



# How does the use of information technologies affect the adoption of environmental practices in SMEs? A mixed-methods approach

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## Abstract

In this paper we show two original alternative models. Model 1 involves two sources for the adoption of environmental practices (PRAC): the collaboration-oriented human resources management system and the organizational learning capability. Model 2 adopts three sources for PRAC: the collaboration-oriented human resources management system, the organizational learning capability and information technology support (ITS). Both models also use three moderating variables: the manager's education level and experience, and the firm's size. We use a mixed-methods approach with structural equation modeling and a fuzzy-set qualitative comparative analysis on 349 small and medium-sized Portuguese firms. The results show that collaboration oriented human resources system, organizational learning capability, and ITS have a positive effect on PRAC. In addition, the individual characteristics of the managers significantly improve the explanatory power of the models. However, the firm's size has a negative moderating effect. Therefore, the smaller the firms are, then the larger the positive effects of the antecedents on PRAC. The results also show that ITS is an important source for the development of PRAC, and it contributes to different pathways that lead to PRAC. But, no alternative causal configurations exist that lead to PRAC regarding Model 1, yet alternative causal configurations do exist that lead to PRAC regarding Model 2. In this line, the findings from both the quantitative and the qualitative analyses show the relevancy of ITS to PRAC.

**Keywords** Adoption of environmental practices · Information technology support · Mixed methods · Structural equation modelling · Fuzzy-set qualitative comparative analysis

**Mathematics Subject Classification** 91C99

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## 1 Introduction

The aim of this study is to answer three questions: Do SMEs with information technology support (ITS) adopt environmental practices? What are the contributions of human resource management and technology that lead to the adoption of environmental practices in small and medium sized enterprises (SMEs)? What are the manager's characteristics that lead to the adoption of environmental practices in SMEs?

Answering such research questions provides an understanding of the key processes and pathways that allow companies to manage and integrate the antecedents of PRAC, e.g., knowledge search strategies, information technologies and human resource management. This challenge often calls for organizational restructuring and the adoption of more diverse knowledge components or new routines, thus leading to new pathways. Furthermore, sustainable development requires a "society pool" approach whereby different stakeholders (e.g., trade partners, employees...) are involved, i.e., there is collaboration.

The study proposes two original alternative original models (one with ITS and one without it). Model 1 proposes the antecedents to environmental practices (PRAC) of a collaboration-oriented human resources management system (CHRMS) and organizational learning capability (OLC), and Model 2 introduces ITS as a third antecedent. Both models include three moderating variables: the manager's education level (EL) and experience (EXP), and the firm's size (SIZ).

The adoption of environmental practices by a firm requires it to respond satisfactorily to the concerns of its various stakeholders (such as employees, customers, and suppliers) (Dahlsrud 2008). However, there are few studies that have compared the effort of SMEs reaching PRAC with and without the contribution of ITS. This study address a major gap in the literature on small- and medium-sized enterprises (SMEs) by using a mixed methods approach (quantitative and qualitative). While previous research have focused primarily on the PRAC of large companies, the interest in the sustainability of SMEs is relevant for several reasons. SMEs are the backbone of the economy and represent more than 95% of enterprises across the world (Ayyagari et al. 2011). The PRAC is significantly different between SMEs and large companies as a result of several peculiarities: owners directly manage most SMEs; they are tightly linked to business partners and the local community; and they have financial, human, and time resource limitations that can hinder the implementation of PRAC with respect to larger firms (Testa et al. 2016). For these reasons, a sample of Portuguese SMEs has been used in this study.

The literature argues that SMEs should manage their human resources (HR) and ITS in order to adopt PRAC. Therefore, HR and ITS are two important predictors of PRAC (Dahlsrud 2008).

The adoption of PRAC is a relevant issue for the progress of SMEs and society in general. In this line, the triple bottom line approach argues that sustainable development should have three important pillars: social development, economic development, and sustainable development (Glavas and Mish 2015).

In addition, the literature on traditional HR only studies it as an internal resource for SMEs. But the collaboration between SMEs and organizational

learning can be two relevant predictors of PRAC. Thus, this study addresses the effect of collaboration-oriented human resources system (CHRMS) on PRAC in interorganizational settings.

The adoption of PRAC takes place inside organizations through influences such as own capabilities like learning and technological (Longoni and Cagliano 2018). Further, manager's characteristics and the firm's size can improve the adoption of a new CHRMS, new technologies, and consequently PRAC. Therefore, this study uses two research models with variables at different levels (individual, organizational, and interorganizational) (Longoni and Cagliano 2018).

This study makes several contributions. First, we extend the sparse literature on antecedents of sustainable practices in SMEs by empirically analyzing the extent to which human, social and technological factors drive engagement in sustainability. Second, ours comparative models identified the relevant effects of ITS on PRAC, i.e., the firms with ITS can implement the use of sustainable practices. Therefore, ours models identified a relevant antecedent of PRAC in SME. Third, we used information from the managers of Portuguese SMEs to test the models with a mixed methods approach. Initially, we applied structural equation modelling (SEM) to test our hypotheses. Then, we applied fuzzy-set qualitative comparative analysis (fsQCA) to identify alternative pathways within the proposed model that lead to PRAC. Fourth, ours models consider the manager's characteristics (EL and EXP) and firm size influences to adopt environmental practices in SMEs. SMEs with different size (small or medium), different manager's educational level (secondary, graduate and postgraduate) and different manager's experience (junior or senior) can have different sustainability goals. Therefore, two comparative models and a double methodology have been used in this study to explain the effects of ITS, CHRMS and OLC on PRAC taking into account firm size and two manager's characteristics.

The study aims to contribute to the fields of sustainability, technology, and HR within SMEs with a mixed-methods approach (SEM and fsQCA).

The remainder of this paper proceeds as follows: Sect. 2 provides a comprehensive acknowledgment of the constructs and the formulation of the hypotheses. In Sect. 3, we introduce the methods, the sample, and the measurement assessment. Section 4 contains the survey's results. Section 5 contains a discussion and conclusions.

## 2 Literature review and hypothesis development

In recent years, one of the key topics tackled by the sustainable development discourse concerns the interrelated relationship between firms' technologies and sustainability (Muñoz-Pascual et al. 2019). The implementation of new technologies by firms has been deemed necessary condition for the successful applications of new environmental practices. New technologies, new collaboration practices or new knowledge represent means through which organizations can actually encourage the adoption of environmental practices (Roig-Tierno et al. 2018).

The previous arguments emphasize that more research is needed to fully comprehend the interrelated nature of firms' technology, HRM and sustainability. In

addition, there continues to have considerable uncertainty about whether the adoption of new technologies into firms actually leads to more sustainability (Hall and Wagner 2012). Therefore, we propose the following research questions:

- Do SMEs with information technology support (ITS) adopt environmental practices?
- What are the contributions of human resource management and technology that lead to the adoption of environmental practices in SMEs?
- What are the manager's characteristics and firm size that lead to the adoption of environmental practices in SMEs?

## 2.1 Collaboration-oriented human resource management system

CHRMS develops connections and quality relationships with external stakeholders and partners (Razmerita et al. 2016). The research shows that HRM should be studied from both an internal and an external approach at different levels (individual, organizational, and interorganizational). CHRMS uses alliances and relationships between partners to exchange information or to collaborate (Aljuwaiber 2016), for example, relationships with external institutions such as universities, firms, or governments.

Therefore, on the one hand, internal HRM focuses on organizational learning; on the other hand, external HRM focuses on collaboration with other stakeholders. Both forms of HRM are key antecedents of PRAC. However, if organizational learning is an important internal source of PRAC, can a CHRMS be even more useful for generating PRAC? Authors such as Ashok et al. (2016) argue that CHRMS is conducive to the search for external knowledge and the adoption of new practices (Roig-Tierno et al. 2018).

Firms build collaborative alliances and links with different stakeholders. Through these new alliances and relationships, firms create new and valuable knowledge and, consequently, new environmental practices. This study proposes a full research model that includes external and interorganizational human capital through CHRMS. Firms need to develop internal and unique HRM (Muñoz-Pascual and Galende 2017), but they also need to cooperate in the search for the common good. Relationships are the structural, administrative, institutional, resource, relational, and environmental ties with external entities, which assist in the collection of useful knowledge and information (Rathi et al. 2014). Through partnerships, organizations can create interorganizational structures that support PRAC (Ashok et al. 2016). Organizations exposed to such broad and complementary knowledge sources have a higher propensity of exploring new PRAC (Zahra and George 2002). In addition, CHRMS is most effective when the connections are noncompetitive, that is, both competition and cooperation exist between firms. This is called “coopetition.” The interorganizational sharing of fine-grained information is more effective among organizations that trust each other than among those that keep each other at arm's length (Mariano and Awazu 2017). We therefore propose that CHRMS is an

important driver of PRAC (Lin and Lo 2015). Therefore, this discussion leads to the following hypothesis for Models 1 and 2:

**H1** Collaboration-oriented human resource management systems have a positive effect on the adoption of environmental practices.

## 2.2 Organizational learning capability

Organizational learning capability (OLC) refers to the importance of organizational learning to facilitators (Jérez-Gómez et al. 2005). Organizational learning represents the refinement and renewal of dynamic knowledge. The renewal of knowledge assets provides the ability to learn and explore new knowledge while exploiting existing knowledge (Jaw and Liu 2003). Organizational learning occurs in a context that consists of “both the organization and its external environment” (Argote 2013).

Lichtenthaler (2009) classifies organizational learning into three processes: explorative, exploitative, and transformative. All three processes have positive effects on PRAC. Organizational learning requires organizations to plan, envision, and to transact. According to Chiva et al. (2007), OLC comes from experimentation (OLC-E), risk-taking (OLC-R), dialog (OLC-D), and participative decision-making (OLC-P) as well as interaction with the external environment (OLC-I). Experimentation is the extent to which firms try out new ideas and practices, are curious about how things work, or carry out changes in work processes. Risk-taking regards the tolerance for ambiguity, uncertainty, and errors that facilitates organizational learning. Interaction with the external environment regards the extent of the relationships that a firm has with its immediate environment. Dialog is defined as a sustained collective inquiry into the processes, assumptions, and certainties that compose everyday experience. Finally, participative decision-making refers to the level of influence that employees have in the process. A degree of ambiguity and inconsistency still surrounds the question of how OLC affects PRAC (Valaei et al. 2017). Thus, the next hypothesis for both models is:

**H2** Organizational learning capability has a positive effect on the adoption of environmental practices.

## 2.3 Information technology support

This construct refers to the degree to which the use of information technology supports the adoption of PRAC (Gold et al. 2001). Information technology is a crucial element in the creation of knowledge and new practices (Lee and Choi 2003) by facilitating the rapid collection, storage, and exchange of knowledge (Roberts 2000; Eggers et al. 2017; Richter et al. 2017; Kraus et al. 2019). A well-developed technology integrates new mechanisms and practices (Gold et al. 2001) that can eliminate barriers to communication among departments in an organization (Riggins and Rhee 1999; Medina-Molina et al. 2019). Firms with ITS can develop new sustainable mechanisms and green product innovation performance. ITS is a central pillar of

environmental-intensive industries that can reduce costs within the production chain (Song et al. 2019).

In addition, ITS presents the characteristics of rarity, appropriability, nonreproducibility, and nonsubstitutability that can lead to a competitive advantage (Wade and Hulland 2004). The research on ITS has recently increased (Kohli and Grover 2008). Most findings from empirical studies show that firms that possess strong ITS realize PRAC (Kim et al. 2011). ITS provides the necessary tools for effectively transforming inputs into sustainable outputs and green product innovation performance (Orlikowski and Iacono 2001; Song et al. 2019). Therefore, we emphasize the need to understand ITS as an antecedent to PRAC. A developing consensus in the research shows that ITS should be measured and examined at the organizational level (Kohli and Grover 2008). In this respect, ITS serves as an antecedent for the creation of new PRAC. Accordingly, the following hypothesis applies to Model 2:

**H3\*** Information technology support has a positive effect on the adoption of environmental practices.

## 2.4 Adoption of environmental practices

The reinforcement of environmental regulations worldwide in recent years has motivated countries and firms to seek the adoption of environmental management practices (Malovics et al. 2007; Gavronski et al. 2008; COP21 2015). Researchers have found that the main economic or social factors that lead to the adoption of environmental practices are new investments in human resources and organizational learning capability (Kraus et al. 2018). In the case of SMEs, the main stakeholders behind PRAC are customers, employees, and suppliers as well as local society and the government. Others stakeholders are competitors, insurers, banks, and firms in the area (Fernández-Viñé et al. 2010).

In addition, PRAC might require the application of more efficient methods of consumption and waste recycling, and the consequent reduction in the total amount of a company's operational costs (Ramanathan et al. 2010). Aragón-Correa et al. (2008) show that a proactive environmental strategy requires changes in routines and operational methods. Chan and Hawkins (2010) add that the adoption of environmental practices helps to achieve better safety standards and healthier working conditions. Moreover, companies that are proactive in environmental practices can take advantage of public support or government subsidies (Mohamed 2001).

Fresner and Engelhardt (2004) assert that the adoption of PRAC is very beneficial to SMEs by producing an immediate and visible improvement in organizational efficiency.

## 2.5 Manager's education level

In this paper, we focus on the education competency profile of managers who play a role in the firm's PRAC (secondary, graduate, and post-graduate). Vila et al. (2014) argue that significant effects exist from specific competencies on the

probability that managers act as innovators in the adoption of PRAC. These competencies are alertness to new opportunities and the ability to present ideas or reports, to mobilize the abilities of others, to come up with new ideas and solutions, and the ability to use computers and the internet. That is the high technological level of the managers is an important competency that can help firms to be more sustainable. The technological level creates power effects on PRAC and reduces the risk of managers' resistance to new systems (Wang et al. 2010). Implementing a business–process system without a supportive learning environment could have drastic consequences (Bassellier et al. 2003). Thus, we have the following hypotheses:

**H3** For Model 1, the managers' education level has a moderating effect on hypotheses H1 and H2.

**H4\*** For Model 2, the managers' education level has a moderating effect on hypotheses H1, H2, and H3\*.

## 2.6 Manager's experience

One of the ways to see the predisposition of the firm to adopt new ideas or practices is through the manager's experience represented by his or her tenure (junior: < 5 years and senior: > 5 years). The experience can act as a reflection of the intentions of the manager thanks to his or her know-how to implement new mechanisms that help improve the environment. It can influence better communication and creativity that leads to the adoption of new practices within the firm (Kuemmerle 1998).

Kumar and Saqib (1996) find a positive relationship between experience, as measured through age, and the realization of Research and Development (R&D) and the adoption of new practices. Kuemmerle (1998) analyzes the relationship between the innovative results of I+D laboratories, as measured through interviews with their managers and by obtaining patents, and their experience. The author finds a positive relationship that can be extended to the possibility of performing better design and management of new laboratories. Gumbau (1997) verifies that the time taken by the manager in the firm has a positive influence on the level of resources invested in new practices and the innovation in SMEs.

However, the studies by Molero and Buesa (1996) show that the firms with younger managers and with less experience are the most proactive in the implementation of new technologies and environmental management practices. In this line, we propose:

**H4** For Model 1, experience has a moderating effect on hypotheses H1 and H2.

**H5\*** For Model 2, experience has a moderating effect on hypotheses H1, H2, and H3\*.

## 2.7 Firm size

Some studies argue that the firm's size can influence the adoption of PRAC. According to the European Union, the definition of SMEs is set out in Annex I of Commission Regulation (EU) no 651/2014 of June 17, 2014. The text defines the types of companies with respect to their number of employees (small: < 50 employees and medium: > 50 employees) (Camison-Zornoza et al. 2004). A larger or medium size can facilitate the adoption of PRAC because the greater possibility of obtaining economies of scale, lower risk, and the possibility of a better performance can exist. In short, medium firms can access a wider range of information and skills that allows for more PRAC (Rothwell and Dodgson 1994). By contrast, a smaller size can facilitate PRAC quickly. A better communication network, better coordination, and greater motivation among workers might exist for the adoption of PRAC. In addition, a smaller size means a greater presence of informal links that support long-term PRAC (Rothwell and Dodgson 1994). Thus, we have the following hypotheses:

**H5** For Model 1, the firm's size has a moderating effect on hypotheses H1 and H2.

**H6\*** For Model 2, the firm's size has a moderating effect on hypotheses H1, H2, and H3\*.

This study sheds light on the conditions that managers and firms need to gain a better understanding of the relationships between CHRMS, OLC, ITS, and PRAC. We consider that education level and experience of managers and the size of the firms are aspects that can help in the adoption of PRAC (Drummond et al. 2017).

## 2.8 Alternative configurations

The configuration theory explains the sufficient and necessary conditions to lead to the outcome (PRAC). In this line, equifinality exists if more than one path of conditions leads to the same result (PRAC). This study is relevant because several asymmetric pathways and synergetic effects replace the traditional bivariate interaction. Therefore, we show that conditions that lead to PRAC (Fiss 2011):

**H6** For Model 1, alternative configurations exist that lead to PRAC (fsQCA).

**H7** For Model 1, alternative configurations exist that lead to the absence of PRAC (fsQCA).

**H7\*** For model 2, alternative configurations exist that lead to PRAC (fsQCA).

**H8** For Model 2, alternative configurations exist that lead to the absence of PRAC (fsQCA).



**H9** Information technology support improves the adoption of environmental practices (SEM and fsQCA).

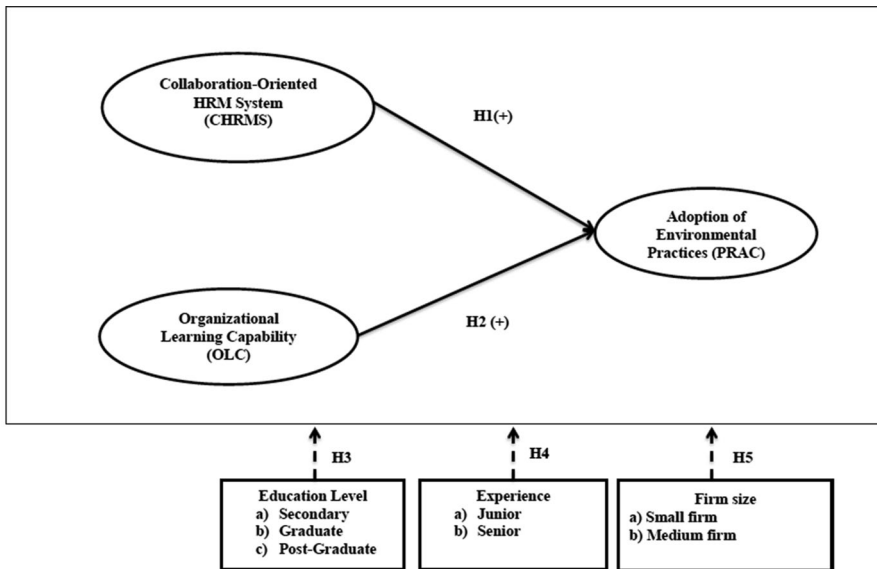
Therefore, we present the two comparative and integrative models in Figs. 1 and 2.

**3 Methods**

Following Alegre and Chiva (2008), we apply a quantitative method to test for PRAC (hypotheses H1 to H5 in Model 1; hypotheses H1 to H6\* and H9 in Model 2). But, Osabutey and Jin (2016) argue that traditional quantitative methods have important limitations in their ability to account for complex interactions between variables. Therefore, the use of quantitative methods is insufficient for a complete study of what drives SMEs to adopt PRAC.

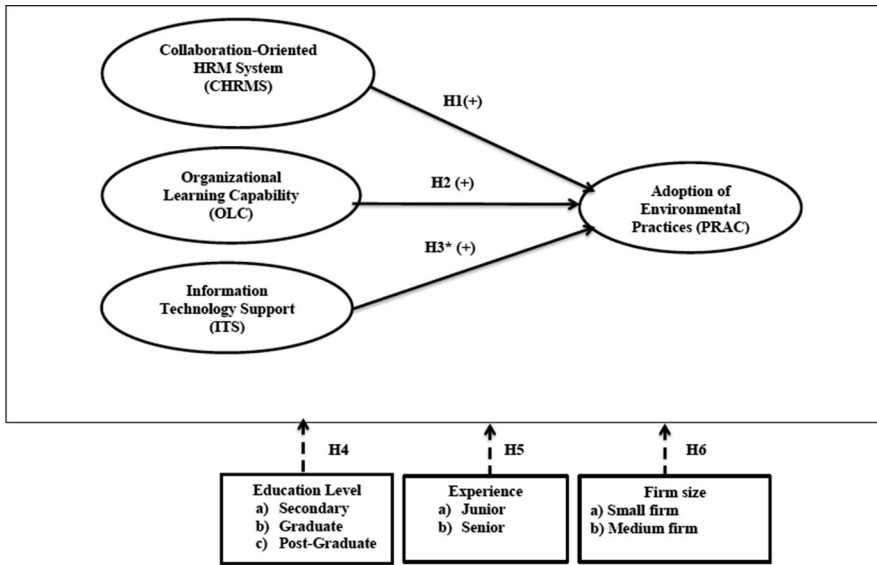
In this line, other recent studies apply qualitative methods. Oyemomi et al. (2016) use fsQCA. FsQCA identifies the necessary and core conditions of the configurations that lead to the outcome variable (hypotheses H6 and H7 in Model 1; hypotheses H7\*, H8 and H9 in Model 2).

Few mixed-method studies offer both a quantitative analysis and a qualitative comparative analysis of PRAC (Cragun et al. 2016; Kraus et al. 2017; Curado et al. 2018; Muñoz-Pascual et al. 2019). Therefore, this study completely covers the antecedents, the ITS, and the paths to PRAC.



H6: There are alternative configurations leading to PRAC.  
 H7: There are alternative configurations leading to the absence of PRAC.

Fig. 1 Research model 1 (without ITS)



**H7:** There are alternative configurations leading to PRAC.

**H8:** There are alternative configurations leading to the absence of PRAC.

**H9:** ITS significantly improves the adoption of environmental practices (SEM and fsQCA)

**Fig. 2** Research model 2 (with ITS)

## 3.1 Mixed methods

### 3.1.1 Mixed-methods approach

Research as a way of knowing, interpreting, and transforming reality cannot ignore the constant demands of an increasingly unstable, complex, and diverse business world. Hence, for some researchers (Oyemomi et al. 2016), the traditional qualitative and quantitative research approaches fall short in resolving the problems and situations that require new perspectives. In this context, the application of a mixed-methods approach is important because it exploits the strengths of both approaches to achieve a more complete understanding of economic, social, environmental problems (Berkovich 2018).

This study applies structural equation modeling (SEM), which is a quantitative approach. SEM is a complex statistical technique for studying causal relationships between variables with direct and indirect effects. We also use different multigroup analyses for testing three moderating variables in the two models. From a qualitative perspective, we apply fsQCA that is a relevant statistical technique for studying alternative configurations that lead to PRAC.

Following Creswell and Plano (2007), this is a triangulation design for the application of the mixed-methods approach:

1. Combining the strengths provided by the two approaches.
2. Attenuating the weaknesses of its separate application.

### 3. Gaining a better understanding of PRAC.

This triangulation means that the quantitative and qualitative methods are not incompatible. Their combination is relevant when looking for the causes and conditions that lead companies to PRAC (Cook and Reichardt 2005).

### 3.2 Sample and measurement assessment

The data came from an online survey through Qualtrics® that was sent to 6846 Portuguese SMEs certified as innovative in several industry categories: manufacturing, power and gas supply; water supply and pollution; building; vehicle trade and repair; transport and storage; catering; information and communication; housing; scientific activities; administrative activities; health activities; and other services. The survey garnered 385 responses. After applying adequate cleaning procedures (Hair et al. 2005), the final sample comprised 349 firms (5.1% response rate).

To minimize the probability of errors due to the interpretation of the language used, the survey was initially drafted in English and the back-translation method was used for the survey items. Therefore, the questionnaire was originally written in English, then was translated into Portuguese by a certified translator and finally back-translated into English. Before the survey's design, a pre-test was carried out with five prestigious scholars and managers who helped to draft the final survey. Finally, the firms were contacted by telephone to introduce the study and mass mailings of the survey were then sent to them. The survey took on average 20 min to answer and the respondents were the CEOs within each firm. CEOs are responsible for making decisions and they know all the information and tools required for economic, social, and environmental development. In this sense, CEOs have a realistic and broad vision and they know the firm's situation about technology usage and environmental development (Muñoz-Pascual and Galende 2017).

Most of the respondents were female (56.4%), held graduate or post-graduate degrees (76.5%), were on average 43.6 years old, and had tenure of more than 5 years (77.4%) at their firm. Of the firms, 92.4% were 10 years old or more, and the majority (65.9%) had 50 employees or less; 63.6% were public limited companies and 36.4% were general partnerships. To check for a possible nonresponse bias, we used a time-trend extrapolation test to compare late and early respondents. The late respondents are those responses that we received after the first round of mailing, that is, after the follow-up. These respondents were very similar to nonrespondents given that they would have fallen into that category without the follow-up efforts (Armstrong and Overton 1977). A one-way analysis of variance (ANOVA) showed no significant difference between the early and late responses in terms of measures such as the firm's size (numbers of employees) and age.

Therefore, the sample was representative of the population.

### 3.2.1 Variables and measurements

This study uses Likert-type scales (Westland 2015). The ranges are: from 7 (strongly agree) to 1 (strongly disagree). CHRMS is measured using the Zhou et al. (2013) scale; and the OLC scale comes from Alegre and Chiva (2008) and has five dimensions: experimentation, risk-taking, dialog, and participative decision-making as well as interaction with the external environment. The ITS scale comes from Lee and Choi (2003); and the PRAC is measured using the Molina-Azorín et al. (2009) scale. We have three constructs with one dimension (CHRMS, ITS and PRAC) and one construct with five dimensions (OLC). We use all OLC dimensions for measure this construct but in SEM and fuzzy models we use OLC as a complete construct because our objective is to analyze the complete impact of OLC on PRAC.

EL reports the manager's education level (secondary, graduate, and post-graduate). EXP is the manager's experience as represented by his or her tenure (junior: < 5 years and senior: > 5 years). SIZ is the firm's size that is measured by the number of employees (small: < 50 employees and medium: > 50 employees). It is one of the direct measures that is most frequently used in the literature (Blau and McKinley 1979; Kim 1980; Glisson and Martin 1980; Ettlíe 1998; Sengupta 1998; Graves and Langowitz 1993).

To assess measurement validity, we use a confirmatory factor analysis (CFA) by AMOS<sup>®</sup>. The 30 items have good levels that indicates good measurement validity. The factors explain 64.21% of the variance, which is above the recommended value of 60% (Hair et al. 2005). Table 1 summarizes the variables' descriptions and the CFA.

The survey was designed to reduce the common method bias (CMB) (Podsakoff et al. 2003). We use Harman's Single Test to evaluate the existence of CMB. The four factors that emerge from the exploratory factor analysis account for 64.21% of the variance in the data, with the first factor accounting for 35.29% (less than 50% of the total variance). Therefore, no evidence of CMB exists.

### 3.3 Fuzzy-set qualitative comparative analysis (fsQCA)

As applied to the present study, the use of fsQCA (Fiss 2011) allows for more than one combination (or configuration) of causal conditions that leads to sustainability (PRAC). Thus, the identification of alternative causal configurations that can produce PRAC. Causal conditions in the fsQCA analysis correspond to the variables used in the SEM analysis: CHRMS, OLC, ITS, EL, EXP, and SIZ. Since OLC involves five dimensions (OLC-E, OLC-R, OLC-I, OLC-D and OLC-P), we directly measure it by using the fsQCA function "fuzzyand" (corresponding to the mathematical logic operation in Boolean algebra that is called "interception") to generate the condition. Therefore, the presence of the OLC condition corresponds to the cumulative presence of five dimensions. The outcome is the adoption of PRAC.

**Table 1** Variables descriptions and CFA

Constructs	Mean	SD	CFA
*Collaboration-Oriented HRM System (CHRM) (Zhou et al. 2013) (V.E=51.17%); ( $\alpha=0.81$ )			
CHRM1. My organization provides formal external learning program with business partners	3.61	1.88	.71
CHRM2. My organization provides consulting service buy-in	3.53	1.88	.76
CHRM3. My organization provides flexible partnership with autonomous external professionals	4.31	1.88	.74
CHRM4. My organization provides long-term personnel alliance with external academic intuitions	3.43	1.92	.80
CHRM5. My organization provides extensive social networks	3.64	1.85	.72
CHRM6. My organization provides professional HR outsourcing	2.59	1.78	.63
*Organizational Learning Capability (OLC) (Alegre and Chiva 2008) (V.E=70.09%); ( $\alpha=0.95$ )			
Experimentation (OLC-E)			
OLC-E1. In my organization, people receive support and encouragement when presenting new ideas	4.91	1.65	0.86
OLC-E2. In my organization, initiative receives a favorable response, so people feel encouraged to generate new ideas	4.85	1.58	0.86
Risk-Taking (OLC-R)			
OLC-R3. In my organization, people are encouraged to take risk	4.54	1.62	0.85
OLC-R4. In my organization, people often venture into unknown territory	3.79	1.58	0.84
Interaction with the external environment (OLC-I)			
OLC-I5. In my organization, it is part of the work of all staff to collect, bring back, and report information about what is going on outside the company	4.21	1.78	0.83
OLC-I6. In my organization, there are systems and procedures for receiving, collating and sharing information from outside the company	3.90	1.73	0.83
OLC-I7. In my organization, people are encouraged to interact with the environment: competitors, customers, technological institutes, universities, suppliers, etc.	4.48	1.69	0.82
Dialog (OLC-D)			
OLC-D8. In my organization, employees are encouraged to communicate	5.07	1.59	0.80
OLC-D9. In my organization, there is a free and open communication within my work group	5.38	1.47	0.77
OLC-D10. In my organization, managers facilitate communication	5.26	1.60	0.77
OLC-D11. In my organization, cross-functional teamwork is a common practice	4.84	1.70	0.73

Table 1 (continued)

Constructs	Mean	SD	CFA
Participative decision-making (OLC-P)			
OLC-P12. Managers in my organization frequently involve employees in important decisions	4.64	1.76	0.67
OLC-P13. In my organization polices are significantly influenced by the employees' views	4.33	1.67	0.63
OLC-P14. In my organization, people feel involved in main company decisions	4.28	1.72	0.58
*Information Technology Support (ITS) (Lee and Choi 2003)			
ITS1. My organization provides information technology support for collaborative works regardless of time and place	3.91	1.99	0.70
ITS2. My organization provides information technology support for communication among organization members	5.01	1.69	0.86
ITS3. My organization provides information technology support for searching for and accessing necessary information	5.13	1.63	0.90
ITS4. My organization provides information technology support for simulation and prediction	4.34	1.79	0.71
ITS5. My organization provides information technology support for systematic storing	4.90	1.68	0.80
* Adoption of Environmental Practices (PRAC) (Molina-Azorin et al. 2009) ( $VE=66.89\%$ ); ( $\alpha=0.87$ )			
PRAC1. My organization buys ecological products	4.27	1.69	0.86
PRAC2. My organization has reduced the use of cleaning products that are harmful to the environment	4.76	1.71	0.88
PRAC3. My organization implements energy-saving practices	5.39	1.44	0.82
PRAC4. My organization implements water-saving practices	5.21	1.48	0.77
PRAC5. My organization implements the selective collection of solid residues	5.79	1.45	0.72

### 3.3.1 Calibration

FsQCA uses calibrated data to transform demographic, categorical, and Likert scale variables into conditions with values ranging from zero to one. Calibration is the process of classifying conditions from full membership to full nonmembership. The transformation of the Likert scale variables (CHRMS, OLC, ITS, and PRAC) into fuzzy sets involves calculating the average values of the items (Woodside et al. 2011). Since the measurement uses a seven-point scale, we identify full nonmembership, the crossover point, and full membership as two, four, and six, respectively. Following Woodside et al. (2015), we adjust the cut-off values depending on the number of items in each variable and their statistics. SIZE is a binary variable that requires no calibration (it adopts either the value of one or zero). EXP and EL are categorical variables that we calibrate in three levels (1, 0.5, 0) (Table 2).

**Table 2** Descriptive statistics and calibrations of outcome and causal conditions

Outcome and causal conditions	Descriptive statistics	Calibration cuts
PRAC	$\mu = 5.08$ ; $\sigma = 1.28$ ; $min = 1.00$ ; $max = 7.00$	(6.8;5.3;2.6)*
CHRMS	$\mu = 3.52$ ; $\sigma = 1.33$ ; $min = 1.00$ ; $max = 7.00$	(5.1;3.7;1)*
OLC-E	$\mu = 4.89$ ; $\sigma = 1.57$ ; $min = 1.00$ ; $max = 7.00$	(7;5.5;3)*
OLC-R	$\mu = 4.17$ ; $\sigma = 1.49$ ; $min = 1.00$ ; $max = 7.00$	(6.5;4.4;2)*
OLC-I	$\mu = 4.22$ ; $\sigma = 1.49$ ; $min = 1.00$ ; $max = 7.00$	(6.2;4.3;2)*
OLC-D	$\mu = 5.14$ ; $\sigma = 1.44$ ; $min = 1.00$ ; $max = 7.00$	(7;5;4.3)*
OLC-P	$\mu = 4.41$ ; $\sigma = 1.62$ ; $min = 1.00$ ; $max = 7.00$	(6.4;4.8;1.8)*
ITS	$\mu = 4.67$ ; $\sigma = 1.46$ ; $min = 1.00$ ; $max = 7.00$	(6.5;4.9;1.9)*
EL (managers education level)	Secondary = 23.43%; Graduation = 54.23%; Post-graduation = 22.34%	Secondary = 0; Graduation = 0.5; Post-graduation = 1
EXP (# years at the firm)	< 2 = 7.36%; 2–5 = 15.26%; > 5 = 77.38%	< 2 = 0; 2–5 = 0.5; > 5 = 1
SIZ (# employees of the firm)	< 50 employees = 65.94%; ≥ 50 and ≤ 250 employees = 34.06%	< 50 employees = 0; ≥ 50 and ≤ 250 employees = 1;

$\mu$  average;  $\sigma$  standard deviation;  $min$  minimum;  $max$  maximum

\*(0.95;0.50;0.05)

## 4 Results

### 4.1 Measurement and structural model fit

We use structural equation modeling (SEM) to test the fit of the data for hypotheses H1 to H5 for Model 1 and for hypotheses H1 to H6\* for Model 2. In model 1 (without ITS), to test H3, H4 and H5, joint multigroups moderation analyses were performed with SEM. To test H3 (Education Level) a distinction has been made between managers with secondary studies ( $N=84$ ), graduate studies ( $N=191$ ) and postgraduate studies ( $N=74$ ). To test H4 (Experience) a distinction has been made between junior managers ( $<5$  years,  $N=79$ ) and senior managers ( $>5$  years,  $N=270$ ). Finally, to test H5 (Firm Size) a distinction has been made between small firms ( $<50$  employees,  $N=231$ ) and medium firms ( $>50$  employees,  $N=118$ ). In model 2 (with ITS), this multigroup analysis is applied again, to test H4\*(Educational Level), H5\*(Experience) and H6\*(Firm size). The firm's size and manager's characteristics can affect the adoption of environmental practices.

Tables 3 and 4 present the absolute (model 1 (without ITS):  $\chi^2/df=3.110$ , RMSEA=0.078 and model 2 (with ITS):  $\chi^2/df=2.529$ , RMSEA=0.066) and incremental (model 1: CFI=0.911, TLI=0.900 and model 2: CFI=0.918, TLI=0.910) indexes of the recommended values for a good fit as in Hair et al. (2005) and Tarka (2018).

#### 4.1.1 Structural equations model 1 (without ITS)

Hypothesis 1 considers the relationship between CHRMS and PRAC. The results in sub-model 1.3A (EL secondary), sub-model 1.4A (EXP junior), and sub-model 1.5B (SIZE medium) confirm the nonsignificant effects of CHRMS on PRAC. But, the results in sub-model 1.3B (EL graduate,  $\beta=0.666$ ,  $p<0.05$ ) and in sub-model 1.3C (EL post-graduate,  $\beta=0.371$ ,  $p<0.05$ ) confirm the significant and positive effects. In addition, the sub-models 1.4B (EXP senior) and 1.5A show significantly and positive effects between CHRMS and PRAC. Therefore, Model 1 and sub-models 1.3B, 1.3C, 1.4B, and 1.5A support H1. CHRMS has a positive impact on PRAC if the manager has a high education level and longer experience (senior) at a small firm. However, no evidence exists when the manager is a junior, he or she has a low education level (secondary), or he or she works in a medium firm.

Hypothesis 2 refers to the relationship between OLC and PRAC. The results confirm the significantly positive effects of OLC on PRAC in all the models and sub-models (model 1: ( $\beta=0.299$ ,  $p<0.001$ ); sub-model 1.3A: EL secondary ( $\beta=0.158$ ,  $p<0.010$ ); sub-model 1.3B: EL graduate ( $\beta=0.296$ ,  $p<0.001$ ); sub-model 1.3C: EL post-graduate ( $\beta=0.576$ ,  $p<0.001$ ); sub-model 1.4A: EXP junior ( $\beta=0.427$ ,  $p<0.005$ ); sub-model 1.4B: EXP senior ( $\beta=0.262$ ,  $p<0.001$ ), sub-model 1.5A: small firm ( $\beta=0.295$ ,  $p<0.001$ ); and sub-model 1.5B: medium firm ( $\beta=0.287$ ,  $p<0.001$ ).



**Table 3** Structural equation model 1 (without ITS)

	Paths	Estimate	SE	CR	<i>p</i>	Results	
<b>Model 1</b>							
H1 (+)	PRAC←CHRMS	0.262	0.103	2.534	0.011	Supported	
H2 (+)	PRAC←OLC	0.299	0.057	5.262	***	Supported	
<b>Sub-model 1.3 education level 1.3A: secondary</b>							
H1		0.063	0.104	0.609	0.542	Not supported	
H2		0.158	0.093	1.691	0.091	Supported	
<b>1.3B: graduate</b>							
H1		0.666	0.260	2.560	0.010	Supported	
H2		0.296	0.075	3.964	***	Supported	
<b>1.3C: post-graduate</b>							
H1		0.371	0.358	1.034	0.031	Supported	
H2		0.576	0.155	3.719	***	Supported	
<b>Sub-model 1.4 experience</b>							
<b>1.4A: junior</b>							
H1		0.457	0.363	1.257	0.209	Not supported	
H2		0.427	0.139	3.076	0.002	Supported	
<b>1.4B: senior</b>							
H1		0.212	0.102	2.081	0.037	Supported	
H2		0.262	0.062	4.226	***	Supported	
<b>Sub-model 1.5 firm size</b>							
<b>1.5A: small</b>							
H1		0.345	0.148	2.328	0.020	Supported	
H2		0.295	0.078	3.795	***	Supported	
<b>1.5B: medium</b>							
H1		0.091	0.123	0.741	0.459	Not supported	
H2		0.287	0.083	3.463	***	Supported	
	$\chi^2$	<i>df</i>	<i>p</i> value	$\chi^2/df$	CFI	TLI	RMSEA
Structural model:	830.316	267	0.000	3.110	0.911	0.900	0.078
Measurement model:	170.297	43	0.000	3.960	0.924	0.903	0.092

$\chi^2$  Chi-squared, *Df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker–Lewis index, *RMSEA* root mean squared error of approximation, *CHRMS* collaboration-oriented HRM system, *OLC* organizational learning capability, *PRAC* adoption of environmental practices, *ITS* information technology support

Consequently, the results partially support H1, but fully support H2. In addition, major evidence exists for the three moderating effects: manager’s EL (H3), manager’s EXP (H4), and the firm’s size (H5). Table 3 shows the results for Model 1 with the structural equation modeling.

**Table 4** Structural equation model 2 (with ITS)

	Paths	Estimate	SE	CR	<i>p</i>	Results	
Model 2							
H1 (+)	PRAC ← CHRMS	0.265	0.103	2.575	0.001	Supported	
H2 (+)	PRAC ← OLC	0.298	0.057	5.259	***	Supported	
H3* (+)	PRAC ← ITS	0.069	0.037	1.838	0.066	Supported	
Sub-model 2.4 education level							
2.4A: secondary							
H1		0.069	0.104	0.659	0.510	Not supported	
H2		0.155	0.092	1.694	0.090	Supported	
H3*		0.036	0.047	0.761	0.447	Not supported	
2.4B: graduate							
H1		0.682	0.261	2.614	0.009	Supported	
H2		0.294	0.074	3.946	***	Supported	
H3*		0.130	0.077	1.693	0.091	Supported	
2.4C: post-graduate							
H1		0.340	0.358	0.950	0.034	Supported	
H2		0.580	0.154	3.755	***	Supported	
H3*		0.083	0.091	0.911	0.036	Supported	
Sub-model 2.5 experience							
2.5A: junior							
H1		0.382	0.419	0.911	0.362	Not supported	
H2		0.463	0.154	3.014	0.003	Supported	
H3*		0.065	0.087	0.744	0.457	Not supported	
2.5B: senior							
H1		0.230	0.103	2.231	0.026	Supported	
H2		0.255	0.062	4.124	***	Supported	
H3*		0.075	0.043	1.726	0.084	Supported	
Sub-model 2.6 firm size							
2.6A: small							
H1		0.356	0.147	2.415	0.016	Supported	
H2		0.291	0.077	3.795	***	Supported	
H3*		1.119	0.054	2.188	0.029	Supported	
2.6B: medium							
H1		0.091	0.123	0.741	0.459	Not supported	
H2		0.287	0.083	3.463	***	Supported	
H3*		0.002	0.044	0.057	0.955	Not supported	
	$\chi^2$	<i>df</i>	<i>p</i> value	$\chi^2/df$	CFI	TLI	RMSEA
Structural model:	996.613	394	0.000	2.529	0.918	0.910	0.066
Measurement model:	272.215	101	0.000	2.695	0.937	0.926	0.070

$\chi^2$  Chi-squared, *Df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker–Lewis index, *RMSEA* root mean squared error of approximation, *CHRMS* collaboration-oriented HRM system, *OLC* organizational learning capability, *PRAC* adoption of environmental practices, *ITS* information technology support

### 4.1.2 Structural equation model 2 (with ITS)

As in Model 1, hypothesis 1 considers the relationship between CHRMS and PRAC. The results confirm the nonsignificant effect of CHRMS on PRAC in sub-model 2.4A (EL secondary), sub-model 2.5A (EXP junior), and sub-model 2.6B (SIZE medium).

As in Model 1, hypothesis 2 refers to the relationship between OLC and PRAC. The results confirm the significantly positive effects of OLC on PRAC in all the models and sub-models.

Model 2 introduces a new hypothesis, hypothesis 3 (H3\*). This hypothesis predicts the relationship between ITS and PRAC. The results confirm the nonsignificant effect of ITS on PRAC when the manager's EL is low, he or she has little experience, and he or she works in a medium firm.

In this new model, you can see that the power of the joint effects has improved between CHRMS, OLC, ITS, and PRAC.

In summary, the results partially support H1 and H3\*; and totally support H2. For Model 1, in the case of OLC and PRAC, the effects of ITS on PRAC have more power if the manager has a high education level, more experience, and works in a small firm. Therefore, evidence exists for all moderating effects in Model 2 with ITS.

Table 4 shows the results for Model 2 (with ITS) with structural equation modeling.

## 4.2 fsQCA

We use fsQCA (Ragin 2008; Fiss 2011; Oyemomi et al. 2016) to assess the conditions for necessity and sufficiency. The condition's degree of necessity shows its impact on achieving the PRAC (consistency score that exceeds 0.90) (Schneider et al. 2010). No necessary variables exist that lead to PRAC. On the other hand, the condition's degree of sufficiency shows the extent of its relationships with the explanation of PRAC (configurations of several conditions that lead to PRAC). Acceptable solutions should respect the consistency threshold of 0.75 (Ragin 2008; Fiss 2011) and the coverage level within the range limits of 0.25 to 0.90 (Ragin 2008; Woodside and Zhang 2013).

Considering Model 1, no acceptable or sufficient solutions lead to PRAC (consistency < 0.75), therefore, no configurations of the considered causal conditions (CHRMS, OLC, EL, EXP and SIZE) exist that lead to PRAC. When considering Model 2, eight alternative causal configurations exist that lead to PRAC. These results offer managers eight different options to reach PRAC. Considering both models there are no acceptable or sufficient solutions lead to the absence of PRAC (consistency < 0.75).

### 4.2.1 Causal configurations

The intermediate solution reported in Table 5 regards Model 2 and shows the eight configurations that lead to PRAC. Five configurations exist with four conditions, and three exist with three conditions. The Table 5 shows that CHRMS and ITS are two relevant core conditions for PRAC. ITS is present in six of the eight causal configurations that lead to PRAC, and CHRMS is present in four.

Therefore, the findings reflect the assumptions of fsQCA (Fiss 2011). More than one configuration of causal conditions leads to PRAC that confirms the existence of alternative combinations of causal conditions. And alternative causal configurations can produce the same outcome, which confirms equifinality. The solutions present consistency and coverage values that respect the thresholds from the literature and are within the suggested limits (Ragin 2008; Woodside and Zhang 2013). No pathways exist that lead to PRAC when ITS is not included in the model as a causal condition, which highlights the contribution of ITS to PRAC.

### 5 Discussion and conclusions

The relevancy of environmental practices in SMEs has been emphasized by many scholars and managers. ITS can represent a driving force for the adoption of new environmental practices into firms. However, few studies about SMEs have examined the relationships between ITS, HR and PRAC. In addition, this study offers the opportunity to understand whether SMEs with different size and manager’s profiles behave differently in terms of implementation and adoption of environmental practices. The aim of this study is to answer three research questions: Do SMEs with information technology support (ITS) adopt environmental practices? What are the contributions of human resource management and technology that lead to the adoption of environmental practices in SMEs? What are the manager’s characteristics and firm size that lead to the adoption of environmental practices in SMEs?

**Table 5** Intermediate solutions for PRAC

Configurations	CHRMS	OLC	ITS	EL	EXP	SIZ	Coverage		Consistency
							Raw	Unique	
Model: PRAC=f (CHRMS, OLC, ITS, EL, EXP, SIZ)									
1			●	◊	●		0.466994	0.007332	0.818725
2	●			◊	●		0.474806	0.033648	0.821173
3			●		●	●	0.473426	0.042796	0.807044
4		◊	●	◊		◊	0.357278	0.010977	0.878233
5	◊	◊	●		●		0.353719	0.006966	0.826575
6	●	◊		●	◊		0.114447	0.011823	0.841263
7	●	◊	◊	●			0.288488	0.008872	0.837654
8	●	●	●			◊	0.318462	0.025688	0.912523

Overall solution coverage: 0.759098 Overall solution consistency: 0.767394

Black circles (●) indicate the presence of a condition, and open circles (◊) indicate its absence. Large circles indicate core conditions (present in both the parsimonious and intermediate solutions), small ones identify peripheral conditions (present only in the intermediate solution). Blank spaces indicate the condition does not contribute to the configuration

PRAC adoption of environmental practices, CHRMS collaboration-oriented HRM system, OLC organizational learning capability, ITS information technology support, EL education level, EXP experience, SIZ firm size

This study examined: (a) the impact of CHRMS and OLC on PRAC; (b) the impact of CHRMS, OLC and ITS on PRAC using a mixed-methods approach. The quantitative results are very direct, rational, and self-explanatory, whereas the qualitative ones are more numerous, present nuances, and need interpretation. The two approaches complement each other and indicate that CHRMS and ITS are important to the adoption of environmental practices in SMEs (Roig-Tierno et al. 2018; Kraus et al. 2019).

The results from the quantitative approach show that CHRMS, OLC, and ITS positively impact the adoption of PRAC (Argote 2013; Roig-Tierno et al. 2018; Eggers et al. 2017). They also support the moderating role of EL, EXP, and SIZ. The individual characteristics of managers (EL and EXP) significantly improve the explanatory power of Models 1 and 2. Managers with higher EL and EXP are related to the implementation of CHRMS, OLC, and ITS in firms, which facilitates the adoption of PRAC (Vila et al. 2014; Kuemmerle 1998). In addition, the firm's size has a negative moderating effect. The smaller the firms are, the larger the positive impact of the antecedents on PRAC is. Smaller size can facilitate PRAC adoption. A better communication network, better coordination and greater motivation among workers might exist for the adoption of PRAC. In addition, a smaller size means a greater presence of informal links that support long-term PRAC (Rothwell and Dodgson 1994). The results also show that ITS is an important antecedent for the development of PRAC.

In the qualitative approach, we propose two original models as well as a relevant contribution regarding the calibration step in order to integrate the quantitative and qualitative methods. The findings show that there are no necessary conditions to PRAC. However, there are several alternative sufficient configurations (Model 2) that indicate alternative ways to reach PRAC (Kraus et al. 2017).

Model 1's solution does not present consistency and coverage values that respect the limits (Ragin 2008; Woodside and Zhang 2013). Therefore, no pathways exist that lead to PRAC when ITS is not considered as a causal condition, which highlights our contribution.

Model 2's solution presents consistency and coverage values that respect the thresholds (Ragin 2008; Woodside and Zhang 2013) generating alternative causal configurations that lead to PRAC when ITS is considered. These configurations offer managers several options when implementing PRAC. CHRMS (consistent with H1 from the SEM analysis in Model 2) and ITS (consistent with H3\* from the SEM analysis in Model 2) are core conditions in the fsQCA analysis, which reflects they are important conditions to consider. Such results identify the key contribution of HRM and ITS to PRAC.

The qualitative findings show that Model 2 offers more than one configuration of causal conditions that lead to PRAC and that these configurations can produce the same outcome, which confirms the fsQCA characteristic of equifinality.

Overall, the main finding of the study show that HR factors are important but ITS is the key to adopt environmental practices in any SME. Therefore, innovative and digital business models are very relevant for the adopt environmental practices and sustainable future growth (Bouncken et al. 2019).

In summary, this paper proposes alternative research models that shows how CHRMS, OLC and ITS are three relevant pillars of PRAC, being ITS the cornerstone for the adoption of environmental practices in SMEs. Very consistent results support our contribution: according to the qualitative approach, without ITS is not possible to adopt environmental practices, and according to the quantitative approach, with ITS the power of models is better for the adoption of environmental practices. This is important to know for SMEs managers. This paper shows the antecedents of PRAC and shows the relevance for SMEs to use ITS. Therefore, the results from both the quantitative and the qualitative analyses underline the ITS's relevancy to PRAC (Bouncken et al. 2019).

### 5.1 Implications for theory

The study significantly extends the knowledge on ITS's contribution to PRAC in SMEs by showing that it is an antecedent. CHRMS and OLC are two human resource-related variables that are very important for sustainable development but they are not the only ones. In addition, individual level variables also matter, since the education level and experience of the manager can boost the adoption of environmental practices in SMEs. Using a mixed-methods approach allows us to contribute in a more robust way to academia, since we can combine the strengths of both the quantitative and qualitative approaches and therefore deliver a more complete understanding of the phenomenon in question. Our quantitative and qualitative findings are coherent and reinforce each other: Information technology support significantly improves the adoption of environmental practices. Moreover, the results show the importance of complex causation for PRAC. The contributions of this study uncover the complexity involved in adopting sustainable practices by showing that eight alternative configurations of conditions lead to PRAC.

Therefore, the document establishes clear theoretical advances by proposing and testing two models of causal relationships and by demonstrating which are the paths that lead SMEs to adopt environmental practices. The document makes three major theoretical contributions: (a) SMEs wishing to incorporate environmental practices—it is essential that they have advanced technological systems (Eggers et al. 2017), (b) In order for SEMs more easily implement environmental practices, it is necessary to promote learning and collaborative climate (Argote 2013; Roig-Tierno et al. 2018) and, (c) To help the implementation of environmental practices, SMES should consider the size of the firm, and the education and experience of the manager (Rothwell and Dodgson 1994; Vila et al. 2014; Kuemmerle 1998).

### 5.2 Managerial implications

Empirical consequences arise. CHRMS and ITS are core conditions in the qualitative solution that show the key contribution of HRM and ITS to PRAC. The quantitative results support these contributions. On the other hand, since no qualitative solution leads to PRAC when neglecting ITS, SMEs' managers who seek sustainable development should pay close attention to the implementation of ITS.

For example, managers may choose to implement the Eco-Management and Audit Scheme (EMAS) or other software for environmental regulation. Our quantitative findings show that a manager with a high education level and experience is more proactive in adopting environmental practices. Overall both the quantitative and qualitative results are consistent in supporting the relevancy of ITS to PRAC in SMEs.

Finally, we offer five relevant practical recommendations and implementation guidelines for the adoption of environmental practices in SMEs:

1. Use collaborative Human Resources Management:
  - Reinforcement of relationships with new alliances and business partners.
  - Creation of a culture that encourage new collaborations.
  - Support for business networking and congress.
  - Use of technologies to promote contact and new relationships between internal and external partners.
2. Develop an organizational Learning Capability:
  - Involvement of employees in new decisions about environmental practices.
  - Teamwork and effective communication in environmental practices
  - Climate for learning and experimentation.
  - Encouragement to take risks in the design of new sustainable practices.
  - Implementation of environmental information collection systems.
3. Get a Information Technology Support:
  - Implementation of new systems for the energy saving practices.
  - Implementation of new systems for the reverse logistics practices.
  - Implementation of new systems for productive activity with ecological input.
  - Training in new technologies for environmental practices development.
4. Manager's educational level and experience can change the adoption of environmental practices:
  - A high level of training of managers can contribute to the improvement and implementation of environmental practices in firms.
  - Extensive managerial experience can contribute to improving and more easily implementing environmental practices within firms.
5. Firm size can change the adoption of environmental practices:
  - In small firms it is easier to implement new environmental development practices. Small firms have more effective trust and communication mechanisms.

### 5.3 Limitations and future research

We use a mixed-methods approach to depict the relevance of CHRMS and ITS to the adoption PRAC and provide alternative configurations that lead to it. However, the road to the fulfillment of the research objectives has not been free from obstacles.

Limitations apply to this study. First, despite no evidence of CMB, the measures are self-reported. Second, the use of other measures of sustainability and using more complete data could allow for additional analysis and discussion. Additionally, other antecedents of sustainability could be considered in future studies, such as the role of leadership, or the organization's communication level. Furthermore, future research can study the effects of OLC sub-dimensions (experimentation, risk-taking, interaction with the external environment, dialog and participative decision making) on PRAC. Third, moreover, we invite colleagues to use other dimensions for sustainable development, for example, economic development or social development. We argue that addressing such dimensions of sustainable development separately is a challenge worth pursuing with the triple bottom line approach (Glavas and Mish 2015). In addition, determinants of environmental practices, such as industry and return on assets, could be considered in the future developments of this line of research. Fourth, a sample of 349 is small (response rate is 5.1%). Nevertheless, the survey is nationwide, and the sample it generates is representative of Portuguese SMEs. Future studies on countries other than Portugal could large our conclusions. Fifth, the fact that the sample only includes certified innovative SMEs in each industry could affect the results and conclusions. Future studies could compare the results obtained and include a more varied sample of companies. Finally, longitudinal studies that incorporate several levels of analysis could provide evidence on the causal relations and interactions among the dimensions of sustainable development.

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