Investment in Design and Firm Performance: The Mediating Role of Design Management*

Ricardo Chiva and Joaquin Alegre

Design management is an increasingly important concept, research into which is remarkably scarce. Although the literature suggests that design management has an effect on design effectiveness, there is no empirical support for the impact of design management on firm performance. Furthermore, few studies have quantified the contribution that design makes to company performance. The aim of this paper is to analyze the effect of design investment on company performance and how this relationship is mediated by design management skills. Structural equation modeling was used to test the research hypotheses on a data set from the Italian and Spanish ceramic tile industry. Results suggest, first, that design management enhances firm performance. Second, this research also provides empirical evidence that investing in design is positively related to design management. Third, design management plays a significant role in determining the effects of design investment on firm performance. Companies that manage design effectively and efficiently attain better performance than those that do not. Therefore, good design does not emerge by chance or by simply investing in design but rather as the result of a managed process. Additionally, a methodological contribution of the present study lies in the empirical validation of a scale to assess design management skills. Finally, some suggestions are put forward for future lines of research that would complement this study and would go beyond some of its limitations.

Introduction

Design is essentially the application of human creativity to a purpose—to create products, services, buildings, organizations and environments which meet people's needs. It is the systematic transformation of ideas into reality, and it is something which has been going on since the earliest days of human ingenuity” (Bessant, 2002, p. 3). However, good design does not emerge by accident, but rather as the result of a managed process (Bruce and Bessant, 2002, p. 38). Apart from the development process leading up to the creation of an artifact or product, the concept of design has traditionally involved a series of organizational activities, practices, or skills that are required for this development to be achieved (Gorb and Dumas, 1987). These practices have been considered by the literature as design management.

Nevertheless, research into design management in theoretical (Bruce and Morris, 1994; Chiva, 2004a; Dumas and Mintzberg, 1989, 1991; Kotler and Rath, 1984; Olson, Slater, and Cooper, 2000; Walsh, 1996) and empirical studies (Ahire and Dreyfus, 2000; Bruce, Cooper, and Vazquez, 1999; Dickson et al., 1995; Gorb and Dumas, 1987; Perks, Cooper, and...
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CONCEPTUAL BACKGROUND

As Bruce and Bessant (2002, p. 1) state, design is, in a broad sense, the conception and planning of man-made objects. Ulrich and Pearson (1998, p. 352) define product design as the activity that transforms a set of product requirements into a specification of the geometry and material properties of an artifact. As these authors explain, product design is part of the broader product development activity, which is the overall process of strategy, organization, concept generation, production, and marketing plan creation, and execution, evaluation, and commercialization of a new product (Belliveau, Griffin, and Somermeyer, 2002, p. 454) (see Ulrich and Eppinger, 1995, for a description of the role of design in the product development process). Iváñez (2000, p. 142) understands product design as a two-phase process: (1) the analytical-conceptual; and (2) the technical-creative. The objective of the former is to assess and analyze the socioeconomic context and the tendencies within the target market, together with the commercial, strategic, productive, logistic, and technological facets of the firm, and aspects dealing with image and communication, all of which determine the characteristics of the product. On the other hand, the technical-creative phase involves a formal and creative interpretation of the aforementioned characteristics, as well as the technical resolution required to determine the product. These convergences and requirements entail a complexity within the process—necessarily supported and sustained by certain management activities, practices or skills—that are considered by the literature as design management.
Definitions of design management can be either very specific or very broad. However, all of them seem to emphasize the need for certain managerial activities or skills to optimize the design process. Basing this study’s definition on Gorb and Dumas (1987), design management is considered as a series of organizational and managerial skills or practices that are required to accomplish the design process. The concept of design management is chiefly covered in theoretical papers (Bruce and Cooper, 1997; Bruce and Morris, 1994; Cooper and Press, 1995; Dumas and Mintzberg, 1989, 1991; Jevnaker, 2000; Joziasse, 2000; Olson et al., 2000; Veryzer, Habsburg, and Veryzer, 1999; Walsh, 1996). Some empirical studies, however, deal with it implicitly, by defining certain activities associated with product design (Hise et al., 1989; Roy and Potter, 1993; Roy and Riedel, 1997). In sum, depending on the aspects or activities highlighted, product design management can be understood in several ways and involves diverse typologies and connotations. Most of the literature has focused on activities, approaches and skills.

Dickson et al. (1995) suggest five design management skills and analyze how they are managed by chief executive officers (CEOs) of small, high-growth firms. According to their research, CEOs report having the greatest difficulty with their ability to manage design for manufacturability, involvement of suppliers in the design process, and estimation of cost and the use of computer-aided manufacturing tools during the design process. In contrast to these engineering-related aspects, the respondents were more confident in their ability to handle such marketing-related tasks as generating new design ideas and involving customers in the design process. Design management is conceptualized as a high-order construct composed of five first-order factors. These factors have a similar level of importance; they comprehend many of the skills and activities underlined by the literature and are empirically sustained. The present research is based on these five factors.

**Basic Skills**

The first skill involves managing basic activities of the design process to design high quality, manufacturability, and low cost into products and to ensure new products are designed and launched faster. All these skills are considered as basic or essential to the design process. Roy and Riedel (1997) found that commercially successful product development projects focused on product performance and quality and, where appropriate, technical or design innovation and paid more attention to genuine product improvements than simply cost reduction.

**Specialized Skills**

The second of these skills is the ability to manage certain specialized activities required by the product design process, such as the cost estimation of a new product during the design process, the ability to use the latest computer-aided design tools effectively, testing manufacturability of new products during the design process, and finding people with excellent design skills. As an example, Topalian (1994) and Cooper and Press (1995) stress the importance of the selection of design specialists and the designer selection criteria for the success of the design process.

Recently, Perks et al. (2005) carried out a multiple case study and proposed three roles for design in the new product development process. Certain skills were identified for each role. In the first role, “design as a functional specialist,” actions are associated with the traditional role of design, such as idea and theme generation, design prototype, and use of computer-aided design (CAD) and product samples. Designers in this category focus on deploying a set of traditional design skills: aesthetics, visualization, and technical skills. They are similar to Dickson et al.’s (1995) basic and specialized skills.

**Involving Others**

The third skill entails involving customers and suppliers in the design process and getting new product ideas from customers. Gorb and Dumas (1987) underline the importance of the interaction of design with other actors and consider that the product design process requires the presence and active involvement of various participants, such as customers and suppliers.

**Organizational Change**

The fourth skill is the ability to manage change, both generally and in relation to moving toward concurrent design and cross-functional team management. Dickson et al. (1995) include changing traditional ways of doing things, getting different functions in the firm to
work together, and replacing sequential with concurrent design. Some authors (Kotler and Rath, 1984; Olson et al., 2000; Rothwell and Gardiner, 1989; Roy and Potter, 1993) underline the importance of design department communication with marketing, sales, engineering, or research departments to stimulate dialogue with other areas surrounding product development.

Innovation Skills

The fifth skill is the ability to manage innovation by quickly becoming aware of competitor innovations and imitations and finding new design ideas, not only “me-too” imitations. Kotler and Rath (1984) emphasize the relevance of managerial encouragement of creative design expertise. Rothwell and Gardiner (1989) maintain that one of the most important aspects of design management is a thorough knowledge of the company and its competitors, which represents an input for the innovation process. Olson et al. (2000) also state the importance of stimulating creativity. Bailetti and Guild (1991) argue that the designer’s depth of knowledge and diversity of background, multidisciplinary teams, and his or her involvement in the early planning stages are critical in the formulation of innovative new products.

Perks et al.’s (2005) second role of design management highlights “design as part of a multifunctional team”; designers’ activities are dominated by communication and interfacing behaviors, which require personal, communication, and teamwork development. In the third role, “design as process leader,” design is seen as a major force for innovation, for proposing new markets and segments. Skills include observation, research, business, and analysis. These latter two roles are similar to Dickson et al.’s (1995) involvement, organizational change, and innovation skills.

Hypotheses

Based on the previous discussion on design management and product design, the conceptual model shown in Figure 1 is proposed. In this model design management is conceptualized, following Dickson et al. (1995), as a higher-order construct composed of five first-order factors representing basic skills, specialized skills, involving others, organizational change, and innovation skills. The contention of this model is that the effect of investment in design on firm performance is mediated by design management skills. Accordingly, three hypotheses representing (1) the relationship between investment in design and firm performance, (2) the relationship between design investment and design management, and (3) the relationship between design management and firm performance are developed and tested.

Design Investment and Firm Performance: A Case for Partial Mediation

Investment in design has traditionally been linked to firm performance (Bloch, 1995; Gemser and Leenders, 2001; Potter et al., 1991; Ulrich and Pearson, 1998). Nevertheless, Gemser and Leenders suggest that this relationship is not unconditional but rather that it is dependent on industry evolution and design strategy. They also point out that other issues such as design management skills may influence this relationship. Design investment by itself seems to be rather ineffective in providing a basis for sustainable competitive advantage because this can be easily duplicated. The benefits from a growing investment in design can be more readily defended if the company employs these resources through effective skills. A company that invests in design and develops the right skills to obtain efficient designs may have better results than others that do not have these skills. Support for the present study’s claim that the relationship between design investment and firm performance is partially mediated by intervening factors stems directly from the resource-based perspective. Therefore, the following hypothesis is put forward:

H1: The relationship between design investment and firm performance is mediated by design management.

Design Investment and Design Management

Design investment provides designers and organization members with financial resources for the design process. These financial resources can be used to acquire new designs from external designers, to buy hardware and software for designing, or to develop or improve design management skills. Similarly to Perks et al. (2005), design management skills can be considered as a form of tacit expert knowledge possessed by individuals (Cook and Brown, 1999) that improve the design process in a company. Skills can be a form of know-how, developed from either practical experience or formal training and education (Perks et al.). Both
will require financial resources for this development. These skills might be related to a multitude of design management activities, like designing low cost into products, involving customers in the design process, getting new product ideas from customers, or finding new design ideas.

By asserting that investment in design has an effect on design management skills, it is not claimed that this investment is the sole reason for the enhancement of design management skills. Obviously, strategic posture, organizational structure, and cultural approach may also be determinant in the development of these skills. Given the potential impact that design investment has on design management skills, the following hypothesis is proposed:

\[ H_2: \text{Design investment is positively related to design management.} \]

**Design Management and firm Performance**

Design management, as previously defined, can be considered as the organizational and managerial skills that allow us to obtain good and efficient designs. Consequently, the whole design management literature suggests that design management has an impact on design effectiveness, a theory that some research (Ahire and Dreyfus, 2000) has empirically validated.

Furthermore, Herstenstein et al. (2005) provide strong evidence that good design is related to corporate performance. Efficient designs may increase market share or develop new markets, among other things. These lines of argument allow the following hypothesis to be proposed:

\[ H_3: \text{There is a positive relationship between design management and firm performance.} \]

**Research Methodology**

**Data Collection**

The hypotheses were tested by focusing on a single industry: ceramic tile producers. Ceramic tile production is a largely globalized industry. The biggest ceramic tile producers are China followed by Spain, Italy, Brazil, and Turkey. However, Italian and Spanish firms are the first- and second-world exporters, respectively. This is mainly due to their high-quality value-added products, achieved through the emphasis on design, technology, and corporate image (Chamber of Commerce of Valencia, 2004).

Italian and Spanish ceramic tile producers have substantial common traits. Most of them are considered to be small to medium-sized enterprises (SMEs), as they generally do not exceed an average of 250
workers, and they tend to be geographically concentrated in industrial districts (Alegre, Lapiedra, and Chiva, 2004; Enright and Tenti, 1990). The Italian ceramic tile industrial district is located in Sassuolo (Northern Italy) and the Spanish one in Castellón (Eastern Spain). The aggregate production volume of the two districts is similar.

In line with Pavitt’s (1984; Tidd, Bessant, and Pavitt, 1997) taxonomy of technological trajectories, the Italian and Spanish ceramic tile industry presents aspects that are characteristic of two trajectories: scale intensive and science based. In this sector, technology is accumulated through two channels: (1) design, construction, and setup of complex production systems (scale-intensive-based trajectory); and (2) knowledge, skills, and techniques deriving from academic research into chemistry (science-based trajectory). Previous studies provide compelling evidence of the significant innovating behavior of Italian and Spanish ceramic tile producers (Alegre et al., 2004; Chiva, 2004b; McDonald and Vertova, 2001).

Several recent studies (Alegre, Lapiedra, and Chiva, 2005; Oltra, Flor, and Alegre, 2002) have analyzed product innovation in the ceramic tile industry and have found enamels and design to be the most important areas of product improvement. New enamels provide better product characteristics, such as nonslip properties or better frost resistance. Novelty in design is focused on new sizes and aesthetics.

By focusing the data collection on the ceramic tile industry, the range of extraneous variations that might influence the constructs of interest is reduced. Analyzing one single sector has the advantage that it avoids a common problem in intersectoral product studies: that of the technological and economic diversity in products (Coombs, Narandren, and Richards, 1996; Santarelli and Piergiovanni, 1996). Furthermore, the industry effect is avoided; according to Gemser and Leenders (2001), the effect of design investment on company performance is dependent on the industry in which the company operates and its design strategy. The shortcoming of such sampling is recognized herein, but the present authors believe that the advantages of this approach outweigh the disadvantages of limited generalizability.

The field work was carried out from June to November 2004. The questionnaire was addressed to two company directors. Product development managers answered items dealing with design management and investment, whereas general managers responded to items dealing with firm performance. A pretest was carried out on four technicians from ALICER, the Spanish Center for Innovation and Technology in Ceramic Industrial Design, to assure that the questionnaire items were fully understandable in the context of the ceramic tile industry. The questionnaire (see the Appendix) was applied using a seven-point Likert scale. The present study received a total of 182 completed questionnaires, 101 from Spanish firms and 81 from Italian firms. The sample obtained represents around 50% of the population under study for both the Italian and the Spanish subsamples (Alegre et al., 2004; Chamber of Commerce of Valencia, 2004). The number of responses and the response rate can be considered satisfactory (Spector, 1992; Williams, Gavin, and Hartman, 2004).

To check for nonresponse bias, the sales turnover and number of employees of respondents and nonrespondents were compared. This comparison did not reveal any significant differences.

**Measures**

**Design Investment.** Owing to the difficulties in obtaining design investment data or average expenditure on design during new product development projects (Gemser and Leenders, 2001) from the companies, Dickson et al.’s (1995) self-reported approach to measure design investment was used. These authors make use of a single item to measure the growth of investment over time: “How much has your company increased or decreased its investment in design over the past three years?” This item is expressed on a seven-point Likert scale ranging from “greatly decreased” to “greatly increased.” Evidence from interviews with technicians from ALICER, the Spanish ceramic design and technological institute, suggests that these companies do not usually facilitate any of their expenditure figures, because they consider them confidential as they are embedded in a very competitive industrial district. Furthermore, technicians from ALICER maintained that investment in design in the ceramic sector is relatively continuous and normally increases over time. As companies do not usually invest once and then remain constant, the growth of investment was considered as appropriate for use in this research.
Design Management

Dickson et al.’s (1995) scale was used to measure design management skills, as it appears to be the only proposal available that serves this purpose. Furthermore, previous analysis of the literature on design management supports the five dimensions suggested by Dickson et al. Although these authors carried out an exploratory factor analysis, further statistical tests will be required to consider this scale as reliable and validated. Product development managers were asked how well they managed certain areas of new product design. Seven-point Likert scales were used to operationalize the five dimensions of design management skills: (1) basic skills; (2) specialized skills; (3) skills in involving others; (4) managing organizational change skills; and (5) managing innovation skills. The complete questionnaire used in this research is reproduced in the Appendix.

Firm Performance. Due to the difficulties in obtaining objective firm performance data from the companies and to the vagaries of accounting methods (Christmann, 2000; Dechow, Sloan, and Sweeney, 1995), this study adopted a self-evaluation approach. Research has also demonstrated that self-reported firm performance measures are positively related to objective firm performance measures (Gatignon et al., 2002; Powell, 1992; Wall et al., 2004). To measure firm performance, general managers were asked to rate their firm’s performance over the last three years against competing firms. Venkatraman’s (1989) business performance scale was used, as it is a reliable and validated self-reported scale. Specifically, managers were asked to score their firm’s growth and profitability on a scale from 1 to 7, with 1 indicating that the firm belonged to the lowest scoring and 7 to the highest scoring of competing firms.

Control Variables

Firm size and location were included as control variables in the overall model since they were able to explain the variation in innovation performance. Firm size affects the endowment of significant inputs to the innovation process such as money, people, and facilities and has been shown to influence product introductions (Capon et al., 1992). Respondents were asked to classify their company into one of six categories according to the number of employees, devised ad hoc on the advice of the four ALICER technicians who participated in the study and bearing in mind that the ceramic tile industry predominantly consists of SMEs. Table 1 shows the distribution of sample firms according to their size category and location.

Respondent firms were all located in the Italian (Sassuolo, in Northern Italy) or the Spanish ceramic tile industrial districts (Castellón, in Eastern Spain). Location was included in the model to control whether being in a particular industrial district that provides access not only to a specific institutional setting but also to a geographical market for labor and energy has a significant impact on firm performance.

Analyses

The primary analyses of the data set are based on structural equation modeling. Structural equation models have been developed in a number of academic disciplines to substantiate theory (Hair et al., 1998). This approach involves developing measurement models to define latent variables and then establishing relationships or structural equations among the latent variables. EQS 5.7 software was used to estimate the models for this study’s research hypotheses. EQS 5.7 operates upon the normalized variance-covariance matrix derived from the raw database (Bentler, 1995).

Confirmatory factor analysis (CFA) was used to check the goodness of the measurement scales (Figure 2). CFA assumes that the factor structure is known a priori. The factor structure for design management is based on Dickson et al. (1995), whereas that for firm performance is based on Venkatraman (1989). The
objective of CFA is to empirically verify or confirm a factor structure that is based on an underlying theory (Sharma, 1996; Uriel and Aldás, 2005).

Exploratory factor analysis (EFA) and CFA are different techniques with complementary applications. The primary objectives of EFA are to determine (1) the number of common factors influencing a set of measures, and (2) the strength of the relationship between each factor and each observed measure. The primary objective of CFA is to determine the ability of a predefined factor model to fit an observed data set (DeCoster, 1998). Dickson et al. (1995) carried out an EFA to suggest five factors for design management skills. In an EFA, the researcher has little or no knowledge about the factor structure and collects data and explores or searches for a factor structure or theory that can explain the correlations among the indicators (Sharma, 1996, p. 128). Dickson et al. used their data and previous knowledge on design management to build a theory and to propose a factorial structure for design management skills. EFA can be viewed as a technique to aid theory building. In CFA, on the other hand, the precise structure of the factor model, which is based on an underlying theory, is hypothesized. CFA can be viewed as a technique for theory testing (Sharma, p. 144; Uriel and Aldás, 2005). Accordingly, in this research, the objective was to confirm Dickson et al.’s factor structure for design management using a CFA.

One common rule of thumb on the minimum threshold for SEM use is that of 100 subjects (Williams et al., 2004); the present sample meets this threshold. Following Sharma, Durvasula, and Dillon (1989) and Tippins and Sohi (2003), the elliptically reweighted least square (ERLS) method was used as the estimation procedure to test the hypothesized model due to its satisfactory performance regardless of the data distribution.
Results

Descriptive Statistics

The data analysis begins with the use of descriptive statistics. According to Flynn et al. (1990), descriptive statistics make the data more intelligible and are appropriate to describe sector practices. Table 2 exhibits means, standard deviations, and response distribution. Table 3 shows factor correlations.

Table 4 exhibits the distribution of sample firms according to their level of investment in design and performance. The sample was split using the median for these two criteria, thus obtaining four groups of firms. The distribution is fairly symmetrical; most firms have high investment in design and high performance (Situation 1; N = 70) or low investment in design and low performance (Situation 4; N = 67). Situation 2 (N = 23) and Situation 3 (N = 22) reflect fewer frequencies. Since most firms belong to Situation 1 (high-high) and Situation 4 (low-low), the sample firms' distribution supports the existence of a positive relationship between investment in design and firm performance.

Furthermore, this finding from the data provides a detailed insight into the design management skills of the sample firms. By comparing Situation 1 and Situation 2, it was observed that simply spending money on design is not enough: Design investment must be executed wisely to connect with design management skills. Table 4 reveals that high-performance firms (Situation 1 and Situation 3) have generally higher scores in design management skills. This descriptive data reveal that design management skills seem to play an important role in connecting investment in design and firm performance and appear to be crucial to ensure any substantial effect of design on firm performance.

Psychometric Properties of Measurement Scales

The psychometric properties of the measurement scales were assessed in accordance with accepted pro-
Table 4. Sample Firm Distribution

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<tr>
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<th>High Firm Performance</th>
<th>Low Firm Performance</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>High Investment in Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Situation 1 (N = 70)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Skills</td>
<td>5.84</td>
<td>0.68</td>
</tr>
<tr>
<td>Specialized Skills</td>
<td>5.70</td>
<td>1.13</td>
</tr>
<tr>
<td>Involving Others Skills</td>
<td>5.96</td>
<td>0.76</td>
</tr>
<tr>
<td>Organizational Change Skills</td>
<td>5.87</td>
<td>0.74</td>
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<tr>
<td>Innovation Skills</td>
<td>5.91</td>
<td>0.79</td>
</tr>
<tr>
<td>Global Design Management Skills</td>
<td>5.86</td>
<td>0.84</td>
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<tr>
<td>Low Investment in Design</td>
<td></td>
<td></td>
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<tr>
<td>Situation 3 (N = 22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Skills</td>
<td>4.93</td>
<td>0.95</td>
</tr>
<tr>
<td>Specialized Skills</td>
<td>4.97</td>
<td>1.09</td>
</tr>
<tr>
<td>Involving Others Skills</td>
<td>5.15</td>
<td>0.78</td>
</tr>
<tr>
<td>Organizational Change Skills</td>
<td>5.17</td>
<td>1.02</td>
</tr>
<tr>
<td>Innovation Skills</td>
<td>5.07</td>
<td>1.33</td>
</tr>
<tr>
<td>Global Design Management Skills</td>
<td>5.06</td>
<td>1.03</td>
</tr>
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To confirm dimensionality second-order CFAs were run (Figure 2). The loadings of the measurement items on the first-order factors, and the loadings of the first-order factors on the second-order factors were all significant at $p < .001$. Furthermore, the fit indices exceeded the recommended thresholds for the measurement models, indicating good model fits and confirming the scale dimensionality (Gatignon et al., 2002).

Testing of the Research Hypotheses

Adopting the approach used by Singh, Goolsby, and Rhoads (1994) and followed by Tippins and Sohi (2003), the presence of a mediating effect by performing a competing model analysis is showed. Despite the narrow range of answers in Table 2, after norming the variables (Bentler, 1995), the results came out well. The first model (direct effect) examined the direct relationship between design investment and firm performance, while a second model (partial mediation) examined the same relationship with design management acting as a mediator. Figure 3 and Figure 4 show the results for the direct effect model and the partial mediation model. (We wish to thank the anonymous JPIM reviewer for suggesting both of these figures.) In both models, the loadings of dimensions on the second-order factors were all high and significant at $p < .001$, once again verifying the dimensionality of the firm performance and design management constructs. The chi-square statistic for each model is significant, but other relevant fit indices suggest a
good overall fit (Seibert, Kraimer, and Liden, 2001; Tippins and Sohi, 2003).

Figure 3 reveals a moderate, positive, and significant relationship between design investment and firm performance ($a = 0.270$, $t = 2.238$, $p < .01$). This finding confirms that design issues significantly affect firm performance in a significant way and also verifies that firm performance depends on a number of factors (Capon, Farley, and Hoenig, 1990), one of which is design. However, when testing this relationship simultaneously with an indirect relationship mediated by design management, the direct path becomes close to zero and nonsignificant ($b_1 = 0.057$, $t = 0.783$), while the indirect path is significant and relevant (Figure 4). In fact, almost all the loading of design investment on firm performance is transferred to the indirect path. The indirect path reveals two effects: a positive and significant effect of design investment on design management ($b_2 = 0.407$, $t = 4.456$, $p < .01$) and a positive and significant effect of design management on firm performance ($b_3 = 0.753$, $t = 6.419$, $p < .01$). This means that the relationship between design investment and firm performance is almost completely mediated by design management and therefore supports H1. It is through the interaction with design management that design investment affects firm performance.

The direct effect model shown in Figure 3 “summarizes” the actual entire connection, which includes design management. Figure 4 provides the complete picture, from which the following is learned: (1) Design management has a strong, positive, and significant effect on firm performance; and (2) design investment has a moderate, positive, and significant effect on design management. Hence, special attention needs to be paid to design management skills, as these are the key to translating design initiatives into firm performance. Results also reveal that design management depends only partially on design investment. There may be other factors, not been taken into account in this research, that affect design management skills.

The partial mediation model reveals a positive and significant, although moderate, relationship between design investment and design management, thus supporting H2 ($b_2 = 0.407$, $t = 4.456$, $p < .01$), and between design management and firm performance, thereby supporting H3 ($b_3 = 0.753$, $t = 6.419$, $p < .01$). Finally, the direct relationship between design investment and firm performance indicated in the direct effect model ($a = 0.270$, $t = 2.238$, $p < .01$) is almost canceled out and becomes nonsignificant in the partial mediation model ($b_1 = 0.057$, $t = 0.783$).
means that the positive and significant impact of design investment on firm performance evidenced in the direct effect model ($a = 0.270$, $t = 2.238$, $p < 0.01$) is due to a concept not taken into account in this model: design management. When design management is included in the partial mediation model, this impact is lower (close to zero) and becomes nonsignificant. Hence, design management plays a substantial role in translating design investment into performance.

Control variables behave similarly in both models. There is a significant and moderate impact of size on performance. The impact of location on performance is negligible as it is consistently low and nonsignificant. The nonsignificant effect of location might be explained by the important similarities between the Italian and the Spanish ceramic tile industrial districts.

**Discussion**

The possibility that design can provide firms with a basis for competitive advantage has received a great deal of attention in recent years. Although all claim that investment in design enhances firm profitability, there seem to be hints that this relationship is not unconditional. As Gemser and Leenders (2001) suggest, it is very likely that the impact of design on company performance will vary depending on the skills and talents of the people involved in the design process. These skills, which are presumed to facilitate the design process, are considered as design management skills. Although design management is assumed to have an impact on design effectiveness, and consequently on firm performance, no empirical research had previously confirmed it.

In this paper, an extra step has been taken toward testing the relationship between design investment, design management and firm performance. Results provide support for the model presented and the underlying hypotheses. Findings have important implications in the field of design management.

First, this research provides empirical evidence that design management enhances firm performance, supporting H3. Although there is theoretical support in the literature for such a relationship, this study tests it empirically. As design management is considered as the organizational and managerial skills that allow a company to develop good and efficient designs, and recently the latter has been empirically related to firm performance (Hertenstein et al., 2005), design management was assumed to be positively related to firm...
performance. However, no previous research had proven this relationship.

Second, the present research also provides empirical evidence that investing in design is positively related to design management, sustaining H2. This is probably because to improve design management skills, financial resources are required. However, it does not seem to be the only reason for the enhancement of these skills. Other organizational, cultural, or strategic factors might also be essential if design management skills are to increase. On the other hand, design investment is used not only to improve design management skills but also to acquire new designs from external designers or to buy hardware or software for designing, among others. Consequently, it is important to emphasize that simple design investment do not imply improvement in design management skills.

Furthermore, although high investment in design might improve skills, it also seems true, according to ALICER technicians, that higher skills usually justify additional investment in design. Companies invest in design and consequently improve design management skills. This improvement increases design effectiveness. Because of this, these companies invest more in design, as they feel it is a source of competitive advantage. Consequently, this might imply the existence of a virtuous cycle between design investment and design management. Third, design investment has an indirect positive effect on firm performance, mediated by design management, supporting H1. Therefore, design management seems to play an essential role when investing in design. Companies that manage design effectively and efficiently attain better performance than those that do not. It is important to emphasize the importance of design management versus simple design investment. The significance of these skills for the relationship between design investment and performance. Therefore, good design does not emerge by chance or by simply investing in design but rather as the result of a managed process. This process requires and implies the development of certain skills.

A methodological contribution of this study lies in the empirical validation of a scale to assess design management skills. This scale was developed by Dickson et al. (1995) in North American small high-growth companies. Five factors emerged. Although Dickson et al. (1995) carried out an EFA, further statistical tests were required to verify the reliability and validity of the scale. Dickson et al.’s scale has been validated with more compelling statistical procedures (CFA) and within a different industrial setting.

Managerial Implications

This paper has implications for practitioners. Even though managers recognize the importance of design, its management is often an ignored ingredient for its success. Investment in design is a primary input for the design process. Design management skills are required to carry out that process effectively. This study provides additional insights into why design management is relevant and exhibits its positive effects on firm performance.

Many previous studies had relied on the assumption that simply investing in design would enhance performance (Potter et al., 1991; Ulrich and Pearson, 1998). However, it is not a question of how much you spend, but how you spend your money. Similarly, a Booz Allen & Hamilton study (Jaruzelski, Dehoff, and Bordia, 2005) maintained that there is no discernable statistical relationship between research and development (R&D) spending levels and measures of business success. The main managerial implication therefore recommends that managers spend on design but spend the money wisely and efficiently.

Finally, the measurement scale used for design management skills (see the Appendix) can be applied by managers to audit their company internally. This research finding suggests that, depending on the results of such an audit, investment in design will be more or less effective. The design management construct provides managers with the concrete issues (each of the five dimensions) that should be examined if design management skills are to be enhanced.
**Limitations and Future Research**

These results must be viewed in the light of the study’s limitations. As with all cross-sectional research, the relationship tested in this study represents a snapshot in time. While it is likely that the conditions under which the data were collected will remain essentially the same, there are no guarantees that this will be the case. Furthermore, the investment in design may have further implications on firm performance in the long term, but as we are not carrying out a longitudinal study we cannot evaluate its effects. Future longitudinal studies might assess the design investment outcomes in the long term in both design management and firm performance.

Design investment is measured by the growth of investment in design over time. This is a single-item, self-reported method previously used by Dickson et al. (1995) and has been supported by technicians of ALICER. Based on their information, investment in design in the Italian and Spanish ceramic industry usually increases over time as companies observe better skills and design effectiveness, which in turn justifies additional investment. This is because some companies consider design as a source of competitive advantage and explains why most companies tend to increase their investment in design. Therefore, it is assumed that companies do not invest heavily and then remain constant. However, in future research the use of objective data or other measurement instruments to gauge investment in design might solve some of these limitations.

The use of self-reported firm performance may be regarded as a further measurement limitation (Venkatraman, 1989). This choice was due to the difficulties of obtaining objective performance data, which in turn might also be manipulated by accounting methods (Dechow et al., 1995). Nevertheless, future and complementary research could improve these deficiencies by using objective firm performance data rather than self reports.

The analysis of measurement scales constitutes an accepted research method that is particularly useful to test theoretical relationships between concepts such as investment in design, design management and firm performance. However, further qualitative research could be useful to provide a more in-depth picture of these relationships.

Because this research carries out a single industry analysis, it has benefited from dealing with firms that are likely to be economically and technologically homogeneous. However, it must be stressed that single industry conclusions should be considered with caution. Further research in other industries is needed to empirically assess the effect of design investment on design management and firm performance.

As design investment does not appear to be the only cause for the enhancement of design management skills, future research could analyze organizational or cultural factors that facilitate the development of these skills. Smith, Vasudevan, and Tanniru (1996) underline the importance of organizational learning for developing essential skills and resources and achieving sustainable competitive advantage. Therefore, future studies might analyze the effect and importance of organizational learning for design management skills.

**References**


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**Appendix. Questionnaire**

How much has your company increased or decreased its investment in design over the past three years? (Dickson et al., 1995)

<table>
<thead>
<tr>
<th>Greatly Decreased</th>
<th>Greatly Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>

Indicate whether each of these new product design issues is one your firm manages well or whether it is one your firm has trouble managing. (Dickson et al., 1995)

<table>
<thead>
<tr>
<th>Manages Poorly</th>
<th>Manages Extremely Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 3 4 5 6 7</td>
</tr>
</tbody>
</table>

**BASIC SKILLS**

BA1. Designing quality into products.

BA2. Designing manufacturability into products.

BA3. Designing low cost into products.

BA4. Designing and launching new products faster.

**SPECIALIZED SKILLS**

SP1. Using the latest computer aided design tools effectively.

SP2. Estimating the true cost of new products during the design process.

SP3. Finding people with excellent design skills.

SP4. Testing manufacturability of new products during the design process.

**INVOLVING OTHERS**

IG1. Involving customers in the design process.

IG2. Involving suppliers in the design process.

IG3. Getting new product ideas from customers.
ORGANIZATIONAL CHANGE
OR1. Changing traditional ways of doing things.  
OR2. Getting different functions in the firm to work together.  
OR3. Replacing sequential with concurrent design.  

INNOVATION SKILLS
IN1. Finding new design ideas - not just me-too imitations.  
IN2. Quickly becoming aware of competitors’ innovations and imitations.  

Please rate your firm’s performance over the last three years against competing firms. (Venkatraman, 1989)

<table>
<thead>
<tr>
<th>Your firm belongs to the lowest scoring firms</th>
<th>Your firm belongs to the highest scoring firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

GROWTH DIMENSION
GR1. Sales growth position relative to competition  
GR2. Satisfaction with sales growth rate  
GR3. Market share gains relative to competition  

PROFITABILITY DIMENSION
PR1. Satisfaction with return on corporate investment  
PR2. Net profit position relative to competition  
PR3. ROI position relative to competition  
PR4. Satisfaction with return on sales  
PR5. Financial liquidity position relative to competition