ORGANIZATIONAL LEARNING CAPABILITY AND PRODUCT INNOVATION: AN EMPIRICAL TEST ON SPANISH AND ITALIAN CERAMIC TILE PRODUCERS

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ABSTRACT

This paper examines how organizational learning capability affects product innovation performance. This study proposes a measurement scale for organizational learning capability, based on the contextual learning conditions, which consists of 5 dimensions: experimentation, risk taking, interaction with the external environment, dialogue and participative decision making. We have conceptualized product innovation performance as a latent construct with two dimensions: innovation efficacy and innovation efficiency. We used structural equations modelling to test our research hypothesis on a data set from the ceramic tile industry, Spanish and Italian ceramic tile producers. The results support our conceptual model and underline the importance of learning for knowledge creation and innovation performance. Furthermore, Italian companies show significant better results in organizational learning capability and innovation performance than Spanish companies.

1. INTRODUCTION

Innovation is fast becoming a crucial factor in company performance and survival as a result of the evolution of the competitive environment[1,2]. In this vein, Bachalandra and Friar[3] consider that the successful introduction of new products is the lifeblood of most organizations. The importance of product innovation for good long-term company results is now widely recognized and has been extensively reported in the literature[4].

Innovation is closely related to organizational learning. Innovation is commonly defined as the taking up of an idea or behaviour in relation to a product, service, instrument, system, policy or programme which is new to the company[5,6]. Product innovation consists of successful implementation of creative ideas within an organization[7,8]. The innovation process involves the acquisition, dissemination, and use of new knowledge[9]. There is theoretical support for a positive link between organizational learning and firm innovation[10,11]. However this link needs further clarification and empirical testing[4,2].

This study introduces the concept of Organizational Learning Capability (OLC), which stresses the role of the facilitators for organizational learning. Then, we clarify and measure its contribution to product innovation performance. We report the results of a survey that examines OLC and innovation performance in ceramic tile producing firms. We use the structural equations method to analyse the links between these constructs.

We make two contributions to the literature. First, we conceptualise OLC as the organizational and managerial characteristics that facilitate organizational learning or allow an organization to learn. This study proposes a measurement scale, based on the contextual conditions for learning, which consists of 16 items grouped into 5 dimensions: experimentation, risk taking, interaction with the external environment, dialogue and participative decision making.

Second, we explain innovation performance in a particular industry as a function of OLC. By examining innovation performance and not overall firm performance we avoid confounding the impact of other firm actions that do not belong to the OL and innovation domain or may contribute differentially to overall performance[12]. However, we also note that according to prior research, innovation performance is closely linked to overall performance[13,14]. Therefore, it is reasonable to assume that innovation performance is positively related to competitive advantage.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS

2.1. ORGANIZATIONAL LEARNING CAPABILITY

The concept of organizational learning capability (OLC)[15,16] stresses the importance of the facilitators for organizational learning. Organizational learning is understood as a process, and OLC is the organizational characteristics that enable an organization to learn. According to a review of extant literature, we conceive OLC as a second order factor that includes five dimensions: experimentation, risk taking, interaction with the external environment, dialogue and participative decision making.

2.1.1. Experimentation

Experimentation can be defined as the degree to which new ideas and suggestions are attended to and treated in a kindly manner. Experimentation is the most heavily supported dimension in the OL literature[17,18,19,20,21,15]. Nevis et al.[18] consider that experimentation involves trying out new ideas, being curious about how things work, or carrying out changes in work processes. It involves the search for innovative solutions to problems, based on the possible use of distinct methods and procedures. Weick and Westley[23] explain the importance to organizational learning of small rather than big changes or experiments.

Experimentation, the constant flow of ideas, or proposals that challenge the established order are dimensions included in studies on the creative environment[8]. In these studies experimentation is regarded as a manifestation of the creative environment.

2.1.2. Risk taking

Risk taking can be understood as the tolerance of ambiguity, uncertainty, and errors. March's concept of exploration[22], regularly associated with organizational learning, includes activities and characteristics such as searching, variety, experimentation, flexibility, discovery, innovation and risk taking. Hedberg[17] proposes a range of activities to facilitate organizational learning, amongst which is stressed the design of environments that assume risk-taking and accept mistakes. Accepting or taking risks involves the possibility of mistakes and failures occurring. Kouzes and Posner[23] stress that the key to opening up business opportunities lies in learning from the successes and mistakes that arise from risk-taking. Sitkin[24] goes as far as to state that failure is an essential requirement for effective organizational learning.

2.1.3. Interaction with the external environment

We define this dimension as the degree of relationships with the external environment. The external environment of an organization is defined as factors that are beyond the direct control of influence of the organization. It consists of competitors, the economic system, the social system, the monetary system and the political/legal system, among others.

Environmental characteristics play an important role in learning and its influence on OL has been studied by a number of researchers[25]. Relations and connections with the environment are very important, since the organization attempts to evolve simultaneously with its changing environment. Hedberg[17] considers the environment as the prime mover behind organizational learning. More turbulent environments generate organizations with greater needs and desires to learn[26]. In recent years, researchers have stressed the importance of observing, opening up to and interacting with the environment[20,18,15].

2.1.4. Dialogue

Brown and Duguid[10] and Weick and Westley[19] highlight the importance of dialogue and communication for organizational learning. Dialogue is defined as a sustained collective inquiry into the processes, assumptions, and certainties that compose everyday experience[27]. Schein[28] considers dialogue as a basic process for building common understanding, in that it allows one to see the hidden meanings of words,

first by seeing such hidden meanings in our own communication. Oswick et al.[34] claim that authentic dialogue fosters organizational learning because it creates, rather than suppresses, plural perceptions. Individuals or groups with different visions who meet to solve a problem or work together create a dialogic community. In sum, in the literature, dialogue is understood to be vitally important to organizational learning[29,18,15].

2.1.5. Participative Decision Making

Participative decision making refers to the level of influence employees have in the process of decision-making[36]. Organizations implement participative decision making to benefit from the motivational effects of increased employee involvement, job satisfaction and organizational commitment[31]. Evidence from previous studies suggests participative decision making gives better access to information and improves the quality and ownership of decision outcomes[31]. The literature considers participative decision making as one of the aspects that can facilitate learning[25,18,15,21,31].

2.2. PRODUCT INNOVATION PERFORMANCE

Product innovation consists of successful exploitation of new knowledge[7,8]. Therefore it implies two conditions: novelty and use[41]. Product innovation is a process that includes the technical design, R&D, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product. In this research, we have conceived product innovation performance as a construct with two different dimensions: innovation efficacy and innovation efficiency. Innovation efficacy reflects the degree of success of an innovation. On the other hand, innovation efficiency reflects the effort carried out to achieve that degree of success. These two dimensions of product innovation performance are consistent with previous literature[1,33,34,35].

2.3. OLC AND PRODUCT INNOVATION PERFORMANCE

Innovation implies the generation and implementation of new ideas, processes or products. It seems reasonable that OLC is closely related to knowledge creation and thereby to product innovation performance. Many scholars support such relationship[11,1,2].

Learning occurs largely through organizational interaction with and observation of the environment. With regard to innovation, customer demand uncertainty, technological developments and competitive turbulence are crucial environmental factors[1]. Therefore, an organization committed to learning can enhance its innovation performance. Therefore, we hypothesise:

> *Hypothesis 1: The higher the level of OLC, the greater the degree of product innovation performance.*

We propose a conceptual model shown in Figure 1. This model links OLC and product innovation performance. OLC is conceptualized as a higher-order construct consisting of five dimensions: experimentation, risk-taking, interaction with the external environment, dialogue and participative decision making. Similarly, product innovation performance is conceptualized as a higher-order construct consisting of two dimensions: innovation efficacy and innovation efficiency.

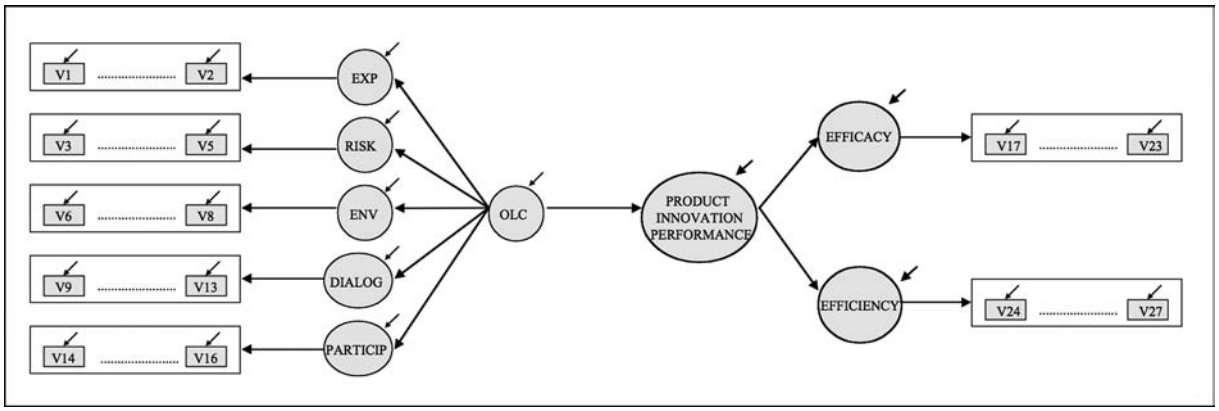

Figure 1. Conceptual model

3. METHODOLOGY

3.1. DATA COLLECTION

We test our hypotheses by focusing on a single industry: ceramic tile producers. Knowledge manifests itself in different ways in different industries[36]. Thus, the analysis of a single industry may be advantageous to assess innovation performance, as knowledge and learning involved in innovation processes will be likely to be more homogeneous[37]. Therefore, the analysis of one single sector has the advantage of avoiding a common problem in inter-sector innovation studies: that of the technological and economic diversity in innovations[39].

Ceramic tile industry is largely globalized. However, Italian and Spanish firms leader ceramic tile production thanks to superior technology and design. Such firms have substantial common traits. Most of them are considered to be SMEs, as they do not exceed an average of 250 workers[40] and they tend to concentrate geographically in industrial districts[41]. Features of the ceramic tile industry suggest it belongs to the scale-intensive and to the science-based trajectories of Pavitt's taxonomy[42,43]. In the production of ceramic tiles, technological accumulation is mainly generated by (1) the design, building and operation of complex production systems (scale-intensive trajectory) and (2) knowledge, skills and techniques emerging from academic chemistry research (science-based trajectory). Previous studies provide compelling evidence of the significant innovating behaviour of Italian and Spanish ceramic tile producers[40,43].

Finally, by focusing our data collection on the ceramic tile industry, we reduce the range of extraneous variations that might influence the constructs of interest. We recognise the shortcoming of such sampling, but we believe that the advantages of this approach outweighed the disadvantages of limited generalisability.

The field work was carried out from June to November 2004. The questionnaire was addressed to company directors. A pre-test was carried out on four technicians from ALICER, the Spanish Centre for Innovation and Technology in Ceramic Industrial Design, to assure that the questionnaire items were was fully understandable in the context of the ceramic tile industry. The questionnaire was applied using a 7-point Likert scale, where 1 represented total disagreement and 7, total agreement (Table 1).

DIMENSION	ITEM	LITERATURE SOURCE
Experimentation	1. People here receive support and encouragement when presenting new ideas	Isaksen et al. (1999);
	2. Initiative often receives a favourable response here so people feel encouraged to generate new ideas	
Risk taking	3. People are encouraged to take risks in this organization	Isaksen et al. (1999); Amabile et al. (1996)
	4. People here often venture into unknown territory.	
	5. Untested ideas are often put forward here	
Interaction with the external environment	6. It is part of the work of all staff to collect, bring back, and report information about what is going on outside the company.	Pedler et al. (1997)
	7. There are systems and procedures for receiving, collating and sharing information from outside the company.	
	8. People are encouraged to interact with the environment: competitors, customers, technological institutes, universities, suppliers etc.	
Dialogue	9. A wide variety of view points are expressed here.	Isaksen et al. (1999); Templeton (2002); Amabile et al. (1996); Pedler et al. (1997); Hult & Ferrell (1997); Goh & Richards (1997);
	10. Employees are encouraged to communicate.	
	11. There is a free and open communication within my work group	
	12. Managers facilitate communication	
	13. Cross-functional teamwork is a common practice here.	
Participative decision making	14. Managers in this organization frequently involve employees in important decisions	Pedler et al. (1997)
	15. Policies are significantly influenced by the view of employees	
	16. People feel involved in main company decisions	
Product innovation efficacy	17. Replacement of products being phased out	OECD-EUROSTAT (1997)
	18. Extension of product range within main product field through new products	
	19. Extension of product range outside main product field	
	20. Development of environment-friendly products	
	21. Market share evolution	
	22. Opening of new markets abroad	
	23. Opening of new domestic target groups	
Product innovation efficiency	24. Average innovation project development time	Wheelwright & Clark (1992); Griffin (1993); Griffin & Page (1993); Chiesa, Coughlan & Voss (1996); Valle & Avella (2003)
	25. Average number of innovation projects working hours	
	26. Average cost per innovation project	
	27. Global satisfaction degree with innovation projects efficiency	

Table 1. Questionnaire

Our study received a total of 182 completed questionnaires, 82 from Italian firms and 100 from Spanish firms. The sample obtained represents around the 50% of the population under study[39,43]. Both the number of responses and the response rate can be considered satisfactory[44,45].

3.2. MEASUREMENTS

3.2.1. OLC

From the concept of organizational learning capability adopted in our theoretical review, we proceed to the development of a measurement instrument comprising a set of scales that represent theoretical dimensions or latent variables through their items. There is broad agreement in the literature on the steps to be followed in the creation of a measurement scale, with only slight discrepancies in the detail of the stages[44].

Following a literature review of OLC, we obtain the theoretical representation and the specification of the concept. We consider organizational learning as the process of social construction of shared beliefs and meanings, in which the social context plays an essential role[45]. Organizational learning capability (OLC) consists of the organizational and managerial characteristics that enable an organization to learn. As we explained in the theory section, we found five dimensions that represent the essential factors that determine organizational learning capability: experimentation, risk taking, interaction with the external environment, dialogue and participative decision making.

The selected indicators were taken from measurement scales available in the organizational learning literature. Spector[44] argues that the content of other scales may help in the development of a new scale. He proposes the use of items from existing scales to develop a new one. Our scale makes use of OLC and creative climate items. Table 1 exhibits this scale highlighting the literature sources of the items.

3.2.2. Product Innovation Performance

We conceive product innovation performance as a construct with two different dimensions consistent with previous literature: innovation efficacy and innovation efficiency. Both dimensions have been widely discussed in innovation research[46,48]. The product innovation performance measurement scale we use has already been satisfactorily validated in the context of biotechnology firms[49].

The OECD's Oslo Manual provides a detailed measurement scale for the assessment of the economic objectives of innovation[33] and is the one we propose to measure product innovation efficacy. This scale was put forward by the OECD to give some coherent drivers for innovation studies, thereby achieving a greater homogeneity and comparability among innovation studies. Nowadays, many innovation surveys use this scale, which has been widely validated[33].

Innovation efficiency is the second dimension that we take into account to measure innovation performance. Innovation efficiency is widely accepted to be determined by the cost and the time of the innovation project[1,50,51,52,53]. Cost and development time have been measured both objectively[67] and subjectively[66,34,35]. Objective measurement usually refers to a specific innovation project that has been analyzed in detail while subjective measurement has generally been implemented in innovation surveys.

Besides the relevance of cost and time to determine the innovation process efficiency, several studies have also included a subjective assessment on global

innovation project efficiency. Ancona and Caldwell[53] used subjective assessment items on global innovation performance in their works on external communications of product development teams. Barczak[63], in her empirical study in the telecommunications industry, also uses a overall satisfaction item with the firms' new product development efforts to measure performance. Chiesa, Coughlan and Voss[50] also introduced perceptive assessments in their innovation efficiency audit toolbox. The four-item scale we propose to measure innovation efficiency is consistent with this issue.

3.3. ANALYSES

Before testing our hypotheses, we assessed the likely extent of common method variance (CMV). This is a problem that can arise when dependent and independent variables are collected from a single informant. We checked that CMV was not a substantial problem by testing the non-existence of a single factor from a factor analysis of all survey items[54,55].

The primary analyses of the data set are based on structural equations modelling. Structural equations models have been developed in a number of academic disciplines to substantiate theory. 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 our research hypotheses. Confirmatory Factor Analysis (CFA) was used to check the goodness of the measurement scales.

One common rule-of-thumb on the minimum threshold for implementing SEM is as of 100 subjects[45]; our sample meets this threshold. Following Tippins and Sohi[55], we used elliptically reweighted least square (ERLS) method as the estimation procedure to test our hypothesized model because this method has a satisfactory performance regardless of the data distribution.

4. RESULTS

4.1. PSYCHOMETRIC PROPERTIES OF MEASUREMENT SCALES

The psychometric properties of the measurement scales were assessed in accordance with accepted practices[56,55], and included content validity, reliability, discriminant validity, convergent validity, and scale dimensionality. Content validity was established through a revision of extant literature and through personal interviews with ceramic tile industry experts (four ALICER technicians). We computed coefficient alpha to assess scale reliability. All scales achieved acceptable coefficient alphas of at least 0.70 (Table 2)[57].

In the context of multi-dimensional scales, the discriminant validity analysis sets out to confirm that each of the dimensions (or subscales) we are working with measure different aspects of the concept they are related to. In order to verify this, we use the matrix of the correlations between the concept dimensions be examined. Discriminant validity is considered to exist if the correlation coefficients do not exceed 0.9 and they are statistically significant[58].

	MEAN	S.D.	EXP	RISK	ENV	DIALOG	PARTICIP	EFFICACY	EFFICIENCY
EXP	5.22	1.13	(0.74)						
RISK	4.60	1.34	0.57**	(0.81)					
ENV	4.77	1.33	0.59**	0.60**	(0.82)				
DIALOG	5.39	1.02	0.63**	0.44**	0.53**	(0.82)			
PARTICIP	4.59	1.40	0.46**	0.59*	0.63**	0.50**	(0.87)		
EFFICACY	5.06	1.11	0.47**	0.39**	0.46**	0.54**	0.34**	(0.91)	
EFFICIENCY	4.68	1.21	0.49**	0.51**	0.51**	0.48**	0.46**	0.80**	(0.92)

***Correlation coefficient statistically significant (p<0.01).*
Cronbach's alphas are shown on the diagonal.
To calculate the correlation coefficients we worked with the means of the items that make up each dimension.

Table 2. Factor correlations, means, standard deviations, and Cronbach's alphas

Table 2 presents the correlations between the dimensions of the operationalized constructs. All coefficients fall below 0.9 and are statistically significant (p<0.01); we can therefore consider that the OLC scale complies with the property of discriminant validity.

CFA was used to establish convergent validity by confirming that all scale items loaded significantly on their hypothesized construct factors[56]. Finally, to confirm dimensionality of the higher-order constructs –OLC and product innovation performance– we ran second-order CFAs. 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. Further, the fit indexes exceeded their recommended thresholds (Table 3), indicating good model fits and a confirmation of scale dimensionality.

PARAMETER	MODEL R^2 = 0.480
Hypothesized path	
OLC → PRODUCT INNOVATION PERFORMANCE	0.696 (5.275)
Measurement model and first-order factors	
OLC → Experimentation	0.86(1)
OLC → Risk taking	0.85 (6.161)
OLC → Interaction with the external environment	0.91 (5.962)
OLC → Dialogue	0.75 (4.970)
OLC → Participative decision making	0.79 (6.060)
PRODUCT INNOVATION PERFORMANCE → Innovation efficacy	0.88(1)
PRODUCT INNOVATION PERFORMANCE → Innovation efficiency	0.92 (8.259)
Goodness-of-fitness statistics	
$\chi 2$	498.24 (p=0.000)
d.f.	316
Bentler-Bonnet normed fit index (NFI)	0.949
Bentler-Bonnet non-normed fit index (NNFI)	0.978
Comparative fit index (CFI)	0.981
Root mean square error of approximation (RMSEA)	0.057

(1) The parameter was equalled to 1 to fix the latent variable scale.
Parameters estimates are standardized with t-values shown in parentheses.

Table 3. Structural equations model

4.2. TEST OF THE RESEARCH HYPOTHESIS

Table 5 shows the results of the structural equations modelling analysis. The chi-square statistic for the model is significant (p=0.000), but other relevant fit indices suggest a good overall fit[35,34]. Therefore, our research hypothesis is confirmed. The model has been satisfactorily tested. There is compelling evidence of a positive link between OLC and product innovation performance (α=0.696, t=5.275, p=0.000).

4.3. COMPARING ITALIAN AND SPANISH CERAMIC TILE PRODUCERS

Table 2 shows some descriptive statistics of the whole sample. The means of all dimensions, belonging both to OLC and to Product Innovation Performance, are above 4, the average of the 1 to 7 Likert scale we have implemented. This evidences that the ceramic tile industry is quite "healthy" in terms of organizational learning and product innovation performance. In fact, this should not be surprising if we take into account that the sample is focused on the two best performing countries in ceramic tile production.

However, it is interesting to look inside the whole sample and compare the Italian and the Spanish sub-samples. Table 4 provides evidence that the Italian sub-sample gets better scores since its means are all higher. Further, we carried out a one-factor ANOVA analysis to check for the consistency of these results. One-factor ANOVA analysis is an analysis of variance that tests the hypothesis that a difference between two independent samples means is attributable to chance. We find that there are statistical differences among both sub-samples (Table 4), except for the dimension of dialogue.

	SUB-SAMPLE	N	MEAN	S.D.	SIG. ANOVA
EXP	Spanish Italian	101 82	5,01 5,49	1,15 1,05	0,004
RISK	Spanish Italian	101 82	3,96 5,38	1,14 1,13	0,000
ENV	Spanish Italian	101 82	4,29 5,36	1,29 1,13	0,000
DIALOG	Spanish Italian	101 82	5,31 5,49	0,99 1,04	0,227
PARTICIP	Spanish Italian	101 82	3,94 5,36	1,18 1,14	0,000
OLC	Spanish Italian	101 82	4,50 5,41	0,82 0,97	0,000
EFFICACY	Spanish Italian	101 82	4,95 5,19	0,87 1,34	0,003
EFFICIENCY	Spanish Italian	101 82	4,27 5,19	0,95 1,32	0,000
PRODUCT INNOVATION PERFORMANCE	Spanish Italian	101 82	4,63 5,18	0,72 1,32	0,000

Table 4. ANOVA Analysis

5. CONCLUSION

We have taken a further step towards testing the relationship between OLC and product innovation performance. Results provide support for the model presented in Figure 1 and the underlying hypothesis. Findings have important implications in the field of organizational learning and knowledge management. This research provides evidence that OLC enhances knowledge creation and product innovation performance.

Our study makes a contribution to the literature by supporting the perspective that innovation performance is a function of OLC. This finding is important both for academics and for practitioners. Learning facilitating factors should be taken into account when setting innovation objectives.

When taking into account the Italian and the Spanish sub-samples we find that OLC and product innovation performance are important for Italian and Spanish firms. However, Italian firms get higher scores consistently. This finding seems to suggest that Spanish firms need to make more efforts on organizational learning in order to reduce this gap and be competitive in the global ceramic tile market.

A conceptual contribution is also made to the development and empirical validation of a scale to assess OLC. A perceptual measure for OLC may be useful for further academic research as well as for carrying out internal audits at companies.

Our results must be viewed in the light of the study's limitations. As with all cross-sectional research, the relationship tested in this study represent 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. Because we have carried out a single industry analysis, our study has benefited of the advantage of dealing with new products that are likely to be economically and technologically homogeneous. However, it must be stressed that single industry conclusions have to be considered with caution. Further research is needed to determine the applicability of these results to other industries. Finally, the results of this study provide further guidance for future research: OLC could be related to other firm issues such as quality or flexibility.

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