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Design Management Capability: Its mediating Role between OLC and Innovation Performance in SMEs

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Abstract

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Design is the result of a process that translates the ideas and opportunities into reality through the consistent

development of creativity (Bruce and Bessant, 2002 p.25). Currently, creativity is essential given the competitive environment faced by SMEs, so it is important to know how to manage it. So, good design does not emerge by chance, but rather as the result of a managed process (Bruce and Bessant, 2002). Organizational activities, practices, or skills that are considered for the development of the design are called design management (Gorb and Dumas, 1987).
In terms of innovation, value creation and competitive advantage, design management (DM) is an increasingly important concept, research into which is remarkably scarce (Perks et al., 2005; Abecassis-Moedas, 2006; Verganti, 2008).
We perceived description given in the literature for DM allows it to be understood as a dynamic capability (Teece et al, 1997, Teece, 2007). The first aim of this paper is to present this dynamic capability.
As dynamic capabilities arise from learning (Zollo and Winter, 2002; Easterby-Smith and Prieto, 2008) it is easy to connect this concept to organizational learning capability (OLC) as an antecedent. Following those studies suggesting that OLC affects positively product innovation (Alegre and Chiva, 2008) the second aim of this study is to develop a better understanding of how OLC impacts product innovation performance and how this relationship is mediated by DM capability.
Structural equation modeling was used to test research hypotheses on a data set from the Italian and Spanish ceramic tile industry (the results are obtained from the responses to a questionnaire of 182 companies, which represented 50% of target population). Results suggest, first, that DM capability enhances firm product innovation performance. Second, this research also provides empirical evidence that OLC is positively related to DM capability. Third, DM capability plays a significant role in determining the effects of OLC in product innovation performance. Companies that manage design effectively and efficiently attain better product innovation performance than those that do not.
Finally, some suggestions are put forward for future lines of research that would complement this study and would go beyond some of its limitations.

SELECTED REFERENCES

Abecassis-Moedas, C. and Ben Mahmoud-Jouini, S. (2008). Absorptive Capacity and Source-Recipient Knowledge Complementarily in Designing New Products: An Empirically Derived Framework. Journal of Product Innovation Management, 25:473?490.

Alegre, J. and Chiva, R. (2008). Assessing the impact of organizational learning capability on product innovation performance: An empirical test. Technovation, 28: 315-326.

Bruce, M. and Bessant (2002) Managing design as a process. In: Design in Business: Strategic Innovation through design, Bruce, M and Bessant J. (eds). Essex: Prentice Hall, pp: 36-58.

Easterby-Smith, M. and Prieto, I.M. (2008). Dynamic capabilities and Knowledge Management: An integrative framework. British Journal of Management, 19:235-249.

Gorb, P. and Dumas, A. (1987) Silent design, Design studies, 8 (3).

Perks, H. Cooper, R. and Jones, C. (2005) Characterizing the Role of Design in New Product Development: an empirical taxonomy. Journal of Product Innovation Management, 22:111-127.

Teece, D.J., Pisano, G., and Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18:509-533.

Teece, D.J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. Strategic Management Journal, 28:1319-1350.

Verganti, R. (2008). Design, Meanings, and Radical Innovation: A Metamodel and a Research Agenda. Journal of Product Innovation Management, 25(5):436-456.

Zollo, M., and Winter, S.G. (2002). Deliberate learning and the evolution of dynamic capabilities. Organization Science, 13:339-351.

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Abstract

Design management is an increasingly important concept for small and medium enterprises, research into which is remarkably scarce. We note that the description given in the literature for the design management allows it to be understood as a dynamic capability. The aim of this paper is to present this dynamic capability and analyze its mediator relationship between organizational learning capability (OLC) and product innovation performance. Structural equation modeling was used to test the research hypotheses on a SME data set from the Italian and Spanish ceramic tile industry. The results suggest that organizational learning capability enhances product innovation. Furthermore, design management capability plays a significant role in determining the effects of the organizational learning capability on product innovation.

Keywords: Organizational learning capability; product innovation; design management; dynamic capability

Introduction

Design is extremely important to small and medium–sized enterprises (SMEs) since it can improve communication and product development, and can become a source of support for innovation (Brazier, 2004). Design is the result of a process that translates ideas and opportunities into a reality through consistent development of creativity (Bruce and Bessant, 2002). Creativity is essential for firms in the current competitive environment; thus, it is important to know how to manage it. Good design does not emerge by chance; rather it is the result of a managed process (Bruce and Bessant, 2002). The organizational activities, practices, and skills considered for the development of design are referred to collectively as design management (Gorb and Dumas, 1987).

As design has become increasingly important for competitiveness, it has attracted the attention of practitioners and scholars (Perks et al., 2005; Abecassis-Moedas, 2006; Abecassis-Moedas and Mahmoud-Jouini, 2008; Verganti, 2008). Design has been related empirically to firm performance (Hertenstein et al., 2005), and Chiva and Alegre (2009a) show that design management plays a significant role in determining the effects of investment in design on firm performance.

We would suggest that more research is required to link design management with organizational change and the Resource-Based View of the firm. Some scholars have considered dynamic capabilities but without specifying their nature (Teece et al., 1997, Teece, 2007), but there are some empirically-based studies that conceptualize and use specific dynamic capabilities in discussing acquisitions (Zollo and Singh, 2004), alliances (Kale, Dyer, and Singh, 2002), research and development (R&D) (Yeoh and Roth, 1999), marketing (Morgan, Zhou, Vorhies, and Katsikeas, 2003), joint new product development (Ettlie and Pavlou, 2006), radical innovation (Colarelli O'Connor, 2008) and knowledge management (Alegre et al., 2011).

The first objective of the present study is to extend the range of specific dynamic capabilities considered in the literature by conceptualizing and implementing design management as a dynamic capability. We use a dynamic capabilities framework to explain intra-industry differences (Zott, 2003) in innovation performance.

Since dynamic capabilities arise from learning (Zollo and Winter, 2002; Easterby-Smith and Prieto, 2008) we can identify organizational learning capability as their antecedent. The second aim of this study, which is in line with studies that suggest that organizational learning capability affects product innovation positively(Alegre and Chiva, 2008), is to develop a better understanding of how organizational learning capability impacts on the product innovation performance of SMEs and how this relationship is mediated by design management capability .

We focus on the Italian and Spanish ceramic tile sectors, which are composed of SMEs. We draw on 182 responses to a questionnaire (50% of the target population).

In the succeeding sections we review the design management capability and the relationships among design management capability, organizational learning capability and product innovation. We describe the methodology used to explore these relationships and present and discuss our results. We provide some implications and directions for further research.

Literature review and hypotheses

Design Management

Design is a creative process within which products and processes are conceptualized and specified. It plays a vital role in enabling firms successfully to exploit their innovative research (Langdom and Rothwell, 1985). In a broad sense, design can be described as the conception and planning of man-made objects (Bruce and Bessant, 2002).

Design activity involves the creative visualization of concepts, plans, and ideas, which are represented in sketches, and provides instructions about how to create something that does not yet exist, or at least not in the particular form envisaged (Walsh, 1996; Bruce and

Cooper, 1997). The act of designing requires a combination of logical and intuitive thought. Design is crucial to innovation and represents its creative aspect in which ideas are put into material form. It is based on the coming together, the combination of technical capabilities and consumer demands (Walsh, 1996; p.514).

Product design is an essential aspect of product innovation (Roozenburg and Eekels, 1995; Perks et al., 2005). It is limited not just to usability and style, it also includes materials and vendor selection, prototyping, design process management, and so on (Utterback et al., 2006). Product development projects in small firms operate under severe resource constraints which do not apply to the projects conducted by large firms. Small firms have limited amounts of budget and time, and often lack the skills required for design (Oakley, 1982; Bruce et al., 1999; Lewis and Brown, 1999). In some SMEs, design is regarded as another of the activities involved in the front end of the product development process, and other activities, such as attending to short-term customer or retailer demands, are prioritized (Lindman and Otero-Neira, 2008).

How to organize the design function has evolved in response to the current competitive environment. Several studies show that firms with higher levels of internal resources are better able to exploit external resources (Belso-Martinez et al., 2011). Efficient management of the design function is a vital internal capability even if the function is outsourced. Outsourcing design is becoming an important option for firms (Utterback et al., 2006) and especially SMEs (Berends et al., 2011). Experienced designers can mitigate the lack of internal firm design skills, and create solutions that no SME on its own could ever achieve. Designers can transfer and integrate knowledge about different socio-cultural contexts to propose new aesthetic solutions or new product meanings (Dell´Era and Verganti, 2009). Also, since small firms´ resources are limited, design expenses can be controlled by involving external designers on a project basis, as a variable cost (Bruce and Morris, 1994; Berends et al., 2011) and for small firms design in the context of product innovation can be extended over a

long time frame of several months or even years. This may have an impact on process dynamics (Visser, 2009); the company will be more competitive if it has the capacity to perform this function better and faster. The current economic context makes clear the need for effective design management. We consider three ways to organize the design management function: (1) inside the company only, (2) outsourced only; or (3) a combination of in-house design and outsourced design (Bruce and Morris, 1994).

Definitions of design management vary between being very specific and quite broad. However, all emphasize the need for particular managerial activities or skills to optimize the design process. We follow the definition proposed by Gorb and Dumas (1987) and consider design management as a series of organizational and managerial activities or practices that are required to realize the design process.

Dickson et al. (1995) suggest five design management skills and how they are managed by the CEOs of small, high growth firms. We revise their concept and adapt if to the dynamic capabilities literature by considering design management as a dynamic capability. Thus, design management is conceptualized as a high-order construct composed of five first-order factors. These factors are of similar importance and encompass many of the skills and activities underlined in the literature. (1)*Basic Skills* which involve managing the basic activities of the design process in order to design high quality, manufacturability, and low cost into products, and to ensure new products are designed and launched rapidly. (2)*Specialized Skills*, which refer to the ability to manage certain specialized activities required for the product design process. (3) *Involving Others*, which means involving customers and suppliers in the design process in order to get new product ideas. (4) *Organizational Change*, which is the ability to manage change, both generally and in relation to moving towards concurrent design and cross-functional team management. (5) *Innovation Skills*, which is the ability to manage innovation through awareness of and knowledge about competing innovations and imitations as a source of radical new design ideas.

Organizational Learning Capability and Design Management Capability

The organizational learning literature includes attempts to analyze and determine whether and how learning is accomplished by organizations. The capacity to learn is considered a key indicator of an organization's effectiveness and potential to innovate and grow (Jerez-Gómez et al., 2005: 279) and organizations and scholars increasingly are focusing on enhancing organizational learning capability and building learning organizations.

Anderson et al. (2001) emphasize that management learning in small firms is frequently informal and unplanned and occurs through a process of interaction within social and business networks. The evidence suggests that learning in small firms is often unintentional, incidental, or accidental, and that knowledge is generated mainly from trial an error decision making processes (Matlay, 2000). It shows also that learning processes are temporal and contextual (Zhang et al., 2006) and can occur through social relationships that are crucial to the innovation process (Pittaway and Rose, 2006). For example, investment decision-making can be understood as a learning process (Ekanem and Smallbone, 2007).

Organizational learning capability is defined as an organizational and managerial characteristic that facilitates the organizational learning process or allows an organization to learn (Goh and Richards, 1997; Chiva and Alegre, 2009b). It underlines the importance of enabling organizational learning factors or the firm´s propensity to learn.

Dynamic capabilities enable firms to integrate, build, and reconfigure internal and external competencies in order to address rapidly changing environments; the more dynamic the market, the greater the level of dynamic capabilities required (Wang and Ahmed, 2007). We argue that the different elements of Dickson et al.'s (1995) design management framework - basic skills, special abilities, participation of others, organizational change, and innovation skills - include the notion of reconfiguring competence, and therefore could be considered a dynamic capability.

Dynamic capabilities are based on the creation of knowledge and may represent an important source of competitive advantage for the firm, since they allow the generation of unique organizational skills which are updated continuously (Teece et al., 1997). Since dynamic capabilities arise from learning (Zollo and Winter, 2002; Easterby-Smith and Prieto, 2008), we suggest that organizational learning capability is a precursor to design management capability.

Therefore:

Hypothesis 1: Organizational learning capability has a positive effect on design management capability.

Design Management Capability and Product Innovation

Innovation consists of the successful exploitation of new ideas (Amabile et al., 1996). It requires two conditions to be fulfilled: novelty, and utility. In general, the requisite of novelty is verified when the innovation process puts into practice an invention, a scientific discovery or a new production or management technique. The requisite of utility is borne out through its use or commercial success. If the innovation involves new features, or significantly improved the service offered to customers, is a product innovation. The product innovation hardly depends of firm´s internal capabilities (Vega-Jurado et al., 2009), as is the ability to manage the design function. Product innovation differs from process innovations since it not requires using methods of equipment and / or new or significantly improved knowledge to provide the service. Also it differs from marketing innovations since it is not necessary to have a significant change in the functions or uses of the product (OECD, 2005).

Ho et al., (2011) hypothesized that strong design capabilities can promote successful technology commercialization, including new product commercialization frequency and speed, degree of innovation, and even number of patents. Furthermore, given that dynamic capabilities enable adaptation to the environment and as the design management capability includes among its functions the search for new design ideas, we hypothesize that:

Hypothesis 2: The design management capability has a positive effect on product innovation

Organizational Learning Capability and Product Innovation: a case for empirical assessment.

Innovation involves the generation and implementation of new ideas, processes and products. Organizational learning processes involve the acquisition, dissemination and use of knowledge and therefore are strongly associated with product innovation performance (Lemon and Sahota, 2004). Following Chiva et al. (2007) we propose that organizational learning capability consists of five dimensions: experimentation, risk taking, interaction with the external environment, dialogue and participatory decision-making.

The literature shows a positive association between the dimensions of organizational learning capability and product innovation (Damanpour, 1991, Amabile et al., 1996, Koc and Ceylan, 2006; Chipika and Wilson, 2006; Azagra-Caro et al., 2006; Alegre and Chiva, 2008), and among design management capability and product innovation. The dynamic capabilities enable firms to adapt to environment changes. Given that design management capability emerges from learning (Zollo and Winter, 2002; Easterby-Smith and Prieto, 2008) we assume that organizational learning capacity could influence the firm design management capability, and the latter affects product innovation.

Therefore:

Hypothesis 3: Design management capability acts as a mediating variable between organizational learning capability and product innovation.

Methods

Data Collection

The hypotheses are tested on a single industry, ceramic tile production, which is a globalized industry. The biggest production of ceramic tiles is in China followed by Spain, Italy, Brazil, and Turkey. Italy and Spain are ranked first and second for tile exports based on high quality and

value added achieved through an emphasis on design, technology, and corporate image (Chamber of Commerce of Valencia, 2004).

Italian and Spanish ceramic tile producers have several things in common. Most are SMEs with a maximum of 250 workers on average, and are generally geographically concentrated in industrial districts (Enright and Tenti, 1990; Alegre et al., 2004). The Italian ceramic tile industrial district is located in Sassuolo (Northern Italy) and the Spanish district is in Castellón (Eastern Spain). Aggregate production by the two districts is similar.

Several studies have analyzed product innovation in the ceramic tile industry and find enamels and design to be the most important areas of product improvement (Alegre et al., 2005). New enamels provide improved product characteristics such as non-slip properties or greater frost resistance. Novelty in design is focused on size and aesthetics.

Our focus on the ceramic tile industry reduces the range of extraneous variations in the data which could influence the constructs of interest. Analyzing a single sector has the advantage that it avoids a problem common to inter-sectoral studies, of technological and economic diversity of products (Coombs et al., 1996; Santarelli and Piergiovanni, 1996). We acknowledge the disadvantages of this sampling in terms of limiting generalizability but believe that they are outweighed by the advantages offered by this approach.

The field work was conducted in June to November 2004. The questionnaire was addressed to Product Development Managers, who responded to items dealing with design management and innovation performance, and Human Resource Managers who focused on items dealing with organizational learning capability. Pre-testing was carried out on four technicians from ALICER, the Spanish Center for Innovation and Technology in Ceramic Industrial Design, to ensure comprehensibility of the questions in the context of the ceramic tile industry. The questionnaire (see appendix) used a 7-point Likert scale.

We received a total of 182 completed questionnaires, 101 from Spanish firms and 81 from Italian firms, which represents around 50% of the population under study for both the

Italian and the Spanish subsamples (Chamber of Commerce of Valencia, 2004). The number of responses and the response rate can be considered satisfactory (Spector, 1992; Williams et al. 2004). To check for non-response bias, sales turnover and number of employees in respondent and non-respondent firms were compared. The comparison did not reveal any significant differences.

Measures

Organizational learning capability. We use the organizational learning capability measurement instrument developed by Chiva and Alegre (2009b) which considers organizational learning capability as comprising the skills and characteristics that enable an organization to learn. The concept has five dimensions: experimentation, risk taking, interaction with the external environment, dialogue, and participative decision making. The organizational learning capability measurement scale was applied as a 7-point Likert scale, with 1 representing complete disagreement and 7 complete agreement (Table 1).

Design management capability. We used Dickson et al.'s (1995) measurement scale conceiving their construct as a dynamic capability.

Product innovation performance was measured using the scale provided in the OECD's (2005) Oslo Manual for the assessment of the economic objectives of innovation. This scale was proposed by the OECD in order to achieve greater homogeneity and comparability among innovation studies. Many innovation surveys use this scale, which has been well validated (Pla-Barber and Alegre, 2007).

Results

Psychometric Properties

The psychometric properties of the measurement scales were assessed in accordance with accepted practice (Gerbing and Anderson 1988; Tippins and Sohi 2003), including content validity, reliability, discriminant validity, convergent validity, and scale dimensionality. Table 1 presents the factor correlations, means, and standard deviations.

Content validity was established through a review of the literature and interviews with ceramic tile industry experts (four ALICER technicians). We computed the coefficient alpha and composite reliability indicator to assess scale reliability (Fornell and Larker 1981; Bou-Llusar et al. 2009). All scales achieved acceptable coefficient alphas and composite reliability indicators of at least 0.70 (Table 1).

Insert Table 1 about here

Discriminant validity was assessed through confirmatory factor analysis by comparing the χ^2 differences between a constrained confirmatory factor model and an interfactor correlation set at 1 (indicating they are the same construct) and an unconstrained model with an interfactor correlation set free. All χ^2 differences were significant, providing evidence of discriminant validity (Anderson and Gerbing 1988; Gatignon et al. 2002; Tippins and Sohi 2003). Confirmatory factor analysis was used also to establish convergent validity by confirming that all scale items loaded significantly on their construct factors (Anderson and Gerbing 1988). Convergent validity was also confirmed by comparing the χ^2 differences between a constrained confirmatory factor model with an interfactor correlation set at 0 (indicating no relationship between the two constructs) and an unconstrained model with an interfactor correlation set free. All χ^2 differences were significant, providing evidence of convergent validity (Gatignon et al. 2002).

We checked the dimensionality of the constructs through the loadings of the measurement items on first-order factors, and the loadings of the first-order factors on second-order factors. All loadings were above 0.40 and significant at $p<0.001$. No cross-loadings emerged.

Before testing our hypotheses, we assessed the extent of common method variance by conducting a Harman's single-factor test (Podsakoff and Organ 1986; Podsakoff et al. 2003). Common method variance is a problem that can arise when the dependent and independent

variables are collected from a single informant. In our study, we used different key informants to minimize this problem.

Test of the Research Hypotheses

We tested for the presence of a mediating effect by performing competing model analysis. The first model (direct effect) examines the direct relationship between organizational learning capability and product innovation performance. Figure 2 shows the results of the competing model analyses. The χ^2 statistic for each model is significant, and the other relevant indices suggest a good overall fit (Tippins and Sohi, 2003).

Insert figure 1 about here

Insert figure 2 about here

First, the direct effect model was tested and found to be satisfactory. There is evidence of a positive link between organizational learning capability and product innovation performance. Second, the inclusion of design management capability in the analysis helps to explain this positive link: design management capability acts as a mediating variable that boosts the positive effect (Grewal and Slotegraaf, 2007). The mediating effect of design management capability on the relationship between organizational learning capability and product innovation performance is demonstrated by the following sequence, suggested by Tippins and Sohi (2003): (1) the partial mediation model explains more of the variance of the dependent variable than the direct model (R^2=0,591 vs. R^2=0,329); (2) there is a positive relationship between organizational learning capability and dynamic capability in design management; (3) there is a positive relationship between dynamic capability in design management and product innovation performance; and (4) the significant relationship between organizational learning capability and product innovation performance indicated in the direct effect model is lower and non-significant in the partial mediation model. Statements (1)–(4) provide compelling evidence of a clear mediating effect of dynamic capability in design

management on the relationship between organizational learning capability and product innovation performance. Thus, the partial mediation model represents a significant contribution to our understanding of the positive influence—supported by the theory and previous empirical research—of organizational learning capability on innovation performance. The positive impact of implementing organizational learning capability practice on innovation performance is mediated by the firm's design management capability. These results provide support for our research hypotheses.

Discussion

This study examines the effects of organizational learning capability and design management capability on SME´s product innovation. Given that product innovation performance varies among ceramic tiles producers, we investigate this asymmetry through the lens of organizational learning and design management capabilities. We find strong support for the research models and the underlying hypothesis depicted in Figure 2—in other words, convincing evidence that organizational learning capability and design management capability enhance product innovation performance. An analysis of the direct and indirect effects shows that the indirect effect prevails when both types of capability are taken into account. Thus organizational learning capability can enhance sustained competitive advantages in SME product innovation performance, but does so *indirectly* through the creation of design management capability. Therefore, sustained competitive advantage in the ceramic tile industry requires firm strategies that focus on organizational learning capability and design management. However, special attention must be paid to design management capability, because the impact of organizational learning capability on innovation performance is mediated by the firm's design management capability.

Innovation is an important outcome of firm processes and has been shown to be critical to firm performance. Our results have important implications for decision making in relation to organizational learning and design management, particularly in the context of

SMEs' product innovation. This study supports new trends in RBV research that seek to identify a particular industry's critical specific assets and to improve our understanding of the entire process of creating competitive advantage by considering the role of dynamic capabilities. Our results also show why some SMEs show lower performance: while their managers may have the ability to facilitate organizational learning, they need also to know how to manage design efficiently to achieve better innovation performance.

Limitations

This study has some limitations and its results come with some caveats. First, the data were gathered at one point in time, so we cannot conclusively demonstrate causality or rule out reverse causality. Second, the study's target population was narrowly defined to include a fairly homogeneous set of firms. Although a restrictive sampling approach increases confidence that the findings are the result of the hypothesized relationships, it may limit the generalization of our research results.

Future Research

The results of this study suggest directions for future research. The mediating effect of design management capability should be taken into account in research on organizational learning and product innovation. These dynamic capabilities constitute an important step between operational organizational practices and performance. The relationship between organizational learning capability and design management capability should be analyzed further from a longitudinal perspective. Future research could focus also on young innovative companies (Azagra-Caro et al., 2011) and distinguish between radical and incremental product innovation, which would require taking account of both adaptive and generative learning (Khilji, Mroczkowski, and Bernstein, 2006; Chiva, Grandío, and Alegre, 2010).

REFERENCES

Abecassis-Moedas, C. (2006). "Integrating Design and Retail in the Clothing Chain: an Empirical Study of the Organization of Design". *International Journal of Operations and Production Management*, Vol. 26 No.4, pp. 412–28.

Abecassis-Moedas, C. and Ben Mahmoud-Jouini, S. (2008). "Absorptive Capacity and Source-Recipient Knowledge Complementarily in Designing New Products: An Empirically Derived Framework". *Journal of Product Innovation Management*, Vol. 25, pp. 473–90.

Alegre, J. and Chiva, R. (2008). "Assessing the impact of organizational learning capability on product innovation performance: An empirical test". *Technovation*, Vol. 28, pp. 315-26.

Alegre, J., Lapiedra, R. and Chiva, R. (2004). "Linking operations strategy and product innovation: An empirical study of Spanish ceramic tile producers". *Research Policy*, Vol. 33, No. 5, pp. 829-39.

Alegre, J., Lapiedra, R. and Chiva, R. (2005). "A literature-based innovation output analysis: implications for innovation capacity". *International Journal of Innovation Management*, Vol. 9 No. 4, pp. 385-99.

Alegre, J., Sengupta, K. and Lapiedra, R. (2011). "Knowledge management and innovation performance in a high-tech SMEs industry" *International Small Business Journal 0266242611417472, first published on October 12, 2011 doi:10.1177/0266242611417472*

Amabile, T., Conti, R., Coon, H., Lazenby, J. and Herron, M. (1996). "Assessing the work environment for creativity". *Academy of Management Journal*, Vol. 39 No. 5, pp. 1154-84.

Anderson, J.C. and Gerbing, D.W. (1988). "Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach", *Psychological bulletin,* Vol. 103, No. 3 pp. 411.

Anderson, V., Boocock, G. and Graham, S. (2001). "An Investigation into the Learning Needs of Managers in Internationalizing Small and Medium-sized Enterprises", *Journal of Small Business and Enterprise Development,* Vol. 8 No. 3, pp. 215–32.

Azagra-Caro, J.M., Archontakis, F., Gutiérrez-Gracia, A. and Fernández de Lucio, I. (2006). "Faculty support for the objectives of university industry relations versus degree of R&D cooperation: the importance of regional absorptive capacity". *Research Policy,* Vol. 35 No. 1, pp. 37–55.

Azagra-Caro, J.M., Mas-Verdú, F., Martínez-Gómez, V. (2011). "Forget R&D - pay my coach: young innovative companies and their relations with universities". Working paper Nº 2011/07 of INGENIO (CSIC-UPV), Valencia, 18 December.

Belso-Martinez, J., Molina-Morales, F. and Mas-Verdu, F. (2011). "Clustering and internal resources: moderation and mediation effects" *Journal of Knowledge Management,* Vol. 15, No. 5, pp. 738.

Berends, H., Reymen, I., Stultiëns, R. G. L. and Peutz, M. (2011). "External designers in product design processes of small manufacturing firms". *Design Studies*, Vol. 32 No. 1, pp. 86-108.

Bou-Llusar, J., Escrig-Tena, A., Roca-Puig, V. and Beltrán-Martin, I. (2009). "An empirical assessment of the EFQM Excellence Model: Evaluation as a TQM framework relative to the MBNQA Model", *Journal of Operations Management,* Vol. 27 No. 1, pp. 1.

Brazier, S. (2004), "Walking Backward into Design: Support for the SME", *Design Management Review, V*ol. 15 No. 4, pp. 61.

Bruce, M. and Bessant (2002). "Managing design as a process". In: Design in Business: Strategic Innovation through design, Bruce, M and Bessant J. (eds). Essex: *Prentice Hall*, pp. 36-58.

Bruce, M. and Cooper, R. (1997). "Marketing and Design Management". *International Thomson*, London.

Bruce, M. and Morris, B. (1994). "Managing external design professionals in the product development process". *Technovation,* Vol. 14, pp. 585-99.

Bruce, M., Cooper, R. and Vazquez, D. (1999). "Effective design management for small businesses". *Design Studies*, Vol. 20, pp. 297-315

Chamber of Commerce of Valencia (2004). "Informe de la nueva economía global y su incidencia en los sectores tradicionales de la Comunidad Valenciana". *Valencia: Chamber of Commerce of Valencia*.

Chipika, S. and Wilson, G. (2006). "Enabling technological learning among light engineering SMEs in Zimbabwe through networking". *Technovation,* Vol. 26, No. 8 pp.969–79.

Chiva, R. and Alegre, J. (2009a). "Investment in design and firm performance: the mediating role of design management". *Journal of Product Innovation Management*, Vol.26, pp. 424-40.

Chiva, R., and Alegre, J. (2009b). "Organizational learning capability and job satisfaction: An empirical assessment in the ceramic tile industry". *British Journal of Management*, Vol. 20 No. 3, pp. 323-40.

Chiva, R., Alegre, J. and Lapiedra, R. (2007). "Measuring organizational learning capability among the workforce". *International Journal of Manpower*, Vol. 28 No. (3/4), pp.224-42.

Chiva, R., Grandío, A. and Alegre, J. (2010). "Adaptive and generative learning: Implications from complexity theories". *International Journal of Management Reviews*, Vol. 12 No. 2, pp. 114-29.

Colarelli O'Connor, G. (2008). "Major Innovation as a Dynamic Capability: A Systems Approach". *The Journal of Product Innovation Management*, Vol. 25 No. 4, pp. 313-25.

Coombs, R., Narandren, P. and Richards, A. (1996). "A literature-based innovation output indicator", *Research Policy*, Vol. 25, pp. 403-13.

Damanpour F. (1991). "Organizational innovation: a meta-analysis of effects of determinants and moderators". *Academy of Management Journal*. Vol. 34, pp. 555-90.

Dell'Era, C. and Verganti, R. (2009). "Design-driven laboratories: organization and strategy of laboratories specialized in the development of radical design-driven innovations". *R&D Management*, Vol. 39, pp. 1-20.

Dickson, P., Schneider, W., Lawrence, P. and Hytry, R. (1995). “Managing design in small high growth companies”. *Journal of Product Innovation Management*, Vol. 12 No.5, pp. 406-415.

Easterby-Smith, M. and Prieto, I.M. (2008). “Dynamic capabilities and Knowledge Management: An integrative framework”. *British Journal of Management*, Vol. 19, pp. 235-49.

Ekanem, I. and Smallbone, D. (2007). “Learning in Small Manufacturing Firms: The Case of Investment Decision-making Behavior”. *International Small Business Journal,* Vol. 25 No. 2, pp. 107-29.

Enright, M.J. and Tenti, P. (1990). “How the diamond works: The Italian ceramic tile industry”. *Harvard Business Review*, Vol. 68, pp. 90-91.

Ettlie, J.E. and Pavlou, P.A. (2006). “Technology-based new product development partnerships”. *Decision Sciences*, Vol. 37 No. 2, pp. 117-47.

Fornell, C. and Larcker, D. (1981). “Evaluating Structural Equation Models with Unobservable Variables and Measurement Error,” *Journal of Marketing Research*, Vol. 18, pp. 39-50.

Gatignon, H., Tushman, M.L., Smith, W. and Anderson, P. (2002). “A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics”, *Management Science, V*ol. 48 No. 9, pp. 1103.

Gerbing, D.W. and Anderson, J.C. (1988). “An Updated Paradigm for Scale Development Incorporating Uni”, *Journal of Marketing Research,* Vol. 25, No. 2, pp. 186.

Goh, S., and Richards, G. (1997). “Benchmarking the learning capability of organizations”. *European Management Journal,* Vol. 15 No. 5, pp. 575-83.

Gorb, P. and Dumas, A. (1987). “Silent design”, *Design studies*, Vol. 8 No. 3, pp. 150-56.

Grewal, Rajdeep and Rebecca J. Slotegraaf (2007), “Embeddedness of Organizational Capabilities,” *Decision Sciences*, Vol. 38, pp. 451-88.

Hertenstein, J.H., Blatt M.B. anb Veryzer, R.W. (2005). “The impact of industrial design effectiveness on corporate financial performance”. *Journal of Product Innovation Management*, Vol. 22, pp. 3-21.

Ho, Y., Fang, H. and Lin, J. (2011). “Technological and design capabilities: is ambidexterity possible?”, *Management Decision, V*ol. 49, No. 2, pp. 208.

Jerez-Gómez, P., Céspedes-Lorente, J. and Valle-Cabrera, R. (2005). “Organizational Learning and compensation strategies: evidence from the Spanish chemical industry”, *Human Resource Management*, Vol. 44 No. 3, pp. 279-299.

Kale, P., Dyer, J.H. and Singh, H. (2002). “Alliance capability, stock market response, and long-term alliance success: The role of the alliance function”. *Strategic Management Journal*, Vol. 23, pp. 747-67.

Khilji, S.E., Mroczkowski, T. and Bernstein, B. (2006). “From invention to innovation: Toward developing an integrated innovation model for biotech firms”. *Journal of Product Innovation Management*, Vol. 23, pp. 528-40.

Koc, T. and Ceylan, C. (2006). “Factors impacting the innovative capacity in large-scale companies”. *Technovatio,* Vol. 27 No. 3, pp. 105–14.

Langdon, R. and Rothwell, R. (1985). “Design and innovation, policy and management” (introduction of the editors). *The Design Council*, London

Lemon, M. and Sahota, P.S. (2004). “Organizational culture as a knowledge repository for increased innovative capacity”, *Technovation, V*ol. 24, No. 6, pp. 483.

Lewis, A. and Brown, R. (1999). “Key issues in managing the product development process in very small manufacturing companies”. *Technology and Innovation Management,* Vol. 2, pp. 261-65.

Lindman, M., Scozzi, B. and Otero-Neira, C. (2008). “Low-tech, small- and medium-sized enterprises and the practice of new product development: an international comparison”. *European Business Review*, Vol. 20, pp. 51-72

Matlay, H. (2000). “Organizational Learning in Small Learning Organizations: An Empirical Overview”, *Education + Training,* Vol. 42 No. (4/5), pp. 202–10.

Morgan, N.A., Zhou, S., Vorhies, D.W. and Katsikeas, C.S. (2003). “Experiential and informational knowledge, architectural marketing capabilities, and the adaptive performance of export ventures: A cross-national study”. *Decision Sciences*, Vol. 34 No. 2, pp. 287-321.

Oaley, M. (1982). “Product design and development in small firms”. *Design Studies*, Vol. 3, pp. 5-10.

OECD (2005). The measurement of scientific and technological activities. Proposed guidelines for collecting and interpreting technological data. Paris: OECD.

Perks, H., Cooper, R. and Jones, C. (2005) “Characterizing the Role of Design in New Product Development: an empirical taxonomy”. *Journal of Product Innovation Management*, Vol. 22, pp. 111-127.

Pittaway, L. and Rose, M. (2006). “Learning and Relationships in Small Firms: Introduction to the Special Issue”, *International Small Business Journal,* Vol. 24 No. 3, pp. 227–31.

Pla-Barber, J. and Alegre, J., (2007). “Analysing the link between export intensity, innovation and firm size in a science-based industry”. *International Business Review*, Vol. 16 No. 3, pp. 275-93.

Podasakoff, P.M., MacKenzie, S.B., Lee, J. and Podsakoff, N.P. (2003). “Common method biases in behavioral research: A critical review of the literature and recommended remedies”, *Journal of Applied Psychology,* Vol. 88, No. 5, pp. 879.

Podsakoff, P.M. and Organ, D.W. (1986). “Self-Reports in Organizational Research: Problems and Prospects”, *Journal of Management, V*ol. 12, No. 4, pp. 531.

Roozenburg, N.F.M., & Eekels, J. (1995). “Product Design, Fundamentals and Methods”, *Wiley*, Chichester, UK.

Santarelli, E. and Piergiovanni, R. (1996). "Analysing literature-based output indicators: the Italian experience". *Research Policy*, Vol. 25, pp. 689-711.

Spector, P.E. (1992). "Summated rating scale construction: an introduction". *Sage University*. California.

Teece, D.J. (2007). "Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance". *Strategic Management Journal*, Vol. 28, pp. 1319-50.

Teece, D.J., Pisano, G. and Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, Vol. 18, pp. 509-33.

Tippins M.J., and Sohi, R.S. (2003). IT competency and firm performance: is organizational learning a missing link? *Strategic Management Journal*, Vol. 24, pp. 745-761.

Utterback, J., Vedin, B.-A., Alvarez, E., Ekman, S., Sanderson, S. W., Tether, B. and Verganti, R. (2006). *Design-inspired innovation*. Singapore: World Scientific Publishing

Vega-Jurado, J., Gutierrez-Gracia, A. and Fernandez-de-Lucio, I. (2009). "Does external knowledge sourcing matter for innovation? Evidence from the Spanish manufacturing industry". *Industrial and Corporate Change*, Vol. 18 No. 4, pp. 637-70.

Verganti, R. (2008). "Design, Meanings, and Radical Innovation: A Metamodel and a Research Agenda". *Journal of Product Innovation Management*, Vol. 25 No. 5, pp. 436-56.

Visser, W. (2009). "Design: one, but in different forms". *Design Studies*, Vol. 30, pp. 187-223.

Walsh, V. (1996). "Design, innovation and the boundaries of the firm". *Research Policy*, Vol. 25, pp. 509-29.

Wang, C. L. and Ahmed, P. K. (2007). "Dynamic capabilities: a review and research agenda". *International Journal of Management Reviews*, Vol. 9 No. 1, pp.31-51.

Williams, L.J., Gavin, M.B. and Hartman, N.S. (2004). "Structural equation modeling methods in strategy research: Applications and issues". In Ketchen, D.J. Jr and Bergh; D.D. (Eds.) *Research Methodology in Strategy and Management,* Vol. 1, pp. 303-46. Oxford: Elsevier.

Yeoh, P.L. and Roth, K. (1999). "An empirical analysis of sustained advantage in the U.S. pharmaceutical industry: impact of firm resources and capabilities". *Strategic Management Journal*, Vol. 20, pp. 637-53.

Zhang, M., Macpherson, A. and Jones, O. (2006). "Conceptualizing the Learning Process in SMEs: Improving Innovation through External Orientation", *International Small Business Journal,* Vol. 24 No. 3, pp. 299–323.

Zollo, M. and Singh, H. (2004). "Deliberate learning in corporate acquisitions: Post-acquisition strategies and integration capability in U.S. bank mergers". *Strategic Management Journal,* Vol. 25, pp. 1233-53.

Zollo, M. and Winter, S.G. (2002). "Deliberate learning and the evolution of dynamic capabilities". *Organization Science*, Vol. 13, pp. 339-51.

Zott, C. (2003). “Dynamic capabilities and the emergence of intra-industry differential firm performance: insights from a simulation study”. *Strategic Management Journal*, Vol. 24, pp. 97-125.

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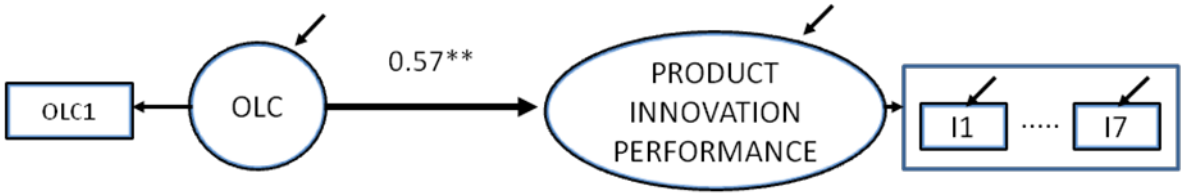
Table 1.

	Mean	s.d.	CR	1	2	3	4	5	6	7	8	9	10	11
1.- Exp	5,22	1,13	0,76	(0,74)										
2.-Risk	4,6	1,34	0,71	0,53**	(0,81)									
3.-Env	4,77	1,33	0,82	0,59**	0,60**	(0,82)								
4.-Dialog	5,39	1,02	0,83	0,60**	0,38**	0,52**	(0,82)							
5.-Partic	4,59	1,4	0,87	0,45**	0,56**	0,63**	0,49**	(0,87)						
6.-Basic S.	5,07	1,17	0,8	0,52**	0,41**	0,47**	0,49**	0,38**	(0,91)					
7.-Special	4,8	1,47	0,87	0,49**	0,45**	0,50**	0,44**	0,42**	0,75**	(0,92)				
8.-Invol	5,11	1,28	0,82	0,42**	0,32**	0,52**	0,54**	0,37**	0,65**	0,59**	(0,74)			
9.-Organizat	5	1,3	0,86	0,52**	0,42**	0,57**	0,55**	0,42**	0,76**	0,71**	0,72**	(0,74)		
10.-Innov S.	5,15	1,33	0,72	0,45**	0,37**	0,46**	0,44**	0,37**	0,62**	0,65**	0,54**	0,68**	(0,74)	
11.-Product Innov.	5,06	1,11	0,91	0,47**	0,38**	0,46**	0,55**	0,33**	0,53**	0,55**	0,54**	0,61**	0,61**	(0,91)

** Statistically significant correlation coefficient ($p<0,01$).

Cronbach´s alpha are shown on the diagonal. Composite reliabilities are shown on the CR column
To calculate the correlation coefficients, we worked with the means of the items that make up each dimension.

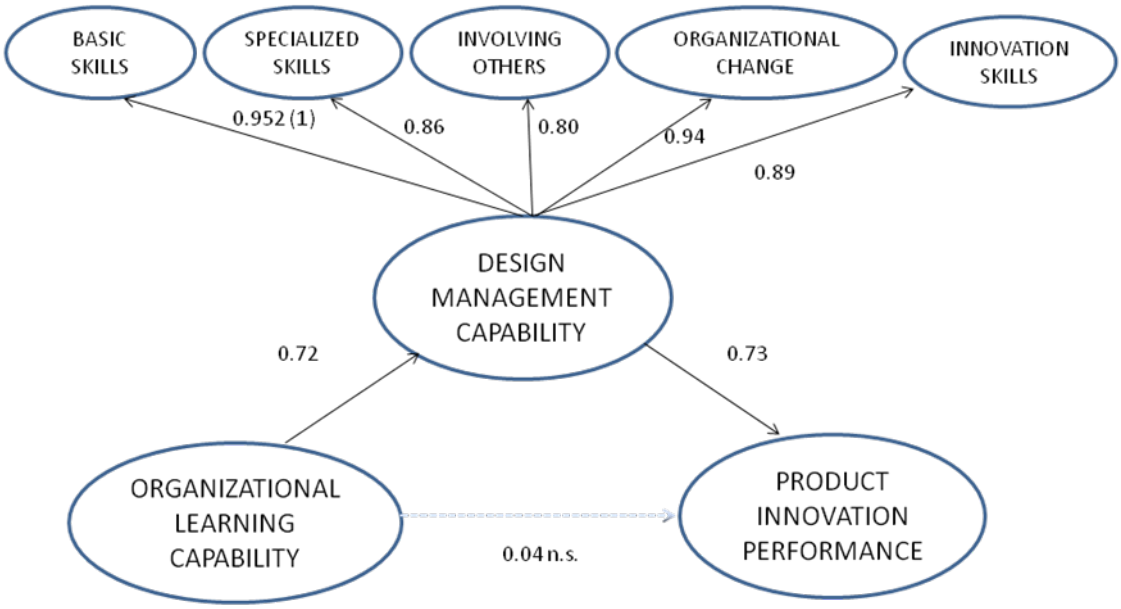
Figure 1. Direct model[1]



X^2=67.035 p=0.000; d.f.=20; χ^2/d.f.=3.35
NFI=0.997; NNFI=0.996; CFI=0.998; RMSEA=0.114

[1] The parameter was equalled to 1 to fix the latent variable scale. Parameters estimates are standardized. All parameter estimates are significant at a 95% confidence level

Figure 2. Mediation Model[2]



X^2=532.876 p=0.000; d.f.=245; χ^2/d.f.=2.17
NFI=0.975; NNFI=0.985; CFI=0.986; RMSEA=0.081

[2] The parameter was equalled to 1 to fix the latent variable scale. Parameters estimates are standardized. All parameter estimates are significant at a 95% confidence level