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Social web knowledge sharing and innovation performance in knowledge-intensive manufacturing SMEs

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Abstract This paper develops an integrative research model to assess the effect of different factors on social web knowledge sharing and its effect on innovation performance in manufacturing small and medium-sized enterprises (SMEs). In addition, this study analyzes whether social web knowledge sharing may be a mediator in the relationship between human resource (HR) practices and innovation performance. The proposed research model and its associated hypotheses were tested by using partial least squares structural equation modeling on a dataset of manufacturing SMEs. This study contributes to research seeking to understand the factors affecting social web knowledge sharing by demonstrating that technological and organizational factors have greater impact than environmental factors on social web knowledge sharing. It also contributes to research by exploring the indirect effects of the social influence of HR practices on organizational innovation performance by offering evidence on the mediating effect of social web knowledge sharing in the relationship between HR practices and organizational innovation performance in manufacturing SMEs.

Keywords Social web · Social media · Knowledge management · Technology · Innovation performance · SMEs

JEL Classification M15 · O31

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1 Introduction

The term social web was originally coined in the wake of the "dot com bust" to distinguish static websites in which individuals were only recipients of information, from interactive and dynamic sites in which they collaborate and share information. The social web was initially identified to distinguish between traditional static web sites and interactive web platforms or online social networks, where users exchange information and reconfigure existing knowledge simultaneously (Palacios-Marqués et al. 2015a; Xin et al. 2014). Recently, the term Knowledge Management (KM) 2.0 has been coined as the acquisition, creation and sharing of collective intelligence through online social networks and communities of knowledge (Sigala and Chalkiti 2014). The social web constitutes an Internet-based digital platform that enables the creation of social networks, facilitating information dissemination and knowledge sharing (Joo and Normatov 2013; Pan 2012). Consequently, firms are deploying social web technologies such as social networking, wikis, and internal blogging to improve collaboration and social web knowledge sharing within their boundaries (Lim et al. 2010; Soto-Acosta et al. 2014a, b). In addition, although the literature suggests that findings from studies examining KM practices in large companies are unlikely to be generalizable to small and medium-sized enterprises (SMEs), very few and recent studies focus on this specific type of firms (Chan et al. 2012; Huy et al. 2012; Lopez-Nicolas and Soto-Acosta 2010; Palacios-Marqués et al. 2015b; Xin et al. 2014), with even less existing research focusing on KM practices in manufacturing SMEs. Meanwhile, manufacturing SMEs are of key importance for economic growth, employment and wealth creation, representing over 80 % of the total number of firms within the manufacturing industry and accounting for around 60 % of the employment in Europe (Jardim-Goncalves et al. 2012; Snieska and Valodkiene 2015; Soto-Acosta et al. 2015).

Existing investigations have demonstrated that, although firms have extensively adopted Internet technologies, technology use is an important link to business value and that such link is sometimes limited especially in SMEs (Devaraj and Kholi 2003; Zhu and Kraemer 2005). In this sense, studies in SMEs suggest that, although having a proper information technology (IT) infrastructure can facilitate knowledge creation, it does not necessarily mean that knowledge is created (Cegarra-Navarro et al. 2016; Lopez-Nicolas and Soto-Acosta 2010; Popa et al. 2016). Thus, implementing IT applications, by itself, is not enough to ensure a better outcome in terms of knowledge sharing, since interaction between employees has to occur. Knowledge will not necessarily circulate freely firm-wide just because accurate IT to support such circulation is available (Brown and Duguid 2000).

Innovation is recognized as a key driver to improve the position of a country and its industries in global markets, since a country with reputable innovation can attract foreign investment and compete globally (Rosenzweig, 2016). Literature suggests that knowledge is precursor of innovation through organizational learning (Del Giudice and Della Peruta, 2016; Lopez-Nicolas and Soto-Acosta 2010; Nonaka and Takeuchi 1995; Templeton et al. 2002). Although there is research that has analyzed the relationship between KM and innovation (Darroch 2005; López-Nicolás and Meroño-Cerdán 2011), little is known about whether and how different factors promote or hinder social web knowledge sharing and the different effects of social web knowledge sharing on innovation performance in manufacturing SMEs. To delve into these questions, grounded in the Technology-Organization-Environment (TOE) theory, this paper develops an integrative conceptual model to assess the effect of different factors on social web knowledge sharing and its effect on innovation performance in manufacturing SMEs. Moreover, this study analyzes whether social web

knowledge sharing may be a mediator in the relationship between human resource (HR) practices and innovation performance, when employees are motivated to work together and share knowledge. With this aim in mind, the rest of our study is organized as follows. Next, the literature review and hypotheses are presented. Following that, the research methods drawing from a sample of 175 manufacturing SMEs are described. Then, data analysis and results are examined and, finally, conclusions, limitations and future research guidelines are presented.

2 Theoretical background and hypotheses

2.1 Factors affecting social web knowledge sharing

The TOE theory conceptualizes the context of adoption and implementation of technological innovations as consisting of three aspects: technological context, organizational context and environmental context (Tornatzky and Fleischer 1990). The technological context refers to the characteristics of the technological innovation, the organizational context describes characteristics of the organizations, and the environmental context implies characteristics of the environment in which the adopting organizations operate (Tornatzky and Fleischer 1990; Thong 1999). This framework has been considered in the literature as one of the main theoretical frameworks to analyze factors which affect the adoption and use of different ITs including: electronic business (e.g. Bordonaba-Juste et al. 2012; Xu et al. 2004), electronic collaboration (Chan et al. 2012), mobile commerce (San Martín et al. 2012), enterprise resource planning (Zhu et al. 2010), electronic data interchange (Kuan and Chau 2001), and information and open systems (e.g. Chau and Tam 1997; Thong 1999). Also, recent studies specific to the adoption and use of Internet technologies have employed this theoretical approach (Bordonaba-Juste et al. 2012; Chan et al. 2012; Gu et al. 2012; San Martín et al. 2012, Soto-Acosta et al. 2014a, b). Thus, drawing upon literature analyzing Internet technologies adoption/use and the TOE theory, this paper proposes several hypotheses to investigate factors that influence social web knowledge sharing and its effect on innovation performance in manufacturing SMEs.

Social web knowledge sharing is expected to be influenced by firms' technology, since IT plays a pivotal role to support KM processes. As a result, Information Systems (IS) integration has been found significant in studies using the TOE framework (e.g. Zhu et al. 2006; Zhu and Kraemer 2005). IS integration is conceptualized as front-end integration and back-end IT integration (Zhu et al. 2004). IS integration may influence social web knowledge sharing, since it enables efficient communication and collaboration through different IS and electronic devices. Therefore, IS integration may be an important technological issue to explain the extent of knowledge sharing through social networking tools in organizations. In addition, the TOE framework has long discussed the importance of organizational factors in influencing Internet-based technologies adoption and use (Gu et al. 2012). Technology enablers are a necessary, but not a sufficient condition, for employees to collaborate and share knowledge (Colomo-Palacios et al. 2011, 2014; Soto-Acosta et al. 2010a). That is, although it is essential to develop interaction networks that allow individuals not only to access the same information but also to come together and collaborate through the network, knowledge creation and acquisition rarely occurs if individuals do not interact (Lucio-Nieto et al. 2012; Alavi and Leidner 2001). Thus, promoting a positive working environment may be crucial to motivate employees to work

together and share knowledge (Valkokari et al. 2012). This is even more crucial when sharing tacit knowledge, which requires more interaction between employees (Del Giudice et al. 2015; Fox 2000). The literature distinguishes between transaction-based HR practices, which concentrate on individual short-term exchange relationships, and commitment-based HR practices, which draw their attention to mutual long-term exchange relationships, suggesting that the latter may contribute to a positive working environment (Tsui et al. 1997). As a consequence, Collis and Smith (2006) found that commitment-based HR practices are positively related to knowledge exchange among workers. Based on this discussion, the following hypotheses are proposed:

Hypothesis 1 IS integration is positively related to social web knowledge sharing.

Hypothesis 2 Commitment-based HR practices are positively related to social web knowledge sharing.

Furthermore, the TOE framework considers that the environmental context influences the adoption and implementation of technological innovations. According to Thong (1999), competition is determined by the business environment in which a company operates. Early studies on technology diffusion found that competition increases firms' incentives to adopt new technologies so as to remain competitive (Thong 1999). Competition intensity has been encountered to be a driver of Internet technologies adoption (Wang et al. 2010; Zhu et al. 2003, 2006). However, there is also investigation (e.g. Chan et al. 2012; Zhu et al. 2006) showing that competition may deter firms from using Internet technologies and, thus, challenging the traditional wisdom about competition and technology use in large and small businesses. Chan et al. (2012) and Zhu et al. (2006) found a positive relationship between competition and Internet technologies adoption, but a negative relationship between competition and the extent of Internet technologies use. Thus, Internet technologies use is less tied to competition intensity than initially thought in both large and small businesses. Too much competitive pressure lead firms to change rapidly form one technology to another without sufficient time to infuse the technology into the company (Soto-Acosta et al. 2016; Zhu et al. 2006). Thus, although competition encourage technology adoption, it is not necessarily good for technology use. According to the Porter's (1985) five forces competition comes mostly from horizontal competition: threat of substitute products; threat of existing rivals; and threat of new entrants. Thus, the following hypothesis is proposed:

Hypothesis 3 Horizontal competition is negatively related to social web knowledge sharing.

2.2 Social web knowledge sharing and innovation performance: direct and mediated associations

Knowledge has been recognized as the main driver of new products, services and processes (Choy et al. 2006; Lopez-Cabrales et al. 2009; Vila et al. 2015). However, the literature suggests that the ability to create new knowledge, which enables firms to innovate especially in dynamic environments, comes mostly from the collective ability of employees to share and combine knowledge (Del Giudice et al. 2013; Nahapiet and Ghoshal 1998). In this sense, there are a number of studies that suggest that knowledge sharing is an antecedent of innovation. For instance, Capon et al. (1992) found that encouraging scientific discussions enhances the firm ability to innovate. Other studies link knowledge sharing and

innovation to inter-functional coordination and the use of networks (Darroch 2005). Thus, since innovation largely depends on tacit knowledge, knowledge sharing is a major requisite for innovation (Del Giudice and Della Peruta 2016; Nonaka 1994).

Collaborative technologies and virtual spaces, where participants can share knowledge and information in real time, have been found to be positively related to innovation in SMEs (Meroño-Cerdan et al. 2008a, b). Similarly, social web technologies can be used to distribute and share individual experience and innovation throughout the organization and offer the chance of applying knowledge for the creation of new products and/or services or processes. These technologies facilitate the execution of the innovation process with users and partners from remote places. Thus, the benefits from social web knowledge sharing, which include efficient information and knowledge sharing as well as working with no distance limitations, are expected to be positively related to innovation.

Social exchange theory argues that employees balance their level of commitment with the company's level of commitment to them (Wayne et al. 1997). Based on this, Eisenberger et al. (2001) suggested that employees contribute to firm success in response to the rewards or care they receive from the organization. Commitment-based HR practices may be considered as kind of group incentives (Park and Kim 2013; Peterson and Luthans 2006). However, recent research found that HR practices are not directly related to innovation unless they into consideration employees' knowledge (Lopez-Cabrales et al. 2009). Group-incentive improves employees' attitude toward organizational communication (Hanlon and Taylor 1991). Thus, commitment-based HR practices may affect innovation positively through social web knowledge sharing. In other words, commitment-based HR practices are expected to motivate employees to work together and share knowledge through social networks, such strong climate for cooperation and knowledge sharing is expected to contribute to innovation performance. Thus, the following hypotheses are suggested:

Hypothesis 4 Social web knowledge sharing is positively related to innovation performance.

Hypothesis 5 Social web knowledge sharing mediates the relationship between Commitment-based HR practices and innovation performance.

The set of relationships is illustrated in Fig. 1.

3 Research methodology

3.1 Data collection and sample

The target population of our study are manufacturing SMEs from Spain. Nonetheless, to ensure a minimum firm complexity in which ITs may be relevant, only firms with at least 15 employees were used. This is in line with previous research in the Spanish context (e.g., Meroño-Cerdan et al. 2008a, b), which suggested that using IT is crucial for firms with at least 10 and over. Thus, the population was the set of all Spanish enterprises, with at least 15 employees, located in the South-east of the country whose primary business activity is manufacturing. A total of 1291 were identified for participation. Data collection was conducted in two phases: a pilot study and a questionnaire. First, five SMEs were randomly selected from a database to pretest the questionnaires. Based on the responses and subsequent interviews with participants in the pilot study, minor modifications were made to

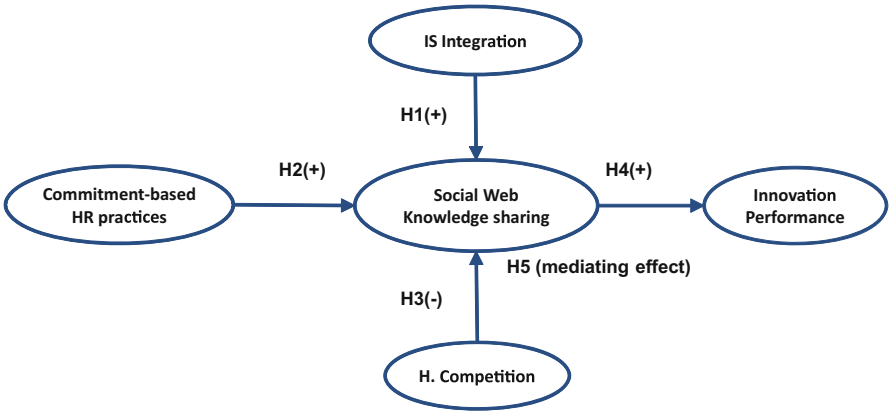

Fig. 1 Research model

the questionnaire for the next phase of data collection. Responses from these five pilot-study firms were not included in the final sample. Second, the survey was administered in face-to-face interviews with to the CEO of the companies and the unit of analysis for this study was the company. In total, 175 valid questionnaires were obtained, yielding a response rate of 13.55 percent. Finally, the dataset was checked for potential bias in terms of non-response by comparing the characteristics of early and late participants in the sample. These comparisons did not reveal significant differences in terms of general characteristic and model variables, suggesting that non-response did not cause any survey bias.

3.2 Measures

Measurement items were introduced on the basis of a comprehensive literature review. Constructs and associated indicators in the measurement model are listed in the Appendix and discussed below. To facilitate cumulative research, operationalizations tested by previous studies were used. Scales were measured on a 5-point Likert scale with anchors from strongly disagree (1) to strongly agree (5).

All the variables were operationalized as multi-item constructs. *IS integration* assessed the extent to which internal information systems and databases are connected, and the extent to which company IS are linked to business partners' databases and systems. Items for IS integration are based on Zhu et al. (2006). *Commitment-based HR practices* were operationalized based on Collins and Smith (2006), Delery and Doty (1996) and Youndt et al. (1996). Overall, 7 items were adapted to measure Commitment-based HR practices as a second-order single consisting of two dimensions: Training support and employees interest (CHRP1) and career plans and evaluation reporting (CHRP2). *Social web knowledge sharing* measured the extent of use of social web technologies for sharing collective knowledge between employees. Social web knowledge sharing scale is based on Meroño-Cerdan et al. (2008a, b), Meroño-Cerdan and Soto-Acosta (2005, 2007) and Soto-Acosta and Meroño-Cerdan (2006). *Innovation performance* was measured following the definition of the overall innovation performance of the firm by the OSLO manual (OECD

2005) and items in previous studies (López-Nicolás and Meroño-Cerdán 2011; Soto-Acosta et al. 2015) and represents the implementation of a new or significantly improved product (good or service), or process, organizational practice, or marketing method. *Horizontal Competition* was measured as a formative construct following the three concepts of Porter's (1985) horizontal competition: threat of substitute products, threat of existing rivals, and threat of new entrants. Such operationalization has been previously used as well in the IT literature (Thong 1999; Zhu et al. 2004).

3.3 Instrument validation

We used Structural Equation Modelling (SEM) for measurement validation and testing the structural model. SEM is particularly useful for testing complex models and when researchers need to incorporate latent variables. More specifically, we opted to use SEM based on Partial Least Squares (PLS) approach because the variance-based PLS method is preferable to the covariance-based when research models incorporate both reflective and formative measures (Chin et al. 2003). The general rule of thumb regarding appropriate sample size when using PLS is to multiply by ten the number of indicators on the most complex construct or the largest number of paths leading to a dependent construct in the model. In the proposed model, the highest number of paths leading to a dependent variable is three, while the number of indicators on the most complex is seven (Barclay et al. 1995). Thus, according to this rule, the minimum sample size necessary would be 70. With 175 responses, the PLS analysis appears to have sufficient power.

The measures from the dataset were refined by assessing their unidimensionality and reliability. First, an initial exploration of unidimensionality was made using principal component factor analyses. In each analysis, eigenvalues were greater than 1, lending preliminary support to a claim of unidimensionality in the constructs. Next, we verified the reliability and validity of the measurement model (Barclay et al. 1995). Convergent validity of the scales is contingent on the fulfillment of three criteria (Fornell and Larcker 1981; Hair et al. 1998): (1) all indicator loadings should exceed 0.65 (2) Composite Reliabilities (CR) should exceed 0.8; and (3) the average variance extracted (AVE) for each construct should exceed 0.5. As shown in Table 1, all the indicator loadings are above the recommended threshold, the CR values range from 0.85 to 0.89, and the AVE ranges

Table 1 Descriptives statisticts and discriminant validity

Constructs	Av.	SD	Shared variance matrix					
			(1)	(2)	(3)	(4)	(5)	(6)
1. CHRP1	3.72	0.83	**0.62**					
2. CHRP2	3.43	0.94	0.09	**0.74**				
3. H. competition	4.19	0.64	0.11	0.12	na			
4. IS integration	2.70	1.20	0.00	0.17	0.05	**0.81**		
5. Innovation perf.	3.41	0.88	0.13	0.03	0.08	0.01	**0.66**	
6. Social web KS	3.27	1.02	0.02	0.19	0.07	0.26	0.08	**0.74**

Av. average score of all items included in the construct, *SD* standard deviation

na. variance extracted is not applicable to formative constructs; Diagonal values in bold represent the AVE; Shared variances are given in the lower triangle of the matrix

from 0.62 to 0.81. All three conditions for convergent validity thus hold. As presented in Table 2, discriminant validity holds for the model, since the AVE for each construct is greater than the shared variances between pairs of constructs (Fornell and Larcker 1981). Furthermore, the Cronbach's alpha values of all indicators should exceed the recommended value of 0.6 (Nunnally 1967) and all our measurement items noted in Table 1 exceed 0.6. Thus, overall measurement items have adequate item reliability.

Most researchers agree that common method variance is a potentially serious bias threat in behavioural research, especially with single informant surveys. Three procedures were used to empirically determine whether or not common method bias threatened the interpretation of our results. First, the Harman's one-factor test was used by entering all the indicators into a principal components factor analysis (Podsakoff and Organ 1986). With all indicators entered, no single factor accounted for threshold of 50 % variance, indicating no substantial common method bias. Second, a partial correlation method was used

Table 2 Reliability and convergent validity

Construct	Item loading[a]	t-statistic	Cronbach's Alpha	CR &AVE
CHRP1				
HR1	0.78	18.86	0.80	CR = 0.87 AVE = 0.62
HR2	0.84	27.79		
HR3	0.81	27.27		
HR4	0.72	14.40		
CHRP2				
HR5	0.79	15.95	0.82	CR = 0.89 AVE = 0.74
HR6	0.90	52.76		
HR7	0.88	37.40		
Competition[b]				
HC1	0.39	2.16	na	na
HC2	0.61	3.07		
HC3	0.46	1.98		
IS integration				
ISI1	0.88	34.19	0.77	CR = 0.89 AVE = 0.81
ISI2	0.92	61.47		
Innovation performance				
IP1	0.83	22.92	0.82	CR = 0.88 AVE = 0.66
IP2	0.77	15.92		
IP3	0.82	19.68		
IP4	0.82	19.28		
Social web K. Shar.				
SWKS1	0.78	15.09	0.82	CR = 0.89 AVE = 0.74
SWKS2	0.91	64.26		
SWKS3	1088	44.94		

na. Cronbach's alpha, CR and AVE are not applicable to formative constructs

CR composite reliability, *AVE* average variance extracted

[a] $p < 0.01$; [b] formative construct

(Podsakoff and Organ 1986). The highest factor from the principal component factor analysis was added to the Partial Least Square (PLS) model as a control variable on all dependent variables. According to Podsakoff and Organ, this factor is assumed to "contain the best approximation of the common method variance if is a general factor on which all variables load" (Podsakoff and Organ 1986: 536). This factor did not produce a significant change in variance explained in any of the dependent variables, again suggesting no substantial common method bias. Third, we checked for bivariate correlations between constructs and did not find extremely high correlations ($r > 0.90$) and, thus, this test confirmed no evidence of common method bias as well (Bagozzi et al. 1991). In summary, these tests suggested that common method bias is not a serious threat in our study.

4 Empirical results

Prior to the hypotheses testing, cross validation (CV)-communality and CV-redundancy indices assess the quality of the structural model. The mean of the CV-communality indices confirms the global quality of the structural model if the indices are positive for all the blocks, taking into account the measurement model as a whole. In addition, the CV-redundancy index offers a metric to evaluate the quality of each structural equation. This index should be positive for all endogenous constructs (Tenenhaus et al. 2008). For this study, since all the latent variables had positive values for CV-redundancy and CV-communality indexes, the model demonstrated adequate predictive validity and fit. After analyzing the quality of the structural equation, the next step is to test the relations between all constructs. Consistent with Chin (1998), bootstrapping (500 subsamples) generates standard errors and t-values. Figure 2 displays the results of hypotheses H1 to H4, showing the path coefficients along with their significance levels. The results of the statistical model offer support for H1, H2, and H4, and fail to corroborate H3. With regard to hypothesis H5, a variable may be considered a mediator to the extent to which it carries the influence of a given independent variable to a given dependent variable. We conducted three tests to examine the mediating effect of organizational innovation: the Sobel test, the Aroian test, and the Goodman test. Accoding to MacKinnon et al. (1995), the Sobel test and the Aroian

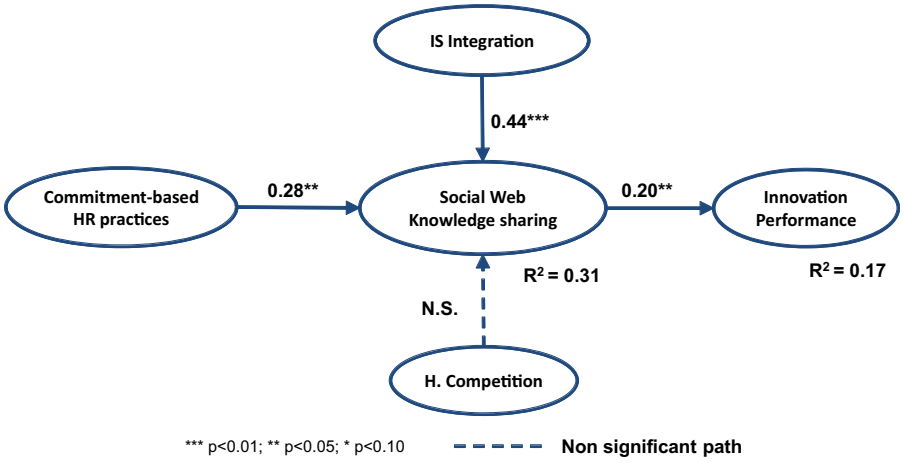

Fig. 2 Empirical results

test perform best with sample sizes greater than 50 or so. The three tests were all significant at the $p < 0.05$ level (Sobel test statistic: 2.42; Aroian test statistic: 2.40; Goodman test statistic: 2.45) and, thus, corroborating the mediating effect. Our finding supports a partial mediation effect of social web knowledge sharing between commitment-based HR practices and innovation performance since the effect of commitment-based HR practices on innovation performance shrinks upon the addition of social web knowledge sharing to the model. Thus, results offer partial support for hypothesis H5.

5 Discussion

This paper develops an integrative conceptual model, grounded in the TOE theory, to assess the effect of different factors on social web knowledge sharing and its effect on innovation performance in manufacturing SMEs. The empirical results have shown that factors have different effects on social web knowledge sharing. With regard to the technological context, results found that IS integration is positively associated with social web knowledge sharing. This first finding confirms existing research analyzing Internet technologies (e.g. Zhu et al. 2006; Zhu and Kraemer 2005), which found that technology integration is positively related to the extent of e-business use (Zhu et al. 2006) and positively associated to e-business value (Zhu and Kraemer 2005). However, the literature suggests that intangible IT resources are also important because every firm can purchase IT in the marketplace (Bharadwaj 2000; Colomo-Palacios et al. 2013; Soto-Acosta and Meroño-Cerdan 2008). Therefore, companies need integrated IS but also IT skills and capabilities to get the most from technology. Soto-Acosta et al. (2010b) found that intangible IT resources such as IT skills and IT training are critical determinants of how IT is deployed in the organization which, in turn, affect business value.

Regarding the organizational context, results showed a positive relationship between commitment-based HR practices and social web knowledge sharing. This finding supports previous studies (Collins and Smith 2006) which, though not focusing on Internet technologies, found that commitment-based HR practices were significantly related to knowledge exchange among workers, while, in addition, Gardner (2012) found that performance pressure undermines knowledge sharing. Thus, manufacturing SMEs should focus on commitment-based HR practices, rather than on transaction-based HR practices, in order to create a social climate which promotes social web knowledge sharing (Hernández-López et al. 2010). Results regarding factors from the environmental context suggest a non-significant relationship between horizontal competition and web knowledge sharing. This finding partially does not support recent research (Chan et al. 2012; Zhu et al. 2006), which found that competition may deter firms from using Internet technologies. Thus, although external competition has been found to positively affect Internet technologies adoption (Del Aguila-Obra and Padilla-Melendez 2008; Wang and Ahmed 2009) and negatively influence Internet technologies use (Zhu et al. 2004, 2006), horizontal competition does not seem to influence social web knowledge sharing in manufacturing SMEs. In addition, this finding demonstrates that social web knowledge sharing emerges from internal technological and organizational resources rather than from external pressure.

Furthermore, results suggest a positive relationship between social web knowledge sharing and innovation performance. These findings support previous research suggesting that knowledge sharing is an antecedent of innovation (e.g. Capon et al. 1992; Griffin and

Hauser 1996) as well as studies suggesting that Internet technologies uses (including knowledge sharing) are related to innovation (Meroño-Cerdan et al. 2008a, b). Therefore, although the literature suggests that innovation cannot be easily split into separate phases or stages and innovation do not neatly proceed in a linear fashion (Anderson et al. 2004), the characteristics of social web knowledge sharing make it suitable to enhance efficient information and knowledge sharing, which, in turn, leads to higher innovation outcomes. In addition, results support the mediating effect of social web knowledge sharing in the relationship between commitment-based HR practices and innovation performance. This finding confirms previous research which found that HR practices are not directly related to innovation unless they take into consideration employees' knowledge (Lopez-Cabrales et al. 2009). Thus, commitment-based HR practices are expected to motivate employees to work together and share knowledge through social networks, such strong climate for cooperation and knowledge sharing is expected to contribute to innovation performance. Thus, commitment-based HR practices are expected to motivate employees to work together and share knowledge through social networks and such strong climate for cooperation and knowledge sharing is expected to contribute, by extension, to innovation performance.

6 Conclusions, limitations and future research

The literature considers KM as a set of practices including: knowledge acquisition/creation, knowledge dissemination, and knowledge utilization (Darroch 2003; Jayasingam et al. 2013; Tiwana 2003). These practices share the use of knowledge as the crucial factor to add and generate value (Alavi and Leidner 2001; Pérez-López and Alegre 2012). However, to transfer or create knowledge, interaction of some kind has to take place between the actors. In this sense, knowledge sharing has been considered as essential to achieve the desired outcomes of KM practices (Valkokari et al. 2012). Thus, it is believed that organizations' survival and success depend on the effort and interactions of employees as they carry the skills and generate knowledge to transform new ideas into innovations. Today, firms are using social web technologies in order to enhance knowledge sharing and collaboration (Sigala and Chalkiti 2014). Thus, it is becoming essential for firms to assimilate social web technologies to support information and knowledge sharing within firms (Del Giudice and Maggioni 2014). Although previous studies have advanced our understanding of the subject, the literature tends to focus on large businesses, with very few studies analyzing SMEs and even less research focusing on manufacturing SMEs (Soto-Acosta et al. 2015). This study shed light on the factors that affect social web knowledge sharing and its effect on innovation performance in manufacturing SMEs. The study also investigates whether social web knowledge sharing mediates the relationship between HR practices and innovation performance. Results suggest that technological and organizational factors are the main drivers of social web knowledge sharing and that it mediates the relationship between HR practices and innovation performance. These findings suggest that firms must pay attention to different factors in order to enhance social web knowledge sharing and that IS integration together with commitment-based HR practices create a context that enhances social web knowledge sharing which, in turn, leads to new knowledge and innovation.

As any other research, ours suffers from some limitations which can be addressed in future research. First, the sample used was from Spain. It may be possible that the findings

could be extrapolated to other countries, since economic and technological development in Spain is similar to other OECD Member countries. However, in future research, a sampling frame that combines firms from different countries could be used in order to provide a more international perspective on the subject. Second, developing solid instruments in the IT literature is still an ongoing procedure of development, testing and refinement (Zhu et al. 2004, 2006). Although reliability and validity were empirically tested in our data set, further confirmatory studies are necessary to determine the external validity of the results. Third, this research takes a static, cross-sectional picture of contextual factors affecting social web knowledge sharing, which makes it difficult to address the issue of how contextual factors and their importance may change over years. A longitudinal study could enrich the findings. Fourth, innovation performance measures are subjective in the sense that they were based on Likert-scale responses provided by managers. Thus, it could also be interesting to include objective performance data for measuring this construct (Rosenzweig 2016). In addition, future research designs could consider different degrees of innovation (radical and incremental) as well as other forms of innovation such as open innovation (Della Peruta et al. 2016; Friesike et al. 2015). These suggestions should be taken into account in future studies to increase the validity of our findings.

Appendix: measures

Information systems integration
Extent to which internal enterprise information systems and databases are integrated (1–5)
Extent to which enterprise information systems and databases are integrated to that of business partners (clients, suppliers…) (1–5)
Commitment-based HR practices
Our selection system focuses on the potential of the candidate to learn and grow (1–5)
Internal candidates are considered over external candidates for job openings (1–5)
Selection processes are formalized and rigorous (1–5)
Our company provides career path opportunities (1–5)
Our company support employees willing to take further training (1–5)
Promotion is based on objective criteria (seniority, objectives) (1–5)
Performance appraisals are used to plan skill development and training (1–5)
Job rotation is used to expand the skills of employees and team building (1–5)
Horizontal competition
Threat of existing rivals (1–5)
Threat of substitute products (1–5)
Threat of new entrants (1–5)
Social web knowledge sharing
Extent to which the employees participate in organizational electronic discussion forums (1–5)
Extent to which social web technologies are used for building collective knowledge (1–5)
Extent to which the employees upload information on organizational social networks or wikis (1–5)
Innovation performance
The number of new or improved products (good or service) launched to the market over the last 3 years is above the average of your industry (1–5)
The number of new or improved processes over the last 3 years is above the average of your industry (1–5)

The number of new or improved management practices over the last 3 years is above the average of your industry (1–5)
The number of new or improved marketing methods over the last three years is above the average of your industry (1–5)

(1–5): five-point Likert-type scales; (#): continuous variable

References

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly, 25*(1), 107–136.

Anderson, N. R., De Dreu, C., & Nijstad, B. A. (2004). The routinization of innovation research: A constructively critical review of the state-of-the-science. *Journal of Organizational Behavior, 25*(2), 147–203.

Bagozzi, R. P., Yi, Y., & Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly, 36*(3), 421–458.

Barclay, D., Higgins, C., & Thompson, R. (1995). The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration. *Technology Studies, 2*(2), 285–309.

Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly, 24*(1), 169–196.

Bordonaba-Juste, V., Lucia-Palacios, L., & Polo-Redondo, Y. (2012). Antecedents and consequences of e-business use for European retailers. *Internet Research, 22*(5), 532–550.

Brown, J. S., & Duguid, P. (2000). Balancing act: How to capture knowledge without killing it. *Harvard Business Review, 78*(3), 73–80.

Capon, N., Farley, J. U., Hulbert, J., & Lehmann, D. R. (1992). Profiles of product innovators among large US manufacturers. *Management Science, 38*(2), 157–169.

Cegarra-Navarro, J.-G., Soto-Acosta, P., & Wensley, A. K. P. (2016). Structured knowledge processes and firm performance: The role of organizational agility. *Journal of Business Research, 69*(5), 1544–1549.

Chan, F. T. S., Chong, A. Y.-L., & Zhou, L. (2012). An empirical investigation of factors affecting e-collaboration diffusion in SMEs. *International Journal of Production Economics, 138*(2), 329–344.

Chau, P. Y. K., & Tam, K. Y. (1997). Factors affecting the adoption of open systems: An exploratory study. *MIS Quarterly, 21*(1), 1–25.

Chin, W. W. (1998). The partial least squares approach to structural equation modelling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Mahwah, NJ: Lawrence Erlbaum Associates Publisher.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modelling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic mail emotion/adoption study. *Information Systems Research, 14*(2), 189–217.

Choy, C. S., Yew, W. K., & Lin, B. (2006). Criteria for measuring KM performance outcomes in organisations. *Industrial Management & Data Systems, 106*(7), 917–936.

Collins, C. J., & Smith, K. G. (2006). Knowledge exchange and combination: The role of human resource practices in the performance of high-technology firms. *Academy of Management Journal, 49*(3), 544–560.

Colomo-Palacios, R., Casado-Lumbreras, C., Soto-Acosta, P., & García-Crespo, Á. (2011). Using the affect grid to measure emotions in software requirements engineering. *Journal of Universal Computer Science, 17*(9), 1281–1298.

Colomo-Palacios, R., Casado-Lumbreras, C., Soto-Acosta, P., & García-Crespo, Á. (2013). Decisions in software development projects management. An exploratory study. *Behaviour & Information Technology, 32*(11), 1077–1085.

Colomo-Palacios, R., Casado-Lumbreras, C., Soto-Acosta, P., García-Peñalvo, F. J., & Tovar, E. (2014). Project managers in global software development teams: A study of the effects on productivity and performance. *Software Quality Journal, 22*(1), 3–19.

Darroch, J. (2003). Developing a measure of knowledge management behaviors and practices. *Journal of Knowledge Management, 7*(5), 41–54.

Darroch, J. (2005). Knowledge management, innovation and firm performance. *Journal of Knowledge Management, 9*(3), 101–115.
Del Aguila-Obra, A. R., & Padilla-Melendez, A. (2008). Organizational factors affecting Internet technology adoption. *Internet Research, 16*(1), 94–110.
Del Giudice, M., & Della Peruta, M. R. (2016). The impact of IT-based knowledge management systems on internal venturing and innovation: A structural equation modeling approach to corporate performance. *Journal of Knowledge Management, 20*(3), 484–498.
Del Giudice, M., Della Peruta, M. R., & Maggioni, V. (2013). Collective knowledge and organizational routines within academic communities of practice: An empirical research on science-entrepreneurs. *Journal of the Knowledge Economy, 4*(3), 260–278.
Del Giudice, M., Della Peruta, M. R., & Maggioni, V. (2015). A model for the diffusion of knowledge sharing technologies inside private transport companies. *Journal of Knowledge Management, 19*(3), 611–625.
Del Giudice, M., & Maggioni, V. (2014). Managerial practices and operative directions of knowledge management within inter-firm networks: A global view. *Journal of Knowledge Management, 18*(5), 841–846.
Delery, J. E., & Doty, D. H. (1996). Modes of theorizing in strategic human resource management: Test of universalistic contingency, and configurational performance predictions. *Academy of Management Journal, 39*(4), 802–835.
Della Peruta, M. R., Del Giudice, M., Lombardi, R., & Soto-Acosta, P. (2016). Open innovation, product development, and inter-company relationships within regional knowledge clusters. *Journal of the Knowledge Economy,*. doi:10.1007/s13132-016-0356-x.
Devaraj, S., & Kholi, R. (2003). Performance impacts of information technology: Is actual usage the missing link? *Management Science, 49*(3), 273–289.
Eisenberger, R., Armeli, S., Rexwinkel, B., Lynch, P. D., & Roades, L. (2001). Reciprocation of perceived organizational support. *Journal of Applied Psychology, 86*(1), 42–51.
Fornell, C., & Larcker, F. D. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.
Fox, S. (2000). Communities of practice, foucault and actor network theory. *Journal of Management Studies, 37*(6), 853–867.
Friesike, S., Widenmayer, B., Gassmann, O., & Schildhauer, T. (2015). Opening science: Towards an agenda of open science in academia and industry. *Journal of Technology Transfer, 40*(4), 581–601.
Gardner, H. K. (2012). Performance pressure as a doble-edged sword: Enhancing team motivation but undermining the use of team knowledge. *Administrative Science Quarterly, 57*(1), 1–46.
Griffin, A., & Hauser, J. R. (1996). Integrating R&D and marketing: A review and analysis of the literature. *Journal of Product Innovation Management, 13*(3), 191–215.
Gu, V. C., Cao, Q., & Duan, W. (2012). Unified modeling language (UML) IT adoption—A holistic model of organizational capabilities perspective. *Decision Support Systems, 54*(1), 257–269.
Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis* (5th ed.). London: Prentice-Hall.
Hanlon, S. C., & Taylor, R. R. (1991). An examination of changes in work group communication behaviors following installation of a gain sharing plan. *Group and Organization Studies, 16*, 238–267.
Hernández-López, A., Colomo-Palacios, R., García-Crespo, Á., & Soto-Acosta, P. (2010). Trust building process for global software development teams: A review from the Literature. *International Journal of Knowledge Society Research, 1*(1), 65–82.
Huy, L. V., Rowe, F., Truex, D., & Huynh, M. Q. (2012). An empirical study of determinants of e-commerce adoption in SMEs in Vietnam an economy in transition. *Journal of Global Information Management, 20*(3), 23–54.
Jardim-Goncalves, R., Popplewell, K., & Grilo, A. (2012). Sustainable interoperability: The future of Internet based industrial enterprises. *Computers in Industry, 63*(8), 731–738.
Jayasingam, S., Ansari, M. A., Ramayah, T., & Jantan, M. (2013). Knowledge management practices and performance: Are they truly linked? *Knowledge Management Research & Practice, 11*(3), 255–264.
Joo, J., & Normatov, I. (2013). Determinants of collective intelligence quality: Comparison between Wiki and Q&A services in English and Korean users. *Service Business, 7*(4), 687–711.
Kuan, K. Y., & Chau, Y. K. (2001). A perception model for EDI adoption in small businesses using a technology-organization-environment framework. *Information & Management, 38*(1), 507–521.
Lim, S., Trimi, S., & Lee, H. (2010). Web 2.0 service adoption and entrepreneurial orientation. *Service Business, 4*(3–4), 197–207.
Lopez-Cabrales, A., Pérez-Luño, A., & Cabrera, R. V. (2009). Knowledge as a mediator between HRM practices and innovative activity. *Human Resource Management, 48*(4), 485–503.

López-Nicolás, C., & Meroño-Cerdán, A. L. (2011). Strategic knowledge management, innovation and performance. *International Journal of Information Management, 31*(6), 502–509.
Lopez-Nicolas, C., & Soto-Acosta, P. (2010). Analyzing ICT adoption and use effects on knowledge creation: An empirical investigation in SMEs. *International Journal of Information Management, 30*(6), 521–528.
Lucio-Nieto, T., Colomo-Palacios, R., Soto-Acosta, P., Popa, S., & Amescua-Seco, A. (2012). Implementing an IT service information management framework: The case of COTEMAR. *International Journal of Information Management, 32*(6), 589–594.
MacKinnon, D. P., Warsi, G., & Dwyer, J. H. (1995). A simulation study of mediated effect measures. *Multivariate Behavioral Research, 30*(1), 41–62.
Meroño-Cerdan, A. L., & Soto-Acosta, P. (2005). Examining e-business impact on firm performance through website analysis. *International Journal of Electronic Business, 3*(6), 583–598.
Meroño-Cerdan, A. L., & Soto-Acosta, P. (2007). External web content and its influence on organizational performance. *European Journal of Information Systems, 16*(1), 66–80.
Meroño-Cerdan, A. L., Soto-Acosta, P., & López-Nicolás, C. (2008a). Analyzing collaborative technologies' effect on performance through intranet use orientations. *Journal of Enterprise Information Management, 21*(1), 39–51.
Meroño-Cerdan, A., Soto-Acosta, P., & López-Nicolás, C. (2008b). How do collaborative technologies affect innovation in SMEs? *International Journal of e-Collaboration, 4*(4), 33–50.
Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review, 23*, 242–266.
Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *OrganizationScience, 5*(1), 14–37.
Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York: Oxford University Press.
Nunnally, J. C. (1967). *Psychometric Theory*. New York, NY: McGraw-Hill.
OECD. (2005). *Oslo Manual. Guidelines for collecting and interpreting innovation data*. doi:10.1787/9789264013100-en.
Palacios-Marqués, D., Merigó, J. M., & Soto-Acosta, P. (2015a). Online social networks as an enabler of innovation in organizations. *Management Decision, 53*(9), 1906–1920.
Palacios-Marqués, D., Soto-Acosta, P., & Merigó, J. M. (2015b). Analyzing the effects of technological, organizational and competition factors on Web knowledge exchange in SMEs. *Telematics and Informatics, 32*(1), 23–32.
Pan, Z. (2012). Opinions and networks: How do they effect each other. *Computational Economics, 39*(2), 157–171.
Park, R., & Kim, J. (2013). Individual employees' responses to group incentives: The moderating role of innovation. *Journal of Business Psychology, 28*(2), 175–187.
Pérez-López, S., & Alegre, J. (2012). Information technology competency, knowledge processes and firm performance. *Industrial Management & Data Systems, 112*(4), 644–662.
Peterson, S. J., & Luthans, F. (2006). The impact of financial and nonfinancial incentives on business-unit outcomes over time. *Journal of Applied Psychology, 91*(1), 156–165.
Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management, 12*(4), 531–544.
Popa, S., Soto-Acosta, P., & Loukis, E. (2016). Analyzing the complementarity of web infrastructure and eInnovation for business value generation. *Program: Electronic Library and Information Systems, 50*(1), 118–134.
Porter, M. E. (1985). *Competitive Advantage*. New York: Free Press.
Rosenzweig, S. (2016). The effects of diversified technology and country knowledge on the impact of technological innovation. *Journal of Technology Transfer,*. doi:10.1007/s10961-016-9492-5.
San Martín, S., López-Catalán, B., & Ramón-Jerónimo, M. A. (2012). Factors determining firms' perceived performance of mobile commerce. *Industrial Management & Data Systems, 112*(6), 946–963.
Sigala, M., & Chalkiti, K. (2014). Investigating the exploitation of Web 2.0 for knowledge management in the Greek tourism industry: An utilisation-importance analysis. *Computers in Human Behavior, 30*(1), 800–812.
Snieska, V., & Valodkiene, G. (2015). Impact of innovations upon economic growth during recession. *Technological and Economic Development of Economy, 21*(4), 626–642.
Soto-Acosta, P., Casado-Lumbreras, C., & Cabezas-Isla, F. (2010a). Shaping human capital in software development teams: The case of mentoring enabled by semantics. *IET Software, 4*(6), 445–452.

Soto-Acosta, P., Colomo-Palacios, R., & Popa, S. (2014a). Web knowledge sharing and its effect on innovation: An empirical investigation in SMEs. *Knowledge Management Research & Practice, 12*(1), 103–113.
Soto-Acosta, P., Martinez-Conesa, I., & Colomo-Palacios, R. (2010b). An empirical analysis of the relationship between IT training sources and IT value. *Information Systems Management, 27*(3), 274–283.
Soto-Acosta, P., & Meroño-Cerdan, A. (2006). An analysis and comparison of web development between local governments and SMEs in Spain. *International Journal of Electronic Business, 4*(2), 191–203.
Soto-Acosta, P., & Meroño-Cerdan, A. (2008). Analyzing e-Business value creation from a resource-based perspective. *International Journal of Information Management, 28*(1), 49–60.
Soto-Acosta, P., Perez-Gonzalez, D., & Popa, S. (2014b). Determinants of Web 2.0 technologies for knowledge sharing in SMEs. *Service Business, 8*(3), 425–438.
Soto-Acosta, P., Placer-Maruri, E., & Perez-Gonzalez, D. (2016). A case analysis of a product lifecycle information management framework for SMEs. *International Journal of Information Management, 36*(2), 240–244.
Soto-Acosta, P., Popa, S., & Palacios-Marqués, D. (2015). E-business, organizational innovation and firm performance in manufacturing SMEs: An empirical study in Spain. *Technological and Economic Development of Economy,*. doi:10.3846/20294913.2015.1074126.
Templeton, G. F., Lewis, B. R., & Snyder, C. A. (2002). Development of a measure for the organizational learning construct. *Journal of Management Information Systems, 19*(2), 175–218.
Tenenhaus, M., Esposito, V., Chatelin, Y., & Lauro, C. (2008). PLS path modelling. *Computational Statistics & Data Analysis, 48*, 159–205.
Thong, J. Y. L. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems, 15*(4), 187–214.
Tiwana, A. (2003). *The knowledge management toolkit: Orchestrating IT, strategy and knowledge platform.* Upper Saddle River, NJ: Prentice Hall.
Tornatzky, L. G., & Fleischer, M. (1990). *The process of technological innovation*. Lexington. MA: Lexington Books, Lexington.
Tsui, A. S., Pearce, J. L., & Porter, L. W. (1997). Alternative approaches to the employee-organization relationship: Does investment in employees pay off? *Academy of Management Journal, 40*, 1089–1121.
Valkokari, K., Paasi, J., & Rantala, T. (2012). Managing Knowledge within networked Innovation. *Knowledge Management Research & Practice, 10*(1), 27–40.
Vila, L. E., Cabrer, B., & Pavía, J. M. (2015). On the relationship between knowledge creation and economic performance. *Technological and Economic Development of Economy, 21*(4), 539–556.
Wang, Y., & Ahmed, P. (2009). The moderating effect of the business strategic orientation on e-commerce adoption: Evidence from UK family run SMEs. *Journal of Strategic Information System, 18*(1), 16–30.
Wang, Y. M., Wang, Y. S., & Yang, Y. F. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting and Social Change, 77*, 803–815.
Wayne, S. J., Shore, L. M., & Liden, R. C. (1997). Perceived organizational support and leader-member exchange: A social exchange perspective. *Academy of Management Journal, 40*, 82–111.
Xin, J. Y., Ramayah, T., Soto-Acosta, P., Popa, S., & Ping, T. A. (2014). Analyzing the use of the Web 2.0 for brand awareness and competitive advantage: An empirical study in the Malaysian hospitability industry. *Information Systems Management, 31*(2), 96–103.
Xu, S., Zhu, K., & Gibbs, J. (2004). Global technology, local adoption: A cross-country investigation of Internet adoption by companies in the United States and China. *Electronic Markets, 14*(1), 13–24.
Youndt, M. A., Snell, S. A., Dean, J. W., Jr., & Lepak, D. P. (1996). Human resource management, manufacturing strategy and firm performance. *Academy of Management Journal, 39*(4), 836–866.
Zhu, K., & Kraemer, K. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research, 16*(1), 61–84.
Zhu, K., Kraemer, K., & Xu, S. (2003). Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems, 12*(4), 251–268.
Zhu, K., Kraemer, K. L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science, 52*(10), 1557–1576.
Zhu, K., Kraemer, K. L., Xu, S., & Dedrick, J. (2004). Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of Management Information Systems, 21*(1), 17–54.
Zhu, Y., Li, Y., Wang, W., & Chen, J. (2010). What leads to the post-implementation success of erp? An empirical study of the Chinese retail industry. *International Journal of Information Management, 30*(3), 265–276.