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PRODUCT DESIGN: A REVIEW AND RESEARCH AGENDA FOR MANAGEMENT STUDIES

SUMMARY

In this paper, we review research on product design in the broad domain of business studies. We highlight established and emerging perspectives and lines of inquiry, and organize them around three core areas, corresponding to different stages of the design process (design activities, design choices, design results). We identify and discuss avenues for further research at the intersection of these bodies of research, and we argue that management scholars possess conceptual and methodological tools suited to enrich research on design and to effectively pursue lines of investigation only partially addressed by other communities, such as the construction and deployment of design capabilities, or the organizational and institutional context of design activities.

Introduction

The last decade has seen a rising interest in design among scholars in management and organization studies. While early contributions from management scholars mostly appeared on specialized outlets (e.g. Dumas and Mintzberg 1989, 1991), more recent work investigating the practices that underlie how products are designed has been published increasingly on journals of more general orientation (e.g. Hargadon and Sutton, 1997; Boland and Collopy 2004; Rindova and Petkova 2006; Ewenstein and Whyte 2007, 2009; Michlewski 2008; Elsbach 2009). These studies highlight the potential contribution of management concepts and tools to understand how the form and function of goods come to be defined in the design process, and how they influence and are influenced by social processes in and around organizations.

This rising interest of management and organization scholars in design follows increasing awareness in the realms of education (Merrit and Lavelle 2005) and practice (e.g. Nussbaum 1988, 1993; Trueman and Jobber 1998) of the benefits that producers derive from well designed goods and more intense collaboration with designers (see Borja de Mozota 2006). A similar intensification of research efforts has been observed also in related fields, such as marketing and new product development (Swan and Luchs 2011).

Previous reviews on design-related research in the broad domain of business studies (e.g. Bloch 1995; Walsh 1996; Noble and Kumar 2010) have generally focused on past work within specific scholarly communities (e.g. consumer behaviour, technology and innovation). Even a recent attempt to review and reconceptualise research on design restricted its search to marketing journals (Swan and Luchs 2011). In this paper, we provide a more comprehensive portrayal of past research in business studies, by systematically reviewing extant literature on product design in different fields of the business studies, including marketing, innovation, organization studies, and operations and technology, and, by doing so we outline

opportunities to enrich our understanding of the phenomenon associated to new avenues for research lying at the intersection of different streams of research.

In the first part of the paper, we highlight established and emerging lines of inquiry, and we discuss their theoretical underpinnings and contributions to our overall understanding of the phenomenon. In the second part of the paper, we emphasize potential benefits to be gained by more intense cross-fertilization among perspectives and lines of inquiry. We point to promising avenues for further research, suggest possible research methods, and argue how management and organization scholars are well positioned to improve our understanding of issues of theoretical and practical relevance in design and design-related processes.

Methodology

In absence of a dominant approach in the field of management and organization studies (Mays et al. 2005; Tranfield et al. 2003), we adopted a “fit for purpose” methodology (Macpherson and Jones 2010) to categorize the heterogeneous body of research on design in business studies.

Defining the boundaries

Our first task was to specify the boundaries of our review. As Heskett (2002) observes, “discussion of design is complicated by an initial problem presented by the word itself. ‘Design’ has so many levels of meaning that it is itself a source of confusion (2002: 5).” In other words, design can be perceived in different ways: as an outcome, as a process, as the purpose of that process, and as the ability (or capability) to reach that purpose. Indeed, later in this paper, we show how, in business studies, different streams of research have adopted different definitions emphasizing different aspects of design. Consistently with the broad scope of our inquiry, we propose a pragmatic definition of design as “what it is” and “what it

does”. We therefore conceive design as a set of choices regarding both the form and the function of an object, as well as the activities that underpin these choices. From this perspective, thus, design is considered not only in terms of the final outcome, but also in terms of the process leading to that outcome (for a similar approach, see also Swan & Luchs 2011). Although the outcome of design may include a variety of “objects”, such as products, visuals, environments, and interactions, for the sake of simplicity, in this paper we focus only on research on the design of products.

Searching and selecting research output

Following Greenhalgh and Peacock (2005), the selection of research output combined a protocol driven methodology (where the search strategy is defined at the beginning of the study) with a “snowballing” technique (where the search strategy partly emerges as the study unfolds). Accordingly, in order to provide a comprehensive review of the literature on product design, we first searched the Social Sciences Citation Index¹ (SSCI) over a time span from January 1970 to May 2011. We retrieved all papers published in the “Business” and “Management” categories of the SSCI database with titles, abstracts or keywords containing the expression “product design”. This criterion yielded an initial set of 386 contributions. In order to make an accurate screening of the initial set of papers, we read all the abstracts, and searched for articles that contained empirical studies on product design and its management in organizations, and for conceptual articles that advanced our understanding of design in organizations. We excluded short essays reporting personal reflections (e.g. Eppinger 2011; Dahl 2011), and articles that, although containing the words “product design” in the topic/abstract, referred to product design only marginally and really focused on other issues, like new technology ventures, the management of CAD systems, export-led growth in

developing countries, etc. This first round of review led us to select 92 articles published between 1989 and 2011.

In a second stage of our review, we adopted a snowballing technique to capture published output that might have escaped our first round of review. We supplemented our database searching in two ways. First, we extended our search to prominent journals in the fields of design management (Design Management Review, Design Management Journal) and design studies (Design Issues, Design Studies)², not captured by our initial search because not included in the SSCI. Consistently with the criteria adopted for our main body of works, we searched these journals for academic articles on product design and the management of product design. This further round yielded 17 additional articles. Next, we sifted through the bibliographies of the articles selected so far, searching for additional design-related articles (e.g. Holbrook and Zirlin 1985; etc.) and books (e.g. Gorb 1990, Walsh et al. 1992; etc.) not captured by previous rounds of review. This branching and cross-referencing method allowed us to add 16 additional articles and 20 additional books. The final selection, therefore, included 125 articles and 20 books.

Organizing the literature: Analysis and synthesis

At this stage, we carefully read the content of each article and began to map the selected literature in order to identify core themes, reflecting various streams of research in the business studies investigating different aspects of product design. Following past reviews in management and organization studies, we let the classification of books and articles be guided by two combined criteria: the conceptualization of the object of analysis (see, for instance, Campagnolo and Camuffo, 2010; Eisenhardt and Zbaracki, 1992; Jarzabkowski and Spee 2009) and the specific research topic and focus of investigation (see, Blackburn and

Kovalainen 2009; Brown & Eisenhardt, 1995; Jarzabkowski and Spee 2009; Ramanujam and Varadarajan, 1989).

Accordingly, we first categorized books and articles on the basis of on their explicit or implicit conceptualization of design (e.g. design as problem-solving, design as product aesthetics, etc.) and the related conceptual categories they used (e.g. “design problem”, “product language”, etc.). Next, to produce a more fine-grained representation of the structure of the field, we categorized books and articles on the basis of their research topic: the focus of their investigation and the questions driving their research. This categorization effort outlined nine core streams of research. In Table 1, we summarize the conceptualization of design and focus of investigation of these nine streams of research, along with their main findings. Table 2 reports a detailed indication of the articles and books associated to each stream.

Table 1 and 2 about here

In a final stage, in order to move from a piecemeal representation of the structure of the field to a more holistic understanding of our object of analysis (Macpherson and Jones 2010), we grouped these streams around three main areas of research, to draw attention to their convergence in explaining fundamental stages in the design process, namely Design Activities (how design decisions are or should be made), Design Choices (how design decisions affect formal and functional properties of products), and Design Results (how formal and functional properties of products influence firm performance) (see Figure 1). By doing so, we attempted to produce a narrative synthesis of the outcome of our review (Deyner and Tranfield 2006) that would show how different streams of research contribute to explain different aspects of the same phenomenon, and that would highlight emerging insights as well as avenues for further research.

Figure 1 about here

In the remainder of the paper, we first review the nine streams of research emerging from our analysis, organized around the three fundamental areas outlined above. We outline their conceptual foundations and summarize the main findings. Then, we highlight opportunities for cross-fertilization across different streams of research, define a research agenda for management and organization scholars, and suggest possible methods to pursue these emerging lines of inquiry.

Design activities: Design management, designers' practices, and design tools

A first broad area of research in design reflects the notion of design as a set of activities through which formal and functional properties of products are determined – or, in other words, “what designers do” (Heskett 2002). This area includes four streams of research on Design Management, Designers' Practices, Design Tools for Optimization, and User-Centered Design Tools, which collectively have improved our comprehension of how design practices are carried out and coordinated in organizations, and the tools designers and product developers rely upon.

Design management

An important line of inquiry emerging in the mid 1980s primarily focused on design as a process supporting commercial success by properly tailoring products to markets (e.g. Turner 1985; Walsh and Roy 1985; Veryzer and Borja de Mozota 2005). Accordingly, these scholars developed a definition of design as a set of activities (constituting the design process) and distinctive capabilities of an organization (Borja de Mozota and Kim, 2009; Bruce and Jevnaker 1998; Jevnaker 2005; Roy and Potter 1993; Von Stamm 2003). The notion of

“design management” – understood as “the effective deployment by line managers of the design resources available to an organization in the pursuance of its corporate objectives” (Gorb 1990: 2) – provided an overarching theoretical platform for research aimed at understanding how to effectively coordinate design activities.

These scholars observed how good design emerge from a carefully managed process (Bruce and Bessant, 2002; Chiva and Alegre, 2009), and begun to conceptualize alternative solutions for the acquisition of design resources (e.g. von Stamm, 2004) and the coordination of functional activities (e.g. Dumas and Mintzberg 1991). Case-based research further extended this line of inquiry, by investigating the interaction between managers and designers in small and large organizations (Ravasi and Lojacono 2005; Berends et al. 2011).

Designers' practices

While research on Design Management adopted a normative stance, trying to produce prescriptive indications about how to improve the coordination of design activities, a second, more recent line of inquiry has focused on the actual practice of design and has begun to investigate individual practices and organizational processes underpinning product design.

Research in this tradition understands design as a creative, knowledge-intensive practice. An in-depth study of design consultancy IDEO, for instance, highlighted the importance of leveraging on a multi-domain knowledge for effective product design (Hargadon and Sutton 1997) and on frequent and intensive brainstorming sessions for the effective generation of creative ideas during the early phases of the product development process (Sutton and Hargadon 1996). Similarly, Dell’Era and Verganti (2010) showed that working with a broad portfolio of external designers can positively influence companies’ innovativeness thanks to the knowledge diversity brought in by designers as brokers and gatekeepers of knowledge (see also Kalogerakis et al. 2010). Ewenstein and Whyte (2007, 2009) further refined our

understanding of knowledge-related processes in the practice of design, by highlighting a particular type of knowledge derived from the senses and experiences, which they refer to as ‘aesthetic knowledge’.

Building on earlier insights on the distinctiveness of designers’ approach to problem solving (Boland and Collopy 2004; Boland et al. 2008), recent research has begun to investigate more in depth the cognitive processes that underpin the practice of design professionals. Michlewski (2008), for instance, highlighted the multi-domain and open-ended approach of designers and the reliance upon their aesthetic sense and judgment that underpins their capacity to act as “cultural explorers” and to open up new conceptual and commercial spaces. More recently, Elsbach’s study of toy designers uncovered the need for design professionals in large corporation to affirm their creative identities, and the strategies they use to develop and express “signature styles” through their work (Elsbach 2009).

Design tools for optimization

A third stream of research on Design Activities has focused on quantitative tools that designers use (or could use) in order to support their decisions. Scholars in this tradition share a conception of design as a problem-solving activity aimed at addressing the so-called ‘product design problem’ (see Kohli and Krishnamurti 1989; Balakrishnan and Jacob 1996). These studies have focused on how to optimize attributes to be engineered in a product to satisfy the manufacturer’s objectives and the customers’ utility functions. To do so, they have proposed different tools and heuristic techniques, such as conjoint analysis (Pullman et al. 2002), nested partitions method (Shi et al. 2001), quality function deployment (Kahraman et al. 2006; Pullman et al. 2002), and even a “colony of virtual ants” (Albritton and McMullen 2007) to optimize the configuration of multiple product features in presence of multiple consumer preferences.

User-centered design tools

Finally, building on seminal work by von Hippel and Thomke (2002), another line of work rooted in the notion of design as a problem-solving activity, has acknowledged the proactive role of user-centered approaches in the development of new product designs, and investigated the benefits of user-centered tools for the design of product functions and, more recently, product form. Collectively, these studies shown how the use of customer-centered techniques (Lojacono and Zaccai 2004) and tools that enable users to carry out part of the design process (e.g. Baldwin et al. 2006; Thomke and Von Hippel 2002) can facilitate the identification of opportunities for product innovation (Rosenthal and Capper 2006) and reduce the costs and risks associated to new product development (Von Hippel and Katz 2002).

More recently, this line of inquiry has shifted attention to product aesthetics and it has shown how direct involvement in the design of product form positively influences consumers' preferences (e.g. Franke and Schreier 2008; Randall et al. 2007). According to this research, consumers' higher willingness to pay for self-designed products, compared to off-the-shelf ones, is explained by process enjoyment and perceived process effort (Franke and Schreier 2010) and by the feelings of accomplishment that self-design triggers (Franke et al. 2010).

Design choices: Technological vs. stylistic innovation

A second area of inquiry on product design includes an established (Design and Technological Innovation) and an emerging (Design-driven and stylistic innovation) line of inquiry investigating the outcome of decisions regarding innovation in the configuration of technological parameters and formal features of an object.

Design and technological innovation

Resting on the pioneering work of Abernathy and Utterback (1978) and Clark (1985), research on technology and innovation management has focused on the competitive implications of changes in the configuration of technological parameters defining the relative functionality of an object. Elaborating on early definitions of design as a problem solving process (Alexander 1964; 1979; Simon 1969), Clark (1985) proposed the notion of “design hierarchies” to conceptualize both the object of design and the process through which individuals search for fit between its form, function and context. Based on these ideas, students of technology and innovation management converged around a definition of design as the configuration of technological product parameters that determines the functionality of a product (Abernathy and Utterback 1978; Clark and Fujimoto 1990; Henderson and Clark 1990). Inclined to a functionalist view of design, this stream of research has provided us with a rich vocabulary to conceptualize the technological side of design-related phenomena, and advanced our understanding of the dynamics that underpin the diffusion of certain design choices over others (Abernathy and Utterback 1978; Tushman and Anderson 1986).

Research in this line of inquiry conceives technology development as based on the periodic emergence of “dominant designs” (Abernathy and Utterback 1978) – understood as a particular configuration of technological parameters resulting from the successful synthesis of “individual technological innovations introduced independently in prior products (1978: 46)”. The emergence of a dominant design is usually followed by a new era of incremental product and/or process innovations. In this view, product design represents a milestone of change in patterns of industrial innovation (Tushman and Anderson 1986) and inter-firm competition (Christensen and Rosenbloom 1995; Christensen et al. 1998; Srinivasan and Rangaswamy 2006; Suarez and Utterback 1995; Utterback and Suarez 1993).

Related work tried to explain the relative success of a design over other competing solutions in terms of the “goodness of fit” between basic functional parameters and socio-economic and

technological context (Clark 1985). Elaborating on this idea, Clark and Fujimoto (1990) proposed the concept of “product integrity” to refer to the “consistency between a product’s function and its [internal] structure” and “between a product’s performance and customers’ expectations” (1990: 108).

Design-driven and stylistic innovation

A second, more recent line of inquiry has turned attention to the drivers and competitive implications of innovation in formal, rather than technological, product features (e.g. Cappetta et al. 2006; Verganti 2006, 2008). Scholars in this emerging line of inquiry have proposed the application of established theories of innovation to the study of changes in the formal and symbolic qualities of products, and have developed an alternative terminology to conceptualize innovation in product form (e.g. Cappetta et al. 2006; Verganti 2008, 2009). Central to this rising perspective is emphasis on product semantics (Krippendorff 2005) and on the notion of design as a language – a combination of signs that gives meaning to a product (Dell’Era and Verganti 2007; Verganti 2008). These studies point at the limited predictive capacity of theories of technological innovation applied to this different context, and begin to articulate peculiar dynamics associated to design-driven, stylistic innovation, understood as change in the aesthetics and symbolism of a product (Cappetta et al. 2006; Verganti 2009).

Through a longitudinal empirical study of the fine fashion industry, for instance, Cappetta and colleagues (2006) showed how innovation in product form displays dynamics that are only in part similar to technological innovation, alternating periods of convergence – where most of the companies adopted the same style – and periods of divergence – where different styles co-existed together. Later research explored strategies of innovation and imitation in product languages in the Italian furniture industry (Dell’Era and Verganti 2007). Counter

intuitively, design innovators in the furniture industry displayed less heterogeneity in product language than design imitators, pointing at the need for design innovators to establish a clearly recognizable language to help customers easily connect their products to their brand.

Dell’Era and Verganti (2007) trace a link between the design strategy pursued by a producer and the type of research carried out inside the firm showing how superior capacity to interpret socio-cultural and aesthetic trends allows innovators to confidently focus on specific product language, rather than experimenting with a variety of them. Research on stylistic innovation in the fashion industry, corroborates this observation by showing how different strategies are underpinned by different types of search and by different mechanisms for integrating design, production, and marketing units (Cillo and Verona 2008). Karjalainen and Snelders (2009) further extend this line of research by tracing a link between product semantics and the expression of values associated to a company’s brand, and showing how contextual factors – e.g. the life cycle stage of a product category, the renewal cycle of product models, or the width and structure of a product portfolio – influence the relative consistency of formal design features in product portfolios.

Design Results: Financial performance, consumer response, and operational efficiency

Finally, three separate streams of research on Design and Performance, Design and Consumer Response, Design and Operation Efficiency have considerably improved our understanding of the impact of design choices on financial, commercial, and operational performance. While research on design and financial performance attempted to trace broad connections between a firm’s investments in design and a company’s profitability, research in consumer behaviour and operations management respectively investigated the impact of product design on two fundamental determinants of financial performance: product sales and operational efficiency.

Design and performance

Between the mid eighties and the mid nineties, scholars began to acknowledge the strategic relevance of design and pointed out how some organizations managed and used it systematically to gain differential advantage in the marketplace (e.g. Black and Baker 1987; Kotler and Rath 1984; Lorenz 1986; Oakley, 1982; Walsh 1993). Early work in this line of inquiry was based on insightful case-based research suggesting that good design could positively affect competitive performance (e.g. Lorenz 1986). Later, more systematic studies investigated the conditions under which design increases competitive and financial performance. Walsh and colleagues (Walsh et al. 1992) showed how organizations with “good design” credentials – that is organizations that consistently received design awards – performed significantly better than others on several performance indicators. More recently, Hertenstein and colleagues showed how organizations that were rated by a large panel of expert as “more effective at demonstrating good design” collectively displayed better financial results than the rest of the sample (Hertenstein et al. 2005).

Related research investigated in more depth how design activities can be managed to improve competitive performance. Dickson et al. (1995) showed that CEOs of small companies that overcome the reluctance of this type of organization to invest in design activities (see Bruce, Cooper and Vazquez 1999) and are directly involved in design activities experience superior organizational competitiveness. Later, Gemser and Leenders (2001) showed that high level of design integration in product development projects positively influence profits, profit growth and turnover growth. Other studies, however, suggest that the relationships may be true only under condition of high technological innovativeness (Swink, 2000).

More recent research has begun to unpack the ‘black box’ of design integration by outlining areas where tight integration between marketing and design is desirable (Whyte et

al. 2003; Abecassis-Moedas 2006; Zhang et al. 2011), and the conditions that underlie the effective exchange of knowledge between design, manufacturing, and retailing (Abecassis-Moedas and Ben Mahmoud-Jouini 2008). Finally, Perks et al. (2005), showed that organizations where design is considered a crucial aspect of the new product development process and/or is seen as a major force for innovation display superior financial and competitive performance.

Design and consumer response

Consumer research has traditionally focused on the aesthetic aspects of product design (Bloch 1995; Holbrook and Zirlin 1985; March 1994; Solomon 1983; Solomon 1988, Veryzer 1995, 1999), considering product form as the first opportunity for the formation of a customer's impression of a product. Based experimental studies, research in this tradition documented how product aesthetics influence consumers' affective preferences, their understanding and categorization of products or brands, and their purchasing decisions.

A first line of inquiry investigated how various properties of product form influence consumers' liking independently from the functionality of the product (Veryzer 1993). Veryzer and Hutchinson (1998), for instance, observed that product designs that are highly unified and prototypical are most liked by consumers (see also Carson et al. 2007). Cox and Cox (2002) later showed that preferences for visually complex product designs tend to increase with repeated exposure. More recently, Kumar and Garg (2010) show how consumers prefer designs that balance the levels of attentional resources needed and pleasantness in visually evaluating the design. Landwehr et al. (2011) explained how products' "facial" expressions can influence consumers' liking by triggering pleasure and arousal.

Chitturi et al. (2007; 2008) observed how, whereas customers' preferences and satisfaction are mainly driven by functional and utilitarian product benefits, benefits that enhance the hedonic dimension of consumption tend to prevail once minimum standards of functionality are met, eventually leading to higher loyalty and more positive word of mouth. Finally, Hoegg et al. (2010) and Hoegg and Alba (2011) showed that when product aesthetics and feature performance conflict, consumers tend to thoughtfully reconcile incongruous information, and to consequently elaborate the conflicting dimensions when they have to evaluate products.

Scholars (Bloch 1995, Jones 1991) have also hypothesized a moderating effect of individual tastes and preferences on responses to product form, but what shapes these tastes and preferences is less clear. Some scholars argue that some people possess an innate talent – design acumen – that allows them to make quicker sensory connections and exhibit more sophisticated preferences regarding the design of things (Csikszentmihalyi and Robinson 1990). Others suggest that taste is cultivated, and that the development of “design connoisseurship” requires education and exposure to beautiful things (Osborne 1987).

Other researchers investigated how form influences how consumers interpret a product, and the product-related beliefs, quality-related beliefs, and categorization-related beliefs that form elicits. Berkowitz (1987), for instance, showed how consumers use product form to infer more important, but less “easy-to-spot” attributes, such as comfort or freshness. Later, Kreuzbauer and Malter (2005) showed how subtle changes in product design elements could induce different perceptions of a product's uses and category membership. Orth et al. (2008) observed similar effects for the design of packaging.

Recent research in management resonates this line of inquiry. Rindova and Petkova (2006), for instance, explain how product form design may increase customers' perceptions of the value potential of a new product by triggering positive emotional and cognitive responses. Rafaeli and Vilnai-Yavetz (2004) extend this reasoning, arguing that people make inference

about organizations based on the objects that they produce and/or associate with, and that these inferences trigger positive or negative emotional response.

Finally, building on Bloch's seminal work (Bloch, 1995), other scholars tried to link cognitive and emotional responses to product form to consumers' responses purchasing behavior. Page and Herr (2002), for instance, investigated how product design interacts with brand strength to influence consumers' product liking and quality evaluations. Creusen and colleagues (Creusen and Schoormans 2005; Creusen et al. 2010) linked product appearance to the perceived aesthetic and symbolic value of the product.

Design and operational efficiency

Research in operations and technology has shown how fundamental decisions about the configuration of product features (variety vs. component sharing, modularity) influence the efficiency of manufacturing and the supply-chain.

Research on the trade-offs between product variety (to increase appeal to consumers) and component sharing (to reduce production costs), for instance, suggests that designing product-specific components in-house is preferable when these components have strong influence on product quality and are visible to customers (Fisher et al. 1999), and when customers have "holistic" requirements, arising in a complex way from most of the components of a product (Ulrich and Ellison 1999). Desai et al. (2001) also found that coordination between design, manufacturing and marketing departments helps balance costs and revenues from component sharing (see also Kim and Chajjed 2000). Finally, Krishnan and Gupta (2001) shown that product platforms are not appropriate for extreme levels of market diversity or high levels of non-platform scale economies.

A related body of research advanced the notion of 'modularity' as a strategy for improving the speed and efficiency of the design process (Baldwin and Clark 1997, 2000; Sanchez 1995;

see Campagnolo and Camuffo 2010 for a review). Building complex products from smaller subsystems that can be designed independently is also expected to encourage organizational learning (Sanchez 2000), and to increase flexible responses to uncertain environments (Asan et al. 2008; Sanchez and Mahoney 1996; Thomke 1997). Empirical evidence confirmed that product modularity improves cost, quality, and flexibility of manufacturing (Jacobs et al., 2007; Jacobs et al. 2011), increases responsiveness to changing customer demands (Bush et al. 2010), and, to some extent, also improves new product performance (Lau et al., 2010). Hoetker et al. (2007) found that the degree of modularity influence also the duration of buyer-supplier relationships, the level of autonomy from buyer, and the links to prominent buyers (see also Stephan et al. 2008).

Finally, research in this tradition has documented how, despite the alleged risks of outsourcing design work, the involvement of suppliers in product design improves product development (Wasti and Liker 1997; Petersen et al. 2005) and supply chain performance (e.g. Karlsson et al. 1998; Fixson 2005; Petersen et al. 2005), and shortens production and distribution lead times (Cachon and Swinney 2011).

Discussion and research agenda

A popular metaphor in the management field describes academic research on a given topic as a “conversation” (Huff 1999). In this respect, the review carried out in the previous section indicates that so far design has been the subject of conversations taking place in different communities, focusing on different topics, and using only partly overlapping terminologies. While exchanges have taken place at the intersection between different areas of research (e.g. how design choices about product variety or modularity affects manufacturing performance), we believe that the potential for cross-fertilization across conversations is largely underexploited and, in the remainder of this section, for each of these areas of research, we

identify and discuss avenues for further investigation in management and organization studies, arising at the intersection of different bodies of literature. Collectively, these lines of future inquiry depict a promising research agenda for improving our understanding of the organizational and managerial side of design (see Table 3).

Table 3 about here

Design activities: Avenues for future research.

As described in the previous section, research in organization studies has highlighted peculiar traits of what designers do and how they do it, but – with few exceptions (e.g. Hargadon and Sutton 2000) – did not really attempt to investigate what made some organizations or designers “better” than others. Research on product innovation has advanced the idea that long standing innovators in product design possess rare “design capabilities”, manifested in the capacity of the organization to effectively manage design (Chiva and Alegre, 2009) or to systematically design products characterized by superior formal and functional qualities (Utterback et al. 2006; Verganti 2009). These streams of research have begun to illuminate the distinctiveness of design activities, but additional work is needed to enrich our empirical portrayal of the phenomenon and to produce a theoretical account linking findings from these lines of inquiry.

The origins and building blocks of design capabilities. Design capabilities have been often inferred from the investment of dedicated resources such as time and money (e.g. Swan et al. 2005) or by the acknowledgement gathered by a company’s product (e.g. Walsh et al. 1992). Although research has praised the superior design capabilities of companies such as BMW (Bangle 2001), IDEO (Sutton and Hargadon 1996), and Alessi (Salvato 2003; Verganti 2006), it is not clear to what extent these companies really share similar structures, processes,

resources and people. This observation begs the question of what are design capabilities really and where do they come from?

We believe that additional empirical work is required to establish more precisely what drives the capacity to consistently deliver superior product design, without turning to indirect measurement of input or output. In the first case – indirect measurement of input – it seems unlikely that a pure spending strategy will allow an organization to equal Apple or Bang & Olufsen. In the second case, the observation of excellent outcome may only tell us whether an organization has a superior capability or not, but will not tell us where this capability come from or what it is made of.

Chiva and Alegre (2007, 2009) have suggested to measure effective design management in terms of a range of managerial skills (see also Dickson et al. 1995). Organizational capabilities, however, rest on complex patterns of cultural, relational, human, and technological resources (Leonard-Barton 1992; Verona and Ravasi 2003). The study of capabilities, therefore, benefits from longitudinal, in-depth investigation of social practices and structures (e.g. Salvato 2003, 2009). Future research, then, may build on observations from qualitative work to refine current tools for survey-based research and extend the investigation from individual-level design management skills (Chiva and Alegre, 2009) to the structures, practices and resources that underpin organizational-level capabilities.

Moving the investigation of design capabilities to the socio-structural level is likely to raise several issues that have not yet been systematically investigated. Are design capabilities simply a matter of hiring “better” designers, giving them plenty of resources and involving them early in the development process? Or do design capabilities rest in distinctive ways of organizing and managing design resources? Can we conceptualize design capabilities in terms of the consolidation of organizational structures and policies that mirror and/or enhance designers’ distinctive practices (see Boland et al. 2008; Michlewski 2008)? We believe that

tighter integration between research in organization studies and product innovation may support a more fine-grained investigation of the building blocks of design capabilities, as findings from the rich qualitative inquiries of organizational scholars may provide insightful input to the rigorous, survey-based investigation of these relationships diffused in innovation studies.

Designers' traits and the micro-foundations of design capabilities. Empirical investigation of how individuals respond to product form has traditionally been carried out by consumer researchers. In fact, it is not unreasonable to hypothesize that, just like consumers, designers themselves respond more or less favourably to formal stimuli and incorporate them in their own ideas. Incorporating notions of design acumen (Csikszentmihalyi and Robinson 1990; Bloch et al. 2003) or design connoisseurship (Osborne 1987) in organizational research may be important to investigate drivers of design choices and micro-foundations of design capabilities.

Future research may try to investigate whether and how design acumen and individual tastes and preferences guide (or constrain) the capacity of a designer to produce (or of a manager to select) objects that appeal to a certain target segment of the population. Can we explain designers' success as the result of a combination of rare design acumen and relatively widespread tastes and preferences? Are designers really able to design objects that appeal to tastes and preferences that substantially differ from their own? Do designers differ in their capacity to flexibly draw on – and appeal to – different sets of aesthetic canons? If so, does this capacity rest upon rare cognitive skills or distinctive professional practices? Methodologically, these studies may borrow from scales produced by consumer behaviourists (see Bloch et al. 2003). We expect however a preliminary ethnographic phase to be required in order to ascertain whether the same scale can really be applied to consumers and designers, and to modify the scale accordingly.

Tools and practices of “good design”. The cross-fertilization between lines of inquiry across different fields may open up interesting avenues for research about the tools that organization with superior design capabilities employ in their design activities. Research in operations management has followed an optimization logic that may apply well to mass market products. However, it is unclear how this logic – and the tools it underpins – may support endeavours to produce substantial aesthetic or semantic innovation of the type described by Verganti and colleagues. Similarly, while user-centred techniques may be important for the incremental re-design of products for enhanced functionality (von Hippel & Katz 2002), radical innovation in product meanings requires designers to break away from how products are currently used and conceived (Verganti 2008, 2009). What tools, then, do acknowledged “design leaders” use? How do they reconcile pressures for efficiency and radical innovation? Marketing scholars have used experimental studies to link design tools and practices to the creativity of outcome (e.g. Dahl and Moreau 2002). Methodologies available to organizational scholars, such as ethnographic observations (van Maanen, 1979) or longitudinal case studies (Eisenhardt and Graebner 2007) may help build on insights from innovation, and operations and technology studies, and investigate the social conditions of the implementation of these tools and their implications for organizational performance.

More generally, it does not seem unreasonable to wonder whether different types of design capabilities really exist, underpinned by different sets of “best practices”. While both design consultancy IDEO (Hargadon and Sutton 2000) and medium-sized producer of kitchenware Alessi (Verganti 2006) have been considered exemplar of superior design capabilities, they seem to be organized and function in quite different ways. Yet, both of them have been consistently capable of delivering superior design. Future research, then, may investigate whether some deep commonalities associate the way IDEO and Alessi (but also Samsung, Apple, etc.) work, or whether different types of design capabilities really exist. Are there

different ideal configurations of design resources and practices equally capable of producing superior design? Or do design capabilities fundamentally differ in their ways of driving innovation in different aspects of design?

Indeed, research on Italian “design factories” has proposed that the capacity of some companies to repeatedly introduce radical innovation in design languages and product meanings rests on a distinctive capacity to manage a network of actors that allows the organization to gain a better understanding of changes in socio-cultural trends (Dell’Era and Verganti, 2010; Verganti 2006, 2009). Building on this observation, research has begun to describe the organization and practices of companies engaged in “design-driven innovation” (Dell’Era et al. 2008, 2010; Dell’Era and Verganti 2009). Future research may move beyond description to investigate more in depth, for instance, what makes some of these firms more or less effective in the type of innovation they engage in. Given the relative paucity of firms that systematically engage in this type of research, archival or survey-based studies may be at a disadvantage. In this respect, organizational scholars seem well equipped with both conceptual and methodological tools to engage in rigorous comparative cases studies (see Eisenhardt, 1989) contrasting the conditions under which firms engage in successful (vs. unsuccessful) design-driven innovation, and/or building a process model differentiating new product development in design-driven vs. more traditional types of innovation.

The management of ordinary design activities. More systematic research seems to be required also on the management of ordinary design activities (Chiva and Alegre 2009). While only a few companies may claim superior design capabilities, thousands of companies around the world do engage in product design – either independently or with the support of design consultancies. Several practice-oriented articles and books provide practical guidelines on how design management should be introduced and implemented inside an organization (e.g. Gorb 1990; Borja de Mozota 2003; Bruce and Bessant 2002). With notable exceptions

(e.g. Chiva and Alegre 2007, 2009), however, much of this work relies on insightful, but anecdotal evidence and/or personal experience, rather than on systematic, large-scale empirical research about key issues in the management of design.

A case in point is the fundamental choice between in-house and outsourced design (Bruce and Jevnaker 1998; von Stamm 2003). Recognition of the growing strategic importance of design has led some scholars to underline the importance of an autonomous design function, fully integrated with other corporate functions, and occasionally collaborating with external designers (e.g. Walsh et al. 1992; Perks et al. 2005). The potential disadvantages related to the in-house option (i.e. risk of low creativity, distance from market trends, etc.) have brought others to support the choice of outsourcing design (e.g. Bruce and Jevnaker 1998; von Stamm 2003). A recent study of the Spanish and Italian tile industry seems to indicate the superiority of in-house design (Chiva and Alegre 2007). Research conducted in other industries such as furniture and lighting, however, shows that both solutions co-exist with equal success (e.g. Lojacocono 2007). In this respect, systematic replication of Chiva and Alegre's study across different industries, strategic groups, and even across projects may substantially improve our understanding of the contextual conditions under which one solution is preferable over the other.

Another promising line of inquiry lies in how to improve the collaboration between managers and designers. While the benefits of design are widely acknowledged, less is known about how business firms may actually improve the likelihood that the collaboration with external designers will produce mutually satisfactory results. Future research may address this gap by investigating more systematically the conditions of success and failure of these collaborations across projects, companies, and industries. How do different attitudes, practices, and policies affect the collaboration? Do different types of clients (or projects) require designers to adopt different approaches? Similarly, does collaboration with different

types of designers need to be managed differently? More systematic, survey-based or longitudinal research on these issues is likely to provide significant contributions not only from the theoretical, but also from the practical point of view.

The organizational context of design activities. Finally, some studies point at contextual factors that may affect design activities and the outcome of design choices. These studies are too recent and too sparse to constitute an established stream of research. Nevertheless we believe that further investigation of the context of design activities may represent a fruitful area of future research, where organization and management scholars are well positioned, from both a conceptual and a methodological standpoint, to provide significant contributions.

Research suggests how, in several organizations, design choices are guided by a design philosophy, that is by company-specific beliefs and principles about appropriate ways of designing products (Ravasi and Lojacono 2005), possibly reflected in a distinctive style (Karjalainen and Snelders 2009). Little is known, however, about how designers reconcile conformity with these beliefs and the importance of periodically innovating and adapting to changing consumer preferences and competitive landscape. Conversely, while most studies point to these beliefs as a context within which design practices unfold, some research suggests how design practices (Ravasi and Schultz 2006) and distinctive design features (Ravasi and Canato 2010) may come to affect the very identity of the organization. Research in this direction may considerably improve our understanding of how members' conceptualizations of their organization come to be influenced by their engagement with materiality and by the material outcome of design practices.

Past research also suggests how design-related strategic choices (design strategy) such as the breadth of a portfolio (Karjalainen and Snelders 2009) or the degree of innovation (Dell'Era and Verganti 2007; Cillo and Verona 2008), influence the relationships between practices, capabilities and outcome. Research in this direction has been largely based on

comparative case studies or single-industry surveys. More systematic, cross-sectional research may produce a more fine grained account of the interrelations between design strategies, outcome, and performance.

Finally, more research is needed on the role of organizational leaders in shaping the context of design activities. Recent research points to the central role of organizational leaders in shaping a favourable organizational context (Rindova et al. 2011). We expect in-depth qualitative analysis of managers and chief-designers of design-oriented firms to begin to uncover the fundamental personal traits and managerial practices that enable these personalities to successfully “champion” (Dumas and Mintzberg 1989) the establishment of design as a organizational process. Qualitative insights may then be used to feed the development of tools that will allow large scale investigation of design leadership in organizations.

The institutional context of design. Further research is also needed on the broader institutional context within which design activities are carried out. Renowned designer historians and theorists have emphasized the social, cultural and political embeddedness of design (Sparke 1986; Buchanan and Margolin 1995). Research in business studies, however, has only begun to investigate how these factors influence design strategies, practices and choices in organizations. Little is known for instance, about how design is understood across cultures, and whether and how this understanding affects design strategy and organizational performance. Large-scale, multi-country research projects may pursue this line of inquiry by combining survey-based research aimed at investigating cross-cultural differences in how design is understood, with comparative analysis of prevailing design practices and strategies. The preparation of the questionnaire aimed at capturing cross-cultural differences should be based on a preliminary phase of comparative research, in which researchers use multiple sources of data (interviews with experts, focus groups, reviews of the local design literature,

etc.) to establish core dimensions around countries differ in their understanding of what design is and how it should be carried out.

Research in this direction may also illuminate us about why some countries seem to offer particularly fertile milieus for design activities. Recent research, for instance, suggest that the superior capacity of Italian firms to engage in design-driven research rests in their being embedded in a network of actors that help them shape their product language in ways that are coherent with emerging socio-cultural trends (Verganti 2009). Less is known, however, whether and how this condition is replicable in different settings and in a relatively short time. Future research may address this issue by investigating the transferability of design capabilities and their links with the broader institutional context. Gaining access to sites that offer the possibility to directly follow the attempted replication or transfer of design structures and practices may give researchers invaluable insight, especially if researchers are in a position to engage in action research (Hult and Lennung 1980) and exercise a degree of control on the process.

Similarly, future research may investigate the extent to which variation in design practices across industries reflects industry-specific conventions and/or structural conditions, such as the stage in the life cycle of a product or the typical renewal cycle of product models (Karjalainen and Snelders 2009). These studies may rely on techniques for the inductive construction of taxonomies discussed earlier, or survey tools aimed at capturing the configuration of design structures and practices across industries and countries. Indirectly, this line of inquiry should improve our understanding of the extent to which design practices can be successfully transferred across industry boundaries.

Design choices: Avenues for future research.

As outlined in the previous section, the underpinnings and implications of changes in the design of product technologies have been widely studied in the past. More recently, however, research across fields has paid increasing attention to properties of product form, possibly mirroring a rising tendency in design theory and practice to emphasize product semantics (Krippendorff 2005) and user experience (Norman 1988). These studies point at product form as more than simply the consequential expression of a function (Alexander 1964), and raise interesting questions about the practices, processes and resources that underpin the less investigated making of product form.

The making of product form. Research in various fields converges on the idea that the design of form influences both the aesthetics of a product (“How a product looks and feels”) and its semantics (“What a product means”). This research shows how product form is not simply another potential differentiator to revamp mature products or to compensate average technical performance, but may be a fundamental driver of consumers’ responses and behaviors (Noble and Kumar 2010), new technology adoption (Hargadon and Douglas 2001), and inter-firm competition (Cappetta et al. 2006; Dell’Era and Verganti 2007). Less is known, however, about how products acquire their form. What cognitive processes drive the selection of formal features? What resources (cultural, symbolic, technological, etc.) do designers draw upon? Recent research seems to suggest that these processes may rest upon particular attitudes (Boland et al. 2008) and types of knowledge (Ewenstein and Whyte 2007) that designers possess. However, a deep understanding of how these processes unfold is still missing. In this respect, we believe that rich ethnographic studies may build on the insightful findings of these pioneering efforts to produce a more detailed account of the cognitive and social practices that underpin the making of product form.

Managing the synergy between form and function. Another promising line of inquiry lies in the intensification of research on the interrelations between form and function. The well-

known assumption that form should follow function (Alexander 1964) reflected the idea that formal features should enhance the functionality (usability, ergonomics, etc.) of an object. Later work pointed to the importance of form to facilitate the intelligibility of the functions of an object (Norman 1988). Products, however, are increasingly bought for their symbolic properties as well as for their functional ones. Yet, little is known about how to make a synergistic use of technological parameters and product form to enhance the symbolism of a product. Past studies observed how product form may influence the perceived functionality of a product (Berkowitz 1987; Kreuzbauer and Malter 2005). Future experimental research may instead investigate the relative influence of product form and technological parameters on product symbolism, especially in cases of discrepant formal and technological features (e.g. product forms emphasizing the environmental friendliness of products using polluting technologies and materials).

The design of the form and function of intangible objects. Further research, may also examine how design practices and choices vary when the expected outcome of design moves from tangible to intangible objects. Although design is often thought of as primarily concerned with developing tangible objects (e.g. consumer products), for over a decade design professionals have been extending their remit to the design of intangibles – e.g. services, systems and environments. This tendency can be interpreted as the result of the increasing part played by services in the world economy. Companies do not only produce manufactured “goods”, but over the past decades, have tried to combine products and services into innovative offerings in order to attract new customers and increase demand by providing superior value (Shankar et al. 2009).

This shift from product design to service design triggers interesting questions for scholars in management research to investigate the extent to which traditional design principles and practices can really be applied to a completely different outcome. Can we apply to services

the same categories used to understand tangible outcomes (functionality, aesthetics, semantics), or does the intangible nature of services require a re-conceptualization of this framework? How does the intangible nature of the desired outcome affect the relevance of traditional skills and tools described by organization studies? To what extent product design capabilities can be effectively extended to services? At this stage, more comparative case-based research of practices across firms (e.g. service designers vs. industrial designers) or projects within firm is needed to build an initial body of knowledge that future quantitative, survey-based research may draw upon to investigate the phenomenon on a larger scale.

Design results: Avenues for future research.

Multiple evidence from research in marketing, innovation, and operations and technology suggests that design choices eventually influence various measures of company performance (for a detailed model, see Hertenstein et al. 2005). Research in consumer behavior has produced substantial evidence that the outcome of design choices elicits responses of affective, cognitive, and behavioral nature (see Bloch 1985) eventually resulting in increased propensity to purchase. Research in operations management, instead, focused on the implications of design for manufacturing and supply-chain management, highlighting the impact of commonality of components and modularity on the management of upstream activities. These studies substantiate and explain more general observations that “good design is good business”. Building on our previous discussion, however, we believe that research on the relationships between design and performance should now turn to more fine-grained investigations of what type of design is more beneficial to a firm, and under what conditions.

Contextual conditions and the profitability of design capabilities. Earlier on, we have discussed the opportunity to develop a typology of design capabilities, under the assumption that there are multiple, equally viable ways of producing “good design”. This typology could

be used to investigate whether certain types of capabilities are more or less useful in different types of industry (e.g. growing vs. mature), for different types of products (e.g. characterized by the prevalence of functional vs. hedonic or symbolic consumption patterns), or to support certain types of strategies (e.g. design leadership vs. imitation). After all, design-intensive firms are not always the most profitable or competitive ones in their industries.

Researchers interested in this line of inquiry should select a setting allowing for large-scale comparison of competitors across relevant dimensions. Single-industry studies may be appropriate for comparison between different design strategies, while multi-industry studies may be required to investigate the influence of industry specific variables (e.g. product life-cycle) on the viability of different strategies. Accurate investigation of design capabilities is likely to require a combination of archival research and survey methods. Borrowing from past research in strategy, data collection and analysis may be organized around typologies derived from pre-existing qualitative, case-based research (for an application of this method to strategy research, see Snow and Hrebiniak 1980), or build a taxonomy inductively by tracing the co-occurrence of different design practices, tools, and management structures (see Miller and Friesen 1980, 1982). Tracing measures of financial performance over the years and across competitors should then help researchers uncover preliminary evidence of the conditions under which different types of design capabilities (or design strategies) are more or less profitable.

Exploiting the potential of design capabilities. Another fruitful line of inquiry, in our view, lies in a more comprehensive understanding of the conditions to be satisfied to make “good use of good design”. As Hertenstein and colleagues observe, inefficient production or poor marketing skills can undermine even the most effective design choices (Hertenstein et al. 2005). Future research, however, may investigate in more depth what companies need to do to profit from good design. Is it simply a matter of complementing good design with “good

marketing” and “good manufacturing”, or are there specific requirements that these activities should meet to properly support effective industrial design? In other words, is there anything special about “marketing good design” and “manufacturing good design”? Past research should have provided enough evidence to reassure managers and scholars about the potential commercial and financial benefits of good design; future research may want to extend this line of inquiry by investigating in more detail the conditions to be met in order for this potential to be realized.

Research in this direction may rely on either large-scale archival research or in-depth comparative case analysis. Researchers could use design awards and/or positive reviews of the specialized press to identify products that, over a certain period of time, experts have considered instances of “good design” or use market data or other proxies of commercial success to roughly distinguish between “good and profitable” and “good but unprofitable” design. The collection of rich data about how products were marketed and sold (e.g. where and how they were advertised, press coverage received, breadth of distribution and type of retail outlet, etc.) may help discern patterns explaining the relative success and failure of “good design”. The collection of this type of data on a large scale is not going to be easy and will probably require the collaboration of producers. In this respect, in-depth, rich, case-based comparison of producers that seem to be particularly capable (or incapable) of turning “good design” into “good business” may be important to provide insights into best practices, and to focus large-scale data collection.

Conclusions

In this paper, we review and classify a substantial volume of empirical and conceptual work on product design and designers in business studies. We show how researchers have focused their attention on specific aspects of design, adopting perspectives and engaging in lines of

inquiry that overlap only in part with one another. Our review shows how, individually, each stream of research has produced rich knowledge about specific aspects of design, and how, collectively, these streams complement one another in illuminating three broad conceptual areas of the phenomenon (Design Activities, Design Choices, and Design Results). We have then highlighted potential areas of cross-fertilization, discussed possible research questions, and outlined related research methods.

We believe that our review makes three main contributions. Firstly, it provides a broad map of the various streams of research about product design occurring in different fields of business studies, highlighting their focus, their core tenets and concepts, and their findings (Summarized in Table 1). Compared to other recent reviews (Noble and Kumar 2010; Swan and Luchs 2011), our search extended beyond the boundaries of the literature in marketing and innovation, and led to a more comprehensive view of the design process, the activities it rests upon, the context within which it unfolds, the choices it implies, and its influence on firm performance. In particular, our review highlights emerging areas of research, such as stylistic innovation, design and operational efficiency, and designers' practices, that have been largely overlooked by past reviews. By doing so, we hope to provide a broader foundation for future research and scholarly conversations in these areas.

Secondly, by extending our search across different fields, our review highlights opportunities for intensifying dialogue across different streams of research, and draws attention to new possibilities for cross-fertilization (summarized in Table 3). In particular, our review reveals promising areas of research on design capabilities and organizational performance, lying at the intersection of research on marketing, innovation, operations and technology, and organization studies; it acknowledges important insights from past research, but points to the lack of conceptual clarity that might have hampered the accumulation of a coherent body of research on this topic. Another area of research on the organizational

underpinnings of innovation in product form lies at the intersection of marketing, innovation, and organization studies: consumer researchers have widely acknowledged the importance of product aesthetics and symbolism for product sales, and students of innovation have begun to investigate the dynamics of stylistic innovation; yet, we still know little about the practices, structures, tools, and resources that underlie innovation in product form and meanings. Finally, insights from research on innovation and organization studies point to the important, but largely neglected theme of the organizational and institutional context of design. Like any other organizational activity, design is carried out within socio-cognitive premises that influence designers' understanding of the appropriate way of designing products; part of these premises are organization-specific, while part may reflect broader conventions within the industry or society. Despite the obvious relevance for these conditions for the unfolding of design activities and design choices, this topic, however, is rarely investigated by scholars across business studies.

In this respect – and we believe this is to be our third contribution – our review suggests how the application of theories and methods from management and organization studies may enrich considerably our understanding of design by enhancing emerging lines of inquiry, such as design-driven and stylistic innovation, or by revitalizing established areas of research such as design management and design and performance. Compared to past reviews, our research agenda primarily addresses scholars in management and organization studies, who, in our view, possess important conceptual and methodological tools to significantly contribute to further development of this vast body of knowledge. Conceptually, management scholars are well-equipped with theories of strategy and competition, social cognition and interaction, that may help produce more sophisticated accounts of the organizational underpinnings of design phenomena. Methodologically, qualitative research based on ethnographic observation, comparative case study, or action-research may be used to generate insights to be later tested

with the traditional tools employed in research on consumer behaviour (experiments) and new product development (surveys); techniques for the construction of typologies and taxonomies may also help organize large-scale quantitative observations into insightful categorizations of design-related phenomena. So far, management scholars seem to have turned their attention to design and designers mainly as an intriguing research setting to investigate issues of broader relevance for management theory (e.g. knowledge management, creativity, etc.). We hope that, by highlighting opportunities for management scholars to engage in research of conceptual and practical relevance, our review will contribute to gradually re-position research on design and designers as a legitimate area of empirical inquiry and theoretical reflections in management and organization studies.

Endnotes

¹ This database provides bibliographic information from 1970 to present for over 1,700 leading scholarly social sciences journals in more than 50 disciplines. For the sake of focus, our review did not include the heterogeneous literature that, in the humanities, belongs to the so-called field of design studies (for a recent review see Bayazit 2004).

² We are indebted to an anonymous reviewer for this helpful suggestion.

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Table 1. Core streams of research on product design in business studies

Area	Stream of research	Definition of design	Focus of investigation	Core findings
Design activities	Design management	Design as a set of activities and capabilities	How design activities can be successfully managed	<ul style="list-style-type: none"> ◆ Tools and models to conceptualize fundamental issues in design management (acquisition and organization of design resources, management of the process, etc.)
	Designers' practices	Design as a knowledge-intensive, creative practice	How cognitive processes influence the development of novel ideas	<ul style="list-style-type: none"> ◆ Effective product design requires the acquisition and integration of knowledge from different domains ◆ Aesthetic knowledge is central to the practice of product design ◆ Distinctive approach of designers facilitates creative problem-solving
	Design tools for optimization	Design as configuration of product attributes	Search for tools that provide optimal solutions to design-related problems	<ul style="list-style-type: none"> ◆ Different tools and heuristics techniques can optimize the configuration of multiple product features in the presence of multiple consumer preferences
	User-centered design tools	Design as technological or formal solution to a problem	The involvement of users in product design and innovation	<ul style="list-style-type: none"> ◆ Toolkits that involve users in product design reduce time, cost, and risk of innovation ◆ Consumers preferences are positively influenced by their involvement in product design
Design choices	Design and technological innovation	Design as a technological solution to a problem	Configuration of product technologies and inter-firm competition	<ul style="list-style-type: none"> ◆ Product design is central to dynamics of innovation and competition ◆ Good design results from fit between the functionality of the product and users' needs and expectations
	Design-driven and stylistic innovation	Design as product language	Drivers and implications of innovation in product form	<ul style="list-style-type: none"> ◆ Innovation in product form follows dynamics that are only partly similar to technological innovation, and deserves separate investigation
Design results	Design and performance	Design as a set of activities and capabilities	How design influences market performance and enhances profitability	<ul style="list-style-type: none"> ◆ Design capabilities positively influence market performance ◆ High level of design integration is associated to superior company performance ◆ Design management skills are associated to superior company performance
	Design and consumer responses	Design as product form	How product form influences consumers' disposition and action towards a product	<ul style="list-style-type: none"> ◆ Elements of product form (unity, prototypicality, anthropomorphism, etc.) influence consumers' affective responses ◆ Elements of product form affect how consumer interpret and categorize products ◆ Product form positively influence perceived quality and the propensity to purchase a product
	Design and operation efficiency	Design as configuration of product attributes	The implications of product variety and modularity on manufacturing and supply-chain performance	<ul style="list-style-type: none"> ◆ Product modularity improves cost, quality and flexibility of manufacturing ◆ Involving suppliers in the design of components improves supply chain performance ◆ The coordination between design, manufacturing and marketing departments helps balance costs and revenues from component sharing

Table 2. Core streams of research on product design in business studies: Main publications^a

Area	Stream of research	Journals	Articles
Design activities (41)	Design management (15)	Design Studies (4)	Berends et al. (2011), Roy and Potter. (1993), Turner (1985), Walsh and Roy (1985),
		Journal of Product Innovation Management (2)	Chiva and Alegre (2009), Veryzer and Borja de Mozota (2005)
		Design Management Review (2)	Borja de Mozota and Kim (2009) , Von Stamm (2004)
		Design Management Journal (1)	Dumas and Mintzberg (1991)
		Design Issues (1)	Jevnaker (2005)
		Long Range Planning (1)	Ravasi and Lojacono (2005)
	Designers' practices (11)	Books (4)	Bruce and Bessant (2002), Bruce and Jevnaker (1998), Gorb (1990), Von Stamm (2003)
		Organization Studies (3)	Ewenstein and Whyte (2007), Michlewski (2008), Ewenstein and Whyte (2009)
		Administrative Science Quarterly (2)	Hargadon and Sutton (1997), Sutton and Hargadon (1996)
		Journal of Product Innovation Management (1)	Kalogerakis et al. (2010)
		Harvard Business Review (1)	Hargadon and Sutton (2000)
	Design tools for optimization (6)	Human Relations (1)	Elsbach (2009)
		Long Range Planning (1)	Dell'Era and Verganti (2010)
Design Issues (1)		Boland et al. (2008)	
User-centered design tools (9)	Book (1)	Boland and Collopy (2004)	
	European Journal of Operational Research (3)	Albritton and McMullen (2007), Kahraman et al. (2006), Kohli and Krishnamurti (1989)	
	Management Science (2)	Balakrishnan and Jacob (1996), Shi et al. (2001)	
	Journal of Product Innovation Management (1)	Pullman et al. (2002)	
	Journal of Product Innovation Management (2)	Rosenthal and Capper (2006), Franke and Schreier (2010)	
	Management Science (2)	Von Hippel and Katz (2002), Franke et al. (2010)	
	Harvard Business Review (1)	Thomke and Von Hippel (2002)	
Design choices (26)	Marketing Letters (1)	Franke and Schreier (2008)	
	Marketing Science (1)	Randall et al. (2007)	
	Sloan Management Review (1)	Lojacono and Zaccai (2004)	
	Research Policy (1)	Baldwin et al. (2006),	
	Design and technological innovation (13)	Research policy (3)	Clark (1985), Christensen and Rosenbloom (1995), Utterback and Suarez (1993)
		Administrative Science Quarterly (2)	Henderson and Clark (1990), Tushman and Henderson (1986)
Harvard Business Review (1)		Clark and Fujimoto (1990),	
Technology Review(1)		Abernathy and Utterback (1978)	
Management Science(1)		Christensen et al. (1998),	
Strategic Management Journal (1)		Suarez and Utterback (1995)	
Journal of Marketing (1)		Srinivasan et al. (2006)	
Books(3)	Alexander (1964), Alexander (1979), Simon (1969)		

Design-driven and stylistic innovation (13)	Journal of Product Innovation Management (3)	Dell’Era and Verganti (2007), Karjalainen and Snelders (2009), Verganti (2008)
	Harvard Business Review (1)	Verganti (2006)
	Int. Journal of Innovation (1)	Dell’Era et al. (2008)
	Long Range Planning (1)	Cillo and Verona (2008)
Design and performance (22)	R &D Management (1)	Dell’Era and Verganti (2009)
	Organization Science (1)	Rindova and Petkova (2007)
	Research policy (1)	Cappetta et al. (2006)
	Research-Technology Management (1)	Dell’Era et al. (2010)
	Books(3)	Krippendorf (2005), Utterback et al. (2006), Verganti (2009)
	Journal of Product Innovation Management (8)	Abecassis-Moedas and Ben Mahmoud-Jouini (2008), Dickson et al. (1995), Gemser and Leenders (2001), Hertenstein et al. (2005), Perks et al. (2005), Swan et al. (2005), Swink (2000), Zhang et al. (2011)
	Design Studies(5)	Black and Baker (1987), Bruce et al. (1999), Oakley (1982), Walsh (1993), Whyte et al. (2003)
	Design Management Review (3)	Borja de Mozota (2006), Cooper et al. (2009)
	Design Management Journal (1)	Dumas and Mintzberg (1989)
	Int. Journal of Operations and Production Management (1)	Abecassis-Moedas (2006)
Design and consumer response (30)	Journal of Business Strategy (1)	Kotler and Rath (1984)
	Technovation (1)	Chiva and Alegre (2007)
	Books (3)	Borja de Mozota (2003), Lorenz (1986), Walsh et al. (1992)
	Journal of Marketing (4)	Bloch (1995), Orth et al. (2008), Chitturi et al. (2008), Landwehr et al. (2011)
	Journal of Product Innovation Management (4)	Hoegg and Alba (2011), Noble and Kumar (2010), Kreuzbauer and Malter (2005), Creusen and Schoormans (2005)
	Advances in Consumer Research (3)	Berkowitz (1987), Veryzer (1993), Veryzer (1995)
	Journal of Consumer Psychology (3)	Page and Herr (2002), Hoegg et al. (2010), Kumar and Garg (2010)
	Journal of Consumer Research (3)	Solomon (1983), Veryzer and Hutchinson (1998), Bloch et al. (2003)
	Journal of the Academy of Marketing Science (2)	Carson et al. (2007), Cox and Cox (2002)
	Advances in Nonprofit Marketing (1)	Holbrook and Zirlin (1985)
	European Journal of Marketing (1)	Creusen et al. (2010)
	Harvard Business Review (1)	March (1994)
	Int. Journal of Research in Marketing (1)	Solomon (1988)
	Journal of the Market Research Society (1)	Bruce and Whitehead (1988)
	Journal of Marketing Research (1)	Chitturi et al. (2007)
Psychology and Marketing (1)	Veryzer (1999)	
Design and operation efficiency (23)	Books (4)	Lewalsky (1988), Csikszentmihalyi and Robinson (1990), Jones (1991), Osborne (1987)
	Management Science (6)	Cachon and Swinney (2011), Desai et al. (2001), Fisher et al. (1999), Hoetker et al. (2007), Krishnan and Gupta (2001), Ulrich and Ellison (1999)
	Int. Journal of Technology Management (3)	Asan et al. (2008), Sanchez (2000), Stephan et al. (2008)
	Journal of Product Innovation Management (3)	Jacobs et al. (2011), Karlsson et al. (1998), Wasti and Liker (1997)

Journal of Operations Management (2)	Fixson (2005), Petersen et al. (2005)
Int. Journal of Operations & Production Management (2)	Jacobs et al. (2007), Lau et al. (2010)
European Journal of Operational Research (1)	Kim and Chhajed (2000)
Strategic Management Journal (2)	Sanchez (1995), Sanchez and Mahoney (1996)
Harvard Business Review (1)	Baldwin and Clark (1997)
IEEE Transactions on Engineering Management (1)	Bush et al. (2010)
Research Policy (1)	Thomke (1997)
Books (1)	Baldwin and Clark (2000)

^a Three articles (Hargadon and Douglas, 2001; Dahl and Moreau, 2002; Rafaeli and Vilnay-Yavetz, 2004), lying at the intersection of different streams of research, but not clearly belonging to any, have not been classified in the table.

Table 3. Issues for future research in product design

Area of research	Research topic	Core research questions
Design Activities	The origins and building blocks of design capabilities	What are design capabilities really? Where do they come from? What are they made of? What resources and processes underpin the establishment of design capabilities? Are design capabilities simply a matter of hiring “better” designers? Do design capabilities rest in distinctive ways of organizing and managing design resources?
	<i>Designers’ traits and the micro-foundations of design capabilities</i>	How do individual designers’ tastes, innate ability, and education influence the outcome of their activities? How can we explain the superior capacity of some designers to appeal to the preferences of certain groups?
	<i>Tools and practices of “good design”</i>	What design tools do “design leaders” use? How do they reconcile pressures for efficiency and radical innovation? Do different configurations of design resources and practices produce different results? Do design capabilities fundamentally differ in their ways of driving innovation in different aspects of design?
	The management of ordinary design activities	How do “design management” practices influence design capabilities? What “design management” practices allow developing superior design capabilities? Under what conditions is in-house design preferable over outsourced design? How can organizations improve the management of design collaborations?
	The organizational context of design activities	How can we organize design activities to avoid that conformity to current principles stifles future innovation? How do design activities and choices influence organizational identity and identification? How do organizational leaders foster the development of design capabilities?
	The institutional context of design activities	How do institutional factors influence patterns of design practices? What affects the relative transferability of design capabilities across industries and countries?
Design Choices	The making of product form	How do products acquire their form? What cognitive processes drive the selection of formal features? What resources do designers draw upon?
	Managing the synergy between form and function	How do product form and technological parameters affect product symbolism?
	The design of the form and function of intangible objects	How does the design of services differ from the design of products? How does the intangible nature of services affect the relevance of traditional tools and practices?
Design Results	Contextual conditions and the profitability of design capabilities	What type of design (capabilities and outcome) is more beneficial to a firm, and under what conditions? Are certain types of design capabilities more or less appropriate to certain types of industries or strategies?
	Exploiting the potential of design capabilities	Is design leadership always beneficial? What factors influence the capacity to profit from design capabilities? What makes a design-intensive strategy sustainable over time? Does “good design” require specific forms of manufacturing, advertising and retailing it to take advantage of its potential?