by previous studies, is consistent with a sample mainly composed of SMEs (Kull et al., 2018). In these types of organizations, the responsibility for managing design activities is usually assumed by one person who has a design background/experience (often a top manager or even the business owner). Other people lack either the management position or the design background required to be qualified to answer our specific questions. Therefore, following a proven protocol (Montabon et al., 2018), we chose not to draw on multiple respondents and focused, instead, on attempting to reach the single best respondent at each company.

The population initially comprised 457 companies. Companies that did not respond after the initial receipt of the questionnaire were contacted again, up to two more times. Of the 121 questionnaires completed and returned, 106 were considered valid after eliminating the incomplete questionnaires and outliers. Incomplete questionnaires missed relevant data, while those related to projects carried out by different types of organizations, such as cultural associations, were considered outliers. Indeed, these organizations differ in their mission because they are not for profit, and they usually do not have a clear managerial structure. As a result, based on their nature, these organizations could be spurious in how they build and manage dynamic design capabilities.

The final response rate of 23% is consistent with other studies investigating firms through a questionnaire administered to managers, e.g., studies have observed an average response rate of 35% with a standard deviation of 18% (Baruch & Holtom, 2008; Mellahi & Harris, 2016). This approach allowed us to build a sufficiently large data set to conduct a statistical study based on the PLS-SEM approach; Chin (2001) suggests a minimum number of observations equal to 10 times the maximum number of independent variables to be regressed on each of the model's dependent variables.

The characteristics of our sample are summarized in Table 1.

3.2 | Indicator variables and measurement scales

The measurement model includes twelve indicator variables used to capture six different latent constructs. The indicator variables were identified through questions expressed as statements that the managers had to read and use to indicate their level of agreement. A five-step Likert scale (disagree, moderately disagree, neither agree nor disagree, moderately agree, and agree) was used. The questionnaire was designed to be brief

TABLE 1 Characteristics of the sample

Turnover (Mln. Euro)	Number of employees	Examples of firms in the sample	Number of firms in %
>100	>250	Artemide, B-Ticino, Cassina, Natuzzi, Technogym, and Veneta Cucine	10%
>10 and ≤100	≥50 and ≤250	Alessi, Poltrona Frau, and Teuco-Guzzini	35%
>1 and ≤10	≥10 and ≤50	Fiam Italia and Martinelli Luce	28%
≤1	<10	Small-firms and design studios	26%

and easy to answer. As noted in the literature, questionnaires that are excessively long or use multiple items are not well suited to target respondents who are challenging to reach or who may be tempted not to respond or respond without the level of attention needed for our study. However, using a few items or even individual items to capture higher-order constructs still requires some caution. Building on Rossiter (2002), Bergkvist and Rossiter (2007, p. 176) suggest that "*a single-item measure is sufficient if the construct is such that in the minds of raters (e.g., respondents in a survey) (1) the object of the construct is 'concrete singular,' meaning that it consists of one object that is easily and uniformly imagined, and (2) the attribute of the construct is 'concrete,' again meaning that it is easily and uniformly imagined*." Accordingly, we sought the expertise of design experts and academics, who helped us clarify the statements and ensure consistency with the issues investigated.

Moreover, to confirm the reliability of each measurement item, a prototype of the questionnaire was pretested in person with a panel of selected managers to obtain feedback and identify and remove possible sources of misunderstanding and/or ambiguity. Finally, the questionnaire was administered to the whole sample of target respondents through the Qualtrix online platform, whose monitoring features were used to control the behavior of the respondents. Phone support was offered to the respondents for two months to encourage them to complete the questionnaire and provide clarifications if needed. The simplicity of the questionnaire and the small number of items used to describe the constructs lower the risk of common method bias (Williams et al., 1989) without necessarily losing much predictive validity (Drolet & Morrison, 2001).

3.2.1 | Individual designer capabilities

Five items that identify five different individual designer skills/abilities were used to capture three main designer capabilities: ideation, holistic thinking, and envisioning. The following five items were defined using specific terms largely acknowledged and recognized by the design-related community of practitioners: creativity (in finding new solutions), critical thinking, systemic thinking, ability to imagine possible futures, and ability to represent (new scenarios) visually.

As previously noted, creativity is usually associated with designers' ability to generate new ideas by redefining the problem space. Therefore, we used this item to capture the relevance assigned by managers to designers' capability to creatively seek new solutions (ideation capability) (Cooper et al., 2009; Martin & Martin, 2009; Martínez-Villagrasa et al., 2018; Morelli & Tollestrup, 2007; Turner, 2016).

Critical thinking and systems thinking were used as elements to capture managers' perception of the relevance of the ability of designers to adopt a holistic view of both the problem space and solution space (holistic thinking capability) (Martin & Martin, 2009; Reynolds, 2011; Verganti, 2017).

Finally, the ability to imagine different futures and the ability to visually represent new possible scenarios were used to capture managers' perception of the relevance of the designers' ability to develop new visions of the future related to new solution design (envisioning capability) (Michlewski, 2008; Topalian, 2002; Turner, 2016; Verganti, 2017).

Table 2 summarizes the indicator variables used to identify the designers' skills and their association with individual designers' capabilities along with the main studies in the literature that refer to these variables. The questions used to investigate the relevance assigned

TABLE 2 Indicator variables used to capture individual-level designer skills/capabilities

Latent variables (designer capabilities)	Indicator variables (designer skills/abilities)	Key literature references (all at the individual level)
Ideation capabilities (IC)	Creativity (CR)	Amabile (1988), Basadur et al. (2000), Cross (2011); Dorst and Cross (2001); Dorst (2011); Wrigley and Bucolo (2012)
Holistic thinking capabilities (HC)	Critical thinking (CT)	Verganti (2017); Magistretti et al. (2018); Cooper et al. (2009); Jones (2015); Graham (2008); Behrens (1998)
	Systemic thinking (ST)	Cooper et al. (2009); Martin and Martin (2009); Koffka (1922); Bertola and Teixeira (2003); Hargadon and Sutton (1997); Ryan (2014); Mont (2002)
Envisioning capabilities (EC)	Scenario imagination (SI)	Topalian (2013); Sherwin and Maguire (2010); Miller and Moultrie (2013); Morelli and Tollestrup (2007); Wrigley and Bucolo (2012)
	Scenario representation (SR)	Morelli and Tollestrup (2007); Topalian (2013); Sherwin and Maguire (2010); Miller and Moultrie (2013); Joziasse (2011); Turner (2016)

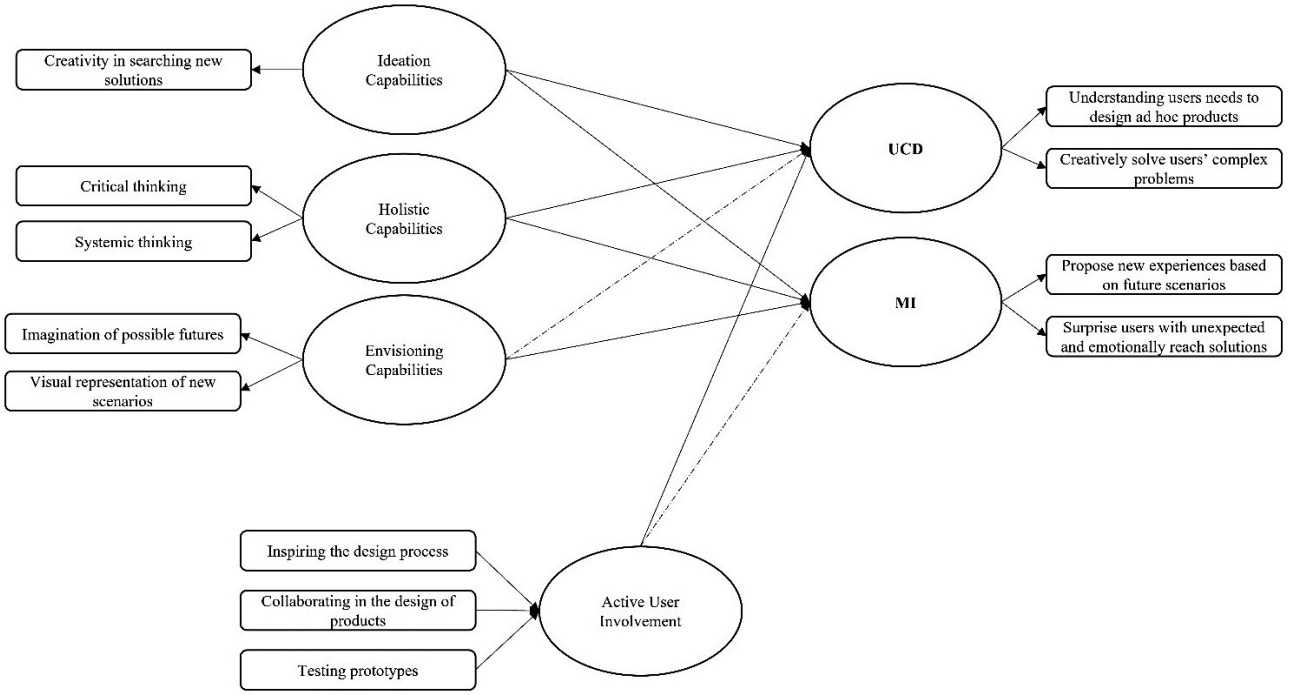

FIGURE 1 Complete structural equation model

by managers to each designer skill are reported in Appendix A.

3.2.2 | Active user involvement

As previously noted, design studies highlighted the different roles of users in the design activities of a company (Sanders, 2002; Sanders et al., 2010). Accordingly, these different roles were used to capture managers' perceptions of the importance of users' involvement for design-related dynamic capabilities. In particular, consistent with the logic presented in the theory development section of this article, the respondents were asked to evaluate the importance of three different ways for users to participate in the design process.

The first type of involvement is about user participation in alerting designers and inspiring them with several new ideas (Gero & Kannengiesser, 2004; Gould & Lewis, 1985; Celikoglu et al., 2017). The second type of involvement relates to collaboration between users and designers in developing new solutions (Füller et al., 2014; Jespersen, 2010; Sanders, 2002; Taffe, 2015). The third type of involvement concerns user testing new solutions developed by designers during the design process (Sauer & Sonderegger, 2009; Sonderegger & Sauer, 2010). These three types of involvement were coded respectively as follows: inspiring the design process (IDP), collaborating in the design of solutions (CDS), and testing new solutions (TNS). All three ways jointly contribute to defining user involvement, which was built as a formative construct. The questions used to identify the managers' perceptions of the relevance of the different possible ways of engaging users in the design process are reported in Appendix A.

3.2.3 | Organizational dynamic design capabilities

As already noted, the two design-related dynamic capabilities considered in this study (i.e., UCD and MI) differ in terms of teleology and ontology (Dell'Era et al., 2020; Norman, ; Norman & Verganti, 2014; Verganti, 2009, 2017). Thus, to assess the relevance of UCD and MI among firms recognized for design excellence, the managers were asked to evaluate the importance of the possible roles of design that can be associated with either UCD or MI. Consistent with the logic presented in the theory development section of this article, UCD was associated with two main design roles. The first role is understanding user needs and developing and proposing ad hoc products based on this understanding (Kouprie & Visser, 2009; Norman & Draper, 1986; Sanders, 2002). The second role is creatively solving complex problems that users can encounter using specific products (Brown, 2008; Buchanan, 1992; Cross, 2001, 2011; Dorst, 2011). Similarly, MI was defined according to its association with two roles. The first role is imagining future scenarios and proposing new user experiences (Verganti, 2009, 2017). The second role of design is surprising users with unexpected and

emotionally rich solutions (Altuna et al., 2017; Verganti, 2009, 2017). Accordingly, both UCD and MI were defined as reflective constructs.

Figure 1 shows the complete structural equation model used to test the relationship between the microfoundations and dynamic design capabilities.

3.3 | Statistical analysis

Statistical analysis was conducted using SEM based on partial least squares (PLS-SEM). This methodology relaxes the data normality condition required by covariance-based structural equation modeling and provides robust results even with relatively small samples. Therefore, this approach is particularly suitable for exploratory studies (Hwang et al., 2010; Wong, 2010, 2013). In contrast to covariance-based SEM (CB-SEM), PLS-SEM is used to estimate coefficients that maximize the R^2 value of the endogenous constructs of the model and does not allow an analysis of biunivocal correlations. The statistical analysis relied on the following two macro phases as suggested in the literature (Hair et al., 2016): (1) measurement model evaluation and (2) structural model evaluation. The measurement model evaluation comprised the following four steps: (1) analysis of the construct reliability and validity of the reflective constructs; (2) analysis of the discriminant validity of the reflective constructs; (3) analysis of the collinearity of the formative indicators; and (4) analysis of the significance and relevance of the formative indicators. The structural model evaluation comprised the following two steps: (1) estimation of the model path coefficients and (2) estimation of the significance of the coefficients through a bootstrapping technique.

4 | RESULTS

4.1 | Measurement model evaluation

The analysis of the results focused primarily on assessing the quality of our measurement model. Accordingly, the internal consistency, reliability and convergent validity of the five reflective constructs were first analyzed. All model constructs indicated internal consistency, reliability, and convergent validity values in the range/above the thresholds suggested in the literature, confirming the goodness of the model. The second step of the analysis was evaluating the discriminant validity of the reflective constructs of the model. This analysis also reported values in the expected range, supporting the conclusion that all reflexive latent variables have discriminant validity. The following step was an analysis of the collinearity between the variable indicators of the only formative construct of

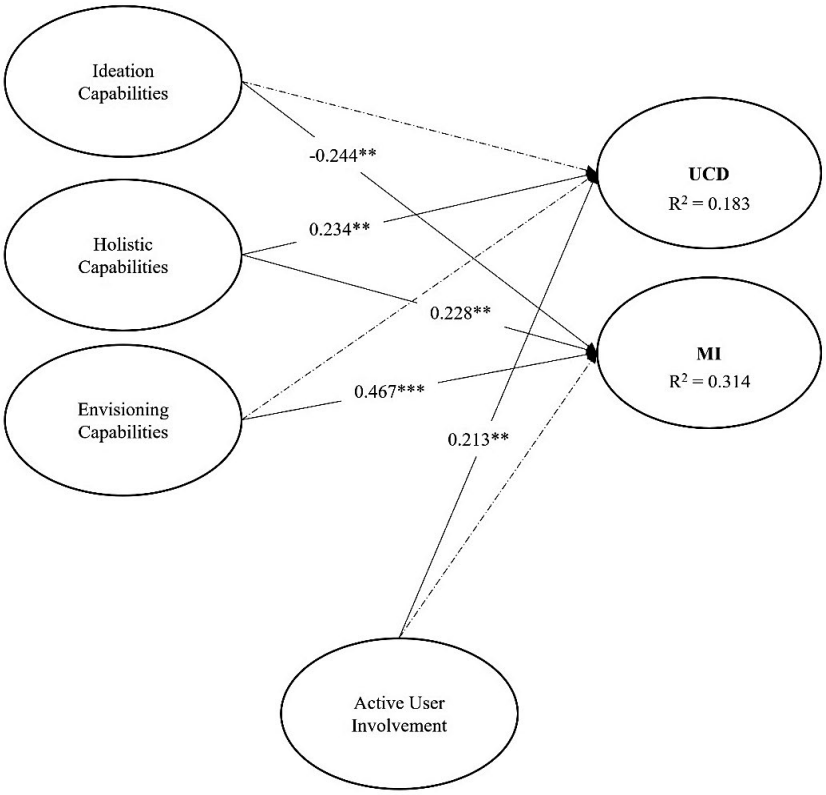

FIGURE 2 Structural equation model results

the model. The test excluded collinearity among the indicators. The final step was the evaluation of the significance of the model's formative indicators. All indicators proved to be significant and, therefore, were retained.

The details of the measurement model evaluation are provided in Appendix B.

4.2 | Structural model evaluation

After the quality assessment of the measurement model, a two-tailed test was used to estimate the path coefficients of the model and, by applying a bootstrapping technique, their level of significance. Following established practice, the number of subsamples used in bootstrapping was set at 5000, and the minimum significance level was set at $p < 0.05$. Figure 2 shows the analysis results; the coefficient and significance of the significant relationships are indicated, and a dotted line represents the nonsignificant relationships for ease of reading. The R^2 values of the two endogenous latent constructs, i.e., UCD and MI, are 0.183 and 0.314, respectively. Although there is a lack of consensus in the literature regarding the levels of R^2 that are acceptable for PLS-SEM models, the exploratory nature of our study may justify the relatively low explanatory power of our dependent variables (Hair et al., 2016). Future studies considering other microfoundations of design-related capabilities are likely to increase the total variance explained and eventually diminish the relative weight of our explanators.

As shown in Figure 2, ideation capabilities are negatively related to MI. Holistic thinking capabilities are positively related to both UCD and MI. Envisioning capabilities are positively related only to MI, and this relationship is the strongest in absolute terms. In contrast to our expectations, the relationship between ideation capabilities and UCD is not statistically significant. Active user involvement, as hypothesized, is positively associated with UCD and has no significant relationship with MI.

5 | DISCUSSION

The data in our sample of managers of Italian companies recognized for their design excellence supported seven of our eight hypotheses. Only H1a, which posited a positive association between designers' *ideation* capabilities and UCD, was not supported. Taken together, these results corroborate the central idea that managers consider their firms' approach to innovation when seeking to build design-related capabilities and recognize that unique combinations of designer capabilities and different levels of user involvement are required.

This cross-level study represents an early effort to conceptually trace and empirically test how specific individual-level designer skills and the scope of user involvement serve as microfoundations (Barney & Felin, 2013) that differentially contribute to two organizational-level dynamic design capabilities. Additionally, while our findings largely corroborate extant theorizing regarding MI and its relationship with designer capabilities, they represent a step forward in gaining the empirical richness that is needed in this stream of design innovation management research. We discuss below some implications and further contributions of these findings specific to each designer capability and to user involvement.

5.1 | Ideation designer capability

Given that H1a was based on the orthodox concept of creativity and the importance routinely assigned to the generation of new ideas (Amabile, 1988; Basadur et al., 2000; Cross, 2001; Paulus & Brown, 2003; Putman & Paulus, 2009), our finding of no significant relationship between designer ideation capabilities and UCD can be somewhat puzzling. The result prompts the question, "why did the managers in our study place no special value on this capability?"

The lack of significance does not necessarily suggest that ideation is unimportant for the firms in our sample. Instead, it may imply that some managers perceive ideation capabilities as beneficial for their designers and other managers view such capabilities as less critical. Indeed, in some organizations, the ideation role, although important, could be played by someone *other* than the organization's designers.[6] In this case, as suggested by the literature, designers act more as facilitators, whose main ability is to acknowledge the ideas of others and translate these ideas into new product requirements, than as developers of new ideas (Bertola & Teixeira, 2003). To effectively translate others' ideas, designers need to leverage specific knowledge about the use of materials, the product's architecture, and its language evolution (Dell'Era & Verganti, 2007; Swan et al., 2005; Verganti, 2003). They don't need ideation capabilities that managers would thus perceive as irrelevant. Specifying the boundary conditions for when designers with ideation capabilities are helpful for UCD and when others may play this role is a promising direction for future work.

The significant negative relationship observed between ideation capabilities and MI (H1b) suggests that designers with these capabilities may even be detrimental to an organization's efforts to build dynamic MI capabilities. Having numerous novel ideas can be distracting, and having expertise in generating ideas may even weaken commitments to a specific direction or blur the vision needed to sustain effort. Future studies linking this finding to

ideation capabilities' impact on MI outcomes could be useful.

5.2 | Holistic thinking and envisioning capabilities

Our results confirm that managers pursuing UCD dynamic capabilities seem to value holistic thinking capabilities (H2a) but not envisioning capabilities (H3a). These findings suggest that good products that delight users do not require designers capable of imagining and visually representing alternative futures. They also echo the call in recent ergonomic studies for a broader focus beyond the user-product relationship, i.e., a focus considering more contextual elements and usage contingencies (Beyer & Holtzblatt, 1999; Hekkert & Van Dijk, 2001; Kouprie & Visser, 2009). Such studies, often referred to as system or holistic ergonomics (a sort of augmented ergonomics), suggest that grasping insights from the user field requires a more comprehensive view of all main spatial-relational and time-based aspects. This holistic view could be particularly useful in competitive environments where companies differentiate their offerings less on tangible products and more on user experiences and "product-service systems" (Baines et al., 2007).

Our results support the idea that having designers with both holistic thinking (H2b) and envisioning capabilities (H3b) is valued by managers pursuing MI. While unsurprising, these findings provide empirical support for the argument that emergent new meanings are more easily grasped by designers equipped with a combination of skills that enable them to question assumptions rooted in the current reality and to develop alternative systemic visions of the future (Verganti, 2017). The firm-level ability to chart new directions for the future is aided, on the one hand, by designers' ability to sense and link scattered weak signals emanating from technological, societal and economic forces; on the other hand, by designers' ability to combine and recombine alternative direction hypotheses that can be tested and iterated. MI may be difficult or even impossible without some general picture of possible futures and the elements that can be mobilized to promote new experiences.

Although our results place designers' holistic thinking capabilities at the core of *both* UCD and MI dynamic design capabilities, future research is needed to determine the extent to which the requisite abilities may differ and how the same abilities may be differentially applied. We argued that holistic thinking is helpful for UCD when applied in the context of the user-product relationship. As designers consider more cognitive and behavioral dimensions of user experience, they need to grasp the signals and insights that contribute to the coherent whole of the context of this relationship. Holistic thinking is needed in MI to reframe and make sense of the complex web of relationships that embed technology scenarios, people's lives, emergent malaises or misalignments between industry standards (which embed consolidated and frozen meanings), and novel cultural languages and registers (Rindova et al., 2011). This role of holistic thinking in MI calls for an ability that does more than expand the designer's consideration to include a broader scope of issues; it must inform warranted changes in the object to which the capability is applied. Whereas UCD essentially focuses on the ethnographic context, MI seeks input from sociological, anthropological, and even philosophical aspects that connect and provide meaning to how people live and how they use products and services. Hence, additional research is needed to test our interpretation that, although the *same* underlying skills of holistic thinking may be helpful for MI and UCD, this same capability may need to be *applied* to a broader context in MI than UCD. Any differences in how this capability is applied will likely also require additional complementary capabilities.

5.3 | User involvement

The observed need for designers with envisioning capabilities for MI but not UCD is consistent with our final set of findings, i.e., active user involvement is at the core of UCD (H4a) but not MI (H4b). Thus, while building UCD dynamic capabilities, managers and designers must pay attention to users' needs and, as a part of the UCD dynamic capability, other organizational capabilities needed to facilitate the desired level of user involvement.

Finally, the supported null hypothesis, H4b, is consistent with the limited role that users play in MI. Indeed, delving into the life of users, asking users to play a lead role in the design process or in the testing of prototypes, is unhelpful for recognizing the emerging social and cultural dynamics that form the basis for designing new meanings (Dell'Era & Verganti, 2007). Future work could, however, investigate specific types of user involvement to understand their impact on MI. For example, some forms of active user involvement aimed at testing the relevance of new meanings could be positively associated with MI.

5.4 | Managing the paradox of pursuing both UCD and MI

Our findings suggest that UCD and MI require a unique combination of designer skills and scope of user involvement, implying that organizing to build *both* capabilities is

not easy. However, UCD and MI are not necessarily mutually exclusive. Indeed, having both dynamic capabilities over time may even be necessary, especially among firms with design excellence that seek to retain such excellence.[7] We view this issue as a paradox confronting design firms similar to the exploitation-exploration paradox described by March (1991).[8] Similar to exploitation and exploration, MI and UCD are likely to conflict if allowed to comingle. Companies that excel in design have to manage their use (e.g., through organizational innovations, such as ambidexterity) or somehow keep the two separated (e.g., temporally, structurally, or even via the structural holes [Burt, 1992] that characterize an actor's innovation networks [Rogan & Mors, 2017]). Also similar to the exploitation/exploration paradox, which has spawned a large, significant stream of literature, MI and the organization it requires may lead to developing a higher-order dynamic capability (like ambidexterity) that can also accommodate and renew an organization's UCD capability. Nevertheless, more research is warranted to explore the nuances of compatibility/incompatibility issues posed by UCD and MI.

5.5 | Continuing and expanding role of design "experts"

Design is becoming an essential strategic tool for companies of all sorts, and managers increasingly recognize its potential. This potential is reflected in the broad dissemination of design thinking (Kolko, 2015) across companies, consultancies, and business schools and the growing consideration of the vital role of design as a dynamic capability in an increasingly VUCA world (Liedtka, 2020).[9] Some researchers claim that design offers the prospect of "unleashing the creative potential within us all" (Kelley & Kelley, 2013). The proliferation of design thinking among organizations, including those noted for their design excellence, is consistent with our explanation for why our analysis did not reveal a strong presence of ideation among the capabilities of expert designers. As we discussed, the ideation role may be played by other individuals, especially in firms noted for their design excellence.

However, our study suggests another more nuanced implication of the evolving role of design and how it is practiced. In a rush to accommodate design thinking, practitioners and scholars risk losing sight of its limits, especially when it is prescribed to be practiced by "everyone" and commonly embedded in easily replicable routines and processes. This study suggests that at least among the firms cited for excellent design in our sample, there is a role for the deeper design cognition inherent in the training, thinking and practices of design experts and professionals. Design thinking, as it is often portrayed, is not a substitute for this expert cognition.[10]

The managers we surveyed recognize the difference between the two perspectives. While they seem to acknowledge a lesser need for ideation capabilities among their designers, they clearly consider the need for expert designers trained in other skills. The significance of designer capabilities for both UCD and MI underscores the need for professional designers with specific design skills to develop design-related organizational capabilities. These managers view (at least implicitly) the capabilities of these professional designers as fundamental for building organizational-level design capabilities that nurture and draw upon the special cognitive abilities of designers. Designers are essential contributors to how learning occurs in firms noted for their design excellence and how they mobilize and transform resources to innovate. The ongoing efforts to build organizational-level design capabilities and render them dynamic suggest an expanded role for professional designers and for the design cognition they help to inculcate, i.e., a role that will guide companies not only in adapting to change but also in leading and even shaping change (Rindova & Courtney, 2020).

6 | CONCLUSIONS AND LIMITATIONS OF THE STUDY

Previous studies show clearly that design plays a crucial role in creating a competitive advantage for companies. Some studies also highlight the central role of designers in developing organizational design capabilities and the central role played by users in design activities. However, such studies are mostly conceptual or draw upon cases to consider (albeit anecdotally) the microfoundations of firms' ability to leverage design approaches in innovation activities. This study is among the first to formalize and statistically test specific hypotheses regarding the relationship between two types of dynamic organizational design capabilities (i.e., UCD and MI) and two types of microfoundations (i.e., individual designer capabilities and active user involvement in the design process). The study provides empirical support for some widely held assumptions, notes apparent inconsistencies in other assumptions, and highlights the importance of still other assumptions not clearly stated in previous studies.

To benefit from data from a large sample of companies, we made a series of choices in the research design that have both advantages and limitations. First, only companies awarded by the ADI for innovative product design were included in the sample. This choice allowed us to restrict the data collected to ensure it would come from managers who are most likely to have design

expertise and are able to discern the different aspects of building design capability in their organization. At the same time, this choice limited our ability to understand whether dynamic design-related capabilities are conceived differently in firms lacking design excellence. Future studies may investigate the differences in leveraging design between excellent and non-excellent firms. Additional studies could also investigate the extent to which the microfoundations of the dynamic design capabilities may differ in different settings across industries. Moreover, the findings could be affected by factors, such as the type of product and market specificities. For example, more technology-focused developments may require skills and tools tailored to conducting technical research, while products more focused on customer value may require skills and tools that are tailored to competences useful for consumer behavior assessments. Future studies might address this issue and relate the investigated design capabilities to different product typologies and market specificities.

Second, to focus on the managers most involved in the process of designing award-winning products, we relied on a single respondent. This approach was especially useful for engaging with the large portion of the sample consisting of SMEs, which tend to have a single manager responsible for design activities. However, this approach may have limited our ability to capture the multiple perspectives of design that may exist in the larger organizations in our sample. Future studies may focus on larger companies demonstrating excellent design to capture differences in perceptions among the key actors involved in assembling the microfoundations of the design capabilities of their organizations.

Third, we used a short questionnaire based on a few key items. This approach is customary in exploratory studies targeting hard-to-reach and reluctant-to-respond informants because it helps increase response rates and ensure more attentive responses. However, using only a few items may entail the risk of reducing the content validity of the constructs and limiting the ability to discriminate finely among the respondents. In addition, some items may be interpreted differently by different respondents, reducing the explanatory power of the results. Although we adopted steps to limit these risks in constructing a questionnaire designed by design experts for a target audience of design experts, the validity of our exploratory results would be enhanced by corroborating evidence from future statistical analyses based on multiple item measures from large samples of companies. Such studies could adopt finer-grained measurement models to verify the latent constructs in our model or possibly include additional microfoundations and/or moderators that we omitted (e.g., the types of products designed, how the design process is conceived, or the radicalness of the innovation developed) to increase the magnitude of the coefficient in the model and the R^2 of the dependent variables.

In some sense the present study poses more questions than it answers and, thus, it clearly calls for additional work. But at least in some important ways, it also sheds light on promising paths for future research. We regard this work as a small but important step in more fully exploring the microfoundations of organizational design capabilities and starting to expand the necessary empirical investigations.

ACKNOWLEDGMENTS

We are grateful to the guest editors and the three reviewers who helped us in the different review rounds to strengthen the whole theoretical structure of the article, better highlight the real contribution to the literature, and clarify the limits of the study. We are also grateful to ADI (the Italian Association for Industrial Design) for the precious support received during the data-gathering phase.

CONFLICT OF INTEREST

There are no conflicts of interest.

ETHICS STATEMENT

The authors have read and agreed to the Committee on Publication Ethics (COPE) international standards for authors.

ORCID

Cabirio Cautela https://orcid.org/0000-0002-5171-2935
Michele Simoni https://orcid.org/0000-0003-1669-3676
Peter Moran https://orcid.org/0000-0001-8049-0377

ENDNOTES

[1] The ADI index comprises a list of firms participating in the Compasso D'Oro award (see note 5 below), which are recognized for their innovative product design.

[2] Although MI is often viewed as more radical and UCD is viewed as more incremental, both capabilities involve the type of "generative sensing" and its use of framing and abduction described by Dong et al. (2016); both capabilities enable organizations to seize opportunities identified through sensing and involve recombining organizations' resources and other capabilities to transform the value they create for users. In addition, MI is more likely to shape the business environment.

[3] In setting the solution space for a particular problem that a product or service user faces, it is fundamental to understand the user's implicit and hidden needs, wishes, and preferences, habits and behavior, as well as the context in which the user acts (Battarbee & Koskinen, 2005; Kouprie & Visser, 2009; Leonard & Rayport, 1997; Mattelmäki et al., 2014; Micheli et al., 2019; Sanders, 2002).

[4] *Hic et nunc* is a Latin locution that can be translated as "here and now" in English. In the design context, it refers to a situational approach to innovation that attempts to elicit qualitative context data from a specific user that can be blended and interpreted to provide insights for charting possible trajectories to improve product and services.

[5] The ADI is the Italian Association of Industrial Design, which since 1956 has brought together designers, companies, researchers, academics, critics, and journalists concerning design issues. Its aim is to promote and contribute to the implementation of the most appropriate conditions for the design of goods and services through cultural debate, intervention in institutions and service provision on a nonprofit basis. It manages the ADI Design Index, which selects the best design projects yearly at the national level to give the Compasso D'Oro award.

[6] For example, currently, after specifying the user framework, it is not unusual for companies to outsource creative activity to communities of external creative people (e.g., through crowd-sourcing platforms, design contests, hackathons or design jam sessions) to generate the greatest number of possible ideas.

[7] We thank one of our anonymous reviewers for this insight.

[8] To be successful in the long term, March (1991) argues that firms need to both exploit current opportunities and explore (and even create) new ones. For more information regarding the management of this paradox, see Smith and Lewis (2011).

[9] VUCA is an abbreviation for volatility, uncertainty, complexity, and ambiguity. See Millar et al. (2018) for a discussion of the challenges and recommendations for management innovation in a VUCA world.

[10] We thank one of our anonymous reviewers for this insight.

REFERENCES

Acklin, Claudia. 2013. "Design Management Absorption Model: A Framework to Describe and Measure the Absorption Process of Design Knowledge by SMEs with Little or No Prior Design Experience." *Creativity and Innovation Management 22*(2): 147–60.

Altuna, Naiara, Claudio Dell'Era, Paolo Landoni, and Roberto Verganti. 2017. "Developing Radically New Meanings Through the Collaboration with Radical Circles." *European Journal of Innovation Management 20*(2): 269–90.

Amabile, Teresa M. 1988. "A Model of Creativity and Innovation in Organizations." *Research in Organizational Behavior 10*(1): 123–67.

Anthony, Callen, Andrew J. Nelson, and Mary Tripsas. 2016. "'Who Are You?... I Really Wanna Know': Product Meaning and Competitive Positioning in the Nascent Synthesizer Industry." *Strategy Science 1*(3): 163–83.

Baines, Tim, Howard Lightfoot, Steve Evans, Andy Neely, Richard Greenough, Joe Peppard, Rajkumar Roy, Essam Shehab, Albert Braganza, Ashutosh Tiwari, Jeffrey Robert Alcock, James Angus, Martin Bastl, A. Cousens, Phil Irving, Mark Johnson, J Kingston, Helen Lockett, Veronica Martinez, P Michele, D. Tranfield, I. M. Walton, and Hugh Wilson. 2007. "State-of-the-Art in Product-Service Systems." *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture 221*(10): 1543–52.

Barab, Sasha A., Michael K. Thomas, Tyler Dodge, Kurt Squire, and Markeda Newell. 2004. "Critical Design Ethnography: Designing for Change." *Anthropology & Education Quarterly 35*(2): 254–68.

Barney, Jay, and Teppo Felin. 2013. "What are Microfoundations?"*Academy of Management Perspectives 27*(2): 138–55.

Baruch, Yehuda, and Brooks C. Holtom. 2008. "Survey Response Rate Levels and Trends in Organizational Research." *Human Relations 61*(8): 1139–60.

Basadur, Min, Pam Pringle, Gwen Speranzini, and Marie Bacot. 2000. "Collaborative Problem Solving Through Creativity in Problem Definition: Expanding the Pie." *Creativity and Innovation Management 9*(1): 54–76.

Battarbee, Katja, and Ilpo Koskinen. 2005. "Co-Experience: User Experience as Interaction." *CoDesign 1*(1): 5–18.

Behrens, Roy R. 1998. "Art, Design and Gestalt Theory." *Leonardo 31*(4): 299–303.

Bergkvist, Lars, and John R. Rossiter. 2007. "The Predictive Validity of Multiple-Item Versus Single-Item Measures of the Same Constructs." *Journal of Marketing Research 44*(2): 175–84.

Bertola, Paola, and José Carlos Teixeira. 2003. "Design as a Knowledge Agent: How Design as a Knowledge Process is Embedded into Organizations to Foster Innovation." *Design Studies 24*(2): 181–94.

Beyer, Hugh, and Karen Holtzblatt. 1999. "Contextual Design." *Interactions 6*(1): 32–42.

Brown, Tim. 2008. "Design Thinking." *Harvard Business Review 86*(6), 84–92, 141.

Buchanan, Richard. 1992. "Wicked Problems in Design Thinking." *Design Issues 8*(2): 5–21.

Buchanan, Richard. 2008. "Introduction: Design and Organizational Change." *Design Issues 24*(1): 2–9.

Burt, Ronald S. 1992. *Structural holes*. Cambridge, MA: Harvard University Press.

Carbon, Claus-Christian. 2019. "Psychology of Design." *Design Science 5*: e26.

Carlgren, Lisa, Ingo Rauth, and Maria Elmquist. 2016. "Framing Design Thinking: The Concept in Idea and Enactment." *Creativity and Innovation Management 25*(1): 38–57.

Celikoglu, Ozge Merzali, Sebnem Timur Ogut, and Klaus Krippendorff. 2017. "How Do User Stories Inspire Design? A Study of Cultural Probes." *Design Issues 33*(2): 84–98.

Cenfetelli, Ronald T., and Geneviève Bassellier. 2009. "Interpretation of Formative Measurement in Information Systems Research." *MIS Quarterly 33*(4): 689–707.

Chang-Arana, Alvaro M., Matias Piispanen, Tommi Himberg, Antti Surma-Aho, Jussi Alho, Mikko Sams, and Katja Hölttä-Otto. 2020. "Empathic Accuracy in Design: Exploring Design Outcomes Through Empathic Performance and Physiology." *Design Science 6*: 16.

Chin, Wynne. 2001. *PLS-Graph User's Guide*. Houston, TX: CT Bauer College of Business, University of Houston.

Chiva, Ricardo, and Joaquín Alegre. 2007. "Linking Design Management Skills and Design Function Organization: An Empirical Study of Spanish and Italian Ceramic Tile Producers." *Technovation 27*(10): 616–27.

Cooper, Rachel, Sabine Junginger, and Thomas Lockwood. 2009. "Design Thinking and Design Management: A Research and Practice Perspective." *Design Management Review 20*(2): 46–55.

Cross, Nigel. 2001. "Designerly Ways of Knowing: Design Discipline Versus Design Science." *Design Issues 17*(3): 49–55.

Cross, Nigel. 2011. *Design Thinking: Understanding How Designers Think and Work*. Oxford, UK: Berg Publisher.

Dell'Era, Claudio, Stefano Magistretti, Cabirio Cautela, Roberto Verganti, and Francesco Zurlo. 2020. "Four Kinds of Design Thinking: From Ideating to Making, Engaging, and Criticizing." *Creativity and Innovation Management 29*(2): 324–44.

Dell'Era, Claudio, and Roberto Verganti. 2007. "Strategies of Innovation and Imitation of Product Languages." *Journal of Product Innovation Management 24*(6): 580–99.

Dell'Era, Claudio, and Roberto Verganti. 2011. "Diffusion Processes of Product Meanings in Design-Intensive Industries: Determinants and Dynamics." *Journal of Product Innovation Management 28*(6): 881–95.

Dong, Andy, Massimo Garbuio, and Dan Lovallo. 2016. "Generative Sensing: A Design Perspective on the Microfoundations of Sensing Capabilities." *California Management Review 58*(4): 97–117.

Dorst, Kees. 2011. "The Core of 'Design Thinking' and its Application." *Design Studies 32*(6): 521–32.

Dorst, Kees, and Nigel Cross. 2001. "Creativity in the Design Process: Co-Evolution of Problem–Solution." *Design Studies 22*(5): 425–37.

Drolet, Aimee L., and Donald G. Morrison. 2001. "Do We Really Need Multiple-Item Measures in Service Research?" *Journal of Service Research 3*(3): 196–204.

Eisenhardt, Kathleen M., and Jeffrey A. Martin. 2000. "Dynamic Capabilities: What are They?" *Strategic Management Journal 21*(10–11): 1105–1121.

Elsbach, K. D., and I. Stigliani. 2018. "Design Thinking and Organizational Culture: A Review and Framework for Future Research." *Journal of Management 44*(6): 2274–306.

Fernández-Mesa, A., J. Alegre-Vidal, R. Chiva-Gómez, and A. Gutiérrez-Gracia 2013. Design management capability and product innovation in SMEs. *Management Decision 51*(3): 547–65.

Füller, Johann, Katja Hutter, Julia Hautz, and Kurt Matzler. 2014. "User Roles and Contributions in Innovation-Contest Communities." *Journal of Management Information Systems 31*(1): 273–308.

Gero, John S., and Udo Kannengiesser. 2004. "The Situated Function–Behaviour–Structure Framework." *Design Studies 25*(4): 373–91.

Gould, John D., and Clayton Lewis. 1985. "Designing for Usability: Key Principles and What Designers Think." *Communications of the ACM 28*(3): 300–11.

Graham, Lisa. 2008. "Gestalt Theory in Interactive Media Design." *Journal of Humanities & Social Sciences 2*(1): 571.

Hair, Joseph, G. Thomas M. Hult, Christian Ringle, and Marko Sarstedt. 2016. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Thousand Oaks, CA: Sage Publications.

Hair, Joe F., Christian M. Ringle, and Marko Sarstedt. 2011. "PLS-SEM: Indeed a Silver Bullet." *Journal of Marketing Theory and Practice 19*(2): 139–52.

Hargadon, Andrew, and Robert I. Sutton. 1997. "Technology Brokering and Innovation in a Product Development Firm." *Administrative Science Quarterly 42*(4): 716–49.

Hekkert, Paul P. M., and Matthijs van Dijk. 2001. "Designing from Context: Foundations and Applications of the ViP Approach." In *Designing in Context, Design Thinking Research Symposium 5*, edited by P. Lloyd and H. Christiaans, 383–94. Delft, Netherlands: Delft University Press Science.

Hollnagel, Erik. 1997. "Cognitive Ergonomics: It's All in the Mind." *Ergonomics 40*(10): 1170–82.

Hulland, John. 1999. "Use of Partial Least Squares (PLS) in Strategic Management Research: A Review of Four Recent Studies." *Strategic Management Journal 20*(2): 195–204.

Hwang, Heungsun, Naresh K. Malhotra, Youngchan Kim, Marc A. Tomiuk, and Sungjin Hong. 2010. "A Comparative Study on Parameter Recovery of Three Approaches to Structural Equation Modeling." *Journal of Marketing Research 47*(4): 699–712.

Jespersen, Kristina Risom. 2010. "User-Involvement and Open Innovation: The Case of Decision-Maker Openness." *International Journal of Innovation Management (IJIM) 14*(3): 471–89.

Jones, Peter H. 2015. "Design Research Methods for Systemic Design: Perspectives from Design Education and Practice." In *Proceedings of the 58th Annual Meeting of the ISSS—2014 United States*, 1–8. Washington, DC.

Joziasse, Frans. 2011. "The Soul of Design Leadership." *Design Management Review 22*(3): 34–42.

Kelley, Tom, and David Kelley. 2013. *Creative Confidence: Unleashing the Creative Potential Within Us All*. New York, NY: Currency.

Khaire, Mukti, and R. Daniel Wadhwani. 2010. "Changing Landscapes: The Construction of Meaning and Value in a New Market Category—Modern Indian Art." *Academy of Management Journal 53*(6): 1281–304.

Koffka, Kurt. 1922. "Perception: An Introduction to the Gestalt-Theorie." *Psychological Bulletin 19*(10): 531–85.

Kolko, Jon. 2015. "Design Thinking Comes of Age." *Harvard Business Review 5*: 66–71.

Kouprie, Merlijn, and Froukje Sleeswijk Visser. 2009. "A Framework for Empathy in Design: Stepping Into and Out of the User's Life." *Journal of Engineering Design 20*(5): 437–48.

Krum, Randy. 2013. *Cool Infographics: Effective Communication with Data Visualization and Design*. Indianapolis, IN: John Wiley & Sons.

Kull, Thomas J., Josip Kotlar, and Martin Spring. 2018. "Small and Medium Enterprise Research in Supply Chain Management: The Case for Single-Respondent Research Designs." *Journal of Supply Chain Management 54*(1): 23–34.

Leonard, Dorothy, and Jeffrey F. Rayport. 1997. "Spark Innovation Through Empathic Design." *Harvard Business Review 75*(6): 102–13.

Lettl, Christopher. 2007. "User Involvement Competence for Radical Innovation." *Journal of Engineering and Technology Management 24*(1): 53–75.

Liedtka, Jeanne. 2020. "Putting Technology in its Place: Design Thinking's Social Technology at Work." *California Management Review 62*(2): 53–83.

Lindgaard, Gitte, Richard Dillon, Patricia Trbovich, Rachel White, Gary Fernandes, Sonny Lundahl, and Anu Pinnamaneni. 2006. "User Needs Analysis and Requirements Engineering: Theory and Practice." *Interacting with Computers 18*(1): 47–70.

Magistretti, Stefano, Lorenzo Ardito, and Antonio Messeni Petruzzelli. 2021. "Framing the Microfoundations of Design Thinking as a Dynamic Capability for Innovation: Reconciling Theory and Practice." *Journal of Product Innovation Management*. https://doi.org/10.1111/jpim.12586

Magistretti, Stefano, Claudio Dell'Era, and Roberto Verganti. 2018. "Evolution of Design Thinking Capabilities." *Conference Proceedings of the Academy for Design Innovation Management 2*(1): 736–49.

March, James G. 1991. "Exploration and Exploitation in Organizational Learning." *Organization Science 2*(1): 71–87.

Martin, Roger, and Roger Martin. 2009. *The Design of Business: Why Design Thinking is the Next Competitive Advantage*. Boston, MA: Harvard Business Press.

Martínez-Villagrasa, Beatriz Martínez, Danae Esparza, and Sergi Cortiñas. 2018. "The Creative Competencies Dictionary, Between Design Practice and Education in 21st Century." In *Proceedings of the 20th international conference on engineering and product design education E&PDE*. London, UK.

Mattelmäki, Tuuli. 2006. *Design Probes*. Helsinki, Finland: University of Art and Design.

Mattelmäki, Tuuli, Kirsikka Vaajakallio, and Ilpo Koskinen. 2014. "What Happened to Empathic Design?." *Design Issues*, *30*(1): 67–77.

McKinsey & Company. 2018. *The Business Value of Design*. https://solutions.mckinsey.com/design-index/.

Mellahi, Kamel, and Lloyd C. Harris. 2016. "Response Rates in Business and Management Research: An Overview of Current Practice and Suggestions for Future Direction." *British Journal of Management 27*(2): 426–37.

Micheli, Pietro, Sarah J. S. Wilner, Sabeen H. Bhatti, Matteo Mura, and Michael B. Beverland. 2019. "Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda." *Journal of Product Innovation Management 36*(2): 124–48.

Michlewski, Kamil. 2008. "Uncovering Design Attitude: Inside the Culture of Designers." *Organization Studies 29*(3): 373–92.

Millar, Carla C. J. M., Olaf Groth, and John F. Mahon. 2018. "Management innovation in a VUCA world: Challenges and recommendations." *California Management Review 61*(1): 5–14.

Miller, Karen, and James Moultrie. 2013. "Delineating Design Leaders: A Framework of Design Management Roles in Fashion Retail." *Creativity and Innovation Management 22*(2): 161–76.

Mont, Oksana K. 2002. "Clarifying the Concept of Product–Service System." *Journal of Cleaner Production 10*(3): 237–45.

Montabon, Frank, Patricia J. Daugherty, and Haozhe Chen. 2018. "Setting Standards for Single Respondent Survey Design." *Journal of Supply Chain Management 54*(1): 35–41.

Morelli, Nicola, and Christian Tollestrup. 2007. "New Representation Techniques for Designing in a Systemic Perspective." In *Proceedings of E&DPE 2006, the 8th International Conference on Engineering and Product Design Education*, 81–6. Salzburg, Australia: Nordes.

Nelson, Richard R., and Sidney G. Winter. 1982. "The Schumpeterian Tradeoff Revisited." *The American Economic Review 72*(1): 114–32.

Norman, Donald. 1999. "Affordance, Conventions, and Design." *Interactions 6*(3): 38–43.

Norman, Donald, and Stephen Draper. 1986. *User Centered System Design: New Perspectives on Human-Computer Interaction*. London, UK: CRC Press.

Norman, Donald A., and Roberto Verganti. 2014. "Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change. *Design Issues 30*(1): 78–96.

Nunally, Jum, and Ira Bernstein. 1994. *Psychometric Theory*. New York, NY: McGraw-Hill.

Osterwalder, Alex, Yves Pigneur, Greg Bernarda, Alan Smith, and Trish Papadakos. 2014. *Value Proposition Design: How to Create Products and Services Customers Want*. Somerset, Shire: John Wiley & Sons.

Paulus, Paul, and Bernard A. Nijstad. 2003. *Group Creativity: Innovation Through Collaboration*. Oxford, UK: Oxford University Press.

Plattner, Hasso, Christoph Meinel, and Uirich Weinber. 2009. *Design Thinking: Innovation lernen—Ideenwelten öffnen*. München, Germany: Mi-Wirtschaftsbuch.

Putman, Vicky L., and Paul B. Paulus. 2009. "Brainstorming, Brainstorming Rules and Decision Making." *The Journal of Creative Behavior 43*(1): 29–40.

Rae, Jeneanne. 2016. "Design Value Index Exemplars Outperform the S&P 500 Index (again) and a New Crop of Design Leaders Emerge." *Design Management Review 27*(4): 4–11.

Reynolds, Martin. 2011. "Critical Thinking and Systems Thinking: Towards a Critical Literacy for Systems Thinking in Practice." In *Critical Thinking*, edited by Christopher P. Horvath and James M. Forte, 37–68. New York, NY: Nova Science Publishers.

Rindova, Violina, and Hugh Courtney. 2020. "To Shape or Adapt: Knowledge Problems, Epistemologies, and Strategic Postures under Knightian Uncertainty." *Academy of Management Review 45*(4): 787–807.

Rindova, Violina, Elena Dalpiaz, and Davide Ravasi. 2011. "A Cultural Quest: A Study of Organizational Use of New Cultural Resources in Strategy Formation." *Organization Science 22*(2): 413–31.

Rogan, Michelle, and Marie Louise Mors. 2017. "Managerial Networks and Exploration in a Professional Service Firm." *Organization Studies 38*(2): 225–49.

Rossiter, John R. 2002. "The C-OAR-SE Procedure for Scale Development in Marketing." *International Journal of Research in Marketing 19*(4): 305–35.

Rothaermel, Frank T., and Andrew M. Hess. 2007. "Building Dynamic Capabilities: Innovation Driven by Individual-, Firm-, and Network-Level Effects." *Organization Science 18*(6): 898–921.

Ruttenberg, Arie, and Shlomo Maital. 2014. *Cracking the Creativity Code: Zoom In/Zoom Out/Zoom in Framework for Creativity, Fun, and Success*. New Delhi, India: SAGE Publications.

Ryan, Alex. 2014. "A Framework for Systemic Design." *FormAkademisk - forskningstidsskrift for design og designdidaktikk 7*(4). https://doi.org/10.7577/formakademisk.787.

Salvador, Tony, Genevieve Bell, and Ken Anderson. 1999. "Design Ethnography." *Design Management Journal (Former Series) 10*(4): 35–41.

Salvato, Carlo, and Roberto Vassolo. 2018. "The Sources of Dynamism in Dynamic Capabilities." *Strategic Management Journal 39*(6): 1728–52.

Salvendy, Gavriel. 2012. *Handbook of Human Factors and Ergonomics*. New York, NY: John Wiley & Sons.

Sanders, Elizabeth B. 2002. "From User-Centered to Participatory Design Approaches." In *Design and the Social Sciences*, edited by Jorge Frascara, 8. London, UK: CRC Press.

Sanders, Elizabeth B., Eva Brandt, and Thomas Binder. 2010. "A Framework for Organizing the Tools and Techniques of Participatory Design." In *Proceedings of the 11th biennial Participatory Design Conference*, 195–8. Sydney, Australia: Association for Computing Machinery.

Sauer, Juergen, and Andreas Sonderegger. 2009. "The Influence of Prototype Fidelity and Aesthetics of Design in Usability Tests: Effects on User Behaviour, Subjective Evaluation and Emotion." *Applied Ergonomics 40*(4): 670–7.

Schäfer, Mirko Tobias. 2011. *Bastard Culture!: How User Participation Transforms Cultural Production*. Amsterdam, Netherlands: Amsterdam University Press.

Sherwin, David, and Justin Maguire. 2010. *Becoming a Design Leader*. http://designmind.frogdesign.com/blog/becoming-a-design-leader.html

Smith, Wendy K., and Marianne W. Lewis. 2011. "Toward a theory of paradox: A dynamic equilibrium model of organizing." *Academy of Management Review 36*(2): 381–403.

Sonderegger, Andreas, and Jürgen Sauer. 2010. "The Influence of Design Aesthetics in Usability Testing: Effects on User Performance and Perceived Usability." *Applied Ergonomics 41*(3): 403–10.

Steen, Marc, Lottie Kuijt-Evers, and Jente Klok. 2007. *23rd EGOS Colloquium*, 1–21. Vienna: Austria.

Swan, K. Scott, Masaaki Kotabe, and Brent B. Allred. 2005. "Exploring Robust Design Capabilities, Their Role in Creating Global Products, and Their Relationship to Firm Performance." *Journal of Product Innovation Management 22*(2): 144–64.

Taffe, Simone. 2015. "The Hybrid Designer/End-User: Revealing Paradoxes in Co-Design." *Design Studies 40*: 39–59.

Teece, David J., Gary Pisano, and Amy Shuen. 1997. "Dynamic Capabilities and Strategic Management." *Strategic Management Journal 18*(7): 509–33.

Topalian, Alan. 2002. "Promoting Design Leadership through Skills Development Programs." *Design Management Journal (Former Series) 13*(3): 10–8.

Topalian, Alan. 2013. "Major challenges for design leaders over the next decade." In *The handbook of design management*, edited by Cooper, Rachel, Junginger, Sabine and Lockwood, Thomas, 379–397. London: A&C Black.

Turner, Raymond. 2016. *Design Leadership: Securing the Strategic Value of Design*. London: Routledge.

Verganti, Roberto. 2008. "Design, Meanings, and Radical Innovation: A Metamodel and a Research Agenda." *Journal of Product Innovation Management 25*(5): 436–56.

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

Verganti, Roberto. 2017. *Overcrowded: Designing Meaningful Products in a World Awash With Ideas*. Cambridge, MA: MIT Press.

Verganti, Roberto. 2003. "Design as Brokering of Languages: Innovation Strategies in Italian Firms." *Design Management Journal 14*(3): 34–42.

Verona, Gianmario, and David Ravasi. 2003. "Unbundling Dynamic Capabilities: An Exploratory Study of Continuous Product Innovation." *Industrial and Corporate Change 12*(3): 577–606.

Vredenburg, Karel, Ji-Ye Mao, Paul W. Smith, and Tom Carey. 2002. "A Survey of User-Centered Design Practice." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 471–8. Minneapolis, MN: Association for Computing Mechinery.

Williams, Larry J., Joseph A. Cote, and Ronald M. Buckley. 1989. "Lack of Method Variance in Self-Reported Affect and Perceptions at Work: Reality or Artifact?" *Journal of Applied Psychology 74*(3): 462.

Wilson, Chauncey. 2013. *Brainstorming and Beyond: A User-Centered Design Method*. Amsterdam, Netherlands: Morgan Kaufmann.

Wilson, John R. 2000. "Fundamentals of Ergonomics in Theory and Practice." *Applied Ergonomics 31*(6): 557–67.

Wilson, John R. 2014. "Fundamentals of Systems Ergonomics/Human Factors." *Applied Ergonomics 45*(1): 5–13.

Wong, Ken. 2010. "Handling Small Survey Sample Size and Skewed Dataset with Partial Least Square Path Modelling." *Vue: The Magazine of the Marketing Research and Intelligence Association*, November 20–23.

Wong, K. 2013. "Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS." *Marketing Bulletin 24*(1): 1–32.

Wrigley, Cara, and Savatore Bucolo. 2012. "New Organisational Leadership Capabilities: Transitional Engineer the New Designer?" In *Leading Innovation Through Design: Proceedings of the DMI 2012 International Research*, edited by Alison Rieple, Erik Bohemia and Jeanne Liedtka, 913–22. Boston, MA: Design Management Institute (DMI).

Wu, Fong-Gong, Min-Yuan Ma, and Ro-Han Chang. 2009. "A New User-Centered Design Approach: A Hair Washing Assistive Device Design for Users with Shoulder Mobility Restriction." *Applied Ergonomics 40*(5): 878–86.

AUTHOR BIOGRAPHIES

Cabirio Cautela, Ph.D, Full Professor at Politecnico di Milano and Deputy Director of the Design Department. He was Visiting Scholar at Stanford University—CDR (Center for Design Research) in 2012. His research topics deal with the strategic role of design, design management processes and how design generates new business models and new ventures. He is currently Director of the Master in Strategic Design and Research Director of the Observatory of Design Thinking for business of Politecnico di Milano.

Michele Simoni, Ph.D., is Full Professor of Innovation and Business Design at the School of Economics and Law of University of Naples Parthenope, Department of Management and Quantitative Studies (DISAQ). He is currently the Observatory of Local Innovation Systems (SLIOB) coordinator, created in 2018 by DISAQ as part of the Department of Excellence project funded by Miur. He is director of the Ph.D. program in Entrepreneurship and Innovation held jointly by Vanvitelli and Parthenope Universities in partnership with the University of Castilla la Mancha. He is also the coordinator of the thematic division on Marketing of Technology and Innovation of the Italian Society of Marketing (SIM). His recent research interests are focused on complex systems, value creation, and innovation.

Peter Moran, Ph.D, is Visiting Associate Professor of Strategy at China Europe International Business School. His research in strategy and entrepreneurship focuses on the mechanisms of value creation and how they are influenced by firms and social networks. His interests include the role firms play: in influencing individuals' access to ideas and resources through their social relations; in influencing how resources are valued, exchanged and combined; and in shaping the evolution of the market's forces.

How to cite this article: Cautela, Cabirio, Simoni, Michele, and Moran, Peter. 2022. "Microfoundations of Dynamic Design Capabilities: An Empirical Analysis of "Excellent" Italian Design Firms." *Journal of Product Innovation Management* 39: 3–23. https://doi.org/10.1111/jpim.12592

APPENDIX A

Questionnaire administered online (Q4, Q7, and Q11 were translated from Italian)

Questions Q1, Q2, and Q3 ask the respondents to report the year of foundation, the number of employees and the average yearly turnover during the 2011–2016 period.

The other questions in the questionnaire pertain to aspects not related to this specific research.

The information regarding the design projects, the designers involved in the ADI award-winning products, and the manager/entrepreneur responsible for the design activities were all obtained from the ADI Index database and used to contact the companies and administer the questionnaire to the target participants.

	Likert scale				
Indicator variables	**Disagree**	**More disagree than agree**	**Neither disagree nor agree**	**More agree than disagree**	**Agree**
Q4. Express your level of agreement/disagreement with the following statements regarding the strategic role that design plays in your organization:					
The main role of design is related to understanding the needs of users and design products to "fit" the user (UN)					
The main role of design is related to solving complex problems in creative and original ways (SCP)	○	○	○	○	○
The main role of design is related to imagining possible future scenarios and designing new experiences to improve people's lives (SE)	○	○	○	○	○
The main role of design is related to designing products that surprise people with unexpected and pleasant solutions that can appeal to them emotionally (US)	○	○	○	○	○
Q7. The fundamental ability/skill that my company seeks in designers is (please express the degree of agreement/disagreement with the importance of each of the following designer abilities/skills):					
Creativity (in searching for new solutions)					
Critical thinking					
Systemic thinking	○	○	○	○	○
Ability to imagine possible futures					

Indicator variables	Likert scale: Disagree	More disagree than agree	Neither disagree nor agree	More agree than disagree	Agree
Ability to visually represent (new scenarios)	○	○	○	○	○
Q11. The key role that users play in the design process is (please express the degree of agreement/disagreement with each of the following statements):					
Inspiring the design process					
Collaborating in the design (of products/ solutions)	○	○	○	○	○
Testing prototypes in terms of usability and experience					

APPENDIX B

Details of the measurement model evaluation

The analysis of the internal consistency, reliability and convergent validity of the five reflective constructs included in our measurement model was conducted in three steps.

The results of this analysis are shown in Table B1.

Internal consistency reliability measures the degree of intercorrelations among the observed indicator variables. To measure internal consistency reliability, we used the composite reliability indicator, which varies between 0 and 1, with higher values indicating higher levels of reliability. For exploratory studies, this indicator is acceptable if it has values between 0.6 and 0.9 (Nunally & Bernstein, 1994). Values higher than 0.9 are considered not positive because they indicate that the variables measure the same phenomenon and, therefore, are redundant and do not contribute individually to the construct measurement (Rossiter, 2002). In contrast, values lower than 0.6 signal a lack of internal consistency reliability. All model constructs have indicators in the range of 0.6–0.9 as suggested by the literature, indicating high reliability.

Convergent validity measures the degree to which the indicators used for each construct share a high proportion of their variance and, therefore, are "captured" by the construct. To assess convergent validity, indicator reliability and average variance extracted (AVE) were used. The indicator reliability uses the absolute value of the outer loadings of the observed indicator variables to evaluate the level of communality of the considered variables. The outer loadings are considered acceptable if they exceed the threshold of 0.708 (Hair et al., 2016). Indicators with outer loadings between 0.4 and 0.708 can be removed from the model if their elimination produces an increase in the AVE (Hulland, 1999), whereas indicators with

TABLE B1 Measurement model evaluation—reliability and convergent validity

Latent constructs and *indicator variables*	Composite reliability	Indicator reliability	Average variance extracted (AVE)
Ideation capabilities (IC)	1	1	1
Creativity (CR)			
Holistic thinking capabilities (HC)	0.854		0.746
Critical thinking (CT)		*0.818* ***	
Systemic thinking (ST)		*0.907* ***	
Envisioning capabilities (EC)	0.831		0.712
Scenario imagination (SI)		*0.822* ***	
Scenario representation (SR)		*0.865* ***	
User-centered design (UCD)	0.865		0.762
Understanding needs (UN)		*0.883* ***	
Creatively solving problems (CS)		*0.862* ***	
Meaning innovation (MI)	0.822		0.7
Scenario and new experiences (SE)		*0.913* ***	
Unexpected solutions (US)		*0.753* ***	

*$p < 0.1$; **$p < 0.05$; ***$p < 0.001$.

TABLE B2 Measurement model evaluation—discriminant validity

	IC	HC	MI	EC	UCD
IC	**1**				
HC	0.242	0.864			
MI	−0.064	0.322	0.837		
EC	0.265	0.324	0.478	0.844	
UCD	−0.01	0.311	0.4	0.26	0.873

values below 0.4 must be removed (Hair et al., 2011). All latent variables in the model have outer loadings of their variable indicators above the minimum threshold value, confirming the convergent validity of the constructs. In contrast, the AVE is a convergent validity indicator that considers the grand mean value of the squared loadings of the indicators associated with the construct. Ave values of a construct below 0.5 suggest low convergent validity (Hair et al., 2016). Constructs comprising a single indicator necessarily have a value of 1. All model constructs with multiple indicators show AVE values above 0.7, further supporting the constructs' convergent validity.

Then, we assessed the discriminant validity of the reflective constructs of the model. This analysis aims to verify the extent to which the different constructs are able to capture phenomena not already explained by the other constructs and, therefore, the extent to which each construct is unique. Discriminant validity, following established practice, was measured using the Fornell-Larcker criterion, which compares the square roots of the AVE with the correlation between the constructs (Hair et al., 2016). A construct has sufficient discriminant validity if the square root of its AVE is higher than its highest correlation with any other construct. Table B2 shows the results of this analysis, emphasizing that all latent reflective variables have discriminant validity (the values on the diagonal are the AVE square roots and are larger than the values in the other cells in the matrix).

TABLE B3 Measurement model evaluation—multicollinearity and relevance of the formative indicators

	VIF	Outer weights	*p*-values	Outer loads	*p*-values
IDP	1.061	0.528	0.113	0.703	0.016
CDS	1.257	0.575	0.082	0.812	0.001
TNS	1.218	0.273	0.43	0.595	0.037

After this analysis, the collinearity between the variable indicators of the only formative construct was evaluated. This analysis is particularly important because as observed in the literature, high levels of collinearity among the formative variables of a latent construct can undermine the significance and correctness of the weights estimated by the model. To test for the presence of collinearities, we used the variance inflation factor (VIF), which has acceptable values if lower than 5 (Hair et al., 2011). As shown in Table B3, the VIF values are lower than the threshold for all three indicator variables of the UI construct.

Finally, we analyzed the significance and relevance of the model's formative indicators. This analysis aims to identify indicators to be removed from the model and requires an assessment of the significance of the outer weights of all indicators and, for nonsignificant indicators, the value of the corresponding outer loadings. Significant variables are retained. Nonsignificant variables may be retained if the corresponding outer loadings are greater than 0.5. In this case, although the variable does not have a high relative relevance, it can be considered to have a high absolute relevance for the construct and, therefore, can be maintained in the model (Cenfetelli & Bassellier, 2009). As shown in Table B3, the results of the analysis indicate that CDP is significant at $\boldsymbol{p} < 0.1$. In contrast, the IDP and TNS variables are not significant. However, their outer loads are 0.703 and 0.595 and significant at $\boldsymbol{p} < 0.05$; therefore, both indicators can be maintained in the measurement model as they concur with the UI construct.