Promoting radical innovation through end-user computing satisfaction

Abstract

Purpose. *The purpose of this paper is to provide empirical evidence of the relationship between end-user computing satisfaction and radical innovation, using organizational learning as an explanatory variable.*

Design/methodology/approach. *An empirical study was conducted in a population of 402 Spanish companies. A sample of 251 valid questionnaires was obtained. Structural equations were used to validate the proposed hypotheses.*

Findings. *Organizational learning capability fully mediates the relationship between end-user computing satisfaction and radical innovation.*

Research limitations/implications. *The sample of companies is heterogeneous in terms of size, sector, age, and market share. The study uses single informants.*

Practical implications. *Results highlight the need to implement adequate information systems to promote radical innovation. In addition, it is necessary to facilitate organizational contexts that encourage dialogue, experimentation, risk-taking, participative decision-making, and openness to the external environment.*

Originality/value. *This research contributes to the study of alternative antecedents of radical innovation by highlighting the importance of end-user computing satisfaction.*

Paper type: *Research paper.*

Keywords: end-user computing satisfaction; radical innovation; organizational learning capability

1. Introduction

Under conditions of uncertainty and high competition, such as those faced by companies in many sectors nowadays, innovation is one of the main mechanisms that allow organizations to increase their competitiveness and ensure their long-term continuity in the market. Among the different types of innovation distinguished in the literature, radical innovation occupies a prominent place as a means to achieve these objectives (Chandy and Tellis, 1998; McDermott and O'Connor, 2002), since it advances the price/performance frontier by far more than the existing rate of progress (Gatignon et al., 2002:1107), and is crucial for both organizational and economic growth (Büschgens et al., 2013).

Radical innovations present a high degree of novelty for both the firm that develops them and the market to which they are addressed. They represent revolutionary changes in technology (Dewar and Dutton, 1986) and are foundational innovations that serve as the basis for future technical developments (Datta and Jessup, 2013). Radical innovation can refer to a new product, service, productive process, etc. (O'Malley et al., 2014). Product innovation is defined as the product or service introduced to meet the needs of the market or of an external user, while process innovation is understood as a new element introduced into production operations or functions (Alegre et al., 2005). In the present research we have focused the analysis on product, service, and process innovation.

Yang et al. (2014) argue that radical innovation needs a wide range of facilitators, both within and outside the organizations. For instance, internal factors such as corporate culture (Tellis et al., 2009), internal knowledge sharing (Zhou and Li, 2012) or education and experience of the entrepreneurs (Marvel and Lumpkin, 2007) are antecedents of radical innovation. External factors such as political ties (Zhao et al., 2016), external market knowledge acquisition (Zhou and Li, 2012) or reliance on partners (Slater et al., 2014) appear to be drivers of this type of innovation. Nevertheless, some authors consider that antecedents and processes related to radical innovation are not well documented (O'Malley et al., 2014). López-Cabrales et al. (2008) consider that studying the organizational characteristics related to radical innovation is still a promising field of study because much of the previous research has been focused on traditional parameters, proposing the analysis of alternative organizational variables.

Radical innovation involves working on highly complex, risky and uncertain projects (Büschgens et al., 2013). In these projects, good quality information systems may be decisive. Popovič et al. (2014:270) state that information systems "support timely decisions, provide information that enhances comparative advantage, promote innovation, and offer a means to manage the uncertainty inherent in the business environment".

In addition, the evolution of information technologies has enhanced the effect of information systems on innovation development (Jha and Bose, 2016). Sainio et al. (2012) suggest that, nowadays, there is a greater potential to innovate and achieve competitive advantages due to new information technologies and the Internet.

In recent times, the amount of information available has increased appreciably, which has been accompanied by the proliferation of systems to access and retrieve it. New information technologies have had a great impact at the organizational level, affecting the way people work within organizations and giving rise to a new type of worker. End-user computing emerged when personal computers allowed users to exert control over their own needs for information without depending upon centralized technologies or departments that managed these needs (Govindarajulu and Arinze, 2008). Nonetheless, although the development of communication and information technologies has improved access to information, detecting information that is both relevant and useful is difficult and requires intensive efforts (Burcharth et al., 2015). In this context, organizations make large investments to develop information systems to achieve their objectives. These investments will be successful if users are satisfied and use the information technology in an effective manner (Somers et al., 2003).

Bokhari (2005) states that the evaluation of the success of information systems is a complicated phenomenon by nature. It is difficult to obtain economic and quantitative measures to evaluate the success of an information system, so scholars and practitioners use subjective measures to do so. The end-user computing satisfaction (EUCS) model is commonly used as a surrogate measure for information system success (Aggelidis and Chatzoglou, 2012). Although there are other means to measure the success of an information system, they present important shortcomings which make them inappropriate to this end, user satisfaction being the best measure of information system success (Lapiedra et al., 2011). EUCS is defined as the affective attitude toward a specific computer application by someone who interacts directly with the application (Doll and Torkzadeh, 1988).

Information systems have a positive impact on organizational performance (Abugabah et al., 2009) and provide a wide variety of benefits for organizations, such as competitive advantage or improvements in decision-making (Ghobakhloo and Tsang, 2015). However, although information systems are positively related to innovation (Popovič et al., 2014; Jha and Bose, 2016), the number of studies that analyze their influence on radical innovation is scarce. Taking into account that the promoters and the consequences of radical innovation are completely different to other innovation typologies and the paramount outcomes that may be achieved through this type of innovation (McDermott and O'Connor, 2002), it is essential to identify the factors that trigger radical innovation. Previous research on the antecedents of this type of innovation has been focused on elements related to organizational culture, organizational structure, leadership or external factors (Slater et al., 2014), underestimating the role played by information systems. This is surprising because innovation has been one of the most significant topics in the field of information systems (Jha and Bose, 2016). In this line, these authors state that research on information systems "does not answer questions related to the different antecedents that are essential for innovation generation for products/services and processes" (Jha and Bose, 2016:303). Consequently, and following Ghobakhloo and Tsang (2015), who call for more research on the potential benefits of information systems, the present study attempts to expand the knowledge related to information systems and innovation by using a measure of information system success to evaluate its influence on radical innovation.

Although information is essential to foster innovation, there are factors that may mediate this effect. Literature shows that organizational learning is one of them, as it plays a key role in the assimilation and transfer of information and knowledge within organizations that, in turn, may promote innovation. For instance, Alegre and Chiva (2008:317) state that the organizational learning process is closely related to product innovation performance. Blazevic and Lievens (2004:374) argue that organizational learning is especially critical during innovation. In addition, organizational learning may be essential to develop radical innovations (Zhao et al., 2016), as, by improving information processing, it helps companies to act ahead of their competitors, and compete in contexts characterized by profound changes (Santos-Vijande et al., 2012). Chiva et al. (2014) state that innovation depends on organizational learning capability (OLC), through which new knowledge is developed, distributed, and used. In the present research, the mediating role of OLC is discussed. Although OLC is not the same as organizational learning, they are related ideas. OLC stresses the importance of the facilitating

factors of organizational learning. These factors have been positively related to radical innovation in a context of information and knowledge management. For instance, Berends et al. (2007) highlight the importance of managing knowledge to promote radical innovation through different means such as experimentation, the scanning of information from external sources, the promotion of participative environments, and so forth.

Despite the fact that quality information systems are important to promote innovation, to our knowledge there is no previous research linking it to radical innovation. A review of the extant literature suggests that more investigations are required to gain a better insight into those relationships. In this vein, the present research tries to cover this gap and empirically analyzes whether EUCS facilitates radical innovation through OLC (Figure 1). To this end, an empirical study was conducted in a population of 402 Spanish companies.

2. Literature review

2.1 Radical Innovation

Radical innovation has become an area of great interest for both scholars and practitioners. Understanding its antecedents and its implications for organizations is an unavoidable duty. Although there are various innovation classifications, one of most extended typologies is the difference between incremental and radical innovation (Dewar and Dutton, 1986).

Radical innovation facilitates better competitive positions (Baker and Sinkula, 2007; Chandy and Tellis, 2000), promotes long-term success and is crucial to renew or maintain the firm's competitive position (Chandy and Tellis, 1998; O'Connor and McDermott, 2004), allows companies to establish themselves or grow substantially (Herrmann et al., 2007), and offers unprecedented customer benefits, substantial cost reductions, or superior organizational performance (Slater et al., 2014).

Notwithstanding, radical innovation is difficult to achieve and is related to many risks and uncertainties. Sorescu et al. (2003) state that most radical innovations come from a minority of firms. In addition, it is hard to find support for radical innovation projects within organizations, as incremental ones are prioritized because they involve fewer risks and conflicts, and provide

immediate rewards (Baker and Sinkula, 2007; McDermott and O'Connor, 2002). For this reason, it is common for organizations to seek a balance between the two types of innovation.

2.2 End-user computing satisfaction

End-user computing has been defined as that carried out by anyone who, as an information consumer, interacts directly with a computer-based information system (Doll and Torkzadeh, 1988). End-user computing has evolved over time. Nowadays, for example, end-users know more about computer-based technologies than those in the past (Govindarajulu and Arinze, 2008). Moreover, end-users can work with the system in real time, introducing data and making enquiries. For this reason, they have an accurate insight into the system's capacity to serve their needs (Roses, 2011), which determines their satisfaction with the system. Aggelidis and Chatzoglou (2012:566) define EUCS as the "end-user's overall affective and cognitive evaluation of the pleasurable level of consumption-related fulfillment experienced with the information system".

Different authors have evaluated information system success through end-users' satisfaction and have developed instruments to measure it. Aggelidis and Chatzoglou (2012:567) state that EUCS "is probably the most widely used measure of information system success".

Doll and Torkzadeh (1988) developed a construct to measure EUCS through five subscales: content, accuracy, format, timeliness, and ease of use of a computer application. Information content refers to precise and sufficient data that meets users' needs; accuracy implies that the information received is correct; format refers to information presented in a clear and useful way; timeliness is the possibility of getting the information on time or having a system that provides up-to-date information; and ease of use refers to user friendliness. Previous research has shown the validity and reliability of this instrument, using different samples, computer applications, and business or cultural contexts (e.g., Somers et al., 2003).

2.3 Organizational learning capability

While organizational learning is the process by which organizations learn, by changing or modifying their mental models, rules, processes or knowledge (Alegre and Chiva, 2008), OLC refers to the organizational and managerial characteristics that facilitate that an organization may learn (Chiva and Alegre, 2009).

OLC is a multidimensional construct and different authors have suggested diverse variables that promote learning (Jerez-Gómez et al., 2005). The present study follows the approach by Chiva et al. (2007), who proposed five facilitating factors of organizational learning: experimentation, risk acceptance, interaction with the environment, dialogue, and participation in decision-making. This conceptualization considers that learning may be either internal or external to the organization.

According to these authors, experimentation involves the search for innovative solutions to problems, by using different methods and procedures, and is considered as one of the manifestations of creative environments. Risk-taking is related to the acceptance of errors, mistakes, and failure. The external environment is defined as factors that are beyond the organization's direct control or influence, which include other competitors, associations, educational centers, etc. Dialogue is a process of thought and collective inquisition by which people learn to think together. Finally, participative decision-making is defined as the level of influence that employees have in the decision-making process.

3. Hypotheses

3.1 End-user computing satisfaction and organizational learning capability

McGill and Slocum (1993:77) state that "information in a learning organization must be accurate, timely, available to those who need it, and presented in a format that facilitates its use". In addition, all the categories composing the OLC construct proposed by Chiva and Alegre (2007) appear to be linked to the main characteristics of a quality information system.

An adequate information system reduces uncertainty (Dewett and Jones, 2001) and provides timely information (Popovič et al., 2014). By reducing uncertainty, perceived risk decreases, which in turn facilitates risk-taking. In addition, these information systems stimulate experimentation, opportunity-seeking and the emergence of new initiatives (Simons et al., 2000).

Accurate and timely information encourages communication within firms (Santos-Vijande et al., 2012), which may foster interaction between people from different departments and the creation of multidisciplinary teams, thus triggering dialogue and knowledge sharing.

Organizations evolve by adapting to the continuous changes in the environment. The more turbulent the environment is, the more there is a need for organizations to learn (Popper and Lipshitz, 2000). Timely, relevant and integrated information strengthens relationships between businesses and customers, consultants, alliances, and suppliers (Yang et al., 2009). Therefore, the proper functioning of an information system fosters relationships with different agents in the external environment.

Systems that provide accurate, complete, timely, and relevant information, that meets users' needs, and are user-friendly promote greater satisfaction with the process among the people who make decisions (Bharati and Chaudhury, 2004). Quality information systems that guarantee effective decision-making, along with an environment that triggers communication and interaction between different departments, may create a context where firms encourage employees' participation in decision-making.

Therefore, we propose the following hypothesis:

Hypothesis 1: EUCS has a positive effect on OLC.

3.2 Organizational learning capability and radical innovation

Jerez-Gómez et al. (2005:279) consider that OLC is a key element to improve efficiency and organizational capacity to innovate and grow. Several studies have shown that OLC has a positive effect on innovation (e.g., Alegre and Chiva, 2013; Baker and Sinkula, 2007).

Additionally, literature also points out that the dimensions of OLC, separately, are associated to innovation in general and radical innovation in particular.

Experimentation is one of the factors considered as crucial for radical innovation. O'Connor and McDermott (2004:11) state that "radical innovation requires organizations to move into unknown territory and experiment with new processes that largely elude systemization". In addition, radical innovation is promoted in organizational contexts that encourage risk-taking (Chang et al., 2012).

The dialogue dimension is comprised of team member diversity, openness to new ideas and communication. Teams made up of people from different areas have a positive effect on innovation. Subramanian and Youndt (2005) state that innovation is a collaborative process, and communication, information dissemination, and both knowledge assimilation and knowledge sharing are vital elements for any type of innovation, including radical innovation. Although individuals can develop breakthrough ideas, these need to be circulated and disseminated within the organization to gain recognition and maximize their impact.

Openness to the external environment and making use of external knowledge are elements related to innovation. Chang et al. (2012) indicate that openness is one of the most influential determinants of radical innovation, as it enables organizations to work with ideas from different sources. Slater et al. (2014) state that external orientation facilitates radical innovation.
Participative working environments in which organizational members take part in decision-making also facilitate innovation. They increase motivation to learn and stimulate creative thinking, leading to the development of new ideas, which are essential for innovation (Hurley and Hult, 1998). Therefore, we hypothesize:

Hypothesis 2: OLC has a positive effect on radical innovation.

3.3 End-user satisfaction and radical innovation: the mediating role of organizational learning capability

Companies pay special attention to information systems, implementing new information technologies in order to, among other objectives, innovate (Tseng, 2008). However, mere access to information, in itself, does not ensure innovation. Information systems must provide

the information that users need because both the lack and the excess of information can be harmful to innovation. Miller et al. (2005) suggest that a lack of information prevents the successful development of radical innovations. Datta and Jessup (2013) state that large amounts of information may overload the organizational capacity to process it, which, in turn, may cause confusion, thus discouraging innovation efforts.

Miller et al. (2005) highlight the critical need for quick, almost instantaneous, access to information because this accelerates the development of radical innovation. In addition, information accuracy may be essential to develop radical innovations. Having clear information is essential to innovate successfully (Bendoly et al., 2012). On the other hand, and regarding format, the way information is stored, transmitted, communicated or processed is an important but neglected means of facilitating the innovation process (Dewett and Jones, 2001:326).

However, other organizational factors must be taken into account in the study of how information is used to innovate. OLC may play an important role in sharing information and making it more accessible to innovate. The fact of having an information system with all the characteristics that favor end-user satisfaction may promote an organizational context where people engage in dialogue, share information and knowledge, suggest new ideas, experiment, interact with the external environment, participate in decision-making, and take risks. In short, an adequate information system may promote an environment that fosters learning and, in turn, innovation.

Improving the accessibility to quality information facilitates risk-taking (Lee et al., 2011), which is one of the factors that promote radical innovation (López-Cabrales et al., 2008). Innovation needs the transformation and exploitation of existing knowledge and, for this to happen, it is necessary that employees share information and knowledge (Jiménez-Jiménez and Sanz-Valle, 2011). Information is more likely to be shared among different departments when it is codified in an appropriate format (Lee et al., 2011). These authors suggest that people accept information and share it when they perceive it is valuable. In addition, in innovative processes, sharing relevant, new, trustworthy and meaningful information is more important than the amount of information. Through the exchange of information, employees improve their knowledge base, refine and test ideas to solve problems, and go beyond their routine work to develop new ideas (Blank, 2014), which may potentially lead to radical innovations.

Advances in information technologies allow access to knowledge that is beyond organizational boundaries. This external knowledge has become essential to innovate. Büschgens et al. (2013) argue that an external orientation fosters the collection of information from the environment, which triggers novel ideas. In addition, many radical innovations are not developed by just one firm and need the collaboration of more companies (Miller et al., 2005), which requires information sharing. Consequently, we hypothesize:

Hypothesis 3: OLC positively mediates the relationship between EUCS and radical innovation.

INSERT FIGURE 1 ABOUT HERE

---

4. Research methodology

4.1 Data collection

The study was focused on a population of 402 Spanish firms, gathered from databases or listings of organizations that regard employees as core elements in their businesses, prioritize human resource management, and are considered by their own employees as good firms to work for. Mallén et al. (2015) state that because of the characteristics of these companies, many other firms use them as benchmarks in their own improvement processes and consider that the relationships among the variables arising in these working environments is a subject worthy of in-depth examination. On the other hand, the European Innovation Scoreboard (2017) provides a comparative analysis of innovation performance in the European Union, identifying the weaknesses and strengths of each country. According to this source, Spain is a moderate innovator and one of its relative strengths is in human resources.

The fieldwork was carried out between October and December 2010. The questionnaire was addressed to human resources managers, with at least two years' experience in the firm. Due to

their position and experience, these managers had an overall view and an in-depth knowledge of the organization. Anonymity was granted to all the participants in the study.

The questionnaire consisted of 31 items that were measured using a five-point Likert scale. All indicators were expressed in a positive way and respondents had to express their agreement or disagreement with each statement included in the questionnaire. The survey was completed via telephone interviews. Finally, a sample of 251 valid questionnaires was obtained.

The questionnaire was administered in Spanish to all participants. While OLC was originally designed in Spanish, EUCS and radical innovation were first developed in English. In order to ensure the accuracy of the translation, a double-back translation procedure was used.

4.2 Measurement instruments

The selected measurement scales had already been used and validated by other researchers in previous studies. The reliability of the scales was assessed using Cronbach's alpha. To measure radical innovation, we used the scale developed by Gatignon et al. (2002), which comprises five items. This construct had a Cronbach's alpha of 0.80. The scale developed by Chiva et al. (2007) and Chiva and Alegre (2009) was used to measure OLC. All dimensions that comprise OLC obtained Cronbach's alpha values above 0.80. The scale developed by Doll and Torkzadeh (1988) was used to measure EUCS, and comprises 12 items and five subscales. Each dimension of EUCS obtained Cronbach's alpha values above 0.80.

4.3. Control variables

Firm size, sector, firm age, and market share were used as control variables. Regarding firm size, 61.3% were small and medium-sized companies (250 employees or less) and 38.7% were large firms (more than 250 employees). Besides, we have distinguished between manufacturing and service firms, obtaining the following sample: manufacturing sector (28.7%); service sector (71.3%). The sample is heterogeneous as it is composed of companies from very different sectors. For instance, manufacturing companies include organizations from sectors such as pharmaceuticals, household appliances or construction, while service companies are those related to sectors such as tourism, banking or consultancy. In terms of the age of the company, the sample is distributed as follows: 10 years or less (14.7%), between 11 and 25

years (37.8%), between 26 and 50 years (29.1%), between 51 and 100 years (16.3%), and more than 100 years (2.0%). Regarding the market share, respondents had to classify their companies comparing them with their largest competitor. The final sample shows that 5.2% of the companies have a smaller market share, 51.0% have a similar market share, and 43.8% have a larger market share than their largest competitor.

4.4. Analyses

The empirical validation of the model was performed using structural equations and the statistical software package EQS 6.1. We used the maximum likelihood estimation method with robust estimators.

Given that the scales were developed using relevant items selected from a common survey, we conducted a Harman's single factor test (Podsakoff and Organ, 1986) to control for common method variance and to deal with the potential social desirability of the responses. The results of the CFA with the 31 indicators loading onto a single factor (Chi-square = 2055.75; p-value = 0.00; NFI = 0.558; NNFI = 0.585; CFI = 0.613; RMSEA = 0.122; Chi-square/d.f. = 4.74) showed a poor fit, suggesting that the single factor does not account for all the variance in the data. In addition, data were collected at different moments and the order of questions was randomly changed (Chang et al. 2010; Podsakoff et al., 2003). Consequently, common method variance should not be a problem in the present research.

Then we tested the structural models corresponding to the proposed hypotheses. In particular, we followed the approach taken by Baron and Kenny (1986) to verify the existence of the mediating effect of OLC on the relationship between EUCS and radical innovation (Hypothesis 3). The significance of the mediated effect was tested using bootstrapping (MacKinnon et al., 2012).

5. Results

5.1. Descriptive statistics and psychometric properties of the measurement scales

Table 1 exhibits means, standard deviations, and factor correlations. Psychometric properties of the measurement scales were evaluated by following accepted practices in the literature (Anderson and Gerbing, 1988).

In the case of the OLC construct, following Chiva and Alegre (2009), we checked the fit of the second-order factor model (Figure 2) to support the proposed multidimensionality of this concept (Chi-square = 93.246 p-value = 0.047; Chi-square/d.f. = 1.295; NFI = 0.947; NNFI = 0.984; CFI = 0.987; RMSEA = 0.034). In addition, the same analysis was performed to check the EUCS construct (Figure 3), which also yielded excellent results (Chi-square = 99.462; p-value = 0.000; Chi-square/d.f. = 1.989; NFI = 0.966; NNFI = 0.977; CFI = 0.983; RMSEA = 0.063).

Regarding the structure of the constructs, in addition to CFA analyses, we also followed the more commonly used approach (Anderson and Gerbing, 1988), which involves assessing a full measurement model that includes all the variables. The overall fit of this general measurement model was as follows: Chi-square (d.f.) = 555.69 (422); p = 0.00; CFI = 0.968; RMSEA = 0.036. The Chi-square statistic was non-significant, and all the standardized estimates were significant and in the expected direction.

The results of the reliability analysis were also satisfactory. Cronbach's alpha coefficient values and the compound reliability values were or exceeded 0.7, which is the minimum accepted value (Nunnally, 1978). Compound reliability values were between 0.7 and 0.9.

The procedure followed to select the measurement scales supports content validity. The variables used to measure OLC were taken from the scale proposed by Chiva et al. (2007) and Chiva and Alegre (2009). The EUCS variables were taken from a scale validated in a previous study (Doll and Torkzadeh, 1988). Finally, radical innovation was measured with the scale by Gatignon et al. (2002).

To assess convergent validity, we used the normed fit index, the value of which must be above 0.9 (Ahire et al., 1996). All factorial loadings were above 0.4 (Hair et al., 1999) and their associated t-values were greater than 1.96 (Anderson and Gerbing, 1988). Both the NFI and the factorial loadings suggest a high level of convergent validity for all the constructs.

For discriminant validity to exist, AVE must be greater than the square of the construct correlations, suggesting that each construct relates more strongly to its own measures than to others (Table 2).

INSERT TABLE 1 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

INSERT FIGURE 2 ABOUT HERE

INSERT FIGURE 3 ABOUT HERE

5.2. Testing the research hypotheses

The results of the direct effect model confirm that a significant relationship exists between EUCS and radical innovation. The value of the structural parameter corresponding to the influence of EUCS on radical innovation is statistically significant ($\alpha = 0.181$), which allows us to continue with the analysis, and hence estimate the mediated model (Hypothesis 3).

The mediated model shows a good fit (Figure 5). As can be seen in Table 3, the mediation model explains more variance than the direct effect model (0.201 vs. 0.127). In addition, the significant relationship between EUCS and radical innovation ($\alpha = 0.181$) in the direct effect model decreases considerably when it includes the mediating effect of OLC, becoming non-

significant (β1 = 0.027). Additionally, there is a significant relationship between EUCS and OLC (β2 = 0.473), and between OLC and radical innovation (β3 = 0.368), which confirms the mediating role, as predicted by Hypothesis 3.

The estimated indirect effect of EUCS on radical innovation is 0.174. The 95% bias-corrected confidence intervals for the indirect effect are between 0.082 and 0.301, with a p-value of 0.001 for the two-tailed significance test. Hence, the standardized indirect effect of EUCS on radical innovation is significantly different from zero at the 0.05 level, and we can reject the null hypothesis of no mediation effect.

These four points, together with the bootstrap analysis, provide evidence to support our hypotheses.

INSERT TABLE 3 ABOUT HERE

INSERT FIGURE 4 ABOUT HERE

INSERT FIGURE 5 ABOUT HERE

---

6. Conclusions

The present research contributes to extend the knowledge about alternative organizational factors that promote radical innovation, by showing the positive effect of EUCS and OLC on radical innovation. Results confirm the model and all the hypotheses proposed. Conclusions have significant implications for the EUCS literature, as well as the literature on OLC and radical innovation.

EUCS has a positive effect on OLC. As stressed in previous research, information quality boosts organizational learning, and the characteristics that define successful information systems promote experimentation, participative decision-making, risk-taking, dialogue, and interaction with the environment. Previous research has shown the importance of OLC to satisfy ERP users (Lapiedra et al., 2011), although it has overlooked the opposite effect. The present study goes a step further by uncovering the importance of EUCS to promote contexts that facilitate learning. Additionally, there is empirical evidence that OLC fosters radical innovation. This result is consistent with some previous studies that relate OLC to innovation (e.g., Alegre and Chiva, 2013; Baker and Sinkula, 2007). Finally, results show that OLC fully mediates the relationship between EUCS and radical innovation. Moreover, this study contributes to the radical innovation literature by offering a better understanding of the factors that trigger this type of innovation.

The present study has practical implications. The results obtained suggest ideas that can be used by those firms that want to develop an organizational context to encourage radical innovation. Organizations usually make major investments to implement the latest advances in information systems. Nonetheless, the results of the present study emphasize the importance of the human element within organizations. Although quality information systems are crucial to develop radical innovation, human resources play an important role in using them, by retrieving information, creating new knowledge and disseminating it, discussing and sharing ideas, inquiring, rethinking current patterns, etc. The management of this internal context is often ignored when implementing an information system (Lapiedra et al., 2011), so a relevant finding of the present study is the importance of facilitating a context to ensure learning. Organizations must prioritize mechanisms that promote experimentation, dialogue, participative decision-making, interaction with the external environment, and risk-taking.

Despite the results of the present research, certain limitations should be noted. Because this research was focused on a particular population of Spanish organizations, our results are limited to this type of organization. In addition, this group of organizations was heterogeneous and included different types of firms in terms of size, sector, age, and market share, which can influence their tendency to innovate. Previous research has highlighted the positive effect of these variables on innovation (e.g., Chandy and Tellis, 2000; Sorescu et al., 2003). However, the results of the present study showed that the effect of these control variables on radical

innovation were non-significant, except in the case of market share. Our data showed that there is a positive link between market share and the development of radical innovations. Processes related to organizational learning and innovation may differ between industries, so future research should focus on companies from the same sector. In addition, as organizational size may influence innovation, future research could focus on a homogeneous sample in terms of size. Finally, distinguishing between start-ups and incumbent companies might clarify the influence of organizational age on the variables that have been studied. Moreover, taking into account the indicators of the European Innovation Scoreboard (2017), future studies should be conducted in other countries. The methodological approach could be quantitative or qualitative. While the former could be used to confirm our results, the latter could contribute to deepen our understanding of the underlying mechanisms that lead to innovation.

Future research should include incremental innovation in order to determine whether the results can be extrapolated to other types of innovation or are limited to radical innovation. In addition, this research did not differentiate between product, service or process innovation. Taking into account that these innovations present specific features, future studies should distinguish between these types of innovation and consider the different phases of the innovation process (idea generation, idea promotion, idea realization, and implementation stages). In addition, a combination of objective (number of new products) and subjective measures of innovation would also be advisable. Moreover, it would be interesting to study the influence of EUCS and OLC on other variables related to innovation such as innovation success, firm innovativeness, administrative innovation, marketing innovation, etc., along with their effect on organizational performance.

Although EUCS was used to measure the success of the information system in an organization, there is an ongoing debate regarding the best method to measure the impact of information systems in organizations (Abugabah et al., 2009). For this reason, future studies should use other measures that may evaluate the quality of the information systems, such as DeLone and McLean (2003), Van der Heijden (2004), and so forth.

The survey only uses single informants. Although using single informants is the primary research design in most studies, multiple informants would enhance the validity of the research findings. The study provides evidence of causality but cannot prove it by using cross-sectional data. Future research should attempt to overcome this limitation by using longitudinal data to evaluate the long-term effect of EUCs and OLC. The present research was focused on OLC as

an intermediate variable between EUCS and radical innovation. It might be worthwhile incorporating into the model some types of learning, such as generative learning (Chiva et al., 2010), market-focused learning, internally focused learning or relationally focused learning (Weerawardena et al., 2006), due to their potential to influence innovation. Future research should rectify and improve all the limitations detected in the present study.

7. References

Abugabah, A., Sanzogni, L., & Poropat, A. (2009). The impact of information systems on user performance: A critical review and theoretical model. *World Academy of Science, Engineering and Technology*, pp. 809-819.

Aggelidis, V. P., & Chatzoglou, P. D. (2012). "Hospital information systems: Measuring end user computing satisfaction (EUCS)". *Journal of biomedical informatics*, Vol. *45* No.3, pp. 566-579.

Ahire, S. L., Golhar, D. Y., & Waller, M.A. 1996. Development and validation of TQM implementation constructs. *Decision Sciences*, 27(1): 23-56.

Alegre, J., Chiva, R., & Lapiedra, R. (2005). A literature-based innovation output analysis: implications for innovation capacity. *International Journal of Innovation Management*, Vol. 9 No. 04, pp. 385-399.

Alegre, J., & Chiva, R. (2008). "Assessing the impact of organizational learning capability on product innovation performance: An empirical test".*Technovation*,Vol.*28 No.*6, pp. 315-326.

Anderson, J. C., & Gerbing, D. W. (1988). "Structural equation modeling in practice: A review and recommended two-step approach". *Psychological bulletin*, Vol. *103*No.3, 411-423.

Baker, W. E., & Sinkula, J. M. (2007). "Does market orientation facilitate balanced innovation programs? An organizational learning perspective". *Journal of Product Innovation Management*, Vol. 24 No.4, pp. 316-334.

Baron, R. M., & Kenny, D. A. (1986). “The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations”. *Journal of personality and social psychology*, Vol. 51 No.6, pp. 1173-1182.

Bendoly, E., Bharadwaj, A., & Bharadwaj, S. (2012). “Complementary Drivers of New Product Development Performance: Cross‐Functional Coordination, Information System Capability, and Intelligence Quality”. *Production and Operations Management*, Vol. 21 No. 4, 653-667.

Berends, H., Vanhaverbeke, W., & Kirschbaum, R. (2007). Knowledge management challenges in new business development: Case study observations. *Journal of Engineering and Technology Management*, Vol. 24 No. 4, pp. 314-328.

Bharati, P., & Chaudhury, A. (2004). “An empirical investigation of decision-making satisfaction in web-based decision support systems”. *Decision support systems*, Vol. 37 No. 2, pp. 187-197.

Blank, T. H., & Naveh, E. (2014). “Do quality and innovation compete against or complement each other? The moderating role of an information exchange climate”. *The Quality Management Journal*, Vol. *21* No. 2, pp. 6-16.

Blazevic, V., & Lievens, A. (2004). “Learning during the new financial service innovation process: antecedents and performance effects”. *Journal of business research*, Vol. *57 No.* 4, pp. 374-391.

Bokhari, R. H. (2005). “The relationship between system usage and user satisfaction: a meta-analysis”. *Journal of Enterprise Information Management*, Vol. *18 No.* 2, pp. 211-234.

Burcharth, A. L. L., Lettl, C., & Ulhøi, J. P. (2015). “Extending organizational antecedents of absorptive capacity: Organizational characteristics that encourage experimentation”. *Technological Forecasting and Social Change*, Vol. *90*, pp. 269-284.

Büschgens, T., Bausch, A., & Balkin, D. B. (2013). "Organizing for radical innovation—A multi-level behavioral approach". *The Journal of High Technology Management Research*, Vol. *24* No. 2, pp. 138-152.

Chandy, R. K., & Tellis, G. J. (1998). "Organizing for radical product innovation: The overlooked role of willingness to cannibalize". *Journal of marketing research*, Vol. 35 No. 4, pp. 474-487.

Chandy, R. K., & Tellis, G. J. (2000). "The incumbent's curse? Incumbency, size, and radical product innovation". *Journal of marketing*, Vol. 64 No. 3, pp. 1-17

Chang, S. J., Van Witteloostuijn, A., & Eden, L. (2010). "From the editors: common method variance in international business research". *Journal of International Business Studies*, Vol. 41 No. 2, 178-184.

Chang, Y. C., Chang, H. T., Chi, H. R., Chen, M. H., & Deng, L. L. (2012). "How do established firms improve radical innovation performance? The organizational capabilities view". *Technovation*, Vol. 32 No.7, pp. 441-451.

Chiva, R., Alegre, J., & Lapiedra, R. (2007). "Measuring organisational learning capability among the workforce". *International Journal of Manpower*, Vol. 28 No. 3/4, pp. 224-242.

Chiva, R., & Alegre, J. (2009). "Organizational Learning Capability and Job Satisfaction: an Empirical Assessment in the Ceramic Tile Industry". *British Journal of Management*, Vol. *2 No.* 3, pp. 323-340.

Chiva, R., Grandío, A., & Alegre, J. (2010). "Adaptive and generative learning: Implications from complexity theories". *International Journal of Management Reviews*, Vol. *12 No.* 2, pp. 114-129.

Chiva, R., Ghauri, P., & Alegre, J. (2014). Organizational learning, innovation and internationalization: A complex system model. British Journal of Management, Vol. 25 No. 4, pp. 687-705.

Datta, A., & Jessup, L. M. (2013). "Looking beyond the focal industry and existing technologies for radical innovations". *Technovation*, Vol. *33 No.*10, pp. 355-367.

Delone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: a ten-year update. *Journal of management information systems*, Vol. 19 No 4, pp. 9-30.

Dewar, R. D., & Dutton, J. E. (1986). "The adoption of radical and incremental innovations: an empirical analysis". *Management science*, Vol.*32 No.*11, pp. 1422-1433.

Dewett, T., & Jones, G. R. (2001). "The role of information technology in the organization: a review, model, and assessment". *Journal of management*, Vol. *27 No.*3, pp. 313-346.

Doll, W. J., & Torkzadeh, G. (1988). "The measurement of end-user computing satisfaction". *MIS quarterly*, Vol. 12 No.2, pp.259-274.

European Innovation Scoreboard (2017). Available at: http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_es (accessed 14 august 2017)

Gatignon, H., Tushman, M. L., Smith, W., & Anderson, P. (2002). "A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics". *Management Science*, Vol. *48 No.* 9, pp. 1103-1122.

Ghobakhloo, M., & Tang, S. H. (2015). Information system success among manufacturing SMEs: case of developing countries. Information Technology for Development, Vol. 21 No.4, pp. 573-600.

Govindarajulu, C., & Arinze, B. (2008). "End User Types: An Instrument to Clarify Users Based on the User Cube". *Journal of Organizational and End User Computing (JOEUC)*, Vol. *20 No.* 2, pp. 61-81.

Hair, H. F., Anderson, R. E., Tatham, R. L., & Black, W.C. (1999). "*Multivariate data analysis"*. 5th Edition. London: Prentice Hall.

Herrmann, A., Gassmann, O., & Eisert, U. (2007). “An empirical study of the antecedents for radical product innovations and capabilities for transformation”. *Journal of Engineering and Technology Management*, Vol. *24 No.*1, pp. 92-120.

Hurley, R. F., & Hult, G. T. M. (1998). “Innovation, market orientation, and organizational learning: an integration and empirical examination”. *The Journal of Marketing*, Vol. 62 No. 3, pp. 42-54.

Jha, A. K., & Bose, I. (2016). Innovation research in information systems: A commentary on contemporary trends and issues. Information & Management, Vol. 53 No.3, pp. 297-306.

Jerez‐Gómez, P., Céspedes‐Lorente, J., & 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.

Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). « Innovation, organizational learning, and performance”. *Journal of Business Research*, Vol. *64 No.*4, pp. 408-417.

Lapiedra, R., Alegre, J., & Chiva, R. (2011). The importance of management innovation and consultant services on ERP implementation success. *The Service Industries Journal*, Vol. 31 No.12, pp. 1907-1919.

Lee, G., & Xia, W. (2011). “A longitudinal experimental study on the interaction effects of persuasion quality, user training, and first-hand use on user perceptions of new information technology”. *Information & management*, Vol.*48 No.*7, pp. 288-295.

Liao, S. H., & Wu, C. C. (2010). “System perspective of knowledge management, organizational learning, and organizational innovation”. *Expert Systems with Applications*, Vol. *37 No.* 2, pp. 1096-1103.

Lim, K. S., Lim, J. S., & Heinrichs, J. H. (2008). “Validating an End-User Computing Satisfaction Instrument: a confirmatory factor analysis approach using international

data". *Journal of International Technology and Information Management*, Vol. *17 No.* 2, pp. 153-166.

López-Cabrales, A., Medina, C. C., Lavado, A. C., & Cabrera, R. V. (2008). "Managing functional diversity, risk taking and incentives for teams to achieve radical innovations."*R&d Management*, Vol. *38 No.*1, pp. 35-50.

MacKinnon, D. P., Coxe, S., & Baraldi, A. N. (2012). "Guidelines for the Investigation of Mediating Variables in Business Research". *Journal of Business and Psychology*, Vol. 27, pp. 1-14.

Mallén, F., Chiva, R., Alegre, J., & Guinot, J. (2015). Are altruistic leaders worthy? The role of organizational learning capability. *International Journal of manpower*, Vol. 36 No. 3, pp. 271-295.

McDermott, C. M., & O'Connor, G. C. (2002). "Managing radical innovation: an overview of emergent strategy issues". *Journal of product innovation management*, Vol. *19 No.*6, pp. 424-438.

McGill, M. E., & Slocum, J. W. (1993). "Unlearning the organization". *Organizational dynamics*, Vol.*22 No.*2, pp. 67-79.

Miller, L., Miller, R., & Dismukes, J. (2005). "The critical role of information and information technology in future accelerated radical innovation". *Information Knowledge Systems Management*, Vol.*5 No.*2, pp. 63-99.

Nunnally, J. C. (1978). "*Psychometric Theory"*. New York: McGraw-Hill

O'Connor, G. C., & McDermott, C. M. (2004). "The human side of radical innovation". *Journal of Engineering and Technology Management*, Vol. *21 No.* 1, pp. 11-30.

O'Malley, L., O'Dwyer, M., McNally, R. C., & Murphy, S. (2014). "Identity, collaboration and radical innovation: The role of dual organization identification".*Industrial Marketing Management*, Vol.*43 No.*8, pp. 1335-1342.

Podsakoff, P. M., & Organ, D. W. (1986). “Self-reports in organizational research: Problems and prospects”. *Journal of management,* Vol. *12 No.*4, pp. 531-544.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & 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. 879-903

Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. (2014). “How information-sharing values influence the use of information systems: An investigation in the business intelligence systems context”. *The Journal of Strategic Information Systems,* Vol.*23* No.4, pp. 270-283.

Popper, M., & Lipshitz, R. (2000). “Organizational learning mechanisms, culture, and feasibility”. *Management learning,* Vol.*31 No.*2, pp. 181-196.

Roses, L. K. (2011). “Antecedents of end-user satisfaction with an erp system in a transnational bank: evaluation of user satisfaction with information systems”. *JISTEM-Journal of Information Systems and Technology Management*, Vol. *8 No.*2, pp. 389-406.

Sainio, L. M., Ritala, P., & Hurmelinna-Laukkanen, P. (2012).”Constituents of radical innovation—exploring the role of strategic orientations and market uncertainty”. *Technovation,* Vol. *32* No.11, pp. 591-599.

Santos-Vijande, M. L., López-Sánchez, J. Á., & Trespalacios, J. A. (2012). “How organizational learning affects a firm's flexibility, competitive strategy, and performance”. *Journal of Business Research,* Vol. *65 No.*8, pp. 1079-1089.

Simons, R., Dávila, A., & Kaplan, R. S., (2000). “Performance measurement & control systems for implementing strategy”. Upper Saddle River, NJ: Prentice Hall.

Slater, S. F., Mohr, J. J., & Sengupta, S. (2014). “Radical product innovation capability: Literature review, synthesis, and illustrative research propositions”. *Journal of Product Innovation Management,* Vol. *31* No.3, pp. 552-566.

Somers, T. M., Nelson, K., & Karimi, J. (2003). Confirmatory Factor Analysis of the End‐User Computing Satisfaction Instrument: Replication within an ERP Domain*. *Decision Sciences*, Vol.*34 No.*3, pp. 595-621

Sorescu, A. B., Chandy, R. K., & Prabhu, J. C. (2003). "Sources and financial consequences of radical innovation: Insights from pharmaceuticals". *Journal of Marketing*, Vol. *67 No.*4, pp. 82-102.

Subramaniam, M., & Youndt, M. A. (2005). "The influence of intellectual capital on the types of innovative capabilities". *Academy of Management Journal*, Vol.*48 No.*3, pp. 450-463.

Tseng, S. M. (2008). "The effects of information technology on knowledge management systems. Expert systems with applications", Vol.35 No.1, pp. 150-160.

Van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS quarterly*, Vol. 28, No. 4, 695-704.

Yang, K. P., Chou, C., & Chiu, Y. J. (2014). "How unlearning affects radical innovation: The dynamics of social capital and slack resources". *Technological Forecasting and Social Change*, Vol.87, pp. 152-163.

Yang, M. L., Wang, A. M. L., & Cheng, K. C. (2009). "The impact of quality of IS information and budget slack on innovation performance". Technovation, Vol.29 No.8, pp. 527-536.

Zhao, J., Li, Y., & Liu, Y. (2016). Organizational Learning, Managerial Ties, and Radical Innovation: Evidence From an Emerging Economy. IEEE Transactions on Engineering Management, Vol. 63 No.4, pp. 489-499.

Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: Knowledge base, market knowledge acquisition, and internal knowledge sharing. *Strategic Management Journal*, Vol. 33 No. 9, pp. 1090-1102.