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Breaking down barriers: The adoption of eco-innovation by SMEs and the influence of personality traits

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Abstract

The role played by leaders in the adoption of eco-innovations (EIs) by small and medium enterprises (SMEs) is crucial, but there is still little evidence regarding the influence of leaders on EIs. Despite the extensive literature on EI, studies that empirically evaluate the association between the role of SME leaders (CEOs, top managers, and board members) on the delimitation of the barriers to EI are lacking. The relationship between combinations of leader personality traits and the adoption of EI from a sensemaking perspective is examined to address this research gap. In addition, fsQCA analysis was applied. The responses of 40 SME leaders revealed that configurations involving barriers and personal traits have led to several solutions in which conscientiousness, openness, and either the presence or negation of neuroticism by SME managers were relevant. Moreover, the offset between financial barriers and the lack of public funding for EIs emerges in all eco-innovative success solutions. These results show that different combinations of personality traits interact with different EI barriers. Therefore, the obstacles to EI depend on the interpretations of the leader rather than being one-size-fits-all. Based on sensemaking theory, as taken from organizational studies and the literature on microfoundations, these findings enhance our understanding of the influence of individual-level psychological traits on EI adoption. Furthermore, practical implications are presented for SMEs with the goal of adopting sustainable innovative strategies.

KEYWORDS

barriers, chief executive officers, eco-innovation, leaders, personality traits, QCA, sensemaking and SMEs

1 | INTRODUCTION

Considering the social and environmental crisis, the role played by small and medium enterprises (SMEs) is paramount. SMEs cause approximately 70% of the total global pollution (Bakos et al., 2020; García-Quevedo et al., 2020). The main reason for this is that 95% of the businesses in OECD member countries are SMEs (OECD, 2017). The OECD (2022) states that SMEs and their leaders constitute the

Abbreviations: AGR, agreeableness; BARN, necessary barrier: a financial barrier or the negation of the lack of government support barriers; BCOL, collaboration barrier; BFIN, financial barrier; BGOV, lack of government support barrier; BKNO, knowledge barrier; BORG, internal organizational barrier; CON, conscientiousness; covS, coverage for sufficiency; covU, unique coverage; EI, eco-innovation; DSEI, Design dimension of eco-innovation; ENISA, National Innovation Enterprise; EXT, extraversion; GNEI, governance dimension of eco-innovation; inclS, consistency for sufficiency; NEU, neuroticism; OPE, openness; PRI, proportional reduction in inconsistency; PSEI, product-service dimension of eco-innovation; SMEs, Small and medium enterprises; USEI, user dimension of eco-innovation.

backbones of leading developed economies and ensure a sustainable, cleaner, and more inclusive pathway to growth. SME leaders address environmental challenges through eco-innovation (EI)[1] (Bossle et al., 2016; Redmond et al., 2008; Urbinati et al., 2017). Thus, leaders are key to firms' adoption of EI (Arena et al., 2018; Salaiz et al., 2021; Sun et al., 2021; Zhang et al., 2020).

Unfortunately, the adoption[2] of EI by SMEs faces several barriers related to technology, finance, regulation, and market demand (Ghisetti et al., 2017; Gupta & Barua, 2018; Jabbour et al., 2018; Murillo-Luna et al., 2011). Previous studies have identified and proposed the use of various barrier taxonomies to distinguish internal and external barriers and the diverse obstacles faced depending on the type, novelty, and maturation stage of EI (Arranz et al., 2019; Caldera et al., 2019; Gupta & Barua, 2018; Jabbour et al., 2018; Polzin et al., 2016). However, these potential barriers are generally conceived as an independent list of the characteristics of SMEs' objectives, concreteness, and immutability (Hudson & Ozanne, 1988). The barriers to adopting EIs are explored as distinct from their general context (Bakos et al., 2020) and, more specifically, as disconnected from the roles of leaders.

Identifying these barriers has inspired the emergence of an increasing body of literature on internal firm factors that facilitate transcending the barriers to EI adoption (Aboelmaged & Hashem, 2019; Salaiz et al., 2021). These internal factors refer to the organizational features that facilitate the adoption of EI (Hojnik & Ruzzier, 2016). Among these studies, a few (Bossle et al., 2016) highlight the role of leaders as a significant internal factor in the adoption of EI by SMEs. Some examples of this include affective drivers or personality traits (Arena et al., 2018; Hrazdil et al., 2021; Walls et al., 2021).

Despite this growing interest in studying the barriers to EI, there are still two underresearched aspects in this field. First, these barriers may be subject to interpretation by SME leaders (Bakos et al., 2020; Marin et al., 2015). For example, a leader who is open to new experiences (openness) sees a lack of funding as a creative opportunity, while a less open leader perceives it as a threat and exhibits resistance to change. In the sensemaking process, leaders create a frame for interpreting a situation and taking action (Gioia & Chittipeddi, 1991; Hahn et al., 2014). We argue that there is an array of leader personality traits that determine the interpretation of the barriers that arise to EI. Second, most previous studies have focused on these traits separately and unidirectionally (Petrenko et al., 2016; Sun et al., 2021; Zhang et al., 2020). Thus, we propose that such leader traits cannot be isolated from each other (Hirsh, 2010; Hrazdil et al., 2021). For example, an open and responsible leader sees regulatory changes as opportunities, acting efficiently and in a timely manner. However, another leader who is open but lacks responsibility might take on such a task but miss deadlines due to poor time management. Therefore, the research gap examined in this paper concerns the relationship between leaders' personality trait combinations and the barriers to EI that need to be overcome. "If leaders can drive business transformation for sustainability, then it is important to uncover how individual-level psychological traits" operate to foster EI (Walls et al., 2021, p. 2) and to analyze the sensemaking process through which leaders interpret the barriers to EI and take action in the form of EI adoption (Gioia & Chittipeddi, 1991).

To advance the understanding of the drivers of EI adoption in SMEs (Bossle et al., 2016; Hojnik & Ruzzier, 2016; Salaiz et al., 2021), we focus on the reconfigurations of diverse personality traits that can overcome EI barriers. Furthermore, we explore the influence of leader personality traits on EI adoption in the managerial decision-making literature (Gond et al., 2017; Hafenbrädl & Waeger, 2017; Salaiz et al., 2021; Walls et al., 2021). Considering the significance of complex managerial motivations to the integration of environmental sustainability into innovation, we address a research question: Are there specific combinations of leader personality traits and barriers to adopting EI?

By addressing this research question, this paper contributes to the literature on the barriers to EI and on the personality traits of the microfoundations (in this case, leaders) involved in EI adoption. The first contribution made involves a novel conceptualization of EI barriers from the perspective of leader interpretations. This approach allows us to delve into the complex relationship between EI barriers and leader motivations through the lens of sensemaking. The second contribution is revealing that examining a joint configuration of personality traits provides more insight into the drivers of EI than examining the individual effect of isolated leader personality traits. Finally, this research offers a methodological contribution to the identification of leader personalities based on configurational theory rather than on traditional statistical methods (e.g., regression and structural equation modeling) (Ou et al., 2015; Petrenko et al., 2016). Moreover, this methodology is seldom used in studies based on psychological microfoundations (Gond et al., 2017; Hafenbrädl & Waeger, 2017; Walls et al., 2021). Therefore, we hope that a configuration of various traits provides additional information to help uncover how and why some leaders can overcome the tension posed by these barriers and facilitate EI (Walls et al., 2021). In this regard, we posit that the qualitative approach based on the configurational theory that is used in this study has the capacity to identify the explanatory factors and complex interdependencies among the internal drivers, mainly linking these factors to leader characteristics in the process of making sense of their environments (external factors) and formulating strategies for adopting EI.

Hence, to achieve our research objectives, we empirically analyze the personality traits of 40 leaders from Spanish SMEs involved in EI. Based on an original semistructured personal interview, our aim is to identify the perceived barriers that had to be overcome to pursue EI, as well as the intensity and type of EI that was conducted. The responses of these leaders enabled us to apply fuzzy-set qualitative comparative analysis (fsQCA) to analyze the influence of personality traits given the sample size and research objectives of this study. Rather than considering personal traits in isolation, fsQCA can be used to identify how the personality traits of leaders and EI barriers combine to achieve a high or low level of EI adoption (Fiss, 2011).

[1]The term eco-innovation is used, as well as the terms environmental innovation and green innovation, are used in this literature, where each indicates an innovation with a lower detrimental impact on the environment (Bossle et al., 2016).

[2]Since firms simultaneously explore and exploit EIs to achieve sustained competitive advantage (Díaz-García et al., 2015), this study does not distinguish between them. Thus, the term EI adoption is related to the development and implementation of both environmental and green innovation.

The remainder of this paper is organized as follows. Section 2 presents an explanation of the conceptual framework and propositions. Section 3 is dedicated to the research methodology, interviews, and data collection procedures. Section 4 presents the data analysis and results. Finally, section 5 concludes the paper by offering a discussion, theoretical and methodological contributions, practical implications, and research avenues.

2 | THEORETICAL BACKGROUND AND PROPOSITIONS

2.1 | Barriers and EI

Authors have examined the barriers that can hinder the adoption of EI by firms (Bakos et al., 2020; Ghisetti et al., 2017; Gupta & Barua, 2018; Marin et al., 2015). Most of these studies identify and classify the types of EI barriers that need to be addressed (Arranz et al., 2019; Caldera et al., 2019; Gupta & Barua, 2018; Jabbour et al., 2018; Polzin et al., 2016). First, a distinction is made between internal and external barriers. Thus, the perception of the risk of high cost due to a lack of knowledge and the uncertainty of demand for EI goods and services have been identified as internal barriers (Arranz et al., 2019). On the other hand, the insufficiency of financial resources for accessing the required knowledge and the time lag needed to accomplish environmental regulations have been identified as external barriers (Triguero et al., 2013), and coercive pressure (through policies and regulations), normative pressure (from the market) and mimetic pressure (from competitors) have also been identified as external barriers to EI (Cai & Li, 2018).

Second, these barriers are classified according to EI type (product, process, or system), EI novelty (radical or incremental), and the stage of EI technological diffusion (mature or immature). Environmental resources, attitudes and perceptions, business practices, a lack of government support, and customer demand are the main barriers to pursuing EI. Moreover, poor external partnerships and insufficient information are more critical barriers to the innovation process. Furthermore, technical barriers, insufficient information, a lack of government support, and commercial environmental benefits are the corresponding for the EI system (Abdullah et al., 2016). Because incremental EI introduces relatively minor changes compared with radical EI, financial restraints and uncertainty in the demand market have been identified as specific barriers to incremental EI, while factors such as technological path dependency or a lack of skilled human resources have been considered more relevant to radical EI (Kiefer et al., 2019; Marin et al., 2015). Finally, the barriers to EI can vary depending on the maturation stage of the EI process. In this sense, supply, demand, and regulatory conditions are important obstacles due to the high levels of risk and uncertainty in the early phases (Triguero et al., 2013), while the need for financial and human resources and the barriers that hinder the transition from pilot projects to larger-scale implementation arise at later stages (Kiefer et al., 2019).

Depending on their origin, dynamic capabilities, SME resources, and the influence of external factors such as government aid or collaboration with partners all hinder the adoption of EIs. The former denotes environmental aspects that SMEs can control, while the latter constitutes barriers that cannot be controlled through resource assignment (Abdullah et al., 2016; Murillo-Luna et al., 2011; Redmond et al., 2008). However, only some studies additionally delve into the combination of these barriers in the pursuit of EI adoption (Marin et al., 2015; Polzin et al., 2016).

A few barriers, such as insufficient consumer demand, governmental support, or commercial benefits, are common. However, they are considered a list of obstacles without the consideration that it is a combination of such barriers that affect the adoption of distinct types of EIs. Regardless of EI targets and outcomes, not all practices imply the same changes within companies. Therefore, various barriers emerge depending on whether the focal EI involves more significant or resource-intensive changes. Financial, customer, and market constraints are perceived as barriers to redesigning products and services. Administrative and regulatory barriers are also identified by SMEs with a focus on waste reduction and renewable energy (Kiefer et al., 2019; Marin et al., 2015).

There are only a few studies that reject the notion of a single particular set of barriers to EI adoption for all SMEs (Bakos et al., 2020; Marin et al., 2015). Thus, Marin et al. (2015) classified SMEs according to the combination of types of perceived barriers. Polzin et al. (2016) also highlighted the configurations of barriers that hinder EI activity. Based on these two studies, we explore the possibility that there are varying combinations of barriers that limit EI. Therefore, we present the following proposition based on this assumption:

> **P1.** The combination of different types of barriers operates as necessary condition for EI adoption.

2.2 | Traits, barriers, and EI

Some features that facilitate EI adoption include environmental capabilities, environmental management, human resources, and environmental strategy (Arranz et al., 2019; Bossle et al., 2016). Recent studies have recognized the role played by leaders in the adoption of EI (Bossle et al., 2016; El-Kassar & Singh, 2019; Fang & Zhang, 2021; Tang et al., 2018). If the role of leaders is essential for EI, then exploring their psychological traits is necessary (Walls et al., 2021). Some leaders are more skilled at overcoming internal barriers, i.e., the obstacles related to corporate culture and knowledge, while others are more skilled at overcoming external barriers, i.e., efficient compliance with policies and legislation within the company's sustainability agenda.

According to Urbinati et al. (2017), there is an essential connection between barriers and leaders because leaders often trigger actions to implement EI. In this way, their perceptions and attitudes help them overcome internal SME barriers, such as insufficient knowledge (Redmond et al., 2008). Furthermore, their perception of stakeholder

barriers results in either a proactive or nonproactive attitude toward environmental initiatives (Guoyou et al., 2013). This leader's proactivity positively breaks through cultural barriers, impacts environmental issues, and fosters collaboration among teams (De Medeiros et al., 2018). Additionally, the commitment of these leaders causes them to accept their legitimate responsibility for the environment and prompts them to address such barriers (Eiadat et al., 2008), for instance, to overcome the technological barriers to adopting EI (El-Kassar & Singh, 2019).

In microfoundations research, individual-level analysis, e.g., the analysis of psychological traits, is used to explain firm-level outcomes through the incorporation of interactions in the business context (Walls et al., 2021). For example, in a context of uncertainty that includes such barriers, individuals may have different opinions and ideas about what is feasible and what is not. Analyzing these traits to determine how such barriers are overcome differently by leaders with different personality traits seems appropriate (Felin et al., 2015).

Studies on personality traits as EI factors typically explore isolated personality traits and are generally based on upper echelon theory, examining how a particular trait can affect the transition toward actions linked to sustainability (Arena et al., 2018; Gond & Moser, 2021; Petrenko et al., 2016; Zhang et al., 2020). Only a few EI studies apply these factors simultaneously (Hrazdil et al., 2021). Thus, the extant studies on the effect of personality traits on EI adoption focus on isolated traits. As Arena et al. (2018) highlight, leader arrogance is an individual factor that intensifies a firm's EI efforts. Another study (Zhang et al., 2020) concludes that such efforts lead to more significant pollution by the firm. Narcissism (Petrenko et al., 2016) can exert positive effects on a company's social and environmental engagement, and leader humility (Sun et al., 2021) facilitates EI activities. Against this background, we aim to broaden this perspective and outline the trait combinations needed to overcome specific barriers to EI adoption.

P2. The combination of different leader traits explains EI adoption.

The basic units that make up personality and affect individual choices are embedded in the Big Five personality traits (Costa & McCrae, 1992; Goldberg, 1999), and they are openness, conscientiousness, extraversion, agreeableness, and neuroticism (OCEAN). For instance, extroverted leaders with distinctive motivational tendencies are more likely to participate in CSR actions (Hrazdil et al., 2021). In the next section, we delve into the personality traits of leaders and the interaction of these traits with the uncertainty of EI adoption barriers, interpreting this situation (Gioia & Chittipeddi, 1991) through a sensemaking process that involves the interpretation of barriers and external dynamics (Weick, 1995).

2.3 | Sensemaking, traits, barriers, and EI

In recent decades, several organizational theories, such as expectation confirmation theory and strategic cognition theory, have explored managerial information interpretations in business decision-making processes. Among them, the sensemaking perspective is critical to organization studies (Sandberg & Tsoukas, 2015). In this regard, there are some studies that focus on sensemaking in leadership (Pye, 2005) and others that consider strategy and organizational change (Palmer & Dunford, 1996). On the one hand, leader characteristics and capacity to effectively make sense of their environments are factors that are considered in the leadership decision-making literature (Thiel et al., 2012). On the other hand, the second group of studies analyzes dynamic capabilities (sensing, seizing, and transforming) through strategy-as-practice (Regnér, 2015). The latter analyzes the behavior of middle management and the ways they formulate strategies for the construction of unique assets to achieve superior performance (Balogun & Johnson, 2004). Sense-making and strategic cognition theory are both cognitive approaches to exploring how people (leaders) and organizations (SMEs) interpret, understand, and respond to complex and dynamic environments. Sensemaking and strategic cognition theories share some common concepts, such as mental models, frames, schemas, and scripts, that shape how people perceive, process, and evaluate information and situations. However, they also exhibit some differences in their focus, scope, and application.

Sensemaking theory addresses how individuals and organizations interpret, understand, and respond to intricate and uncertain environments (Weick, 2001). It is based on the idea that reality is not inherent but rather constructed from the interaction of people and distinct contexts. Furthermore, this theory explores the cognitive, discursive, emotional, and embodied processes that shape how managers make sense of their experiences and how they communicate and coordinate their actions with others (Weick, 2001). According to the sensemaking approach, individuals actively select information from their environment and determine its relevance and meaning (by interpreting information in assessing the potential barriers to EI) (Weick, 1995). A given situation of one manager can be understood as highly relevant or can be completely overlooked. In our case, this relevance assignment leads to one response or the other in regard to EI issues (cf. Daft & Weick, 1984; Thomas et al., 1993, who examine the sequence of the sensemaking process). Interpretation is the scenario in which we extract meaning from signs containing ambiguity, uncertainty, or complexity in enterprise issues (Hahn et al., 2014; Weick, 1995). The sensemaking approach indicates that managers' interpretations are reinforced toward action in the face of these indications.

Akin to sensemaking, strategic cognition theory is focused on the cognitive processes that influence strategic decisions and actions in organizations. Strategic cognition theory emphasizes the analytical and rational aspects of strategic cognition and the ways people use models and techniques to optimize and rationalize their choices and behaviors. It also considers the antecedents and outcomes of strategic cognition, such as environmental scanning, interpretation, decision-making, and performance (Balogun & Johnson, 2004). However, strategic cognition theory is more specific than sense-making theory. Sensemaking theory emphasizes the social and communicative aspects of decision-making processes, including the methods by which people construct and negotiate values with others and the constraints that influence sensemaking (such as uncertainty, surprise, disruption,

politics, and power), while the strategic cognitive view is focused on the strategic context. Despite the differences between these two perspectives, the sensemaking framework enables us to investigate the strategy-as-practice configuration (the adoption of EI) through the manager's understanding of EI barriers (Regnér, 2015; Sandberg & Tsoukas, 2015). Thus, sensemaking is related to strategic managerial cognition.

We focus on the literature that explores managerial cognition and sensemaking approaches in managing environmental and social issues in firms (Hahn et al., 2014; Thomas et al., 1993), and find that most of these studies are motivated by either the goal of identifying the dimensions of business sustainability, e.g., risk reduction or efficiency gains, and exploring the interrelationships between sustainability and managers' ability to form conceptual frameworks (Hockerts, 2015) or to explore how managerial cognition and interpretation influence the response to sustainability issues (Gröschl et al., 2017). Finally, existing studies claim that managers' cognitive frames play an important role in their perceptions of sustainability issues (Hahn et al., 2014). For example, Gioia emphasizes top management sensemaking (Gioia & Chittipeddi, 1991) by examining executive characteristics and drawing a parallel between executive interpretive systems and firm-level interpretations of new phenomena. As Hahn et al. (2014) discussed, sensemaking is not a specific automatic frame used to determine manager sensemaking but rather illuminates managers' personal, situational, and contextual factors and beliefs or backgrounds that serve to moderate this sensemaking (Penttilä et al., 2020). Thus, manager characteristics (i.e., personality traits) influence how cues are recognized and translated into action within a company (Busch et al., 2020). These cues need not always be overt; moreover, the sensemaking scenario can emerge "when the current state of the world is perceived as different from the expected state of the world, or when there is no obvious way to engage with the world" (Weick et al., 2005, p. 409). Other studies also focus on discrepancy, rupture, disconfirmation, or disruption (Weick, 1995). In the current study, we consider personality traits and barriers to have the capacity to jointly interrupt the flow of EI. Based on this assumption, the following proposition is formulated:

P3. Combinations of personality traits and barriers can explain the presence of EI adoption.

3 | METHOD

3.1 | Research model and variables

This study's model for explaining EI adoption in SMEs includes two main components: the barriers to EI adoption and the personality traits of SME leaders. These two components form the conditions, and EI adoption represents the outcome. The variables for the barriers to EI are taken from the study of Gupta and Barua (2018), which covers all the barriers that we have discussed, albeit in a general way. There are seven such barriers: technological and ecological resource-related barriers (BTEC), financial and economic barriers (BFIN), management and organizational human resource-related barriers (BORG), poor external collaboration and stakeholder engagement (BCOL), a lack of government support for green initiatives (BGOV), market and customer-related barriers (BCUS), and insufficient knowledge and information on green practices (BKNO). For the personality trait variables, we follow the Mini-IPIP, which is a 20-item short form of the 50-item International Personality Item Pool-Five-Factor Model measure (Goldberg, 1999). It is used to assess the Big Five personality traits: agreeableness (AGR), conscientiousness (CON), extraversion (EXT), openness to experience (OPE), and neuroticism (NEU), and four items are used for each of these five dimensions. These barrier variables and the Mini-IPIP were measured using a 5-point Likert scale (1 to 5) to indicate the degree of disagreement/agreement, where 1 represents very unlikely, 2 represents unlikely, 3 represents neutral, 4 represents likely, and 5 represents very likely. The study used the mean as a factor for each of the five traits (Donnellan et al., 2006).

To assess the outcome of EI adoption, we use the four critical dimensions of EI identified by Carrillo-Hermosilla et al. (2010) and referred to in many studies to explore the detailed characteristics of each dimension of EI: design, user, product-service, and governance (Kiefer et al., 2021). The design dimension (DSEI) stresses the relevance of the impact of EI on processes, products, and organizational changes, and emphasis is placed on a reduction in both inputs (materials, energy, and water) and outputs (emissions). The user dimension (USEI) refers to company engagement in user–producer interactions, i.e., the changes that a company undertakes to anticipate the market and the changes implemented through the creativity of users. The product-service dimension (PSEI) consists of the delivery of the product or service, and it is used to identify possible changes in customer relations through the improvement of EI, as well as changes in the value chain or in business processes. Finally, the governance dimension (GNEI) describes the stakeholders and their behavior within the value network. We use the mean as a factor of the four dimensions for the EI construct (Carrillo-Hermosilla et al., 2010; Kiefer et al., 2017, 2019).

3.2 | Samples and procedure

Given the complexity of identifying this type of company, to ensure that the sample consists of eco-innovative SMEs and that it is representative, we relied on two Spanish public institutions: Alto Comisionado Para España Nación Emprendedora, which is the body of the Presidency of the Government, and ENISA (National Innovation Enterprise), which supports viable companies aiming to promote innovative entrepreneurship. The ENISA is a part of the Ministry of Industry. The choice of SMEs was derived through consultation with these two entities. A questionnaire was administered to 105 SME managers. Among them, 40 were valid, 27 were nonresponsive, and 38 failed to meet the number of employees and years of activity requirement. Before data collection, a questionnaire and a pilot interview were pre-tested for content validity by three experienced researchers on eco-innovation and three SMEs. Their contributions and comments were considered to refine the questions and minimize the potential

TABLE 1 Characteristics of the sample.

Classification	Frequency	Percentage
Gender		
Male	25	62.5
Female	15	37.5
Age (years)		
18–25	5	12.5
26–30	12	30
31–36	10	25
Above 37	23	32.5
SME experience (years)		
0–4	5	12.5
5–10	12	30
11–20	12	30
Above 20	11	27.5
SME size (employees)		
5–20	23	57.5
21–35	6	15
36–99	7	17.5
Above 100	4	10
Sector category		
Food	11	27.5
Clothing or other textile products	10	25
Industry	6	15
Construction	5	12.5
Consultancy	3	7.5
Logistic	2	5
Technology	2	5
Tourist	1	2.5
Geographical area		
Rural area	14	35
City area	26	65
Total	40	100%

bias in the questionnaire response and interview process (Creswell & Poth, 2016). Moreover, meticulous attention was given to ensuring the precision and clarity of the measurement items for easy comprehension, considering that the target group comprises SME managers who are familiar with EI. The anonymity and voluntary nature of respondent participation were guaranteed to mitigate potential biases such as social desirability and common method biases. The questionnaire was sent out with a brief explanation of the general purpose of the study in compliance with these criteria, and a phone call was made to explain these issues prior to the interview to enhance the validity of the responses and minimize the potential bias in our survey research.

Subsequently, the sample was reduced to 40 leaders; 37.5% of them were female, and 62.5% were male. They had all been active in SMEs for at least 5 years, managed at least five employees, and were located in as many Spanish locations as possible; these locations covered the rural, urban, northern, and southern areas (Table 1). Once selected, we interviewed participants to gather information on personality traits, barriers, and degrees of EI adoption and development. We found this step to be particularly important, as EI self-assessment is complicated, particularly for those less acclimated to technical issues. The interviews were recorded and transcribed, and they lasted from 40 minutes to over an hour. All the interviews were performed online aside from two interviews that were conducted face-to-face.

3.3 | Methodology

Analyzing leader traits and characteristics requires a qualitative approach (Neely et al., 2020). QCA is a research approach based on Boolean algebra that is used to explore how a combination of configurations can be used to explain an outcome (Ragin, 2008). A configuration refers to a combination of conditions that are relevant to the given outcome. QCA is based on equifinality, asymmetry, and conjunctural causation (Schneider & Wagemann, 2013). First, the characteristic of equifinality enables the connection of many combinations of causally relevant conditions to the same outcome, which in our case involves various combinations of personality traits—with a focus on those with the capacity for overcoming barriers—that lead to the same unique outcome (EI adoption). Second, asymmetry occurs when a configuration that leads to a particular outcome is not the opposite configuration from one that leads to a negation of that outcome. In our case, the configurations that lead to an outcome (a high level of EI) may differ from those that lead to its negation (a low level of EI). Finally, conjunctural causation, which is implicit in QCA, enables a consideration of the interactions among conditions in a phenomenon (Oana et al., 2021). QCA assumes that the influence of attributes on a specific result depends on their combination rather than on isolated individual attributes (Medina-Molina et al., 2022). Furthermore, unlike other methods, QCA does not work with independent or dependent variables; rather, it uses terms, conditions, and outcomes. Similarly, rather than stating hypotheses, working propositions are established in QCA.

This approach is well suited to this study because, with access to leaders being very restricted (Walls et al., 2021), a qualitative methodology allows us to keep the number of samples small and to examine the relationship between the characteristics of leaders and specific firm outcomes such as EI adoption (Neely et al., 2020). QCA can be especially useful for conceptualizing the mechanisms that operate across intraindividual levels (e.g., identifying the traits of leaders) and how they might combine in various configurations that can explain specific outcomes (Gond & Moser, 2021; Ortega-Carrasco & Ferrón-Vílchez, 2022). Likewise, set-theoretical methods such as QCA are used for managerial studies because they help improve the understanding of management realities while maintaining their holistic character, i.e., innovation (Neely et al., 2020). Furthermore, fsQCA is suitable for sample sizes of 10–50.

TABLE 2 Conditions, outcomes, and sources.

Conditions/ outcomes		Items	Source
Remote Barrier conditions	Technological (BTEC)		Gupta and Barua (2018)
	Financial (BFIN)		
	Internal organizational (BORG)		
	Collaboration (BCOL)		
	Lack government support (BGOV)		
	Market and customer (BCUS)		
	Knowledge (BKNO)		
Proximate Trait conditions	Agreeableness (AGR)	1. Sympathize with others' feelings 2. Am not interested in other people's problems 3. Feel others' emotions 4. Am not interested in other people's problems	Costa and McCrae (1992), Goldberg (1999)
	Conscientiousness (CON)	1. Get chores done right away 2. Often forget to put things back in their proper place 3. Like order 4. Leave my belongings around	
	Extraversion (EXT)	1. Am the life of the party 2. Do not talk a lot 3. Talk to a lot of different people at parties 4. Keep in the background	
	Openness (OPE)	1. Have a vivid imagination 2. Am not interested in abstract ideas 3. Have difficulty understanding abstract ideas 4. Do not have a good imagination	
	Neuroticism (NEU)	1. Have frequent mood swings 2. Am relaxed most of the time 3. Get irritated easily 4. Seldom feel blue	
Outcome	Eco-innovation	1. Design (DSEI) 2. User (USEI) 3. Product-service (PSEI) 4. Governance (GNEI)	Carrillo-Hermosilla et al. (2010)

[Correction added on 19 June 2024, after first online publication: In Table 2, the data in Outcome row, Items and Source columns were interchanged and have been corrected in this version.]

3.4 | Analytical strategy

3.4.1 | Calibration and measurement validation

The first stage of the analysis involved the calibration of the data. The scores of personality traits and EI (which varied from 1 to 5) and the barriers of a 5-point Likert were translated into fuzzy-set membership values (between 0.0 and 1.0). We set the thresholds for the 5-point Likert scale (1 to 5) as follows: 2 or below was calibrated to 0.0 (full nonmembership), 3 was calibrated to 0.5 (crossover point), and 4 or above was calibrated to 1.0 (full membership) (Pappas & Woodside, 2021). After indicating these three thresholds, the Set-Methods package of RStudio produced the relevant fuzzy scores. After the calibration process, to reflect the diversity and heterogeneity of cases, the conditions are first checked for asymmetry related to skewness (the conditions used in the model are less than 20% or greater than 80%) (Oana et al., 2021). Second, ambiguous cases (with a value of 0.5) are analyzed. For each ambiguous case, 0.1 is added or subtracted after the calibration process (Fiss, 2011), according to the interviews with leaders.

3.4.2 | Previous analysis

Two-step protocol: remote and proximate conditions

Once the data are ready, the two-step protocol is applied (Schneider, 2019; Schneider & Wagemann, 2013). This protocol assists in the minimization process due to the limitation of logical remainders through the reduction in the number of conditions in the necessity analysis, which is the first step, and their inclusion in the sufficiency analysis, which is the second step, through the separation of conditions (Schneider & Wagemann, 2013) into either remote (assuming the context, barriers) or proximate conditions (affecting the outcome, the personal traits of leaders) (Medina-Molina et al., 2022;

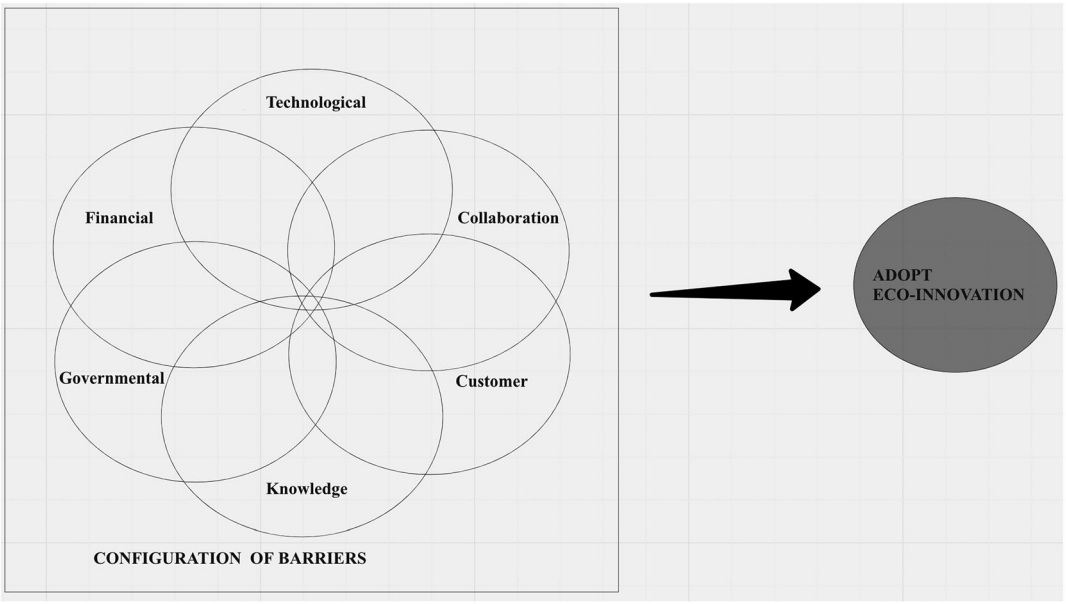

FIGURE 1 Step 1 of the two-step protocol.

Schneider, 2019). The sources of these materials are described in more detail in Table 2.

3.4.3 | Step 1. Identification of the necessary conditions

In step 1, the barriers are analyzed using necessity analysis, as shown in Figure 1. The term necessary conditions implies that each time the outcome is present, the antecedent condition is also present. The possibility of an atomic condition, or a single barrier, being a necessary condition is analyzed. When this is not the case, the possible sets of barriers for this necessary condition, which constitute a supersubset, are analyzed. This constitutes the minimal set of disjunctions that must have theoretical significance and fulfill the established criteria.

The consistency values are used to identify whether a condition is necessary for the EI outcome and its negation (∼EI), which is regarded as consistency (Cons.Nec.) A threshold of 0.90 is used to identify conditions that can be considered necessary (Schneider & Wagemann, 2013). The coverture (Cov.Nec.) and the relevance of need (RoN) are accepted when the threshold is 0.50 (Bazzan et al., 2022). In the Results section, only the solutions that met the need thresholds for consistency, coverture, and relevance are shown.

3.4.4 | Step 2. Identifying the sufficient conditions

In the second step of the two-step protocol, a sufficiency analysis is conducted. Before proceeding with a sufficiency analysis, fsQCA requires the creation of the truth table with consistency (inclS) > 0.75, which is the ratio of cases meeting the condition and the outcome of all cases. A proportional reduction in inconsistency (PRI) > 0.51 is the measure by which a given configuration is part of the outcome and its negation. There are two types of coverage measures: raw coverage and unique coverage. The raw coverage data represent the proportion of cases with the outcome explained by a configuration (covR) between 0.25 and 0.65. Unique coverage, on the other hand, denotes the proportion of cases where the outcome is explained exclusively by a configuration (covR). Finally, the two parameters for the complete solution (of all combinations of conditions) are consistency, the ratio of cases that are explained by the solution, and the outcome. The coverture is the ratio of cases that have an outcome to those that have a solution. Again, only the solutions that met the thresholds of consistency and coverage are shown in the Results section (Eng & Woodside, 2012).

The truth table represents every possible iteration of combinations of the presence and absence of the trait conditions and the barrier conditions identified as necessary conditions in step 1 (Schneider, 2019). The enhanced standard analysis (ESA) is used for the sufficiency analysis. The ESA is carried out because standard analysis does not involve untenable assumptions, so we must keep them in mind when performing our analysis (Oana et al., 2021). We will continue with implausible counterfactuals if we have the necessary conditions for adopting EI. The conservative solution is chosen because it does not lead to more detail in these cases (Oana et al., 2021). Figure 2 provides an overview of the research process.

4 | RESULTS

As explained above, the standard procedure was followed: first, the existence of an atomic barrier condition for each time EI adoption was

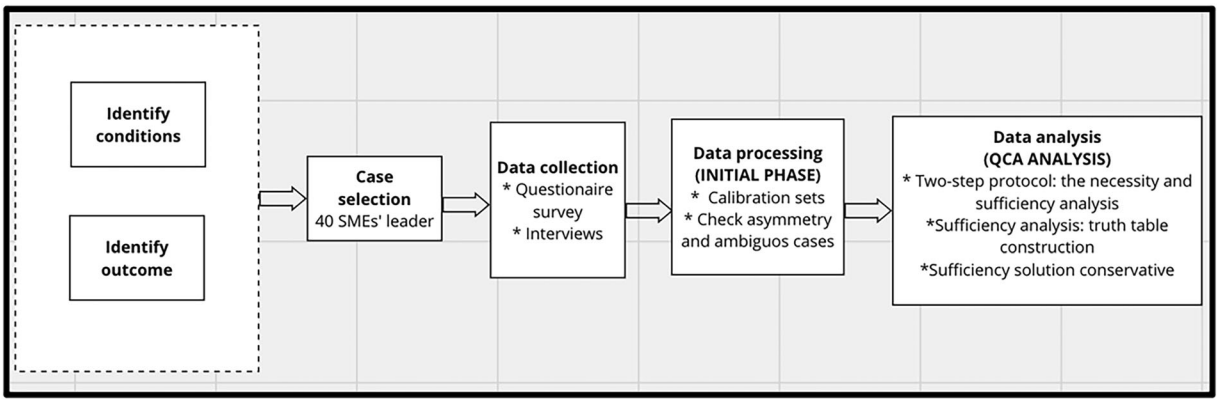

FIGURE 2 Diagram of the research process (research methodology).

TABLE 3 Supersubsets.

	inclN	RoN	covN
BFIN + ~BGOV	0.925	0.539	0.826
~BORG + BKNO	0.902	0.522	0.809
BORG + ~BKNO + BCOL + ~BGOV	0.902	0.519	0.808

Abbreviations: BFIN, financial barrier; BORG, internal organizational barrier; BCOL, collaboration barrier; BGOV, lack of government support barrier; BKNO, knowledge barrier.

studied (Oana et al., 2021). We found that no atomic barrier condition is present. Thus, the existence of a subset of barrier conditions (supersubset of necessary conditions) was studied. These were combined into three supersubsets (Table 3). The first supersubset ("BFIN + ~ BGOV"): the disjunctive between the financial barrier and nonperception of the lack of government support barrier, hereafter referred to as the BARN, exceeded the needed threshold. This configuration has the highest consistency, which is a crucial necessary condition in empirical analysis (Duşa, 2019). Additionally, the results met the theoretical and empirical criteria. Therefore, as we suggested in the preceding section on barriers that appear as a list for all SMEs, there is no single barrier that acts as a necessary condition; that is, there is not a straightforward barrier that consistently obstructs SMEs when adopting EI but rather a combination of them. The former suggests that proposition 1 is accomplished.

Second, the truth table (Table 4) was created to analyze sufficient conditions through enhanced standard analysis. This analysis included the supersubset of barrier conditions presented in the previous step (BARN condition) (Schneider, 2019) and trait conditions. There are six total conditions (see Figure 3). The table shows the enhanced conservative solution for the EI and shows the four solutions. These are four conjunctions with consistency, two covertures (covS, covU), and PRI parameters in excess of the required levels. The complete solution has a consistency of 0.873 and a coverage of 0.837, indicating that 87.3% of the cases of the solution have adopted EI and that the solution accounts for 83.7% of all cases that have adopted EI. Figure 4 shows a graphical representation of the enhanced conservative solution.

All solutions include the necessary condition of the barrier (BARN). Thus, this result further strengthens the importance of financial constraints in the absence of public support schemes. This combination of barriers (BARN) and leader personality traits explains EI adoption. In other words, there are various combinations of traits that can help leaders overcome barriers and achieve a high degree of EI adoption. As shown in Table 4, the first two solutions are simplified as AGR*OPE*BARN (EXT + NEU); that is, leaders with agreeableness, openness, and extraversion traits are more apt to overcome these barriers, and the quality of neuroticism is associated with agreeableness and openness. The subset including the neuroticism trait (covS = 0.330) is much smaller than that containing agreeableness, openness, and extraversion (covS = 0.618), considering the raw coverage parameter.

The third and fourth conjunctions are represented as ~NEU *CON*BARN (OPEN + AGR* ~ EXT). In the first case, a leader with the traits of emotional stability (not neuroticism) and conscientiousness tends to be more open to EI adoption and more able to overcome its barriers. This finding suggests that while being a responsible and stable leader assists in overcoming barriers, the trait of openness is necessary for EI adoption. In the second case, leaders who are conscientious and emotionally stable and who are also agreeable and introverted (rather than extraverted), rather than having an open mind, tend to adopt EI.

From the explanations above, proposition 2, which states that the solution to overcome EI barriers and achieve the highest level of EI depends on the combination of personality traits, is accepted, as it is supported by the conjunctural causation of QCA. Thus, analyzing the traits of leaders in relation to EI adoption alone is not recommended.

Regarding proposition 3, the equifinality of QCA supports the idea that there are four combinations of personality traits that enhance the adoption of EI, including one that involves the disjunctive effect between the financial barrier and one that involves the negation of the lack of government support barrier (BARN). Each SME leader can interpret the barriers in various ways. For example, in our study, the SME leader in case 4, who exhibits a combination of traits of the third conjunction, does not consider financial slack a barrier. However, the SME leader in case 9, who exhibits a combination of

TABLE 4 Conservative sufficiency solution with ESA for EI.

	inclS	PRI	covS	covU	Cases
AGR*OPE*NEU*BARN	0.967	0.949	0.330	0.053	3,15,16,19,30,35,40
AGR*OPE*EXT*BARN	0.866	0.816	0.618	0.067	36,29,2,7, 1,2,5,7,11,12,20,21,27 29,31,36,38 20,38
~NEU*CON*OPE*BARN	0.880	0.830	0.613	0.041	1,2,5,7,9,10,11,14,18,20, 21,22,23,24,26,27,29,31, 33,36,38
AGR*~NEU*CON*~EXT*BARN	0.954	0.922	0.311	0.024	4,8,9,14,18,22,26,27
Solution	0.873	0.837	0.857		

Abbreviations: AGR, agreeableness; CON, conscientiousness; EXT, extraversion; OPE, openness; NEU, neuroticism; BARN, necessary barrier: a financial barrier or the negation of the lack of government support barriers; inclS = consistency for sufficiency; PRI = proportional reduction in inconsistency; covS = coverage for sufficiency; covU = unique coverage.

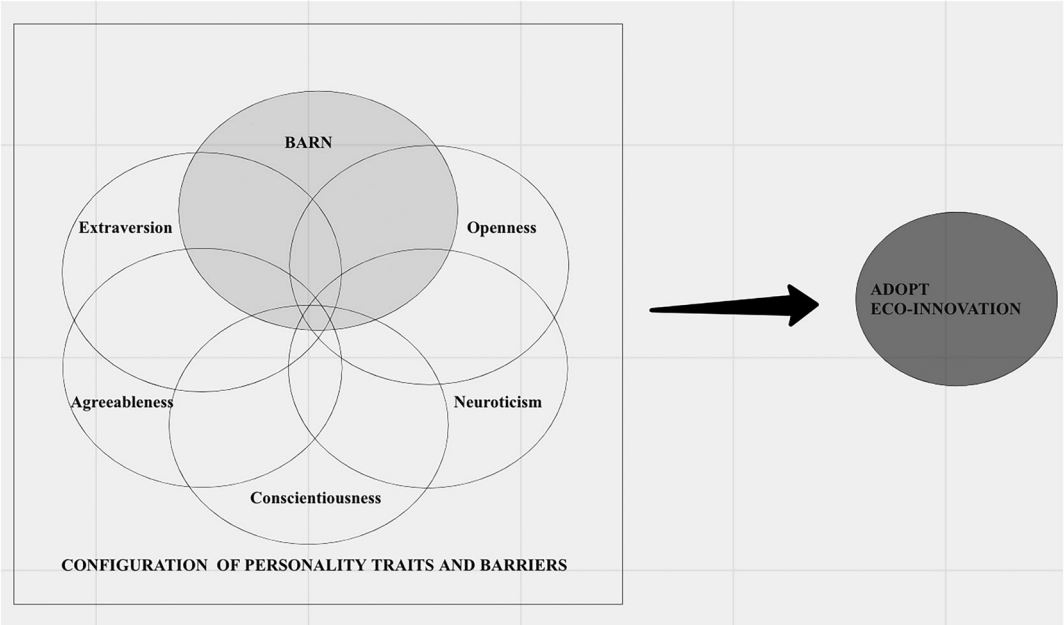

FIGURE 3 Step 2 of the protocol. Abbreviations: BARN, necessary barrier: financial barrier or negation of the lack of government support barrier.

traits of the first conjunction, does perceive financial slack as a barrier. Therefore, EI adoption depends on leader trait combinations and leader interpretation of the EI barriers. In other words, if leaders consider such factors to be obstacles to EI adoption, then they perceive them as barriers; otherwise, they do not. Consequently, proposition 3 is supported, indicating that various combinations of personality traits and barriers facilitate the adoption of EI.

4.1 | Robustness test

In accordance with the recommendation of Oana et al. (2021), a robustness check was conducted to enhance the credibility of the conclusions. This examination involved three steps: (1) establishing the sensitivity of the parameters, (2) establishing fitting-oriented robustness, and (3) establishing case robustness. The first step, the calibration range test, shows that modifying the calibrations has no impact on the result. Moreover, the number of required cases, when higher than 1 and the consistency level was modified beyond 0.85, impacts the results (see Table 5).

Second, Table 5 presents the fit-oriented robustness results and is used to compare the fit parameters for the initial solution (IS), the robust core (RC), and the minimum and maximum test sets. All the parameter scores were above 0.8. Regarding case-oriented robustness, both the number of robust deviant consistency cases and the number of typical robust cases are high, indicating that many of both the robust deviant consistency cases and the typical cases are robust compared to the total number of such cases (robust, shaky, and possible). A ranking of 2 indicates the existence of possible cases.

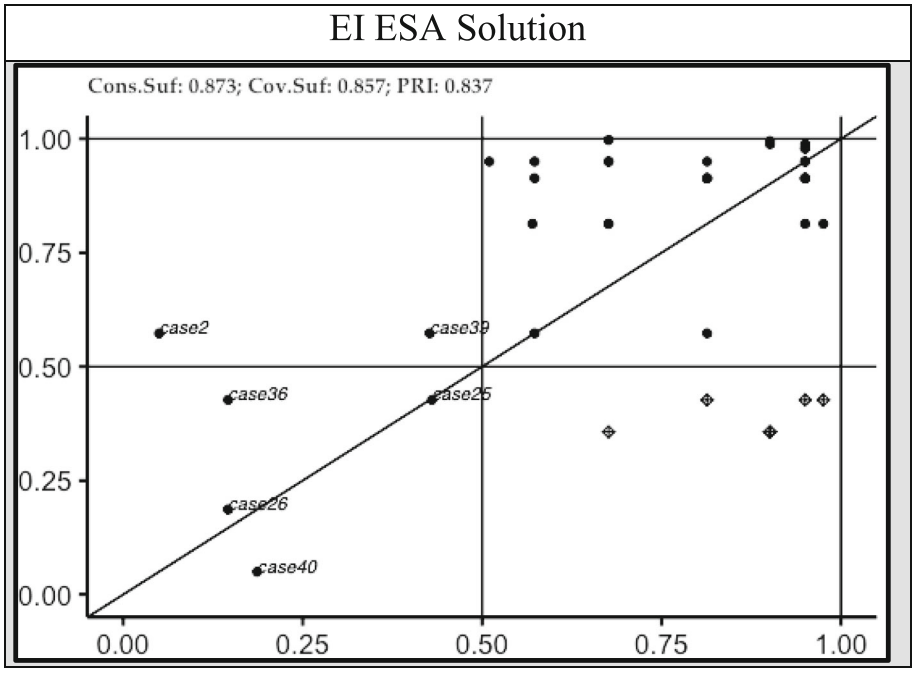

FIGURE 4 Conservative sufficiency solution for EI adoption based on ESA.

5 | DISCUSSION AND CONCLUSIONS

The results obtained from surveying 40 leaders of Spanish SMEs involved in EI lead us to the following conclusions. First, we found that different combinations of barriers arise in adopting EI, corresponding to the various interpretations of leaders depending on whether they perceive barriers to EI. Second, we find that personality traits influence the sensemaking process of SME leaders by helping them interpret the combination of barrier conditions and institute EI adoption as a strategy. Finally, we revealed that specific combinations of leader personality traits determine EI actions.

On the one hand, three distinct barrier combinations are identified: (1) the interaction between the financial barrier and the lack of government support barriers, (2) the interaction between the knowledge barrier and the lack of internal organization barriers, and (3) the interaction among internal organization and knowledge barriers (internal), collaboration and the nonperception of limited government support barriers (external). Regarding the first combination, previous studies have also highlighted financial restraints as an EI barrier (Arranz et al., 2019; Ghisetti et al., 2017; Jabbour et al., 2018), but we find that this condition is unlikely when EI is being funded by government programs. This finding confirms that public support can offset financial EI barriers, particularly for SMEs. This complementarity also strengthens the idea that the effectiveness of public funding interacts with the availability of external financing, as argued by Cecere et al. (2020). Regarding the second combination, we find that knowledge barriers can hinder EI adoption even under a lack of internal organizational barriers. This finding suggests that when internal organizational barriers are low, SMEs can more effectively leverage external knowledge to drive EI. The lack of internal organizational barriers assists in overcoming technological lock-ins and engaging in EI collaboration with suitable partners (Marin et al., 2015). Finally, the relationships between internal organizational and knowledge barriers (internal barriers) and between collaboration barriers and the nonperception of limited government support barriers (external barriers) suggest that both types of barriers are essential for explaining EI adoption. This result is in line with the findings of previous studies that show that internal and external factors either hinder or facilitate EI (Arranz et al., 2019; Kiefer et al., 2019). Thus, given these three combinations of barriers, we suggest that there is no single objective barrier to EI adoption for all SMEs. This conclusion is in line with the findings of Bakos et al. (2020, p. 8), who stated that "all SMEs are unique, and so are their barriers."

We show that the perception of EI adoption barriers is based on leader personalities. Relying on the sensemaking process, and more specifically on its interpretation phase, reveals that certain personality traits play essential roles in leader decisions. In this vein, by establishing the first set of barriers, which is the most theoretically significant and the best fit for the set criteria, four combinations of personality traits are identified as enhancing EI. First, leaders who naturally combine warmth, kindness, and an outgoing, sociable personality (agreeableness, openness, and extraversion) see a lack of government support as the most challenging barrier. With an extensive network of connections, they recognize the need for public funding and feel justified in seeking it. They trust in their ability to overcome this obstacle, readily navigating complexity. They explore creativity through new avenues of thinking to generate new ideas (openness) (Şahin et al., 2019). Furthermore, they exhibit confidence in their interactions (agreeableness). Moreover, the openness trait is one of the most critical traits associated with environmental concern and may offer a broader perspective of humanity's place in ecology (Hirsh, 2010). In line with the studies by Milfont and Sibley (2012), openness and

TABLE 5 Robustness test.

Calibration range				
		Lower bound	**Threshold**	**Upper bound**
AGR	Exclusion	NA	2	2
	Crossover	3	3	3
	Inclusion	3	4	6
NEU	Exclusion	2	2	2
	Crossover	3	3	3
	Inclusion	4	4	4
CON	Exclusion	NA	2	2
	Crossover	3	3	3
	Inclusion	4	4	4
EXT	Exclusion	NA	2	2
	Crossover	3	3	3
	Inclusion	4	4	4
OPE	Exclusion	NA	2	2
	Crossover	3	3	3
	Inclusion	4	4	4
BARN	Exclusion	NA	2	2
	Crossover	3	3	3
	Inclusion	4	4	NA
Raw consistency test		0.85	0.85	0.85
N. cut range		1	1	1
Robustness parameter EI				
Fit-oriented RF_cov: 0.935 RF_cons: 0.983 RF_SC_minTS: 0.919 RF_SC_maxTS: 0.962				
Case-oriented RF RCR_typ: 1 RCR_dev: 0.857 RCC_Rank: 2				
Performing models				
AGR*OPE*BARN + ~NEU*CON*OPE*BARN + AGR*~NEU*CON*~EXT*BARN (2) RCC_rank: 2 SC:0.844				
AGR*OPE*BARN + ~NEU*CON*OPE*BARN + AGR*~NEU*CON*~EXT*BARN (3) RCC_rank: 2 SC:0.844				
AGR*NEU*OPE*BARN + AGR*EXT*OPE*BARN + ~NEU*CON*OPE*BARN + AGR*~NEU*~CON*~EXT*BARN (1) RCC_rank: 1 SC:1.0				

Abbreviations: AGR, agreeableness; CON, conscientiousness; EXT, extraversion; OPE, openness; NEU, neuroticism; BARN, financial barrier, or negation of the lack of government support barrier; EI, eco-innovation.

agreeableness are the personality traits most strongly linked to environmental engagement. This finding aligns with that of Ceglia et al. (2017), who concluded that these traits are crucial for carrying out all activities within an ecological industrial park, even in the face of a significant regulatory barrier. Therefore, our findings show that to overcome the lack of governmental support for EI, leaders must exhibit clear traits of openness and agreeableness. These leaders could be identified with the labels charming and collaboratively environmental. Second, we identify a highly committed, demanding personality with a strong sense of responsibility and a reluctance to delegate (conscientiousness, introversion -no extraversion-, agreeableness and emotional stability -nonneurotic-) for those leaders who do not consider a lack of government support as a barrier but rather see financing as such. According to Hirsh (2010), leaders with conscientious traits exhibit high levels of self-discipline, self-improvement, and competence, displaying the behavior needed to adhere to environmentally positive norms. Based on our results, we find that these leaders perceive external barriers, such as limited government support, as beyond their reach; however, they view these barriers as obstacles to financing, which they perceive as being within their control and competence. These findings support those of Zacher et al. (2023), who explored a green behavioral framework for those working on leadership teams and emphasized conscientiousness as the most suitable trait for addressing those barriers that primarily exist within the work context, including those involving internal resources, such as financial barriers. We can assert that these results indicate that leaders with conscientious traits can overcome financial and internal barriers. Nevertheless, these leaders do not view the government's lack of support as an obstacle. These leaders align with the label of demanding and self-reliant.

In the third and fourth combinations, we find that neuroticism is a significant trait in EI adoption. The presence and negation of neuroticism appear in the solutions, confirming that this study's methodology can effectively identify conditions with opposite causal effects

depending on the combinations presented (Schneider & Wagemann, 2013). On the one hand, the presence of neuroticism is linked to openness and agreeableness. This result is in line with that of Hrazdil et al. (2021), who highlighted the positive influence of neuroticism and agreeableness on the social and environmental engagement of leaders with the aim of enhancing sustainability. This finding echoes the literature on hubris and ruthless leaders with a tendency toward EI adoption (Arena et al., 2018; Petrenko et al., 2016; Tang et al., 2018; Zhang et al., 2020). Previous studies have highlighted the relevance of neuroticism to environmental issues (Wiseman & Bogner, 2003). However, recent research has suggested that this trait might be the least suitable for achieving sustainability (Ceglia et al., 2017; Milfont & Sibley, 2012). Leaders with neurotic tendencies can overcome these barriers by balancing this trait with openness and kindness. These leaders could be known as neurotic yet compassionate. On the other hand, the fourth combination, nonneurotic, is linked to conscientiousness and openness. A highly stable personality trait (no neuroticism) and careful work (conscientiousness) characterized by a strong sense of carefulness make such individuals likely to meticulously adhere to social guidelines and norms regarding environmentally responsible actions (Hirsh, 2010). Overcoming barriers is crucial to EI, which can be stressful if rigorous compliance processes prolong this process. Leaders with a high degree of openness can help make this process shorter and thus more resilient for the firm, as they can apply new ways of acting based on creativity and curiosity to explore new opportunities. Therefore, this trade-off between perfectionism and a broad mindset leads us to label them as resilient and composed leaders.

5.1 | Theoretical and methodological contributions

In light of the relatively scarce attention given to the personality traits of leaders in the EI literature, the relationships among the aspects of SME leadership personalities, barriers encountered, and EI adoption are analyzed, which broadens and deepens the literature. This study makes two significant theoretical contributions and a methodological contribution to the literature.

First, this study's results contribute to a new conceptualization of EI barriers by considering leader interpretations, thus highlighting the importance of the complex relationship between EI barriers and leader motivations through a sensemaking lens. From a theoretical perspective, the use of such a sensemaking view advances the study of personality traits and EI barriers. Although this approach has been widely used in organizational studies as a means of understanding how individuals interpret and respond to their environments (Sandberg & Tsoukas, 2015), we believe that sensemaking can help elucidate how individual personality traits influence the perception and interpretation of EI barriers. In this regard, SME leaders with specific personality traits, such as agreeableness, openness, and conscientiousness, perceive and interpret barriers differently than leaders who exhibit other traits. Leaders may be more willing to engage in EI despite the perceived barriers, or they might interpret certain barriers as challenges to overcome rather than as overwhelming obstacles. Relatedly, the present work contributes to sensemaking theory by revealing the importance of interpreting information to assess potential barriers to EI (Weick, 1995). Thus, this approach enables the integration of the influence of individuals' and firms' heterogeneity on the ability to overcome barriers and the willingness to adopt EI. This goal is in line with the numerous studies that have attempted to reveal such heterogeneity by distinguishing various firm profiles and sectoral patterns (Kiefer et al., 2019; Marin et al., 2015). In addition, our theoretical view considers the sensemaking process to influence strategic SME decisions and actions in EI adoption, thus properly linking sensemaking theory to strategic cognition theory.

Second, considering a combination of personality traits rather than relying on a single trait is pivotal in attaining the highest EI level, thus contributing a renewed approach to the reconfiguration of these traits. Under this assumption, it is confirmed that the reconfiguration of leader personality traits facilitates the adoption of EI. From a theoretical view, the impact of each leader's personality traits may depend on their combination with other traits following microfoundational research. In line with previous recommendations made by other authors (Bossle et al., 2016; El-Kassar & Singh, 2019), we discourage the analysis of leader traits in isolation regarding EI adoption but rather encourage consideration of their various configurations.

Finally, as a methodological contribution, we show that the QCA method is a more suitable empirical methodology than other common methods used in the existing empirical evidence. To date, traditional statistical methods, which are often based on linear patterns, symmetrical relationships, and the uniform causal effects of each variable, have been widely used. These methods suggest that more or less frequent traits can lead to varying degrees of EI adoption, thus revealing the effects of these factors. Following the debate on whether microfoundational factors can be elucidated through the use of traditional statistical methods (Ou et al., 2015; Petrenko et al., 2016), the QCA methodology contributes to a better understanding of the influence of personality traits on EI outcomes; in other words, this methodology contributes to better understanding the causes of these effects. This finding aligns with that of Jaleha and Machuki (2018), who argue that linear models are inadequate for investigating how a distinct and isolated trait influences the scope of EI.

5.2 | Implications for managerial practice and policy

Our results have important implications for managers, entrepreneurs, and policymakers. First, enhancing the understanding of SME managers regarding the influential personality traits associated with EI barriers can help them become more aware of which barriers they can easily overcome and which ones might require assistance. We argue that the more leaders invest in self-awareness, for instance, through a coaching process or self-awareness program, the better they can adjust their actions when overcoming barriers. In other words, all knowledge regarding oneself can be translated into improvements

within the company when facing EI obstacles. In the end, understanding one's self helps in making more informed and strategic decisions, thus potentially nurturing a business environment that is more innovative and environmentally conscious.

Second, maintaining an emphasis on the importance of combinations of leader traits for overcoming EI barriers is particularly relevant for educators in the field of entrepreneurship, particularly for those focused on EI businesses. This enables educators to highlight which members within entrepreneurship teams are more likely to complement each other and which leader traits have the potential to result in greater success, which depends on the particular barriers and sector involved. Specifically, regarding the formation of teams and the selection of staff, educators should consider the combination of traits that these future employees possess. For instance, if a leader has a highly conscientious trait, even to the extent of being obsessed with environmental issues, then they should surround themselves with individuals who exhibit agreeableness or openness. This approach can help offset this overwhelming focus and facilitate a more open and opportunistic perspective.

Finally, from a policy perspective, exploring the adoption of EI offers fresh insights into ways to boost sustainability in SMEs. Considering personality traits when addressing the barriers to EI adoption and sustainability in general, which is a dynamic that has been largely overlooked until now, is crucial. We urge academics to pay closer attention to the psychology of actors in the sustainability literature. This perspective can generate new ideas aimed at innovative societal transformations.

5.3 | Limitations and future research

Given that this work is based on interviews and surveys, the number of SMEs accessed is limited and constrained to Spain. In future research, we would like to contrast our propositions and results using a larger sample of European countries and SMEs, as we are aware of the sociocultural and regulatory differences that may exist between countries.

Second, the Big Five personality traits are used as causal conditions that combine with the barriers to EI adoption. Due to this study's focus on personality traits and the limited number of conditions assessed through QCA, alternate conditions have not been explored. It would be very interesting to include human values, such as Schwartz's ten values (1994), in future studies or to assess emotional aspects beyond those linked to leader personalities in SMEs. We would also like to analyze emotions in strategy work to obtain further insights into our understanding of strategy as practice (Brundin & Melin, 2006).

Finally, we can attempt to establish a cause–effect relationship between these specific combinations of leader personality traits and barriers and the economic, social, and environmental impacts of EI on SMEs. In other words, it would be very interesting to determine the consequences of decisions based on the sensemaking process and whether the interpretation of EI barriers to and EI decision-making changes after this experience. Importantly, EI barriers are not static but rather change over time and across contexts. Therefore, SME strategies for overcoming EI barriers need to be assessed to identify a transition toward a greener and more sustainable economy in the coming years. Any study that brings us closer to the goal of overcoming obstacles and finding approaches that involve lesser impacts on the planet and society is necessary and urgent. Along these lines, Fran Benedito, CEO of ClimateTrade at the UN Climate Change Conference COP28, has stated, "we have a unique opportunity to lead the construction of a more sustainable future and ensure our long-term success" (Climatetrade, 2023).

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CONFLICT OF INTEREST STATEMENT

This manuscript has not been published and is not under consideration for publication elsewhere. We have no conflicts of interest to disclose.

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APPENDIX A

Interview questionnaire

1. You perceive the TECHNOLOGICAL BARRIER as a limitation when adopting Eco-innovations.
   Refers to aspects such as:

- Technological incompetence on the part of the company when it comes to absorbing EI developed by others.
- Complex technological design processes and sophistication in reusing or recycling products and/or reducing the use of resources.
- Skepticism when it comes to investment in technology, it could happen that there is a low response from the market.

Strongly disagree 1 2 3 4 5 Totally in agreement.

2. You perceive the ECONOMIC AND FINANCIAL BARRIER as a constraint to adopting Eco-innovations.

Refers to aspects such as:

- Lack of access to subsidies, tax incentives or bank loans.
- High costs of waste disposal in general.
- High costs of changing from the traditional system to a more sustainable system.

Strongly disagree 1 2 3 4 5 Totally in agreement.

3. You perceive the MANAGEMENT, ORGANIZATION, AND HUMAN RESOURCES BARRIER as a limitation when adopting Eco-innovations.

Refers to aspects such as:

- Lack of commitment on the part of the entrepreneur or company leader, and/or reluctance to shift towards EI practices on the part of the management team.
- Lack of interaction with government agencies in relation to EI.
- Lack of training or programs for EI practices brought in from human resources for employees.

Strongly disagree 1 2 3 4 5 Totally in agreement.

4. You perceive the BARRIER OF STAKEHOLDER (CUSTOMERS, SUPPLIERS, GOVERNMENT, OR SOCIETY) COLLABORATION AND COMMITMENT as a constraint to adopting Eco-innovations.

Refers to aspects such as:

- Unwillingness on the part of your supply chain to share information on EI practices.
- Poor communication with external partners and lack of clarity on the roles of each in relation to EI adoption.
- Lack of platforms or forums for SMEs to discuss EI.

Strongly disagree 1 2 3 4 5 Totally in agreement.

5. You perceive the GOVERNMENT SUPPORT BARRIER as a constraint to adopting Eco-innovations.

Refers to aspects such as:

- Rigid and complex rules when adopting EI.
- Application of environmental policies that favor only a few.
- Lack of training programs to incorporate EI practices and government support for technological upgrading for SMEs.

Strongly disagree 1 2 3 4 5 Totally in agreement.

6. You perceive the MARKET AND CUSTOMER BARRIER as a constraint to adopting Eco-innovations.

Refers to aspects such as:

- Lack of receptivity, awareness, and knowledge on the part of customers towards EI products or services.
- Difficulty in accessing raw materials in the market to produce EI products or services.

Strongly disagree 1 2 3 4 5 Totally in agreement.

7. You perceive the BARRIER OF KNOWLEDGE AND INFORMATION ABOUT EI PRACTICES as a constraint to adopting Eco-innovations.

Refers to aspects such as:

- Lack of knowledge about EI practices and legislation on the part of employees and entrepreneurs.
- Lack of capacity to detect business opportunities and environmental benefits of EI products and services.
- Lack of knowledge about the possibilities of recycling/reuse and/or reverse logistics (responsible for the recovery and recycling of containers, packaging, and hazardous waste; as well as return processes for excess inventory, customer returns, obsolete products, and seasonal inventories).

Strongly disagree 1 2 3 4 5 Totally in agreement.

8. Of all the barriers we have explored, which one do you think limits you the most. You can only choose one.
9. Degree of transformation towards the adoption of Eco-innovation (EI) from THE USER DIMENSION

Refers to these aspects:

- The changes your company undertakes to have the capacity to anticipate the acceptance of EI in the market.
- The changes your company undertakes in order to be able to explore the role of users in the implementation, identification, introduction and development of new EI, benefiting from their creativity.

Strongly disagree 1 2 3 4 5 Totally in agreement.

10. Degree of transformation towards the adoption of Eco-innovation (EI) from the PRODUCT/SERVICE DIMENSION.

Refers to these aspects:

- Changing the delivery of the product or service, identifying possible changes in the relationship with your customer by improving EI.

Strongly disagree 1 2 3 4 5 Totally in agreement.

11. Degree of transformation towards the adoption of Eco-innovation from THE GOVERNANCE DIMENSION

It refers to these aspects:

- Institutional solutions that have to do with changes in norms and values can lead to new organizational or structural changes in your company toward better EI practices.
- Public-private collaboration in addressing EI.
- Your company's leaders encourage business-society collaboration on EI practices.

Strongly disagree 1 2 3 4 5 Totally in agreement.

12. Degree of transformation toward the adoption of Eco-innovation from the DESIGN DIMENSION

It refers to the following aspect:

- The way you design improvements to your company's existing processes.

Strongly disagree 1 2 3 4 5 Totally in agreement.
We will explore the traits you have as a leader.
Strongly disagree 1 2 3 4 5 Totally in agreement (for each).

13. Sympathize with others' feelings
    Am not interested in other people's problems. (R).
    Feel others' emotions.
    Am not really interested in others. (R).
14. Keep in the background. (R)
    Am the life of the party.
    Do not talk a lot. (R).
    Talk to a lot of different people at parties.
15. Get chores done right away.
    Often forget to put things back in their proper place. (R).
    Like order.
    Make a mess of things. (R).
16. Have frequent mood swings.
    Am relaxed most of the time. (R).
    Get upset easily.
    Seldom feel blue. (R).
17. Have a vivid imagination.
    Do not have a good imagination. (R).
    Am not interested in abstract ideas. (R).
    Have difficulty understanding abstract ideas. (R).

APPENDIX B

TABLE B1 Necessary conditions.

	Outcome: adoption EI (EI)			Outcome: non adoption EI (∼EI)		
	Cons.Nec	Cov.Nec	RoN	Cons.Nec	Cov.Nec	RoN
BTEC	0.526	0.836	0.875	0.557	0.308	0.623
BFIN	0.845	0.825	0.644	0.809	0.275	0.303
BORG	0.397	0.757	0.866	0.615	0.408	0.727
BCOL	0.549	0.800	0.828	0.711	0.360	0.601
BGOV	0.686	0.767	0.685	0.828	0.322	0.427
BCUS	0.426	0.741	0.838	0.582	0.351	0.674
BKNO	0.661	0.805	0.767	0.711	0.301	0.479
∼BTEC	0.565	0.786	0.803	0.704	0.340	0.570
∼BFIN	0.257	0.795	0.939	0.485	0.521	0.869
∼BORG	0.690	0.838	0.797	0.634	0.268	0.465
∼BCOL	0.561	0.848	0.873	0.605	0.318	0.604
∼BGOV	0.393	0.868	0.937	0.570	0.257	0.501
∼BCUS	0.626	0.812	0.798	0.570	0.257	0.501
∼BKNO	0.426	0.809	0.891	0.539	0.356	0.707

Abbreviations: BTEC, technological barrier; BFIN, financial barrier; BORG, internal organizational barrier; BCOL, collaboration barrier; BGOV, government support barrier; BCUS, market, and customer barrier; BKNO, knowledge barrier; EI, eco-innovation.

TABLE B2 Enhanced conservative solution for outcome ∼EI.

	inclS	PRI	covS	covU
AGR*NEU*CON*∼EXT*OPE*∼BARN	0.892	0.359	0.204	-

Abbreviations: AGR, agreeableness; CON, conscientiousness; EXT, extraversion; OPE, Openness; NEU, Neuroticism; BARN, necessary barriers: the financial barrier or the negation of the government support barrier.

TABLE B3 Skewness.

Variable	Skewness check*
BTEC	42.5%
BFIN	80%
BORG	37.5%
BCOL	47.5%
BGOV	70%
BCUS	42.5
BKNO	65%
Set Vble-cases	> 0.5/Total number of cases

Abbreviations: BTEC, technological barrier; BFIN, financial barrier; BORG, internal organizational barrier; BCOL, collaboration barrier; BGOV, government support barrier; BCUS, market and customer barrier; BKNO, knowledge barrier.

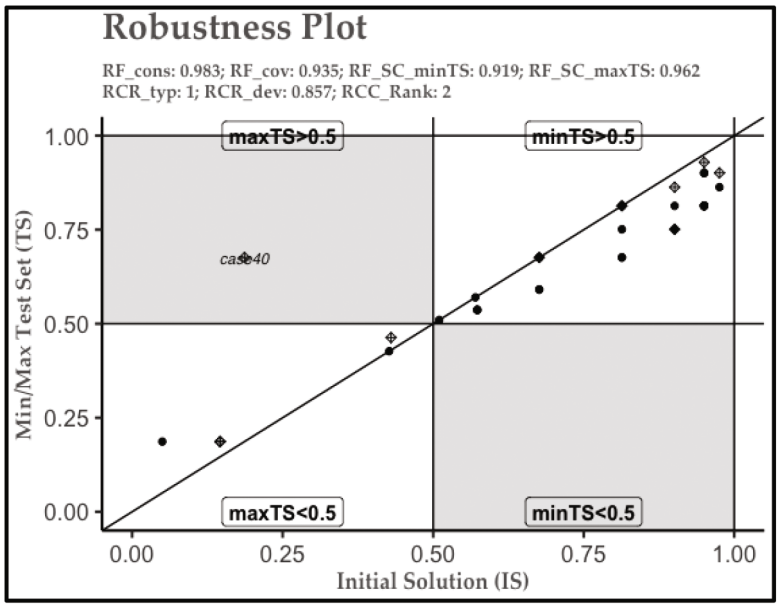

FIGURE B1 Robustness plot for EI.