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Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda

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Design thinking has attracted considerable interest from practitioners and academics alike, as it offers a novel approach to innovation and problem-solving. However, there appear to be substantial differences between promoters and critics about its essential attributes, applicability, and outcomes. To shed light on current knowledge and conceptualizations of design thinking we undertook a multiphase study. First, a systematic review of the design thinking literature enabled us to identify 10 principal attributes and 8 tools and methods. To validate and refine our findings, we then employed a card sorting exercise with professional designers. Finally, we undertook a cluster analysis to reveal structural patterns within the design thinking literature. Our research makes three principal contributions to design and innovation management theory and practice. First, in rigorously deriving 10 attributes and 8 essential tools and methods that support them from a broad and multidisciplinary assortment of articles, we bring much needed clarity and validity to a construct plagued by polysemy and thus threatened by "construct collapse." Second, aided by the identification of perspectives of scholars writing about design thinking, we provide detailed recommendations for relevant topics warranting further study in order to advance theoretical understanding of design thinking and test its applications. Third, we identify the enduring, yet essential, questions that remain unresolved across the extant design thinking literature and that may impede its practical implementation. We also provide suggestions for the theoretic frames, which may help address them, and thus advance the ability of scholars and managers alike to benefit from design thinking's apparent advantages.

Practitioner Points

- This article provides a thorough and comprehensive overview of research on design thinking, and it identifies its constituent attributes and associated tools.
- Design thinking consists of unique attributes and practices, which are combined with existing ones in a distinctive way.
- Design thinking differs but often complements other innovation approaches such as agile product development and lean startup.
- This article outlines promising avenues for the application of design thinking in organizations.

> *If we are to deal with … the "massive change" that seems to be characteristic of our time, we all need to think like designers.* (Brown, 2009, p. 37)
>
> *Even on a cursory inspection, just what design thinking is supposed to be is not well understood, either by the public or those who claim to practice it.* (Kimbell, 2011, p. 286)

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Introduction

If abiding attention for a topic is an indicator of value, "design thinking" merits further scrutiny. Over the past decade, the concept has attracted increasing interest, moving from innovation buzzword to widely diffused practice (Brown, 2008; Liedtka, 2015; Martin, 2009). Indeed, prominent academic journals, including *Journal of Product Innovation Management* and *Academy of Management Journal* have identified design thinking as a critical concept in both innovation (Brown and Katz, 2011; Di Benedetto, 2012; Seidel and Fixson, 2013) and general management (Gruber, de Leon, George, and Thompson, 2015). It is noteworthy that one of the latest publications in the Product Development and Management Association's *Essentials* series was dedicated to design and design thinking (Luchs, Swan, and Griffin, 2016). Similarly, business publications—including *Harvard Business Review* and *The Economist*—have devoted special issues or entire sections to design thinking. The word *thinking* also may belie industry's focus on *doing,* as a growing

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Prof. Michael B. Beverland is a professor of Marketing, and the head of department, strategy and marketing, at the University of Sussex Business School, U.K. His research is focused on consumer culture theory, design-driven innovation, and the relationship between branding and innovation. He has published widely in various journals including *Journal of Product Innovation Management, Design Management Review, Journal of the Academy of Marketing Science, Journal of Advertising, Journal of Consumer Research, Journal of Management Studies*, and many others. His current book is *Brand Management: Co-creating Brand Meaning* (Sage, 2018).

number of implementations of design thinking have been reported in major organizations, including SAP, P&G, Intuit, Bank of America, Samsung and Kaiser Permanente (Brown, 2008; Gruber et al., 2015; Martin, 2009; Yoo and Kim, 2015).

Remarkably, despite compelling calls for the adoption of design thinking (e.g., Luchs, 2016), a generally accepted definition is still lacking, "and even the term itself is a subject of controversy among its practitioners and advocates" (Liedtka, 2015, p. 926). In fact, there appear to be substantial differences between promoters and critics of design thinking about what it is and what it can do (see, e.g., Beverland, Wilner, and Micheli, 2015; Brown, 2009; Johansson-Sköldberg, Woodilla, and Çetinkaya, 2013; Kimbell, 2011; Liedtka, 2015; Martin, 2009). For example, some authors have considered it to be an organizational attribute, whereas others conceive of it at the individual level, highlighting the traits of "design thinkers" (see, e.g., Brown and Katz, 2011; Luchs, 2016). Some scholars have concentrated on tools (Seidel and Fixson, 2013), while others have focused on design as culture (Deserti and Rizzo, 2014; Elsbach and Stigliani, 2018; Kimbell, 2011). Still others have asked whether design thinking can be decoupled from design practice (Carlgren, Rauth, and Elmquist, 2016).[1]

Tensions over what constitutes design thinking are partly due to the varied origins of the term (Johansson-Sköldberg et al., 2013). Design scholars have written extensively on "designerly ways of thinking" (see, e.g., Buchanan, 1992; Dorst, 2006, 2011 ; Lawson and Dorst, 2009), but only recently has "design thinking" become a recognized term in management, where it has been predominantly framed as an approach to innovation and creative problem-solving founded on designers' processes and practices (Brown, 2008, 2009 ; Liedtka, 2015; Martin, 2009). While conflicting views of concepts are not unusual in management research (Suddaby, 2010), divergent definitions can hinder comparability of empirical findings and thus inhibit progress in the understanding of phenomena.[2] Importantly, an "umbrella construct"—a "broad concept or idea used loosely to encompass and account for a set of diverse phenomena" (Hirsch and Levin, 1999, p. 200)—initially may serve the important purpose of "provid[ing] a way to organize a large body of what might otherwise seem to be unrelated findings" (Astley, 1985, p. 501). However, umbrella constructs are also at risk of

[1]While scholarly progress has been relatively slow, practitioners appear increasingly interested in the concept. To illustrate, there were about 7 million Google search results for "design thinking" in October 2016; by June 2018 that number had more than doubled to approximately 15.5 million.

[2]Management researchers have been rightly concerned about conceptual validity. See, for example, Lavie, Stettner, and Tushman's (2010) concerns over generalizability of findings in the organizational ambidexterity literature, and Richard, Devinney, Yip, and Johnson's (2009) argument over lack of clarity in management researchers' theoretical definition and operationalization of "performance."

being untenable if there is insufficient clarity and coherence about the construct's constitution and its effects. Indeed, a healthy tension between breadth in meaning and empirical validity is necessary to avoid a situation in which a concept starts to mean all things to all people (Hirsch and Levin, 1999), as this would lead to the collapse of the construct, and reversion to its constituent elements.

This article argues that the current lack of clarity surrounding design thinking places it at risk of following the same trajectory as umbrella constructs such as organizational effectiveness and work climate which, after "initial excitement," suffered construct collapse (Hirsch and Levin, 1999). The goal is not to dismiss design thinking as a fuzzy, undertheorized management fad (Abrahamson, 1996). Instead, it is to shed light on current knowledge and conceptualizations of design thinking in order to identify its principal attributes, highlight relevant issues and tensions in the literature, and advocate for further studies to advance theory and practice. With this objective in mind, a multiphase study was undertaken followed by additional activities to verify, clarify, and triangulate emergent findings. First, the design thinking literature was systematically reviewed (Tranfield, Denyer, and Smart, 2003), seeking commonalities in descriptive elements of the term and patterns of its use. Second, the attributes of design thinking that emerged from the review were categorized and a card sorting exercise was employed with professional designers to refine and validate the results of the analysis. This exercise also allowed grouping the tools and methods identified in the review. These initial two phases led to the identification of 10 principal attributes and 8 tools and methods for design thinking. Third, a cluster analysis was undertaken to reveal structural patterns within the design thinking literature. This analysis enabled the authors to identify common themes within the literature and generate important questions to be addressed in future studies.

This research makes three principal contributions to both theory and practice. First, a broad and inconsistent body of articles is systematically distilled into a set of 10 attributes and the 8 tools and methods that assist in activating them. Second, the sometimes contradictory focal perspectives of scholars writing about design thinking are identified, and specific recommendations for topics warranting further study are provided. Finally, the enduring questions across the literature that may hinder its practical application are surfaced. Where possible, suggestions for the theoretic frames that may help address them are provided, thus advancing the ability of scholars and managers alike to benefit from design thinking's apparent advantages.

Phase 1: Systematic Literature Review of Design Thinking

A systematic review requires the search and selection of relevant literature on a subject and consists of three phases: data collection, analysis, and synthesis (Tranfield et al., 2003). In the data collection phase, a multistep approach to identify and select sources that discuss the concept of design thinking was adopted. During data analysis, a general summary of the results of data collection was created. Next, two researchers categorized the main attributes of design thinking, first independently and then jointly. In the final synthesis, a total of 10 attributes as well as a broader category for design thinking tools and methods were derived.

Data Collection

Data collection consisted of four main steps (see Figure 1).

It began with a search of four databases (ABI ProQuest, Business Source Premier, Science Direct, and Emerald). The search string was "Design*" AND "Think*" in the title or abstract of peer reviewed journals for the years 1985–2017.[3] A broad search was undertaken to capture the various terms that could be used for "design thinking," e.g., design thinking; thinking by designers; design thinker. This search returned 32,232 articles. A first review of titles and abstracts led to excluding many articles not relevant to the research, for example, those discussing specific designs in technical terms, or those proposing how to rethink elements of design work. Moreover, some specific types of "design" were excluded, for example: design and methods of research, the design of business processes, and so forth. Similarly, several "thinking" paradigms not specifically associated with either design or designers were removed, for example: strategic thinking, lean thinking, etc. Subsequently, articles that appeared in more than one database were removed and articles appearing in journals not included in either the *Journals in the 2013 Release of JCR* or in the *Association of Business School Academic*

[3]No relevant articles were found before 1985.

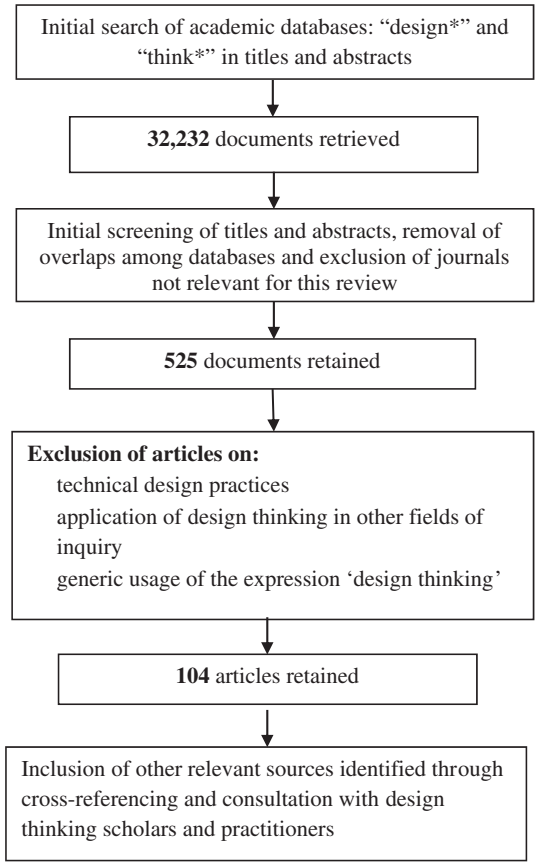

Figure 1. The Data Gathering Process

Journal Quality Guide were excluded, with the exception of seven journals that specifically focus on design and therefore were regarded as relevant for this research (see Appendix 1 in supporting information).

After this selection phase, the remaining 525 articles were transferred to an EndNote database, and the abstracts discussed in detail by two of the authors. This led to a further cull based on quality and relevance to the topic under investigation (Tranfield et al., 2003). In this phase, four additional guidelines were employed to further refine the data set:

1. Because this review focuses on design thinking, rather than on either elements of designers' work (e.g., sketching) or design management practices, articles in which the phrase "design thinking" referred to, or was used interchangeably with, technical design practices were excluded.
2. Therefore, articles where design thinking had been applied to other fields of inquiry such as architecture or chemistry were discarded.
3. Similarly, while prominent contributions on "designerly thinking" were included (e.g., Buchanan, 1992; Dorst, 2011; Lawson and Dorst, 2009), as they describe the academic construction of professional designers' practice (Johansson-Sköldberg et al., 2013), this review concentrates on design thinking in management discourse.
4. Articles that reported examples of specific cases of design thinking implementation but did not provide sufficient information in relation to either what had been done or to what "design thinking" referred were also excluded.

At the conclusion of this phase, 104 articles remained. As is common in systematic literature reviews, these articles were complemented by other sources (primarily books and documents from organizations known for their application of design thinking) that could provide further insight into the concept of design thinking. Sources were selected by considering cross-references, consulting with 7 scholars and 10 practitioners with expertise in design, and relying on the authors' experience in this field (Tranfield et al., 2003). Nine books were identified as highly influential: they were either extensively referenced in the sample of articles and in the broader literature (Brown, 2009; Cross, 2006; Lockwood, 2009a; Martin, 2009) or written by leading authors in the field of design thinking (Lawson and Dorst, 2009; Liedtka and Ogilvie, 2011; Luchs, Swan, and Griffin, 2016; Stickdorn and Schneider, 2010). Three applied models—discussed in greater detail below—were mentioned in the literature and identified as particularly relevant, as they are clearly codified and used in a variety of organizations (see also Liedtka, 2015, p. 928).

Data Analysis

Data analysis was conducted on the 104 resulting articles described above. The process began with descriptive analysis; next, thematic coding was conducted to determine the central features of design thinking. Once identified, these codes were grouped into attributes.

Descriptive analysis. As shown in Figure 2, the majority of the 104 selected articles were published in the past decade, with an initial peak in 2009. Subsequent years' publications peaked in 2015 when *Harvard Business Review* published a special issue on the topic. Most of the articles in the final data set originate in design journals, particularly *Design Management Review*, *Design Studies,* and *Design Issues*. Among management journals, the *Journal of Product Innovation Management*, *Harvard Business*

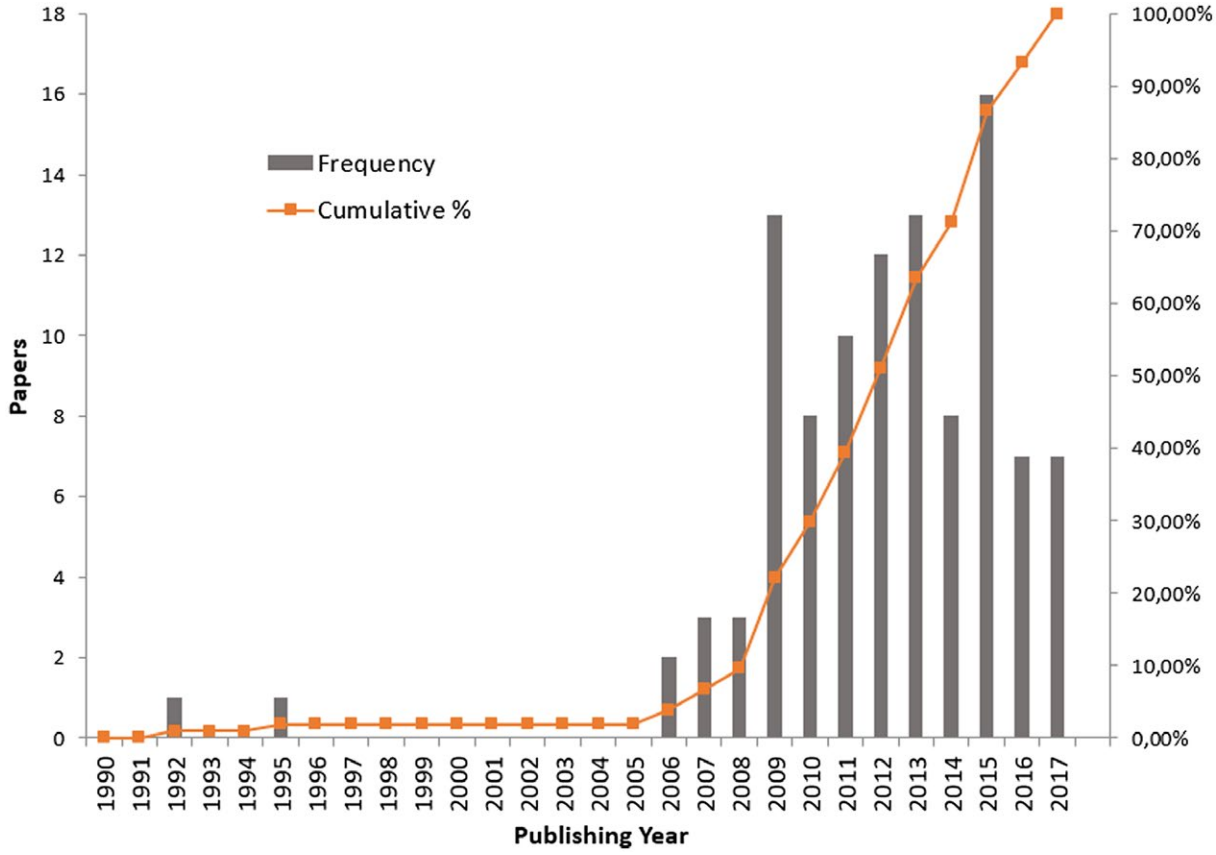

Figure 2. Year of Publication of the Selected Articles

Review, *Journal of Business Strategy*, and *Strategy & Leadership* have published the majority of work on design thinking (Figure 3).

In terms of content, most articles either discuss examples or report results of single case studies, whereas books tend to elaborate on the concept of design thinking and its constitutive elements, often explained through illustrations or guidance on how to use specific tools (see, e.g., Stickdorn and Schneider, 2010). Many of the examples in both articles and books are accounts of the use of design thinking at well-known firms such as IBM, Hewlett-Packard, and Samsung based on the experience of the author(s), often without specifying any formal research method (e.g., Brown, 2009; Chang, Kim, and Joo, 2013; Leavy, 2012; Porcini, 2009; Sato, Lucente, Meyer, and Mrazek, 2010). Furthermore, there are very few quantitative studies; descriptive and normative studies are more common than explanatory ones. Most articles discuss design thinking at individual or organizational levels of analysis, with few examining it at the team level. An overview of the selected articles is reported in Appendix 2 in supporting information.

Among the range of sources reviewed, five were highly cited (i.e., mentioned in more than a third of all articles in the data set, see Table 1), their authors evenly distributed between design and management disciplines. For example, almost half of all the surveyed texts refer to practitioner Tim Brown's initial article on design thinking in *Harvard Business Review* and to his subsequent book (Brown, 2009), where he articulates the process of "inspiration, ideation and implementation" and describes several attributes of "design thinkers." Similarly, academic Roger Martin's *The Design of Business* (2009) is highly cited, especially in relation to his view that design thinking is rooted in abductive reasoning and the capacity to blend rationality and analysis with intuition and synthesis. Herbert Simon's *The Sciences of the Artificial* (1969) is also often referred to, especially in relation to his definition of design as "the transformation of existing conditions into preferred ones" (p. 4). Although not strictly related to "design thinking," this book is often cited to emphasize the link between design thinking and *doing*. Finally, Richard Buchanan's (1992) article

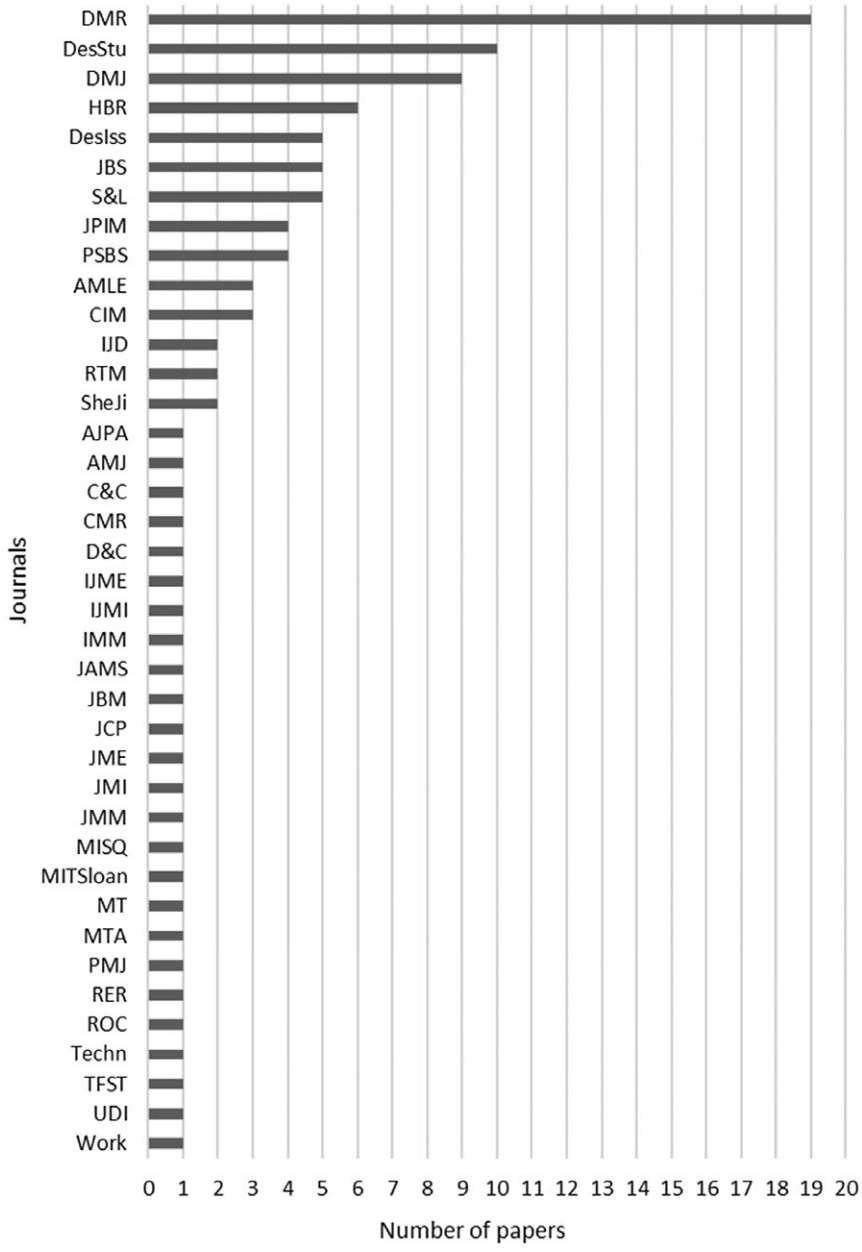

Figure 3. Academic Journals Where the Selected Articles Were Published

Table 1. Most-Cited Sources of Design Thinking

Author	Year	Type	Frequency of citation in the sample
Brown	2008	Article	48%
Martin	2009	Book	46%
Brown	2009	Book	39%
Simon	1969	Book	39%
Buchanan	1992	Article	34%

highlights design's distinctiveness from the natural and social sciences, and argues for design thinking's capacity to question current states, conceive what does not exist, and help address "wicked" problems.

Coding of constructs. In-depth review of the selected articles and books led to the identification of further definitions of "design thinking" as well

as a considerable collection of authors' assertions of constitutive attributes. An initial review conducted by two of the authors elicited a total of 91 codes (54 concepts and 37 tools and methods) associated with design thinking. Some of these were relatively similar and used interchangeably; others had a distinct and precise meaning. For example, different authors utilized "systems thinking" and "holistic approach" almost identically. In contrast, terms such as "abductive reasoning" were consistently utilized with a specific denotation.

Following the initial identification of attributes, two authors worked independently to perform second-order coding, i.e., aggregating groups of related codes into higher level attributes. To do so, two identical sets of 91 cards were prepared and a list of definitions drawn from the literature was created to enable the researchers to clarify the particular denotations of each code (i.e., concepts, tools and methods). Comparing quotes and expressions from the selected sources, one author identified 18 attributes, the other 16. Some of these attributes were labeled by relying upon existing constructs such as "collaboration" and "abductive reasoning"; others to synthesize existing terms, e.g., various design tools and methods were grouped together under a single label.

The researchers next compared their results. Nine attributes were identified by both: "abductive reasoning," "balance," "collaboration," "design tools," "innovation," "problem-solving," "systemic view," "tolerate failure," and "user centeredness." Not only were labels the same or similar (e.g., "problem solving" and "wicked problem solving"), but there was also high correspondence among the constitutive codes. The remaining attributes were partially overlapping, but reflected differences in perspective; that is, one researcher created codes according to their general meaning; the other distinguished design- and designer-related codes from generic ones. For example, the first researcher defined an attribute "ability to visualize," whereas for the other all codes referring to aesthetics and ability to visualize were part of the broader attribute "cognitive abilities." Inter-rater reliability was 58.5%, a high score for an initial coding phase (Miles and Huberman, 1994).

Next, the two researchers discussed the discrepancies highlighted by the comparison among emerging attributes and created enhanced definitions while also slightly modifying and aggregating the attributes they had identified in common. This process was important to enhance convergent and discriminant validity (Rosenthal and Rosnow, 1991). To ensure construct validity, the researchers referred to the definitions of codes as expressed in the literature. The process of refining, merging, and confirming attributes led to the following 10: "abductive reasoning," "ability to visualize," "blending analysis and intuition," "creativity and innovation," "gestalt view," "interdisciplinary collaboration," "iteration and experimentation," "problem solving," "tolerance for ambiguity and failure," and "user-centeredness and involvement." In addition, a broader category, "design tools and methods" was created to encompass the set of 37 tools and methods mentioned in the literature.

Phase 2: Card Sorting Exercise

After categorizing the attributes of design thinking that emerged from the review, the researchers sought to confirm the validity of the analysis and to group the tools and methods identified through member checks (Goulding, 2002). Therefore, they drew upon the assessment of design practitioners and employed a card sorting exercise—a common user experience method (Harloff, 2005; Wood and Wood, 2008). Specifically, a convenience sample of seven designers was asked to describe, critique, and sort cards labeled with the 10 attributes and the 37 tools and methods identified above. The individuals who participated in the card sorting exercise were all design directors or senior designers with work experience ranging from 15 to 25 years; they had all worked as both in-house and external designers, but specialized in different sectors (two in medical devices, two in fast-moving consumer goods, two in industrial products, and one in automotive). During the exercise, the designers were encouraged to question the attributes' labels, and to introduce alternative ones (blank cards were made available) or to merge them, and they were asked to explain their thought process (Harloff, 2005). Each designer's card sorting exercise lasted approximately 45 minutes.

Results of the Card Sorting Exercise

Despite differences in their sectors of experience, the designers who took part in the card sorting exercise expressed very similar views; indeed, no new

significant insights were gathered from the last two individuals involved, further supporting the validity of the initial analysis. In particular, no specific attribute was discarded, nor were any new ones introduced. Participants' questions about the 10 attributes either were requests for clarification (e.g., how abductive reasoning differed from inductive) or related to specific aspects of an attribute (e.g., whether "problem solving" also included problem framing).

However, two outcomes of the exercise were notable. First, when examining the cards, all the designers identified "problem solving" and "creativity and innovation" as principal outcomes of design thinking. Second, certain attributes, such as "user centeredness" and "interdisciplinary collaboration," were typically identified as permeating the whole process, rather than being related to specific stages. Finally, when assessing the 37 cards identifying tools and methods, the designers often combined them into fewer sets. On the basis of this expert-led confirmatory exercise, the 37 tools and methods identified in the literature were merged into eight.

The next section begins by contextualizing the resulting attributes in view of the most prevalent definitions and models. Subsequently, details of the 10 attributes are presented—in order of occurrence in the sample—and 8 essential design thinking tools and methods that emerged from the literature review and were then validated during the card sorting exercise.

The Primary Attributes of Design Thinking as Reflected in Extant Literature

In the literature, three definitions of design thinking were cited most often. According to Brown (2008, p. 86), design thinking is "a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity." This definition qualifies design thinking as both a process ("methods") and an individual-level characteristic ("sensibility"), and explicitly links design with business. Lockwood (2010b, p. 5) states that design thinking is "a human-centered innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis," thus highlighting the application of professional designers' espoused work process, one based on observation, visualization, and prototyping. In contrast, Martin (2009) emphasizes the *thinking* element, defining design thinking as "the productive mix of analytical thinking and intuitive thinking" (Martin interviewed in Euchner, 2012, p. 10).

Table 2. Most Influential Applied Models of Design Thinking

Proponent	Main Stages of Design Thinking
IDEO	Inspiration, ideation, implementation
Stanford Design School	Empathy, define, ideate, prototype and test
IBM	Understand, explore, prototype, evaluate

If the applied models most frequently cited within the selected articles are considered, a certain degree of commonality emerges, although different terms and sequences of action are employed (see Table 2). These models tend to start from an initial exploration with the objective of understanding the problem to be solved. They then move onto an ideation stage to generate possible alternatives. They all conclude with an implementation and testing phase, based on prototyping and iteration.

Examining the full sample of identified sources, while authors have described design thinking in different ways and associated a variety of attributes with the concept, some of these are employed more regularly, suggesting a level of concurrence. Table 3 reports the number of instances in which the identified codes—grouped in attributes—were mentioned.

As seen in Table 3, some attributes are more likely to be related to design thinking in the literature. For example, design thinking is often presented as a means to solve problems—particularly "wicked" ones (Buchanan, 1992)—and as an iterative process that is user-centered (Brown, 2008). Also, while some attributes are quite generic (e.g., "creativity and innovation"), others are more specific (e.g., "abductive reasoning"). While these are not new constructs, the design thinking literature (1) attributes contextually unique meanings to each and (2) combines them to account for consequences that the individual attributes by themselves could not.

Table 3. Codes, Attributes, and Occurrence Frequency

Attributes	Frequency in the Data Set	Codes	Example Quote
Creativity and innovation[a]	104	Innovation Creativity Idea creation Discovering opportunities	Design thinking "is an approach that addresses product, process, and business model innovation" (Liedtka, 2011, p. 13).
User centeredness and involvement	83	User/customer involvement Human-centeredness Working with extreme users End-user profiling Empathy	"You have to know your customers not as statistics but as human beings" (Zaccai, interviewed in Lockwood, 2010a, p. 19).
Problem solving	73	Problem solving Wicked problem solving Constraints as inspiration Decision-making Challenge the norm Reframing Optimism	"If design methods and tools are well suited to addressing wicked design problems, then it would be logical to assume that these methods and tools could be useful for wicked problems outside the traditional design domain. It is this element of design practice that, when separated from the tangible and applied to intangible problems, is often termed Design Thinking" (Collins, 2013, p. 36).
Iteration and experimentation	64	Iteration Experimentation Prototyping Reflexivity Reflective practice	"Design thinking is characterized by trial-and-error learning through iterative forms, prototyping, and trials that test a range of possible solutions with end-users and other project stakeholders" (Beverland et al., 2015, p. 593)
Interdisciplinary collaboration	58	Collaboration Stakeholder involvement Multidimensional team Conflict negotiation Interactive process Involvement of outsiders Participatory design Persuasion and communication	"Collaboration is perhaps the most overlooked experience that is essential to design thinking. … Cross-disciplinary collaborative teams are more likely to create innovative solutions than focused groups of like minded people since varying opinions and sources of expertise can lead to valuable insight" (Davis, 2010, p. 6536).
Ability to visualize	41	Aesthetics Ability to visualize Elegance Style	"The act of moving from abstract thinking to visualizing ideas and then thinking on top of those visualizations is at the heart of design for innovation." (Boni, Weingart, and Evenson, 2009, p. 409).
Gestalt view	35	Holistic approach Embrace complexity Integral intelligence Synthesis Systemic model Systems thinking	"Designers would think about the system as a whole and thereby envisage the consequences of their actions" (Dunne and Martin, 2006, p. 520)
Abductive reasoning	30	Abductive reasoning Emergent Generative	Abductive reasoning is "in opposition to deductive (from the general to the specific) and inductive (from the specific to the general) reasoning… [it is a] 'logical leap of the mind' or an 'inference to the best explanation' to imagine a heuristic for understanding the mystery" (Martin, 2010, pp. 40–41).
Tolerance of ambiguity and failure	30	Acceptance of failure Ambiguity Handle uncertainty Low risk behavior (opposite) Risk taking Tolerant of mistakes	"Facilitating the design thinking process involves helping teams develop a greater tolerance for, and ways of working through, this ambiguity" (Glen, Suciu, Baughn, and Anson, 2015, p. 189)

(Continued)

Table 3. (*Continued*)

Attributes	Frequency in the Data Set	Codes	Example Quote
Blending rationality and intuition	25	Balance between declarative and modal logic Balance between exploration and exploitation Balance between intuitive and analytical thinking Balance between reliability and validity Divergent and convergent thinking Emotional and rational	"Design thinking balances exploitation and exploration, reliability and validity, analysis and intuition, and declarative logic and modal logic" (Lafley et al., 2013, p. 10)
Design tools and methods		37 different types, including personas, journey maps, brainstorming, prototypes, sketching and storytelling	"Both scholarly and practitioner literature have exhibited widespread interest in the application of design methods for promoting innovation, often referred to as the use of 'design thinking'" (Seidel and Fixson, 2013, p. 19).

[a]Reference to Creativity and Innovation was made in all the selected articles, although not all authors explicitly discussed the ways in which design thinking triggers creativity and/or leads to innovation.

Principal Attributes of Design Thinking

Creativity and Innovation

Creativity, intended as "the production of novel and useful ideas by an individual or small group of individuals working together," and innovation, defined as "the successful implementation of creative ideas within an organization" (Amabile, 1988, p. 126), are reflected as important attributes—as well as outcomes—of design thinking, both throughout the literature and in commentary by the expert practitioners who were consulted. Indeed, every article in the sample refers to creativity and innovation, and these aspects are often reported as motivation for engaging in the design thinking process. For example, according to A. G. Lafley, the former CEO of P&G who is credited with supporting a focus on design in that company, "design thinking is a way of thinking that fosters creativity and innovation in products and services, as well as new approaches to business and organization" (Lafley, Norman, Brown, and Martin, 2013, p. 5). More specifically, certain attributes of design thinking—such as prototyping, the trial-and-error approach, and the adoption of an abductive logic—have been considered key means to generate novel ideas and to innovate (Deserti and Rizzo, 2014; Martin, 2009).

User-Centeredness and Involvement

User- or human-centeredness is frequently noted as a fundamental feature of design thinking (Brown, 2009; Martin, 2011). As indicated by Liedtka (2015, p. 927), "virtually all current descriptions of the process emphasize design thinking as human centered and user driven as a core value." Only few authors appear to disagree (see, e.g., Nedergaard and Gryd-Jones, 2013); however, their criticism stems from disciplinary perspectives that stress the centrality of espoused customer needs and therefore equate user-centeredness with direct consumer input into value creation and innovation. Referred to as participatory, or cocreative design, this perspective advocates that end users should have "influence and room for initiative in roles where they provide expertise and participate in the informing, ideating, and conceptualizing activities in the early design phases" (Sanders and Stappers, 2008, p. 5). In contrast, in the design thinking literature, user needs and therefore value cocreation are taken into account in a variety of ways, without necessarily entailing direct user involvement (Beverland et al., 2015).

Empathy is identified as the prime means of actuating the principle of user-centeredness. Indeed, in considering the attributes of "design thinkers," many authors have referred to empathy as "the core value of human-centeredness" (Carlgren et al., 2016, p. 51). In the context of design thinking, empathy refers to taking the perspective of another, for example, identifying their behaviors as well as physical and emotional wants and needs, and understanding what they regard as meaningful (Connell and Tenkasi, 2015). According to Brown (2008, p. 87), design thinkers are

by definition empathic; they "can imagine the world from multiple perspectives—those of colleagues, clients, end users, and customers (current and prospective). By taking a 'people first' approach, design thinkers can imagine solutions." When doing so, they are able to "shift their point of view to better imagine solutions that meet both expressed and unexpressed needs" (Glen, Suciu, and Baughn, 2014, p. 657).

Problem Solving

Design thinking has been widely considered a means of solving problems, particularly "wicked" ones (Buchanan, 1992). Horst Rittell defined wicked problems as a "class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision-makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (cited in Churchman, 1967, pp. 141–142). The authors of most of the articles reviewed agree that real world problems are often "wicked" in nature and thus cannot be solved by the analytical methods advocated in management theory. Importantly, such problems can be addressed, for example, by improving a person's condition, but not fully resolved in the "right" way (Buchanan, 1992). Design thinking is thus proposed as an alternative approach to typical linear problem solving (Luchs, 2016; Martin, 2010), for instance, in the context of reconciling brand consistency and relevance (Beverland et al., 2015).

Iteration and Experimentation

Design thinking has been described as an iterative approach "characterized by trial-and-error learning […] that tests a range of possible solutions with end-users and other project stakeholders" (Beverland et al., 2015, p. 593). Iteration is utilized to clarify the problem being addressed (Beckman and Barry, 2007) and to trigger cycles of problem definition and experimental solution creation (Rylander, 2009), often involving deep user research to develop insights (Liedtka, 2015). Iteration and experimentation are often aided by making ideas tangible through sketches, mock-ups, and prototypes (McCullagh, 2013). Prototypes fulfill a very important role, not as validation for a product, service, or interface, but because they allow stakeholders "to learn about the strengths and weaknesses of [an] idea and to identify new directions that further prototypes might take" (Brown, 2008, p. 87). Indeed, just as empathy is a means of being user-centered, prototyping is regarded as a way to experiment and develop concepts, rather than to finalize them (Seidel and Fixson, 2013).

Interdisciplinary Collaboration

Innovation and wicked problem solving are advanced by bringing people together from different departments, units, and organizations (Beverland, Micheli, and Farrelly, 2016; Luchs, Swan, and Creusen, 2016). The underlying logic is that establishing cross-functional, multidisciplinary teams can help "address project complexity, ensuring that technical, business, and human dimensions of a problem are all represented" (Glen et al., 2014, p. 660). Therefore, the integration of diverse perspectives from within and outside the organization is considered a central aspect of design thinking (Carlgren et al., 2016). At the individual level, the ability and propensity to work with people from different disciplines has been identified as a fundamental attribute of a "design thinker" (Brown, 2009).

Ability to Visualize

According to several authors, "the act of moving from abstract thinking to visualizing ideas and then thinking on top of those visualizations is at the heart of design for innovation" (Boni et al., 2009, p. 409). Design scholars have argued that designers' ability to visualize defines their practices and approach to problem solving; as such, it forms an integral part of design thinking *and* doing (Deserti and Rizzo, 2014; Kimbell, 2011). Indeed, as Cooper, Junginger, and Lockwood, (2009, p. 51) assert, "the ability to visualize concepts and ideas early on" is fundamental "to guide an emerging rather than deterministic inquiry." Verganti (2017, p. 101) also states the "appreciation and deep skills for sophisticated aesthetical representation and reflection" are among the essential attributes of professional designers that set them apart from business managers. Importantly, visualization often, but not necessarily, entails physical artifacts such as the creation of sketches or prototypes. For example, storytelling is a means of visualizing alternatives or outcomes that can be used to make abstract ideas feel vivid and real (Carlgren et al., 2016).

Some researchers closely associating design thinkers with professional designers have suggested that design thinkers are characterized by the capacity to observe, visualize, and use physical artifacts to explore, define, and communicate (see, e.g., Drews, 2009; Glen et al., 2014; Kolko, 2015; Razzouk and Shute, 2012). According to these authors, this is not only because design thinking is rooted in the practices and processes adopted by designers (Beverland et al., 2015), but also because design *thinking* should be intimately related to design *practice* (Deserti and Rizzo, 2014).

Gestalt View

Another defining characteristic of the design thinking process is the adoption of an integrative approach that enables both the development of a deeper understanding of the problem context and the identification of relevant insights (Gruber et al., 2015; Nedergaard and Gyrd-Jones, 2013). According to Gianfranco Zaccai, founder of design firm Continuum, this "integration is not usually just about a product or a service—it's a holistic *gestalt* of the total experience [of] a variety of people" (Zaccai, interviewed in Lockwood, 2010a, p. 19). In the context of product design, *gestalt* refers to the belief that the perception of the whole is not simply the sum of the perceptions of its parts (see, e.g., Bloch, 1995; Noble and Kumar, 2010), but a resolution that, in accounting for context, transcends solutions provided by individual components. Authors describing design thinking have emphasized the importance of examining not only the specific issue or problem under consideration, but also how the issue relates to the environment or system in which it exists (Beverland et al., 2015; Hobday, Boddington, and Grantham, 2012a). In this sense, the term *gestalt* has been used to refer to the conceptualization and representation of problems, whereby design thinking relies on the general "understanding of the problem, including a customer's needs (explicit and tacit), the end-user's environment, social factors, market adjacencies, and emerging trends" (Holloway, 2009, p. 52). In acknowledging multiple stakeholders and contingencies, this context-driven perspective enables design thinkers to "challenge the original problem statement and incorporate the findings already gained to re-phrase the problem in a meaningful and holistic way" (Drews, 2009, p. 41), producing "an elegant integrated whole, or *gestalt*" (Vogel, 2009, p. 19). An inclusive yet systemic understanding of problems prompts design thinkers to "consider users as resourceful actors who, just as designers, draw on interactive artifacts and systems to make sense of and transform their situation" (Dalsgaard, 2014, p. 149; see *user-centeredness,* described above).

Abductive Reasoning

Abductive reasoning is an alternative approach to deductive and inductive reasoning. It can be thought of as the imagination of what *might* be (rather than the analysis of what *is*) (Martin, 2010). Expressed differently, abductive reasoning provides "the argument to the best explanation. … Unlike deduction or induction, abductive logic allows for the creation of new knowledge and insight—C is introduced as a best guess for why B is occurring, yet C is not part of the original set of premises" (Kolko, 2010, p. 20). Therefore, abductive reasoning promotes an "attitude towards workable solutions [that] is 'assertion-based rather than evidence-based'" (Michlewski, 2008, p. 387). In this sense, a design thinker can approach problem solving either by relying on an existing frame *or* by reframing and challenging existing practices and assumptions. It is in this latter case that "design-based practices and organizational innovation are most intimately linked" (Dorst, 2011, p. 531).

Tolerance of Ambiguity and Failure

Some researchers of design thinking have emphasized the importance of accepting equivocal information and failure. Indeed, ambiguity is inherent in defining and addressing wicked problems, and so the literature indicates that design thinkers should be willing and able to embrace ambiguity and engage "in iterative cycles of trial-and-error experiments and stakeholder feedback" (Adams, Daly, Mann, and Dall'Alba, 2011, p. 595) to define and address problems. Furthermore, failure is considered valuable for learning, in that it affords an opportunity to improve a product or process before rigidities set in: "the nature of the design process is to embrace early failure and uncertainty so as to continuously iterate toward better solutions" (Luchs, Swan, and Creusen, 2016, p. 324). Indeed, rapid experimentation and prototyping should enable innovators to learn from early,

and therefore relatively inexpensive, failures (Glen et al., 2014). Organizations that tend to avoid potential failures at all costs also risk missing potential opportunities. Consequently, the capacity to accept ambiguity has been proposed as a defining characteristic of design thinking organizations (Kolko, 2015).

Blending Analysis and Intuition

Several authors have argued that design thinking is an alternative to the analytical logic that dominates management theory and practice (Brown, 2008). In particular, design thinking is said not to disregard analytical thinking, but to blend it with intuitive thinking (Martin, 2010). Also, Porcini (2009, p. 8) states that "design is about research, analysis, intuition, and synthesis," and Stephens and Boland (2014, p. 223) highlight design thinking's role in combining "felt knowledge about patterns and holistic associations ('intuition') with deliberate evaluation of the usefulness and relevance of that knowledge ('rationality')." Indeed, while various authors have rightly emphasized the importance of intuition and synthesis in contexts typically dominated by rationality and analysis, design thinking's distinctive feature appears to dynamically balance between these opposing elements (Martin, 2009). Martin (in Lafley et al., 2013) also extends this notion of blended logics in relation to exploration and exploitation, reliability and validity, and declarative and modal logic.

Design Thinking Tools and Methods

Most authors emphasize the relevance and usefulness of several tools and methods common to design practice in relation to the attributes mentioned above. In the systematic literature review, a total of 37 tools and methods were identified initially, and then grouped on the basis of both what was stated in the literature and evidence gathered during the card sorting exercise. The eight major tools/methods and their occurrence in the selected articles (absolute numbers) are reported in Table 4, and presented in the order identified by most designers participating in the card sorting exercise.

Table 4. Essential Design Thinking Tools and Methods

Tools	Frequency in the Sample
Ethnographic methods	37
Personas	9
Journey map	11
Brainstorming	32
Mind map	4
Visualization	40
Prototyping	41
Experiments	33

Specifically, activities associated with *ethnographic methods*, such as observation, interviewing, and the use of informant diaries (Beckman and Barry, 2007) as well as representational tools including personas and journey maps are typically invoked. *Personas* "are symbolic representations of 'typical' users—archetypes that represent user patterns. … Personas place focus on people with whom the designer can empathize" (Welsh and Dehler, 2013, p. 780). Personas are often created before *journey maps*, intended as "the process of tracking and describing all the experiences a customer has and understanding not only what she encounters, but also her visceral responses to the experiences" (Dalton and Kahute, 2017, p. 24).

Brainstorming and mind maps are also mentioned, particularly in relation to ideation. *Brainstorming* is a collaborative process that promotes "the search for new solutions that might not be possible through individual ideation" (Seidel and Fixson, 2013, p. 21). *Mind maps* are collaborative sensemaking techniques that "facilitate team-based processes for drawing insights from ethnographic data and create a 'common mind' across team members" (Liedtka, 2015, p. 928). Furthermore, design thinking is characterized by ongoing experimentation and testing as concepts are made more concrete and users are involved in developing or assessing prototypes. *Field experiments*, *prototypes*, and *visualization* techniques such as drawings and pictures (Dalsgaard, 2014) can be used to enable continuous learning and concept sharing and to "clarify the characteristics of the idea and make it more amenable to critical consideration and feedback" (Glen et al., 2014, p. 658). Also, storytelling, a form of visualization, can enhance decision-makers' imaginative abilities (Carlgren et al., 2016; Liedtka, 2015).

Notably, within the reviewed articles and while listening to the designers explain their sorting process, it was possible to discern that the deployment of these tools fundamentally enables the design thinking attributes that were identified. While tools and methods should not be considered as isolated elements—for it is not the quantity of tools being

deployed, but the linkage between them that matters (Seidel and Fixson, 2013)—several salient links between specific tools and design thinking attributes emerged from the analysis. For example, in the literature several authors have emphasized that professional designers tend to draw on resources such as sketching and prototyping, to "understand the present situation, to envision and explore potential futures and to expose potential users to their concepts to evaluate which course to take" (Dalsgaard, 2014, pp. 145–46). While prototypes have long been used in industry to test manufacturing concepts, when deployed in the design thinking process, they are more commonly used as artifacts to express ideas and often constitute "local experiments which contribute to the global experiment of reframing the problem" (Schön, 1983, p. 94). During the card sorting exercise, most of the designers highlighted their use of prototypes as boundary spanning objects (Carlile, 2002) when communicating and collaborating across functions and with other firms. In line with the literature (Dalton and Kahute, 2017; Welsh and Dehler, 2013), designers also described the relevance of other tools and methods, such as personas, as particularly helpful in visualizing key stakeholders, thus fostering empathy and providing a gestalt view of the problem by ensuring that users are a represented constituency in the problem-solving process. The principal relationships between design thinking tools and attributes are reported in Table 5.

Table 5. How the Essential Tools and Methods Enable the Design Thinking Attributes

Tool and Methods	Principal Relationships to Attributes
Ethnographic methods	Provide a means of fostering empathy and thus *user-centeredness and involvement.*
	Observational data can complement quantitative data and help *blend analysis and intuition.*
	Help to provide a *gestalt view* by understanding a problem in its context.
	Rich data can trigger "what if?" types of questions and thus support *abductive reasoning*.
Personas	Provide a means of fostering empathy and thus *user-centeredness and involvement.*
	Serve as a boundary-spanning object during *interdisciplinary collaboration* and communication.
	Are a means to *visualize* key stakeholders.
	Help to provide a *gestalt view* of the problem by ensuring that users are a represented constituency in the problem-solving process.
Journey maps	Provide a means of fostering empathy and thus *user-centeredness and involvement.*
	Serve as a boundary-spanning object during *interdisciplinary collaboration* and communication.
	Are a means to *visualize* key stakeholders' experiences.
	Enable *iteration and experimentation* by allowing design thinkers to consider and test multiple user journeys.
	Help to provide a *gestalt view* of the problem by encouraging a contextual and temporal understanding of user experience.
Brainstorming	Provides a forum for *abductive reasoning.*
	Is typically used during *interdisciplinary collaboration.*
	Fosters the *blending of analysis and intuition* by encouraging broad conceptualizations.
	Reinforces *iteration and experimentation,* as most brainstorming techniques include withholding judgement about individual ideas.
Mind maps	Serve as a boundary-spanning object during *interdisciplinary collaboration* and communication.
	Reinforce the *acceptance of ambiguity and failure* by facilitating a process of sensemaking.
	Exemplify the *ability to visualize* and structure complex systems and environments.
	Encourage a *gestalt view* by acknowledging and mapping multiple stakeholders' conceptualizations.
Visualization	Serve as a boundary-spanning object during *interdisciplinary collaboration* and communication.
	Underscores the importance of the *ability to visualize* solutions in the course of ideation.
	Sketches can serve as a communicative tool during *abductive reasoning.*
	The informal nature of sketches encourages *iteration and experimentation.*
	Can capture current and desired states, reinforcing *user-centeredness* and a *gestalt view* and allow the *blending of analysis and intuition.*
Prototypes	Provide a physical means for *iteration and experimentation.*
	Encourage early *failure* in draft form.
	Serve as a boundary-spanning object during *interdisciplinary collaboration* and communication
	Underscores the importance of the *ability to visualize* solutions during ideation, among other phases.
Field experiments	Enable *iteration and experimentation.*
	Foster a *gestalt view* through a deep appreciation of the problem context.
	Encourage early *failure* in draft form.

Phase 3: Cluster Analysis of the Design Thinking Literature

The emergence of 10 attributes from the literature review and the card sorting exercise highlights the multidimensional nature of design thinking. This multidimensionality, coupled with divergent views expressed by various authors (see, e.g., Brown, 2008; Carlgren et al., 2016; Johansson-Sköldberg et al., 2013; Kimbell, 2011; Martin, 2010), creates a conceptual challenge in describing precisely what constitutes design thinking. To further investigate its attributes and to determine points of divergence in the literature, the findings of the initial literature review were supplemented by a cluster analysis. This analysis enabled the authors to identify sets of articles where similar themes are articulated and to generate questions that can inform future research on design thinking (Meyer, Tsui, and Hinings, 1993).

Specifically, cluster analysis takes a sample of elements—in this case, the articles in this study's data set—and groups them in such a way that the statistical variance among elements grouped together is minimized, while between-group variance is maximized. Additionally, cluster analysis allows for the inclusion of multiple variables—here, design thinking's attributes—as sources of identification of relatively homogeneous groups and therefore can provide rich descriptions of different themes existing in the literature without overspecifying the model. Two steps are particularly relevant in conducting a cluster analysis: the selection of the clustering variables and the identification and validation of the clusters (Hair, Anderson, Tatham, and Black, 1992).

Selection of Clustering Variables

The results of the systematic literature review were supported by the feedback received from the seven professional designers involved in the card sorting exercise. Therefore, the 10 attributes identified in the review were included in the cluster analysis. Of these, "creativity and innovation," was present in all the selected articles and therefore not useful in discriminating among themes. Three attributes were mentioned in over 60% of the sample (user centeredness and involvement; problem solving; iteration and experimentation), while the others occurred less frequently. In order to maximize the likelihood of discovering meaningful differences among groups of articles and to identify clusters where different perspectives are articulated, only six attributes—abductive reasoning; ability to visualize, blending analysis and intuition, gestalt view, interdisciplinary collaboration, tolerance of ambiguity, and failure—were retained (see also the *post hoc* analysis reported below).[4]

Identification and Validation of Clusters

Clusters were identified through a two-stage procedure: a hierarchical algorithm was used to define the number of clusters, and then these results served as the starting point for a non hierarchical clustering analysis (Ketchen and Shook, 1996). Thus, the dendrogram that resulted from hierarchical clustering was visually inspected first, and then used these results as inputs of a K-means non hierarchical clustering algorithm (Hartigan and Wong, 1979). In order to validate the clusters, this two-stage procedure was first performed several times by changing clustering algorithms, and then the results coming from the quantitative analysis were coupled with the researchers' judgment based on their knowledge of design thinking theory and practice (Hair et al., 1992).

Results of the Cluster Analysis

The analysis revealed that a five-cluster model provided the best fit. The clustering procedure was intended, where possible, to reflect the heterogeneity of views with regard to the design thinking attributes detailed in each article. Therefore, these clusters can be seen to represent five perspectives in the literature. It is important to underscore that cluster analysis is an exploratory type of analysis. Although the clustering algorithm maximizes the between-group variance among clusters, some attributes invariably will be present in more than one cluster and thus a certain degree of overlap among clusters is expected. For these reasons, when presenting the results of this analysis, the diversity among clusters is highlighted, although in some cases this manifests itself in distinct themes or standpoints within the literature, whereas in others it largely signifies differences in emphasis given to similar themes. The number of articles and the design thinking attributes belonging

[4]A cluster analysis that included all 10 attributes was also undertaken. However, the results were not conducive to providing any relevant empirical evidence, as most articles fell into a large cluster that included the four most common attributes.

Table 6. Results of the Cluster Analysis

	Cluster				
	1	2	3	4	5
Abductive reasoning	0	1	0	0	1
Ability to visualize	0	1	0	1	0
Blending rationality and intuition	0	0	0	0	1
Gestalt view	0	0	0	1	1
Interdisciplinary collaboration	1	1	1	0	0
Tolerance of ambiguity and failure	0	1	1	0	0
Number of articles	38	18	20	14	14

to each cluster are reported in Table 6; the complete list of articles included in the clusters is presented in Appendix 3 in supporting information.

Last, in order to provide additional evidence for the validity of the cluster analysis, an ANOVA was performed to compare the five clusters on the three attributes of design thinking that were excluded from the cluster analysis (i.e., user centeredness and involvement; problem solving; iteration and experimentation). Results show that the null hypothesis that all four groups had the same level of the three attributes cannot be rejected (user centeredness and involvement: $F = .10$, $p > .05$; problem solving: $F = .90$, $p > .05$; iteration and experimentation: $F = 1.50$, $p > .05$). The post hoc Student-Newman-Keuls (S-N-K) procedure was also conducted and this further established that there were no significant differences in any of the three attributes between the five groups (Tables 4.1, 4.2, and 4.3 in Appendix 4 in supporting information show the results of the S-N-K procedure). Therefore, although the five perspectives that emerge from the cluster analysis share some common attributes, they differ on several others. In the next section the five clusters are described in detail and new questions that can inform empirical research in this field are generated.

Perspectives Emerging from the Cluster Analysis

While there are overlaps among clusters and some authors feature in more than one (for example, if they emphasized specific attributes of design thinking in different articles), five perspectives which emphasize divergent aspects of design thinking emerged and raise questions relevant to resolving definitional issues of the concept. Because these findings provoke as many questions as they answer, a brief summary of the main themes for each cluster is provided first and then a set of research questions that should be considered to strengthen and enhance design thinking theory and practice is proposed.

Cluster 1: Emphasis on Interdisciplinary Collaboration

Cluster 1 emphasizes the importance of work both within and across functional groups. As David Kelley, founder of design consultancy IDEO states: "design thinking is definitely a team sport" (interviewed by Camacho, 2016, p. 90). According to Olsen (2015, p. 182), design thinking "engages a broad range of players to find both the problem and provide the solution"; as such, it encourages the "transcendence of organisational and procedural silos, established hierarchies, or bureaucratic categories" (Mintrom and Luetjens, 2016, p. 393). Indeed, several scholars and practitioners appearing in this cluster argue that emulating design practices and methods represents the starting point of introducing and embedding design thinking across functions and disciplines (see, e.g., Dalton and Kahute, 2017; Liedtka, 2011; Seidel and Fixson, 2013). Authors in this cluster are also more likely to advocate for the adoption of design thinking in organizations, often irrespective of industry, context, or type of problem. For example, according to according to Tim Brown (2009, pp. 7–8), design thinking has pulled "design out of the studio and unleash[ed] its disruptive, game-changing potential. … The natural evolution from *design doing* to *design thinking* reflects the growing recognition on the part of today's business leaders that design has become too important to be left to designers." Similarly, Carr, Halliday, King, Liedtka, and Lockwood (2010, p. 62) take the position that design thinking as a "problem-solving methodology can be uncoupled from the design function, it can be scaled throughout an organization."

Interestingly, various authors in this cluster explicitly distinguish between designers and "design thinkers" arguing that all employees should become design thinkers, as expressed in this article's opening quote from Brown (2009). However, while this is an enterprising idea in principle, to these authors' knowledge no studies of such initiatives have been conducted, so claims of beneficial outcomes remain speculative

at best. Moreover, Brown's (2008) original *Harvard Business Review* article reflects the indeterminacy inherent in proposing vague design-oriented practices and their implementation as a curative strategy. He states, "design thinking is a discipline that uses the *designer's sensibility* and methods to match people's needs with what is *technologically feasible* and what a *viable business strategy* can convert into customer value and market opportunity" (p. 86, emphasis added). Thus, while Brown initially presents design thinking as leveraging the skills and mindset of a single discipline, design, there are arguably three professional skillsets embedded in this description: the designer who empathizes, identifies, and ideates on user needs; the technical engineer who determines what is feasible; and the business manager who determines strategic viability and value generation.

Articles falling into this cluster are not unequivocally positive; despite advocating the adoption of design thinking, several authors remark upon the lack of evidence over its effects. McCullagh (2013) speaks of "overblown claims" and Seidel and Fixson (2013, p. 31) highlight "the danger of overselling the methods without an appreciation of the limitations and importance of context." Similarly, Gruber et al. (2015) note that scholarly discourse is limited on the impact of design thinking on firm performance, and Carr et al. (2010) advocate research to identify measures that demonstrate design thinking's impact.

Cluster 2: Emphasis on Reclaiming Design Thinking as Designers' Domain

This cluster emphasizes four attributes of design thinking: abductive reasoning, the ability to visualize, interdisciplinary collaboration, and tolerance for ambiguity and failure. Largely written by nonmanagement authors, they tend to advance critical views on the conceptualization of design thinking typically expressed in management discourse (see, e.g., Burdick and Willis, 2011; Connell and Tenkasi, 2015; Dorst, 2006; Kimbell, 2011; Kleinsmann, Valkenburg, and Sluijs, 2017).

Kimbell (2011), in particular, is vocal in arguing that the very concept of design thinking is ill-conceived, in part because it presumes that design disciplines as varied as product, graphic, service, and interaction design (among many others) have common practices. Equally relevant concerns raised in these articles include the presumption that the hallmarks of design thinking are unique to designers and that all designers necessarily employ them. Even if all designers—and all design disciplines—were found to share the same "sensibilities," all the authors in this cluster agree that the ability to visualize is a central characteristic of both the concept of design thinking and of its practitioners. This is significant, because since the promulgation of the design thinking concept in management discourse, it has faced the question of whether design thinking describes a means of approaching problems or is best understood as a professionally derived skillset. It is a vital question to resolve with future investigation, as it is fundamentally related to existential issues such as whether non-designers (e.g., managers or co-creating customers) can "do" design thinking, or if reaping the benefits of the method requires the involvement of those with professional design training. According to Boni et al. (2009, p. 409), "even though 'design thinking' has become a popular phrase with the business press, there is little written that can help non-designers learn what Brown (2008) calls the 'designer's sensibility' … What is blatantly missing from [Brown's] list is the ability to visualize information." In essence, several authors have challenged the separation of cognitive styles from the use of relevant artifacts, because material practices play a crucial role in designers' worldview (Schön, 1983).

Generally, the articles in Cluster 2 tend to question the "natural evolution from design doing to design thinking" found in Cluster 1. Moreover, if there is a distinction between "design thinking" and "design doing," it remains empirically unexplored. Thus, one fruitful path may be in examining managers' and designers' respective communities of practice, a suggestion explored in the section following the presentation of clusters.

Cluster 3: Emphasis on Resilience in Problem-Solving

Articles in Cluster 3 focus on two attributes: tolerance for ambiguity and failure, and interdisciplinary collaboration. Authors in this cluster are not as critical of design thinking rhetoric as those in Cluster 2, and they evince an emphasis on organizational culture. For example, Indra Nooyi, PepsiCo's CEO (interviewed by Ignatius, 2015, p. 85) acknowledges

that, for design thinking to be fully embraced by the company, "we'll have to be willing to tolerate more failure." Similarly, Drews (2009, p. 40) argues: "an openness to trying multiple paths toward a solution is one of the key strengths of design thinking." For this reason, design thinking is often touted as an alternative approach to narrowly analytical approaches, which are considered ineffective in contexts characterized by complexity and dynamism (Ben Mahmoud-Jouini, Midler, and Silberzahn, 2016; Fixson and Rao, 2014). However, as Dong, Garbuio, and Lovallo (2016, p. 88) admit: "when people are solving strategic problems, no matter the difficulty of the problem, the overwhelming bias is to treat them as a closed-form solution, where a unique, reliable and repeatable outcome is sought."

Within Cluster 3, as in Cluster 2, questions are raised about the importance and role of design experience. According to Deserti and Rizzo (2014), a "design culture" rooted in professional design practice is ideal, but Beckman and Barry (2007) advocate instead for a diversity of thinking styles, emphasizing "successful innovation requires both individuals with high tolerance for ambiguity and those with low tolerance for ambiguity to be on the same team" (p. 52). Empirical evidence, however, is insufficient in this respect, as the articles in this cluster mainly consist of discussions of examples.

Cluster 4: Emphasis on Seeing and Reflecting Upon the Whole

Articles in this cluster emphasize the ability to visualize and a gestalt view of problems. In contraposition with the previous clusters, this cluster focuses on individual designers, as particular attention is paid to the "thinking" part of design thinking (see, e.g., Buchanan, 1992; Cooper et al., 2009) and discussion revolves around how to educate professional designers and design thinkers (e.g., Junginger, 2007; Borja de Mozota, 2008; Dalsgaard, 2014) to leverage these skills.

In doing so, several articles refer to Schön's (1983) book, *The Reflective Practitioner*. For example, Dalsgaard (2014, p. 145) states: "to address wicked problems, designers move through iterative phases of thinking and doing, or action and reflection in the widely used terminology of Schön (1983)." This aligns with an earlier remark by Buchanan (1992, p. 6) for whom "designers are exploring concrete integrations of knowledge that will combine theory with practice for new productive purposes." Moreover, a gestalt view is highlighted as an enabler of problem identification and re-framing (Koomans and Hilders, 2017).

Cluster 5: Emphasis on Learning to Think Like a Designer

Articles in Cluster 5 focus on the high-level themes of gestalt and the role of blending analysis and intuition in achieving insightful solutions. The earlier work of Roger Martin on abductive reasoning and blended logics features prominently here (Dunne and Martin, 2006; Lafley et al., 2013; Martin, 2010). The capacity to balance intuition and rationality is often associated with professional designers but regarded as an ability that could (and should) be learned and adopted by nondesigners (see, e.g., Venkatesh, Digerfldt-Månsson, Brunel, and chen, 2012). For this reason, some authors in this cluster advocate that design thinking be taught in business schools. Dunne and Martin (2006) argue: "design thinking needs to pervade everything business students do: It would necessarily affect their approach to 'traditional' MBA courses. And it is here that design thinking will face its greatest challenge [as business schools should] adopt epistemological pluralism" (p. 522). Similarly, Beverland et al. (2015) talk about designers' capacity to engage with "reconceiving, a process that reframes problems and outcomes. Reconceiving is a particularly useful practice for dealing with the unanticipated and stands in contrast to replication," the logic which characterizes business disciplines such as marketing and branding.

Although training business students and managers in design thinking may be worthwhile, McCullagh (2010, p. 38) notes: "while explaining design as an algorithm goes down well with managers, this pitch skips over the pivotal importance of talent and craft. … It's therefore hard to believe that many senior managers can pick up any meaningful design skills after a workshop or two." This same author goes on to question Martin's very characterization of professional designers: "while few designers (or design thinkers) currently live up to Martin's ideal of a balance between analytical and intuitive thinking, it is a fine goal for the profession to aspire to, both individually and organizationally."

Avenues for Future Research Identified through the Cluster Analysis

Given this research's aim to shed light on current conceptualizations of design thinking and to advance both theory and practice, the cluster analysis is concluded with questions to be addressed in future studies. For example, although the authors of articles in Cluster 1 emphasize the importance and benefits of interdisciplinary collaboration, the relative importance, deployment, and integration of multiple professional skill sets has not yet been adequately investigated. Indeed, surprisingly little empirical research has been conducted in relation to fundamental questions such as:

1. What constitutes a "design thinker" and what kind of training and practice is needed to become one?
2. If management desires to develop a design thinking competency organizationally, what composition of skills and roles is required to support its introduction and deployment? Similarly, how might a design thinking frame (Beverland et al., 2016) best be introduced in contexts where alternative logics are not only dominant, but might inhibit acceptance of the new?

In addition, the scant research on the impact of design thinking highlights the need to answer questions including:

1. What is the effect of design thinking on organizational performance?
2. Can design thinking also affect team and individual outcomes?
3. Do organizational, team, or individual characteristics moderate or mediate the relationship between design thinking and performance?

As noted above, articles in Cluster 2's emphasis on design thinking as a process best left in the realm of professional designers raises the issue of its core constitution, adding urgency to resolving the questions:

1. Is design thinking a means of approaching problems or is it a skillset requiring technical training?
2. And relatedly, is the concept of design thinking reflective of all professional design disciplines?

The articles in Cluster 3 highlight the importance of resilience in the face of failure and uncertainty. If we are to accept that "good designers can effectively tolerate the ambiguity and uncertainty that arises during inquiry" (Glen et al., 2015, p. 186), a number of questions remain, including:

1. Should design thinking be applied predominantly in situations when ambiguity and uncertainty are high?
2. Does design thinking require an organizational culture where failure is accepted, or does its introduction help create such a culture? And, in light of different disciplinary thought worlds (Dougherty, 1992), how might firms orient their structures and cultures to allow for tolerance of failure at different levels of practice (project, departmental, strategic)?

Articles in Cluster 4's emphasis on the fundamental skills and processes of designers and designerly modes of working raises the following issues:

1. How can the acquisition and effectiveness of design thinking skills be assessed (Razzouk and Shute, 2012)?
2. Is the holistic, reflective approach typical of professional designers a necessary condition for deeper investigations of problems and for their potential re-framing? In relation to these questions, empirical research could further investigate professional designers' action and reflection, as these could constitute a micro-foundation of design thinking (a suggestion explored below).

Finally, articles in Cluster 5's view that nondesigners be trained to thinking like professional designers suggests developing a scale for measuring design thinking as well as empirical research on several themes, including:

1. What are the main individual and organizational barriers to adopting design thinking practices (Beverland et al., 2015)?
2. What are the results of introducing design thinking in MBA curricula, not only as a subject to be taught, but as an overarching epistemological approach? (This suggestion is entirely feasible as there are a number of business schools that have already included design topics into their programs.)

3. What are the implications of conceptualizing design thinking at different levels of analysis, such as individual, team, or organization (Chang et al., 2013)?

Contributions and Implications

In an effort to advance understanding and application of design thinking, a multiphase study was undertaken, beginning with a systematic review of the literature and then proceeding to validate emergent findings with additional methods and analysis. The findings help to elucidate what is often presented as a fuzzy construct. In so doing, three contributions to design and innovation management theory and practice are made. First, in rigorously deriving 10 attributes and 8 essential tools and methods that support them from a broad and multidisciplinary assortment of articles, much needed clarity and validity is brought to a construct plagued by polysemy and thus threatened by "construct collapse" (Hirsch and Levin, 1999). Second, aided by the identification of perspectives of scholars writing about design thinking, detailed recommendations are provided for relevant topics warranting further study in order to advance theoretical understanding of design thinking and test its applications. Third, the enduring, yet essential, questions that remain unresolved across the extant design thinking literature and that may impede its practical implementation are identified.

Theoretical Implications

This article has argued that conceptual clarity and methodologically robust empirical studies are critical if design thinking is to avoid the fate of other management concepts in which research disintegrated into a collection of "ad hoc, atheoretical and non-cumulative studies" (Goodman, Atkin, and Schoorman, 1983, p.164). In particular, design thinking suffers from the reverse problem than most academic concepts (Hirsch and Levin, 1999): current discussions and publications on design thinking lack theoretical and methodological rigor, rather than practical relevance. While practical interest in design thinking is expected to endure in the near future, this will not be sufficient to sustain and enrich our understanding of the concept if rigorous research is not undertaken. Challenges to validity occupy a powerful place in academia and inspired this systematic review, including careful examination of the main assumptions taken for granted by many scholars of design thinking. However, empirical research is essential to provide cogent evidence of the nature and benefits of design thinking, if it is to become a meaningful and enduring concept in innovation management. In addition to the questions raised by the cluster analysis presented above, further lines of inquiry[5] are suggested before concluding by articulating the main implications for practice.

Recent scholarship has emphasized the role of individuals' experiences, skills, cognitive interpretations, and related actions on organizational capabilities and performance (cf. Eggers and Kaplan, 2013; Felin, Foss, and Foyhart, 2015). This "microfoundational" perspective appears particularly relevant in understanding the elemental constituents of design thinking and in effectively introducing it in organizations. Specifically, the work on "reflective practitioners" by Schön (1983), mentioned in the findings and particularly in relation to Cluster 4, could inform research into the interplay between design thinking and doing. According to this author, knowing *is* in our actions, and an ambiguous situation "comes to be understood through the attempt to change it, and changed through the attempt to understand it" (Schön, 1983, p. 132). From this point of view, design thinking can be conceptualized as a reflective "conversation" with a situation or presenting problem, and as depending upon professional designers' appreciative systems—rooted in their experiences, images, and understandings—which allow the framing and re-framing of problems and inform action. As highlighted by several authors in Clusters 2 and 4, this perspective clearly emphasizes the unique characteristics and differences among professional groups.

To further explore this issue, empirical studies might adopt the lens of *communities of practice* (Wenger, 1998), a growing literature which examines the tacit elements that are inextricably tied to professional activities beyond specified roles or tasks. In this view, the tacit assumptions and norms that permeate a given profession are part and parcel of its practice: "by participating in a community, a newcomer develops an awareness of that community's practice and thus comes to understand and engage

[5]The articles cited in this section are drawn from, and are fairly uniformly represented in, each of the five clusters, underscoring the point that these underlying concerns remain unresolved *across* the extant literature.

with various tools, language, role-definitions and other explicit artefacts as well as various implicit relations, tacit conventions, and underlying assumptions and values" (Handley, Sturdy, Fincham, and Clark, 2006, p. 645). From this perspective, it is understandable that professional designers and design scholars may bristle at the notion of "any" individual, regardless of training, being capable of design thinking, because the knowledge the individual has acquired has been divorced from membership in design's community of practice.

At the same time, management theorists and practitioners, whose communities of practice emphasize the adoption of systematic processes and a logic of replication (Beverland et al., 2016; Martin, 2009), are more likely to see design thinking as a composite of activities whose elements can be isolated, extracted, and adopted. A reflection (and critique) of this latter perspective can be found by Bruce Nussbaum, who, although an initial proponent of design thinking, later pronounced it a "failed experiment": "In order to appeal to the business culture of process, [design thinking] was denuded of the mess, the conflict, failure, emotions, and looping circularity that is part and parcel of the creative process. […] Companies absorbed the process of Design Thinking all too well, turning it into a linear, gated, by-the-book methodology that delivered, at best, incremental change and innovation" (Nussbaum, 2011)[6]. Similarly, in a recent "provocative" commentary, Verganti (2017, p. 101) criticized the "apostles of design thinking for managers [as they] have done everything they could to say that symbols are irrelevant: you can build whatever goofy prototype you want to build; the aesthetic dimensions of the prototype do not matter. [In doing so,] management has not moved closer to design. Design moved closer to management." Thus, empirically investigating the microfoundations of design thinking could help introduce and embed it in organizations.

Moreover, to date design thinking has mostly been associated with innovation, creativity, and wicked problem solving. Some authors have also pointed to its potential role in achieving sustainable competitive advantage (Collins, 2013) and higher profitability (Clark and Smith, 2008). More recently, design thinking has been proposed as a useful tool in strategy formulation and communication, as well as in post-merger integration (Liedtka, 2014). However, because empirical evidence of the impact of design thinking is still lacking, it is difficult to specify the timing, level, resource intensity, and intended outcomes of its deployment. Besides descriptions of specific instances of implementation of design thinking, very few studies have employed rigorous empirical methods of investigation (for exceptions, see, e.g., Beverland et al., 2015; Seidel and Fixson, 2013). Such studies are long overdue, and, having identified the main attributes and tensions inherent within design thinking in this article, we urge scholars to empirically investigate the applicability and effectiveness of design thinking.

Managerial Implications

When and how should design thinking be used?. Design thinking is often positioned as an antidote to fossilized and ineffective management methods, rooted in practices that no longer serve organizations subject to dramatic and disruptive change. Although many authors have highlighted the relevance and effectiveness of design thinking, a crucial, practical question still remains: when and how should it be deployed?

While most of its reported implementations come from the context of product and service design, according to Buchanan (1992, p. 16), "the subject matter of design is potentially *universal* in scope, because design thinking may be applied to any area of human experience." Indeed, Hobday, Boddington, and Grantham (2012b) argue that design thinking could be utilized in various areas including public policy, education, healthcare, politics, and social and economic development. This is aligned with claims expressed by authors in Cluster 1 over the importance, even the necessity, to introduce design thinking in any kind of organization. Nonetheless, it is still unclear whether design thinking would be more effectively applied in certain areas than others, and determining if it is most conducive, for example, to seeking radical innovation rather than incremental. For example, Lockwood (2010b, p. 5) argues that design thinking "strives for more-radical improvements." At present, though, empirical evidence is limited and even rallying cries are vague: "what we need is an approach … that individuals and teams can use to generate

[6]It is notable that Nussbaum, when advocating for design thinking (see, e.g., Nussbaum, 1998), was an editor at *BusinessWeek*; his subsequent commentaries critiquing a corporate adoption of design thinking were published after he became Professor of Innovation and Design at Parsons The New School for Design.

breakthrough ideas that are implemented and that therefore have an impact" (Brown, 2009, p. 3).

Once the design thinking process is introduced within a firm, it is not currently clear at what stage it is best applied. For example, according to Luchs (2016, p. 3), in product development it belongs at the "'fuzzy front end' of NPD, whereby a project begins with an iterative, Design Thinking approach, followed by a traditional Stage-Gate process." Lockwood (2009b, p. 3) similarly states that design thinking is "part of the 'fuzzy front end' and a great method with which to discover unmet needs and create new product and service offerings." However, Deserti and Rizzo (2014, pp. 55–56) offer conflicting advice, arguing that design thinking "does not contribute to innovation simply by generating new ideas; it does so by actually constructing new, viable solutions" and therefore should permeate the whole NPD process.

Regarding how to best introduce design thinking, some scholars argue that senior management commitment and integration in a company's systems and policies should support its adoption (see, e.g., Drews, 2009; Fraser, 2009; Martin, 2011). In this sense, *organizational* design is a necessary condition for successful design thinking, insofar as it necessitates a change in an organization's culture, structure, and policies to the point of requiring a paradigmatic shift in strategic vision (Collins, 2013). More specifically, examining organizational structures and governance, Chang et al. (2013, p. 22) claim that organizations should "identify and choose a qualified independent design-thinking coordinator." On the other hand, some researchers have maintained that organic structures that favor collaboration across diverse teams and ensure opportunity recognition are necessary to realize the benefits of design thinking (see, e.g., Chen and Venkatesh, 2013; Fraser, 2007). Clearly, progress in its application will be slowed until such contradictory perspectives are resolved.

The relationship between design thinking and other emergent approaches. Some attributes and tools associated with design thinking have also been discussed and utilized in relation to other approaches.[7] For example, agile product development is also characterized by iteration and experimentation as well as a clear focus on user requirements (Beck et al., 2001). As such, agile has also been proposed in opposition to linear and plan-based approaches to innovation (Cooper and Sommer, 2016; Glen et al., 2014). Similarly, the lean startup approach promotes rapid iterations and the creation of minimal viable products that can be distributed to users to produce early market response data (Ries, 2011). While design thinking shares some characteristics with these approaches (see also Carlgren et al., 2016; Fixson and Rao, 2014; Liedtka, 2015), it employs them differently and includes attributes that are specific to its process. Importantly, while agile product development and the lean startup methods tend to focus primarily on activities within processes, design thinking's attributes appear to be a mixture of activities (e.g., iteration and experimentation), skills (e.g., ability to visualize), orientations (e.g., gestalt view; tolerance for ambiguity), and logics (e.g., abductive reasoning).

For example, like agile product development and the lean startup approach, design thinking encourages iteration in the context of user needs. However, the abductive reasoning that underlies the design thinking process encourages participants to frame and reframe problems (Beverland et al., 2015) and to interrogate current assumptions, offerings and their meanings before the search for alternatives has begun. Indeed, aspects related to exploration and ideation are discussed much more widely in the design thinking literature than in relation to either agile product development and the lean startup, and design thinking itself is often associated with the "fuzzy front end" of innovation processes (Luchs, 2016).

As with attributes, the tools and methods used in design thinking are framed and deployed differently or have distinctive origins which color their use. For example, design thinking draws extensively on observational methods, rather than either on the type of feedback associated with the voice of the customer process (Griffin and Hauser, 1993) or on other tools such as scrums, sprints, and root cause analysis that originate from software development or lean thinking (Ries, 2011; Rigby, Sutherland, and Takeuchi, 2016). Also, a number of tools used in design thinking, such as journey mapping, personas, and sketching are clearly derived from design disciplines and extensively examined by design thinking authors and practitioners, as this study shows. For these reasons, the description of the 10 principal attributes and related tools and methods presented in this article depict a distinctive approach. However, additional research should further explore the differences,

[7]The authors thank one of the anonymous reviewers for this comment.

similarities, and synergies between design thinking and other methods and processes. Furthermore, attention should be given to empirically investigating their joint deployment, since in practice many firms experiment concurrently with multiple modes of innovation processes. For example, if both design thinking and agile product development are introduced in an organization, how do problem framing and the interrogation of assumptions take place? Or, what kind of user feedback is considered as legitimate if design thinking and the lean startup approach are implemented together?

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this paper.