

## RESEARCH ARTICLE

# Exploring antecedents of innovations for small- and medium-sized enterprises' environmental sustainability: An interpretative framework

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## Abstract

The need to pursue sustainable development has become a central topic in Western countries due to citizens' greater sensitivity to improving environmental and social conditions. Companies can reach this objective more easily through green innovations, which are now considered a strategic opportunity that simultaneously allows for adherence to sustainable development criteria and the pursuit of competitive advantages. Scholars have identified the determinants that encourage companies to adopt green innovations, but the outcomes of their investigations thus far have often been ambiguous and contradictory. Our paper proposes an interpretative framework for addressing such inconsistencies. Using the partial least squares structural equation modelling (PLS-SEM) methodology, we validate this framework on a sample of small- and medium-sized enterprises (SMEs) and show that SMEs' choices are influenced by cultural elements and stimulated by the prospect of obtaining economic advantages over competitors. SMEs also pay close attention to stakeholder solicitations, while public administration does not affect their eco-innovating choices. The results have policy implications for executives and insiders.

## KEYWORDS

antecedents, green innovations, PLS-SEM, SMEs

## 1 | INTRODUCTION

The United Nations Sustainable Development Goals (SDGs) have been established as a new strategic paradigm to support managerial, organisational and production criteria. Most scholars argue that the pursuit of these objectives is rooted in the implementation of innovations directed to reduce the consumption of resources (raw materials and energy), minimise the impact of production activities in terms of pollution and waste and to improve working conditions. These innovations are usually labelled as 'green innovations' (GIs) or are

synonymous with descriptors such as 'environmental', 'ecological', 'responsible' and so on.

For several years, a debate has flourished on the determinants that encourage investments in GIs aimed at improving firms' environmental performances, although the outcomes of the surveys have often been contradictory and partial (Demirel & Danisman, 2019; Kiefer et al., 2018; Thomas et al., 2021). This is because there are multiple variables that are difficult to consider jointly, and even more so, they tend to influence each other. In particular, two basic aspects tend to be somewhat overlooked. They concern the influence that

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both the external environment (Cainelli et al., 2015; Esposito de Falco et al., 2021; Walton et al., 2019) and the endogenous features of firms have on investment decisions (Bos-Brouwers, 2010; Crossley et al., 2021; Seth et al., 2018). Moreover, less attention has been paid by scholars to the specificities of small and medium-sized enterprises (SMEs) (de Jesus Pacheco et al., 2018; Halme & Korpela, 2014; Triguero et al., 2016), while constituting the backbone of the production system of many countries.

With this in mind, the present paper aims to contribute to this research flow by proposing an interpretative framework that encloses unitarily the determinants that currently affect the investment decisions of SMEs in achieving environmental sustainability through the adoption of GIs. In so doing, it intends to help fill the aforementioned knowledge gaps related to the influence exerted by the external context and resource availability on SMEs. The interpretative framework has been validated by examining a sample of innovative SMEs. The reasons for this choice are twofold. First, the high predisposition to innovation makes these SMEs playing a relevant role for the development and competitiveness of the economic system in which they are placed (Colombelli et al., 2019; Jun et al., 2019; Passaro et al., 2017); second, very few surveys have investigated this type of SMEs (Carfora et al., 2021; Scuotto et al., 2020; Yang, 2017).

Therefore, this paper contributes to the literature by providing theoretical advancement based on an approach that has not yet been proposed by previous studies and by exploring new relationships among similar concepts. Additionally, the proposed interpretative framework aims to be a useful tool for policymakers and practitioners interested in encouraging SMEs to adopt GIs.

The remainder of this paper is structured as follows. Section 2 discusses the theoretical background, Section 3 explains the interpretative framework and the hypotheses to be tested, and Section 4 shows the survey, method and analysed sample. Section 5 reports the findings, which are discussed in Section 6. Implications and conclusions are in Section 7.

## 2 | THEORETICAL BACKGROUND

Researchers' confidence in GIs as the main way to improve the competitiveness of companies while reducing their environmental impact has led to the publication of several studies analysing the determinants supporting GIs, especially concerning large manufacturing firms with high environmental impact. Scholars admit that none of these contributions so far appear to be exhaustive in representing the complex dynamics that induce companies to invest in GIs (Jun et al., 2019; Martinez-Conesa et al., 2017; Saez-Martínez et al., 2016). This is especially true when referring to SMEs, due to the wide heterogeneities characterising these economic units, the different decision-making processes compared to large companies and the stronger influences coming from the resource availability and external context (Cecere et al., 2020; de Jesus Pacheco et al., 2018; Díaz-García et al., 2015).

Furthermore, the findings of previous studies tend to focus on a limited number of determinants: the influence coming from stakeholders, such as customers, suppliers and competitors; public administration, such as regulations and incentives; staff, for instance, managers' awareness; intangible and tangible resources; and structural variables like size and sector. These basic determinants were proven to influence the choices of SMEs in acting as stimuli, or barriers, which hinder GIs when their shortage emerges. However, these determinants do not appear to be significant in all surveys, as they may differ or vary in importance depending on the circumstances (e.g., Aboelmaged, 2018; Linder, 2016; Pinget et al., 2015) causing inconsistencies.

As stated by seminal contributions on this issue (Horbach et al., 2012; Kiefer et al., 2018; Triguero et al., 2013), a crucial reason for these inconsistencies is the difficulty of uniquely framing a concept, which—by its own nature—is multiform, changeable over time and whose influence on behaviours is hard to predict, making it challenging for researchers to achieve shared outcomes.

Faced with this basic criticality, this paper proposes a framework that summarises the variables that the specific literature considers most influential on SMEs' choices to adopt GIs, focusing mainly on two fundamental elements, namely, the role of the external context and of the internal resources. The latter have normally been omitted in surveys of this type and, therefore, could constitute a crucial link in defining the weight and influence of each determinant. Moreover, the proposition of this interpretative framework aspires to minimise some of the typical limits—which we define here as criticalities—characterising the results of the investigations on the determinants affecting GIs.

A first criticality concerns how the notion of GIs is not unique but is often described by researchers with different terms (such as 'environmental', 'clean', 'green' and 'responsible') that could refer to dissimilar concepts, making it difficult to compare results of the various studies (e.g., Ooi et al., 2020; Pierre & Fernandez, 2018). Conversely, the same determinant is often labelled differently, while two identical labels could refer to somehow dissimilar concepts (Keshminder & del Río, 2019; Kiefer et al., 2017).

The scientific literature has also shown that each determinant could have a different impact depending on the type of GI to which it refers (e.g., organisational, technological and managerial) (Demirel & Danisman, 2019; Horbach et al., 2012). However, investigations usually do not distinguish between the different characteristics of GIs, such as whether they are incremental or radical, process or product, technological, managerial or organisational, low-tech or high-tech.

The importance of a determinant tends to vary over time and space, even in relation to contextual or functional elements such as a period of financial difficulty, the possibility of establishing a relationship with an important customer or the issuance of a new standard or incentive. This alters the priorities of companies and, consequently, the effectiveness of policy measures (Buttol et al., 2012; Chege & Wang, 2020).

Another factor affecting the relevance of a determinant is the subjective needs of a company. For example, being part of a supply

chain somehow forces a company to adapt to the requests of supply chain leaders. Similarly, final goods producers are more likely to adopt GI strategies, while companies in business-oriented sectors such as infrastructure-based services are less likely to undertake green strategies (Corrocher & Solito, 2017; Walton et al., 2019).

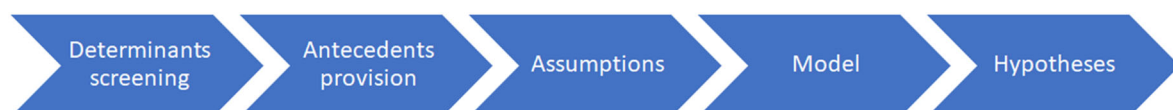
The scientific literature has also verified that determinants tend to influence or overlap with each other, even in opposite directions, making their overall interpretation by the company unique (de Jesus Pacheco et al., 2017; Marin et al., 2015). The greater the number of determinants considered in the survey, the greater the likelihood of reciprocal influences. However, while some studies examine a single determinant or even just one aspect of a determinant, others explore multiple determinants simultaneously, which makes it difficult to compare results due to the reciprocal influences (Aboelmaged & Gharib, 2019; Scuotto et al., 2020).

Moreover, determinants can originate from positive stimuli (e.g., differentiating themselves from the competition, improving stakeholders' satisfaction and benefiting from an incentive) or negative stimuli (e.g., having to comply with a rule, avoiding penalties and adapting to competition). Scholars believe positive stimuli to have the most influence on GIs (Sánchez-Medina et al., 2013; Woo et al., 2014). Solicitations from stakeholders and stimuli related to the availability of resources and expertise have rarely been studied jointly (Liu et al., 2021; Zhang & Walton, 2017). Furthermore, there is little known so far about the contextual factors that promote GIs, since the qualitative features of the external context, such as perceptions of the business climate, are difficult to assess (Buttol et al., 2012; Cuerva et al., 2014).

Last but not least, structural variables such as sector and size, even among the same SMEs, have been proven to influence survey results (Hoogendoorn et al., 2015; Walton et al., 2019). That is to say, the outcomes for micro-firms could be different when compared to SMEs with over 50 or more employees or whether they are active in traditional or innovative sectors.

To address these possible weaknesses, we developed an interpretative framework of determinants affecting GIs among SMEs of the innovative type. It follows the subsequent steps (Figure 1):

- i. Screening the most influential determinants that emerged in the specialised literature
- ii. Synthesis of the emerged determinants in some antecedents to the GIs
- iii. Analysis of the influence of two basic assumptions on the antecedents
- iv. Graphic representation of the framework
- v. Definition of the hypotheses to be tested.



**FIGURE 1** Synthesis of research steps [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

### 3 | THE INTERPRETATIVE FRAMEWORK AND THE HYPOTHESES

#### 3.1 | Determinants of GIs in SMEs

To propose an interpretative framework, the first step of this study was to collect research papers devoted to the analysis of the determinants promoting GIs and explicitly focused on SMEs. The research was started on the Scopus database, including English-language articles published up to March 2021 in journals containing the three basic terms (and their synonyms) in the title, keywords or abstract: (1) determinants, drivers, antecedents or barriers; (2) SMEs—small and medium enterprises/companies/firms, small businesses/companies/firms; (3) GIs—green, clean, ecological, sustainable, responsible. We designed several search strings linked with the Boolean ‘OR’/‘AND’.

Applying these criteria, we initially found 118 articles. We examined each article to ascertain if it was consistent with the aim of this research. We excluded sectorial studies and case studies due to their ambiguous influence on the outcomes. At the end of the selection, we judged 86 articles published from 1999 to 2021 in 35 journals to be consistent.

Next, for each article, we selected the determinants (or barriers) that were found to be qualitatively or statistically affecting GIs in the 86 articles. Then, we grouped together determinants that referred to similar or identical concepts. This grouping process was as attentive as possible to the intentions of the author(s), regardless of the terminological label. It also aimed to avoid two typical criticalities related to the use of different definitions to describe an analogous concept (and vice versa) and to the reciprocal influence among determinants when a large number of them are simultaneously examined. We identified 20 main determinants, which were named consistently with previous literature reviews (de Jesus Pacheco et al., 2017, 2018; del Brío & Junquera, 2003; Díaz-García et al., 2015; Parker et al., 2009).

Table 1 reports the 20 determinants considered, the author(s) who investigated the determinants and the total frequency of determinants identified in the 86 articles.

Only three papers found the following determinants to be significant in affecting GIs: *experience* in previous sustainable innovative initiatives, *investors* (business angels and venture capitalists) and *internationalisation* (being exporters). The *community*—the expression of citizens' sensitivity towards environmental sustainability—was found to be significant four times. Scholars (e.g., Triguero et al., 2015) believe that, as the average income of the community increases, sensitivity towards sustainability and respect for working conditions also grow. That is, sustainability is often seen as a ‘luxury’ for economically wealthy countries. The two structural determinants—*size* and *sector*/

**TABLE 1** The determinants of eco-innovation for SMEs

	Determinants	References	Frequency
1	Competitors	Hansen et al., 2002; Klewitz & Hansen, 2014; Ooi et al., 2020; Tang & Tang, 2012; Wu, 2017; Zhu et al., 2012	6
2	Community	Aboelmaged, 2018; Demirel & Danisman, 2019; Díaz-García et al., 2015; Zhu et al., 2018	4
3	Culture (environmental)	Andersson et al., 2020; Cagno & Trianni, 2013; Carfora et al., 2021; Cuerva et al., 2014; de Jesus Pacheco et al., 2018; del Brío & Junquera, 2003; Díaz-García et al., 2015; Gadenne et al., 2009; Jun et al., 2019; Kiefer et al., 2018; Sánchez-Medina et al., 2011; Seth et al., 2018; Triguero et al., 2013	13
4	Customers	Afshar Jahanshahi et al., 2020; Ardyan et al., 2017; Côté et al., 2006; Cuerva et al., 2014; Fernández-Viñé et al., 2010; Halme & Korpela, 2014; Hitchens et al., 2003; Jun et al., 2019; Kiefer et al., 2017; 2018; Klewitz & Hansen, 2014; Mazzanti & Zoboli, 2009; Ooi et al., 2020; Seth et al., 2018; Thomas et al., 2021; van Hemel & Cramer, 2002; Woo et al., 2014; Wu, 2017; Xie et al., 2010	19
5	Economic performances	Ardyan et al., 2017; Bos-Brouwers, 2010; Chege & Wang, 2020; Chen, 2008; Colombelli et al., 2019; Côté et al., 2006; Halila, 2007; Hitchens et al., 2003; Jové-Llopis & Segarra-Blasco, 2018; Linder, 2016; Martínez-Conesa et al., 2017; Masurel, 2007; Sánchez-Medina et al., 2013; Simpson et al., 2004; Williamson et al., 2006; Yang, 2017; Zhang & Walton, 2017; Zhu et al., 2018	18
6	Employees	Aboelmaged, 2018; Aboelmaged & Gharib, 2019; Bocken et al., 2014; Carfora et al., 2021; Cecere & Mazzanti, 2017; Chege & Wang, 2020; Díaz-García et al., 2015; Jun et al., 2019; Masurel, 2007; Mazzanti & Zoboli, 2009; Singh et al., 2020; Thomas et al., 2021; Zhu et al., 2018	13
7	Environmental performances	Biondi et al., 2002; Chen, 2008; Geng et al., 2021; Lefebvre et al., 2003; Linder, 2016; Martínez-Conesa et al., 2017; Masurel, 2007; Sánchez-Medina et al., 2013; Seth et al., 2018; Simpson et al., 2004; van Hemel & Cramer, 2002; Williamson et al., 2006; Woo et al., 2014	13
8	Experience	de Jesus Pacheco et al., 2018; del Brío & Junquera, 2003; Seth et al., 2018	3
9	External context	Buttol et al., 2012; Cuerva et al., 2014; de Jesus Pacheco et al., 2018; del Brío & Junquera, 2003; Díaz-García et al., 2015; Gombault & Versteeg, 1999; Gupta & Barua, 2018; Hansen & Klewitz, 2012; Jun et al., 2019; Kanda et al., 2018; Kiefer et al., 2018; Klewitz et al., 2012; Marin et al., 2015; Mazzanti & Zoboli, 2009; Scuotto et al., 2020; Triguero et al., 2013, 2015, 2016; van Hemel & Cramer, 2002; Zhu et al., 2012	20
10	Financial resources	Cecere et al., 2020; Clement & Hansen, 2003; Cuerva et al., 2014; del Brío & Junquera, 2003; Jové-Llopis & Segarra-Blasco, 2018; Pierre & Fernandez, 2018; Pinget et al., 2015; Sánchez-Medina et al., 2011; Shi et al., 2008; Zhu et al., 2012	10

TABLE 1 (Continued)

	Determinants	References	Frequency
11	Incentives/subsidies	Cagno & Trianni, 2013; Clement & Hansen, 2003; Gupta & Barua, 2018; Hoogendoorn et al., 2015; Jun et al., 2019; Parker et al., 2009; Shi et al., 2008; Triguero et al., 2015; Xie et al., 2010; Zhu et al., 2012	10
12	Intangible resources	Aboelmaged & Gharib, 2019; Alvarez & Iske, 2015; Bocken et al., 2014; Carfora et al., 2021; Ceptureanu et al., 2020; Chen, 2008; de Jesus Pacheco et al., 2017; Díaz-García et al., 2015; Gupta & Barua, 2018; Halme & Korpela, 2014; Kiefer et al., 2018; Klewitz & Hansen, 2014; Marin et al., 2015; Oxborrow & Brindley, 2013; Pinget et al., 2015; Saez-Martínez et al., 2016; Setiawan & Aryanto, 2019; Scuotto et al., 2020; Thanki et al., 2016; Triguero et al., 2013, 2016; Valdez-Juárez & Castillo-Vergara, 2021; Xie et al., 2010	23
13	Internationalisation	Gombault & Versteeg, 1999; Keshminder & del Río, 2019; Martín-Tapia et al., 2008	3
14	Investors	Demirel & Danisman, 2019; Halme & Korpela, 2014; Pinget et al., 2015	3
15	Managers	Chege & Wang, 2020; Cuerva et al., 2014; de Jesus Pacheco et al., 2017; Aboelmaged, 2018; del Brío & Junquera, 2003; Gupta & Barua, 2018; Lee, 2009; Mitchell et al., 2020; Singh et al., 2020; Williamson et al., 2006; Yang, 2017	11
16	Regulations	Aboelmaged, 2018; Cagno & Trianni, 2013; de Jesus Pacheco et al., 2017; de Jesus Pacheco et al., 2018; Dong et al., 2014; Fernández-Viñé et al., 2010; Gadenne et al., 2009; Gombault & Versteeg, 1999; Hansen et al., 2002; Hitchens et al., 2003; Hoogendoorn et al., 2015; Jun et al., 2019; Linder, 2016; Parker et al., 2009; Pierre & Fernandez, 2018; Pinget et al., 2015; Saez-Martínez et al., 2016; Sánchez-Medina et al., 2013; Shi et al., 2008; Tang & Tang, 2012; van Hemel & Cramer, 2002; Williamson et al., 2006; Xie et al., 2010; Zhu et al., 2012	24
17	R&D	Corrocher & Solito, 2017; Cuerva et al., 2014; de Jesus Pacheco et al., 2018; Geng et al., 2021; Gupta & Barua, 2018; Halme & Korpela, 2014; Mazzanti & Zoboli, 2009; Pinget et al., 2015	8
18	Size	Chen, 2008; Corrocher & Solito, 2017; Darnall et al., 2010; Dong et al., 2014; Hoogendoorn et al., 2015; Woo et al., 2014; Xie et al., 2010	7
19	Sector and localisation	Corrocher & Solito, 2017; Côté et al., 2006; Cuerva et al., 2014; Lefebvre et al., 2003; Triguero et al., 2015; van Hemel & Cramer, 2002; Williamson et al., 2006	7
20	Suppliers	Halme & Korpela, 2014; Keshminder & del Río, 2019; Kiefer et al., 2018; Klewitz & Hansen, 2014; Mazzanti & Zoboli, 2009; Ooi et al., 2020; Thomas et al., 2021; Wu, 2017	8

localisation—were found to be relevant seven times, while eight papers underlined the role of R&D, the general ‘technological capabilities of firms’ (Marin et al., 2015).

The most analysed determinant was *regulations*, which refer to the system of national, European or international norms and rules that

address the companies' choices in terms of sustainable development (*push-effect*). Their relevance is greater than monetary or fiscal *incentives and subsidies*, which encourage firms to adopt virtuous behaviours (*pull-effect*). Policies based on the *push-effect* usually have a greater impact on GIs than those based on the *pull-effect*; that is,

public regulatory policies are believed to be more effective than incentives (Horbach et al., 2012; Triguero et al., 2016).

Moreover, the availability of *intangible* endogenous resources (such as *competencies*, *capabilities* and *skills*) was very relevant. Researchers underline that SMEs typically suffer from a shortage of all the competencies needed to implement innovations (Alvarez & Iske, 2015; Andersson et al., 2020). Establishing a partnership with *customers* (a highly regarded determinant) and *suppliers* is often an optimal way to bridge the aforementioned gaps in competencies and *financial resources* (Jové-Llopis & Segarra-Blasco, 2018; Lagasio et al., 2021). Nowadays, the presence of many specific types of external supports could mitigate the financial needs of innovative SMEs. Only six articles considered the role of *competitors* to be relevant as a stimulus to eco-innovation in order to differentiate output.

The *external context*, here meaning the 'organisation or body that acts as an agent or broker in the innovation process' (Kanda et al., 2018, p. 1006), such as universities, research centres or chambers of commerce, represents a strong driving force for small and fragile businesses to adopt GIs. The factors underlying the possible achievement of better *economic* and *environmental performances* were also important. Investing in GIs is often aimed at reducing costs or improving productivity or competitiveness or minimising the subjective environmental impact in order to strengthen the image, reputation, consensus and legitimation of the company (e.g., Crossley et al., 2021).

Other determinants included *culture*, here understood as the company's endogenous environmental awareness linked to its own image and tradition, and *managers'* environmental awareness and the pressure coming from *employees*. Regarding managers, we refer to the personal features (e.g., age, gender and experience) that could make

them more likely to invest in GIs. Regarding *employees*, we refer to their quadruple role in terms of being beneficiaries of improvements to working conditions at the company, end customers of the products and services made by the company, stakeholders interested in the company's economic performance and citizens of the territory who aspire to a less polluted environment.

Table 2 describes the method adopted in the 86 scientific articles considered to identify the antecedents to explain GIs in SMEs. We highlight that most of them are based on statistical methods. Almost all of them used regression and structural equation models, adopting GIs as the outcome variable. Interestingly, only 12.8% of the selected articles described case studies applied to GIs. Generally, most of the analysed articles adopted single methods, except for two cases. The former combined math-based and artificial intelligence techniques (e.g., fuzzy analytic hierarchic process). The latter combined two different statistical approaches (i.e., simple growth model and cross-sectional regression estimation technique).

### 3.2 | From determinants to antecedents

To minimise the risk of obtaining inconsistent results by considering too many determinants simultaneously, eight out of 12 identified determinants were excluded from next steps of the interpretative framework: *experience*, *internationalisation* and *community* due to their low relevance; *size* and *sector/localisation* because, as already specified, researchers believe they may affect the results. *R&D* and *environmental culture* were excluded as the investigated sample is mainly composed of young micro-firms (see Section 4). Young micro-firms usually do not have their own R&D (Halme & Korpela, 2014; Pinget et al., 2015) nor a stratified culture towards environmental awareness linked to their image and tradition (Seth et al., 2018; Singh et al., 2020). *Environmental performances* were excluded since, in the in the interpretative framework that we intend to propose, they are the expected outcome of GIs rather than a determinant soliciting GIs.

As regards the other 12 determinants, nine of them were further classified into four new homogeneous classes—*stakeholders*, *competitive advantage*, *firm culture*, *public administration*—stimulating the adoption of GIs in SMEs and labelled, in line with the literature (e.g., Ceptureanu et al., 2020; de Jesus Pacheco et al., 2018), as *antecedents* because they represent the firms' motivations to adopt GIs. In detail, the antecedent *stakeholders* mirror the solicitations coming from *suppliers*, *customers* and *investors* in terms of sustainable development, where the links with these stakeholders are often jointly analysed by researchers in terms of networking (e.g., Keshminder & del Río, 2019; Xie et al., 2010). The antecedent *competitive advantage* represents the stimulus to the adoption of GIs related to the ambition to improve economic performance or differentiate a company's output from its competitors (e.g., Ardyan et al., 2017; Zhu et al., 2018). *Firms' culture* includes behaviours and attitudes towards GIs guided by the environmental sensitivity of *employees* and *managers* to environmental sustainability (Jun et al., 2019; Ooi et al., 2020). *Public administration* includes both *regulations* and the provision of *monetary/fiscal*

**TABLE 2** Main statistical methods adopted in the 86 papers

Methods	N°	%
Regression analysis	22	25.6
Structural equation modelling (PLS-SEM)	19	22.1
Case studies	11	12.8
Exploratory factor analyses	6	7.0
Descriptive statistics	5	5.8
Cluster analysis	4	4.7
Correlation analysis	4	4.7
Comparative analysis	3	3.5
MANCOVA	2	2.3
Relative importance index (RII)	2	2.3
Fuzzy analytical hierarchy process (FAHP)	2	2.3
Factor analysis	2	2.3
Qualitative analysis	1	1.2
Interpretive structural modelling (ISM)	1	1.2
Cost-risk-opportunity (CRO) innovation triangle	1	1.2
Analytic hierarchy process (AHP)	1	1.2
<i>Total</i>	<i>86</i>	<i>100.0</i>



benefits encouraging SMEs to adopt GIs (e.g., Jun et al., 2019; Pierre & Fernandez, 2018).

Consistent with this approach, the first set of hypotheses tests whether antecedents affect GIs:

- Hp1a.** Stakeholders positively affect GIs.
- Hp1b.** Competitive advantages positively affect GIs.
- Hp1c.** Firms' culture positively affects GIs.
- Hp1d.** Public administration positively affects GIs.

### 3.3 | The two assumptions

As mentioned previously, although 'the evidence about factors triggering environmental innovations suggests the relevance of complementing the analysis of the external context with the internal resources the firm has access to in order to fully understand and support the development of environmental innovations' (Cainelli et al., 2015, p. 211), these factors are often omitted in studies, mainly due to the high degree of interaction with other determinants (de Jesus Pacheco et al., 2017; Triguero et al., 2016). Our framework considers these two aspects by formulating two basic assumptions consistent with the specialised literature (Aboelmaged & Gharib, 2019; Ceptureanu et al., 2020; Valdez-Juárez & Castillo-Vergara, 2021).

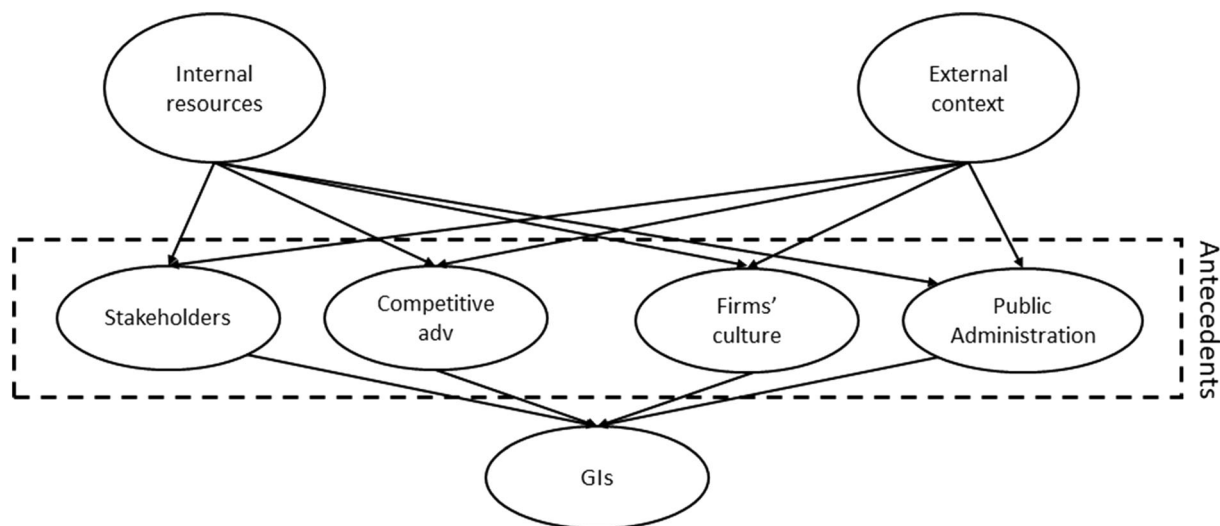
**Assumption 1.** The smaller the size of the firm, the greater the difficulty in achieving adequate intangible and financial resources (that is *internal resources*) to exploit GIs.

**Assumption 2.** The knowledge and support provided by organisations that constitute the external environment are considered to be more significant for SMEs than for other types of firms and for GIs more than for other types of innovation.

To overcome this criticality linked to the influence of *internal resources* and *external context* on the other determinants, the interpretative framework considers them as only affecting the four antecedents but not affecting GIs directly. It can be summarised in the following Figure 2.

Consistent with the theoretical framework, we introduce eight additional hypotheses to be tested:

- Hp2a.** Internal resources affect the *stakeholders*.
- Hp2b.** Internal resources affect the *competitive advantage*.
- Hp2c.** Internal resources affect the *firm culture*.
- Hp2d.** Internal resources affect the *public administration*.
- Hp3a.** External context affects the *stakeholders*.
- Hp3b.** External context affects the *competitive advantage*.
- Hp3c.** External context affects the *firm culture*.
- Hp3d.** External context affects the *public administration*.



**FIGURE 2** The interpretative framework

## 4 | DATA AND METHODS

### 4.1 | Data

To achieve the objectives of this research, we surveyed the population of innovative SMEs enrolled in a special register of the Italian Ministry of Economic Development created in 2015 to encourage the diffusion of this type of SMEs (<https://startup.registroimprese.it/isin/search?3>). To be registered, SMEs have to comply with very strict requirements relating to their innovative character and technological content. In exchange, public administration offers several benefits—not only economic benefits.

We selected the SMEs to be interviewed according to a stratified random sampling plan, using the region (NUTS-2 level) in which the SME has its registered office as the stratification variable. To limit bias deriving from possible listing errors, we contacted all 1035 firms in the register of innovative SMEs as of 30 April 2019. Companies without a website, email or phone number ( $n = 51$ ) were removed from the list.

We considered the variability of some structural characteristics (e.g., employees, capital and production) to fix the minimum sample size. It was set at 200 units, which represent about 20% of the reference population. To prevent bias and an increase in the total variance of estimates caused by total non-response, we increased the sample size to 225 units—about 22% of the target population.

The questionnaire proposed for the interviews follows the objectives of this study and presents four main areas: public administration, stakeholders, endogenous resources and economic and environmental performance. It consists of 51 closed items on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) (see Appendix A). Before its release, the questionnaire was discussed by experienced researchers and business managers who provided suggestions for improving clarity and soundness. In addition, the questionnaire was pre-tested in five innovative SMEs. In order to avoid the criticalities linked to considering GI as a homogeneous concept, we addressed the questionnaire to entrepreneurs (or other staff units in charge of investments), and we prepared a letter specifying the concept of eco-innovation and asking how they approached GIs by making specific investments. To overcome the problem of common method variance, we assured respondents that we would protect their identities, and we minimised apprehension of assessment by using a web-based questionnaire. These procedures can minimise method bias in the reporting or response-editing stage (Tehseen et al., 2017).

The survey was conducted in June 2019. At the end of the survey period (June 30), despite our reminders, three companies had not provided feedback. Thus, the final sample size was 222. Table 3 reports the main sample features. A large percentage of the investigated SMEs is active in the service sector (about 71%), with fewer than 10 employees (more than 50%), low capitalisation (55% less than €100,000) and turnover (about 60% with no more than €1,000,000). Most of them (52.7%) are located in the regions of Northern Italy.

The presence of a relationship between the business characteristics (Table 3) and the firms' regional distribution was tested through

**TABLE 3** Sample features ( $n = 222$ )

	Frequency ( $n_i$ )	Percentage (%)
<b>Activity sector</b>		
Trade	13	5.9
Manufacturing	52	23.4
Service	157	70.7
<i>Total</i>	222	100.0
<b>Turnover (thousands €)</b>		
0 –  1000	134	60.4
1000 –  10,000	74	33.3
>10,000	14	6.3
<i>Total</i>	222	100.0
<b>Employees</b>		
0–9	120	54.1
10–49	85	38.3
≥ 50	17	7.6
<i>Total</i>	222	100.0
<b>Capital</b>		
0 –  100,000	122	55.0
100,000 –  1,000,000	72	32.4
>1,000,000	28	12.6
<i>Total</i>	222	100.0
<b>Localisation</b>		
North	117	52.7
Centre	39	17.6
South	66	29.7
<i>Total</i>	222	100.0

the  $\chi^2$  statistics, which confirmed that the structural characteristics of innovative SMEs are independent of the territorial breakdown (activity sector:  $\chi^2 = 2.497$ ; turnover:  $\chi^2 = 14.469$ ; employees:  $\chi^2 = 14.963$ ; capital:  $\chi^2 = 20.092$ ).

### 4.2 | Methods

To estimate the relationship between the four antecedents and the GIs, we proposed a structural model based on partial least squares structural equation modelling (PLS-SEM). PLS-SEM is a non-parametric statistical method that can test a large set of hypotheses. It assesses the cause-and-effect relationships simultaneously between a set of latent (i.e., unobserved) variables (LVs), each measured by one or more manifest variables (MVs). LVs mainly refer to multi-dimensional concepts that cannot be measured directly but are determined as a combination of measurable variables that act as indicators of the underlying constructs (Khine, 2013). The structural model plot is shown in Figure 1. It represents the explained underlying theory with the variables that are not directly measured (LVs), which are commonly represented as ovals.

GIs, as well as their determinants, are multidimensional concepts defined by a large set of indicators (MVs) measured during the survey.



Using the PLS-SEM method, these indicators were grouped into the latent construct. We further assumed that a change in MVs reflects a change in the latent construct. In other words, we estimated a reflective PLS-SEM model. Consistent with Coltman et al. (2008), there are many reasons behind this choice, such as the nature of the construct—stakeholders exist, in an absolute sense, regardless of the measures; the direction of causality—a change in the construct causes a change in the indicators; and the characteristics of the indicators—a change in the LV must precede the variation in the indicator(s).

The analysis of this class of models is based on the assessment of the two main stages of the equation system (Hair et al., 2017; Henseler et al., 2009): the measurement (or outer) model and the structural (or inner) model.

However, before proceeding to assessing the quality of the estimated model, we checked for common method bias. As reported in Section 4.1, we followed the procedure suggested by Tehseen et al. (2017) to limit the risk of common variance bias. Despite this, we still preferred to test its absence. Several procedures have been proposed to assess the risk of the presence of common method bias, such as Harman's single-factor test summarised by Jakobsen and Jensen (2015). This test is based on the total variance explained by the items detected during the survey, obtained through exploratory unrotated factor analysis. The basic assumption is that, if there is a common method bias, only one component will account for more than 50% of the covariance between the items and the criterion construct. In our case, the factor explains about 38.75% of the total variability. Therefore, we can exclude the presence of a common method bias.

The analysis of the relationships among the four antecedents and GIs was first based on the assessment of the reliability and validity of the nexus between the MVs and LVs to which they are associated, known as the measurement model. Moreover, we implemented a bootstrap procedure to assess the significance of the estimated coefficients. We analysed the data with SmartPLS 3.0 (Ringle et al., 2015).

The model highlights two levels. The first level identifies the determinants of the antecedents that are multidimensional aspects that are not directly observable and related to some of the items surveyed. These aspects help to better define the second level of the proposed interpretative framework, which identifies the antecedents, as a synthesis of the previous LVs and MVs, and which antecedents affect GIs.

#### 4.2.1 | The measurement model

The measurement model specifies how the collected items define the theoretical aspects to be considered relevant and expresses the set of relationships between exogenous and endogenous variables. According to Henseler et al. (2009) and Hair et al. (2017), three criteria can be used to evaluate the measurement model and establish the validity and reliability of the constructs' items, that is, individual item reliability, internal consistency reliability and convergent validity.

Table 4 shows the reliability and validity statistics. The overall results provide clear evidence that the measurement model satisfied

both the internal consistency reliability and convergent validity criteria.

##### *Individual item reliability*

To assess individual item reliability, we examined their factor loadings. It is commonly assumed that loadings greater than the suitable minimum of .4 (Hair et al., 2017) or the preferred level of .7 (Bagozzi & Yi, 1988) are acceptable. Any item below the established threshold value must be eliminated. In this study, we considered the value of .5 as a threshold, in line with the empirical literature specifically related to eco-innovation (e.g., Mazzanti & Zoboli, 2009; Thomas et al., 2021). The model was iteratively estimated. First, we estimated a model in which all items were partitioned into the LVs. We observed that some of the indicators had loadings below the threshold level, so we dropped one of these indicators (A4) and re-estimated the model. We repeated these steps until all loadings were greater than .5. At the end of the iterative procedure, all items of the measurement model had loadings greater than .5 (A1–A6, R1 were progressively dropped). Therefore, the items now considered show a sufficiently strong relationship with their own LVs.

##### *Internal consistency reliability*

Internal consistency reliability is defined as the degree to which all indicators on a certain scale measure a similar variable. It has generally been assessed with Cronbach's alpha, but it has recently been criticised for assuming that all indicators are equally reliable and have the same loadings on the latent construct, neglecting the individual item reliability. Composite reliability is regarded as a more appropriate technique for measuring internal consistency reliability (Hair et al., 2017). Therefore, we preferred to consider Cronbach's alpha and composite reliability jointly.

Both measures are within the range of acceptability. Thus, all LVs exceeded the acceptable threshold of reliability (.60). Only the Cronbach's alpha value for the *external context* was slightly below the acceptability threshold. However, some scholars have suggested that even lower figures of alpha estimates could be accepted (e.g., Bonett & Wright, 2015; Punzo et al., 2019). The internal consistency of the items, therefore, was confirmed.

##### *Convergent validity*

This type of measurement criteria refers to the extent to which a set of items can measure the same LV in agreement (Henseler et al., 2009). Following Valerie (2012) and Hair et al. (2014), we considered the AVE threshold of .50 to assess convergent validity. This means that a LV must be able to explain half or more of the indicators' variability. In this study, the AVE values for all constructs ranged from .657 to .922 (Table 4), thus indicating good convergent validity.

#### 4.2.2 | Structural model

We evaluated the quality of the structural model by examining the full collinearity of the model, the determination coefficients ( $R^2$  and

**TABLE 4** Factor loadings, reliability and validity statistics

Latent and manifest indicators	Factor loadings	Cronbach's alpha	Composite reliability	Average variance explained (AVE)
Firms' culture		.837	.925	.860
FC1	.926			
FC2	.929			
Managers		.622	.841	.726
M1	.857			
M2	.847			
Regulations		.840	.902	.755
R1	.894			
R2	.894			
R3	.815			
Incentives		.915	.959	.922
I1	.957			
I2	.963			
Public administration		.722	.849	.657
PA1	.887			
PA2	.890			
PA3	.626			
Stakeholders		.654	.852	.742
ST1	.894			
ST2	.842			
Competitive advantages		.775	.899	.816
CA1	.917			
CA2	.890			
Customers		.855	.912	.776
C1	.871			
C2	.922			
C3	.848			
Internal resources		.928	.954	.874
IR1	.956			
IR2	.956			
IR3	.891			
Suppliers		.812	.889	.727
S1	.795			
S2	.866			
S3	.893			
Investors		.794	.903	.824
IN1	.870			
IN2	.944			
Employees		.820	.892	.734
EM1	.884			
EM2	.848			
EM3	.838			
External context		.598	.833	.713
EC1	.830			
EC2	.859			

TABLE 4 (Continued)

Latent and manifest indicators	Factor loadings	Cronbach's alpha	Composite reliability	Average variance explained (AVE)
GIs		.909	.936	.786
G11	.910			
G12	.825			
G13	.912			
G14	.898			
Competitors		.691	.866	.763
CO1	.887			
CO2	.861			
Economic performance		.839	.904	.761
EP1	.909			
EP2	.930			
EP3	.768			

TABLE 5 Full collinearity test

Latent constructs	GIs	Stakeholders	Competitive advantage	Firms' culture	Public administration
Internal resources		1.636	1.962	1.750	1.502
External context		1.970	1.448	1.333	1.539
Stakeholders	2.774				
Investors		1.705			
Customers		3.296			
Suppliers		2.941			
Competitive advantage	2.486				
Competitors			3.898		
Economic performances			3.680		
Firms' culture	1.949				
Employees				2.357	
Managers				2.056	
Public administration	1.323				
Incentives					1.314
Regulations					1.401

Adjusted  $R^2$ ) of the endogenous latent constructs, the effect size ( $f^2$ ) and the path coefficients.

#### Full collinearity

We used the full collinearity approach (Kock & Lynn, 2012) to test for collinearity. This procedure assesses both vertical and lateral collinearity (Table 5). Hair et al. (1995) suggest the value 10 as the maximum acceptable level of variance inflation factor (VIF), while Kock (2015) suggests that VIF values should be close to 3 and below. In the proposed model, almost all LVs had a VIF lower than 3. Some LVs (competitors, customers and economic performance) presented a VIF higher than 3 but lower than 5. Therefore, the presence of collinearity is excluded.

#### The determination coefficients and the effect sizes

We also evaluated the quality of the structural model through the determination coefficients ( $R^2$  and Adjusted  $R^2$ ) of the endogenous LVs. With PLS-SEM,  $R^2$  can be interpreted similarly to any multiple regression analysis indicating the amount of variance in the endogenous LV explained by its independent variables. According to the literature on PLS (e.g., Chin, 1998),  $R^2$  values can be classified into three categories: low if  $R^2 \leq .20$ , moderate if  $.20 < R^2 < .50$  and high if  $R^2 \geq .50$ . In the proposed model, the adjusted  $R^2$  of the endogenous LVs was between .496 and .840 (Table 6), indicating a high relationship between the antecedents considered and the outcome variable.

The change in  $R^2$  values when a certain exogenous variable is omitted from the model is known as the effect size ( $f^2$ ). It also offers a

**TABLE 6** Determination coefficients and effect sizes

	$R^2$	Adjusted $R^2$	Effect size ( $f^2$ )
GIs	.629	.617	
Stakeholders	.555	.545	.050
Firms' culture	.505	.496	.063
Competitive advantage	.842	.840	.234
Public administration	.612	.605	.003

measure of practical significance in terms of the magnitude of the effect, regardless of sample size. Following the guidelines proposed by Cohen (1988),  $f^2 \geq .02$ ,  $f^2 \geq .15$  and  $f^2 \geq .35$  represent small, medium and large effect sizes, respectively. It is worth noting that effect size was just above the lowest threshold only for *public administration*. *Competitive advantages* had the largest (medium) effect size in the model, followed by *culture* and *stakeholders*, both with small effect sizes.

#### Significance of the estimates

By virtue of analysing the reliability and validity of the measurement model, the explained variance ( $R^2$ ) and the effect size ( $f^2$ ) of the structural model, we can assume that the model is correctly specified. Therefore, it can adequately explain the hypothesised relationship between the antecedents and GIs in SMEs.

Since PLS does not rest on any distributional assumptions, the significance levels for the parameter estimates are not suitable. We used resampling procedures such as bootstrapping to obtain information on the variability of the parameter estimates. To test the significance of the estimated coefficients (i.e., path coefficients) related to the research hypotheses, we used a bootstrapping technique employing 6000 sample replications.

Table 7 reports the estimated path coefficients, standard errors and  $p$  values.

Focusing on the LVs that help define the antecedents, almost all of them are significant. Only *investors* show a non-significant relationship with the underlying antecedent (*stakeholders*). *Stakeholders*, *firm culture* and *competitive advantage* present a significant relationship with GIs, confirming the hypothesis that the antecedents positively affect SMEs' choices to invest in GIs.

On the other hand, consistent with the literature (e.g., Thomas et al., 2021), *public administration* does not influence the outcome variable. Unexpectedly, both determinants (internal resources and external context) of the antecedents do not have a significant relationship with the same LVs. Only the links between *internal resources* on *stakeholders* and *firm culture* and the *external context* on *public administration* are characterised by a significant effect.

## 5 | FINDINGS

The pressures coming from *stakeholders* (Hp1a), *competitive advantage* (Hp1b) and *firm culture* (Hp1c) significantly influence innovative SMEs'

decisions to invest in GIs, confirming the basic consistency of the interpretative framework (Table 7). In contrast, *public administration* (Hp1d) is not significant, a result consistent with recent surveys on the same context (Carfora et al., 2021; Thomas et al., 2021) in which public administration even exhibits a negative effect on the choices of companies regarding GIs. This means that the action of public administration seems to hinder the sustainability objectives of SMEs. This is linked to a series of interventions proposed by policymakers that are unrelated to the actual needs of SMEs and their operational logic or are not accompanied by adequate bureaucratic procedures or the availability of resources consistent with what was promised, as well as a shortage of flexible policies. As a result, SMEs risk being penalised by uncertainties, such as the timing of subsidies, while investment programmes require certainty. In Italy, however, the work of public administration has never been considered a strength in support of the competitiveness of national companies, at least in recent decades. This is even truer for SMEs, notoriously more fragile and conditioned by contextual elements.

Confirming this supposition, the results also show that the *external context* is not considered to be influential by SMEs. This means that SMEs do not rely on a system of specific organisations that are able to satisfy the requests of stakeholders (Hp3a), seeking forms of competitive advantage (Hp3b) or supporting their sensitivity towards environmental sustainability (Hp3c). SMEs have to rely only on themselves. Consequently, we can assume that the business climate is not suited to the needs of the specific type of SMEs we investigated. The statistical significance of the *external context* only in the case of the antecedent relating to *public administration* (Hp3d) further strengthens this assumption. Innovative SMEs seem to require external support to access public benefits or comply with regulations (for example, in preparing business plans, investment plans and project initiatives); this is a clear limitation reflecting the partial endogenous capacities of SMEs. Overall, there is a clear distrust of public administration from coordinators and organisers of a support system for business development. This serious gap damages the ambitions of the smallest economic units with a high innovative content. Conversely, the interventions of public administration appear to be limited to the bureaucratic activity related to the granting of monetary incentives or fiscal benefits; however, for innovative SMEs, this is not necessarily the best response to their expectations. The evidence for the hypothesis that they suffer from severe financial constraints is not overwhelming (Cecere et al., 2020; Liu et al., 2021).

The influence of *internal resources* is significant in two out of four cases. In line with expectations, they affect the power of antecedent 'stakeholders' (Hp2a). Meeting the stakeholder expectations from the side of corporate sustainability requires an effective availability of resources to be dedicated to the purpose. Conversely, the significance of Hp2c—the internal resources that influence the firm culture—could be interpreted as a consequence of considering environmental and social issues as a 'luxury' accessible only to SMEs that already have adequate resources or that have obtained sufficient economic performances. If confirmed, this result would be the opposite of what is desirable.

**TABLE 7** Hypotheses, path coefficients, standard deviation, t statistics, p value

Hypotheses		Path coefficients	Standard deviation	t statistics	p value	Confirmed/not confirmed
<b>Antecedents</b>						
Hp1a	Stakeholders → GIs	0.227	0.077	2.949	.003	Confirmed
	Suppliers → stakeholders	0.19	0.096	1.992	.047	
	Customers → stakeholders	0.304	0.087	3.487	.001	
	Investors → stakeholders	0.043	0.066	0.649	.516	
Hp1b	Competitive advantage → GIs	0.465	0.064	7.276	.000	Confirmed
	Economic performance → competitive advantage	0.505	0.065	7.726	.000	
	Competitors → competitive advantage	0.408	0.065	6.27	.000	
Hp1c	Firms' culture → GIs	0.213	0.062	3.434	.001	Confirmed
	Managers → firms' culture	0.284	0.085	3.343	.001	
	Employees → firms' culture	0.368	0.084	4.391	.000	
Hp1d	Public administration → GIs	−0.04	0.045	0.873	.383	Not confirmed
	Incentives → public administration	0.573	0.08	7.147	.000	
	Regulations → public administration	0.195	0.05	3.906	.000	
<b>Determinants affecting antecedents</b>						
Hp2a	Internal resources → stakeholders	0.361	0.056	6.434	.00	Confirmed
Hp2b	Internal resources → competitive advantage	0.066	0.041	1.603	.109	Not confirmed
Hp2c	Internal resources → firms' culture	0.126	0.068	1.85	.065	Confirmed
Hp2d	Internal resources → public administration	0.05	0.049	1.037	.300	Not confirmed
Hp3a	External context → stakeholders	−0.044	0.067	0.665	.506	Not confirmed
Hp3b	External context → competitive advantage	−0.01	0.036	0.268	.789	Not confirmed
Hp3c	External context → firms' culture	0.047	0.07	0.666	.505	Not confirmed
Hp3d	External context → public administration	0.173	0.052	3.319	.001	Confirmed

The statistical non-significance of the relationship between *internal resources* and *competitive advantages* (Hp2b) underlines an overall positive attitude. Consistent with what has already emerged in the analysis of the determinants, the high confidence in GIs as a means of differentiating oneself from the competition (although in terms of lower costs) seems to be the primary motivation for the drive towards GIs. It is an objective that SMEs believe they must pursue regardless of the immediate availability of resources.

The non-significance of *internal resources* on *public administration* (Hp2d) attests that adaption to regulations or benefits from the incentives provided does not presuppose a previous availability of tangible or intangible resources. That is, there are no economic or knowledge barriers to accessing benefits or implementing regulations. This is a positive element that dilutes previous judgements on public administration.

In sum, innovative SMEs are aware of the importance of GIs. GIs are primarily seen as a tool to meet the expectations of their stakeholders and differentiate themselves from their competitors, while less attention is devoted to GIs as an instrument for improving environmental performances. However, their objectives in the direction of sustainable development seem to be limited by the ability of public administration, as well as the external context, to satisfy

their needs, as these SMEs have high potential but also are riskier and more fragile.

## 6 | DISCUSSION

The entrepreneurial capacity to adopt GIs has become a dominant topic in almost all economic discussions taking place among scholars, practitioners and policymakers (Cheng et al., 2018; Engle et al., 2021; Ma et al., 2020; Santamaria et al., 2021). This is because GIs represent the point of intersection of different needs that come from various interlocutors at multiple levels. On the institutional side, the need to pursue economic growth paths compatible with environmental sustainability and the safeguarding and reproducibility of resources, including human resources, has been evident for several years. Unsurprisingly, 37% of the EU's formally announced recovery funds will be used to support a green deal and sustainability projects. In this view, GIs can guarantee a fundamental contribution to the pursuit of the SDGs. In terms of the companies, if the increasing intensity of international competition is a constant motivation for innovation, it is now established that innovative processes must be compatible with sustainable development. This is a powerful way to satisfy the growing

expectations of citizens and consumers towards a sustainable development, who are in many cases willing to pay higher prices for eco-friendly goods and services.

However, an exhaustive framework explaining the determinants supporting the investment decisions of SMEs towards GIs is still lacking in the scientific literature. This gap is due to the nature of the determinants, which change over time and space, as well as the different influences related to the type of GIs, the features of the firms, the availability of resources and the external context features.

The present study aimed to fill the knowledge gap regarding the determinants that stimulate SMEs towards GIs. For this purpose, we proposed an interpretative framework and tested it on a sample of 222 innovative SMEs, which should exhibit the highest willingness to invest in innovation. Although innovative SMEs show a low environmental footprint compared to companies operating in traditional sectors, they are crucial for the future of the economic context in which are located. This is due to the intrinsic potential for quantitative development with net employment absorption, the ability to disseminate knowledge and the facilitation of the transition of an economic context towards cutting-edge activities. However, so far, only a few surveys have examined the determinants stimulating GIs in innovative SMEs.

Our results show that *stakeholders*, *competitive advantage* and *firms' culture* affect GIs, while *public administration* does not reveal a significant relationship with the outcome indicator. The latter result could be explained by the peculiarities of the context in which the investigated SMEs are placed. Not by chance the external context affects *stakeholders*, *competitive advantage* and *firms' culture* but not *public administration*, while, conversely, the availability of internal resources affects only *stakeholders* but not the other three antecedents.

Although the role of the public administration is crucial, in the examined context, it seems limited to the passive introduction of regulations or to the possible proposal of incentives not adequately dimensioned on the actual features and needs of innovative SMEs. Consequently, eco-efficiency practices are not perceived by SMEs as an incentive to improve competitiveness, and environmental choices are primarily aimed at reducing costs or avoiding non-compliance sanctions and negative effects on the company's image.

These statements confirm the importance played by the external context, even if its role is often overlooked in empirical investigations. That is, for the purposes of investment choices in GIs, while companies may somehow manage to free themselves from the lack of resources, the absence of a business climate appears to be more penalising. This is especially true for smaller SMEs that aspire to take riskier paths of adopting innovations. These SMEs usually need external support to overcome their intrinsic limitations.

Furthermore, as GIs seem to be linked more to short-term economic objectives rather than to an intrinsic environmental awareness of firms, or to achieving future competitiveness, the obvious consequence for these SMEs could be the limitation of their investments and their risk level. Compared to other economic systems that are increasingly devoted to fostering innovation, in the examined context,

the policies do not yet appear to sufficiently support the adoption of GIs in SMEs. The inadequacy of the external context and the public administration emphasises the SMEs' lack of resources, which, in a vicious circle, reduces the SMEs' propensity towards GIs and discourages riskier investments.

## 7 | IMPLICATIONS AND CONCLUSIONS

Despite its limitations, the findings of this study suggest that many of the basic objectives linked to the diffusion of GIs need to be pursued with the active participation of local policymakers. The lack of specific actions linked to the specificities of the context leads to see public administration as disconnected from the real needs of innovative SMEs and to consider the external context as irrelevant in the investment choices of SMEs.

In light of our study, some actions can be suggested to increase the predisposition of innovative SMEs towards GIs, thereby contributing to the achievement of the SDGs. On the research side, a first objective is to improve the quality of the outcomes by jointly considering the different factors that can affect the results themselves and how these results change in relation to the different features of SMEs. On the policy side, collaboration and networking with larger companies and institutional actors, such as universities, research centres and other public agencies, should be encouraged. Partnership is a great opportunity for sharing knowledge. Of course, this cannot mean that public administration gives up the role of coordinating economic activities or delegate tasks to other actors. Public administration is responsible for introducing measures targeting the specific needs of innovative SMEs, for instance, by moving from financing generic investments in fixed assets to investing in R&D. Similarly, it would be important to look for tools that stimulate serial investors and business angels to finance innovative projects when, often, traditional banks do not have the appropriate competencies to evaluate the potential of GIs. The provision of incentives is not the only solution to cope with credit rationing nor it is necessarily the best solution. As a rule, policies must change over time and for specific areas, consistent with the variability of the determinants.

Entrepreneurs also have to fulfil their duties. They cannot just accept the benefits from the external environment; rather, they must bear the risks associated with the implementation of innovative techniques and technologies at a different level of knowledge and skills compared to previous standards. Therefore, entrepreneurs need to be responsive to GIs, but they must also engage personally with their own capital, not just expecting external support. In parallel, since a high level of specialisation is required in this type of innovative activity, it is important to involve external executives with suitable skills in the working team, to whom responsibilities and roles can be delegated. This delegation is often a source of potential conflicts, as founders fear losing control of the company. In any case, private entrepreneurs will presumably be able to achieve the desired objectives only by acting in synergy with public bodies, jointly pursuing shared objectives.



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## APPENDIX A: QUESTIONNAIRE AND ITEM CODING

A. In order to access innovations, how important is for your company?

- |  |         |
|--|---------|
| 1. Internal R&D activity                               | Dropped |
| 2. The relationship with universities/research centres | Dropped |
| 3. Partnership with other companies                    | Dropped |
| 4. The use of specialised consultancy                  | Dropped |
| 5. The purchase of patents/licenses                    | Dropped |
| 6. Participation in workshops/exhibitions              | Dropped |

B. Your firm:

- |  |     |
|--|-----|
| 1. • Has a documented plan or rules for eco-innovation and ecological management | FC1 |
| 2. • Considers environmental audit as a management standard                      | FC2 |
| 3. • Encourages staff to work towards energy saving and emission reduction       | M1  |
| 4. • Advertises to stakeholders its commitment to eco-sustainability             | ST1 |

C. Do your products/services meet the requirements of national and international environmental regulations? R1

D. Do your productive processes meet the requirements of national and international environmental regulations? R2



E. In your opinion, local Public Administration offers:

- |  |     |
|--|-----|
| 1. Adequate fiscal benefits for the eco-innovations of your interest             | I1  |
| 2. Adequate monetary incentives for the eco-innovations of your interest         | I2  |
| 3. A more streamlined bureaucratic procedure for accessing the expected benefits | PA1 |
| 4. A regulatory framework that supports the adoption of eco-innovations          | PA2 |

F. Do your customers pay attention to environmental and sustainability issues? C1

G. Is your firm encouraged to pursue eco-innovations from customer requests? C2

H. Do your suppliers pay attention to environmental and sustainability issues? S2

I. Is your firm encouraged to pursue eco-innovations from supplier proposals? S3

L. Are banks and financial intermediaries more likely to finance eco-compatible investments? IN1

M. Are venture capitalists and business angels more likely to finance companies pursuing eco-compatible investments? IN2

N. Do the other actors in the local economic context (e.g., competitors) call for the adoption of eco-innovations? EC1

O. Does the presence of research centres and universities favour the adoption of eco-innovations? EC2

P. In your firm:

- |  |     |
|--|-----|
| 1. Environmental sustainability is a very felt problem   | EM1 |
| 2. Our employees propose environmental sustainability actions  | EM2 |
| 3. There are professional figures (e.g., energy managers) who are dedicated to environmental sustainability issues | EM3 |
| 4. We plan to hire professionals dedicated to environmental sustainability issues                                  | M2  |

Q. Investments in eco-innovation have made possible to:

- |   |     |
|---|-----|
| 5. Reduce energy and raw material consumption               | GI1 |
| 6. Reduce the cost of energy and other raw materials        | GI3 |
| 7. Reduce the pollution connected with the company activity | GI4 |
| 8. Increase the number of employees                         | S1  |
| 9. Increase sales   | CO1 |
| 10. Increase the use of productive capacity                 | EP1 |
| 11. Improve economic results and profitability              | EP2 |
| 12. Gain a competitive advantage over competitors           | CA1 |
| 13. Retain customers  | C3  |
| 14. Improve the working environment of employees            | GI2 |

R. How much do you think are appropriate for the eco-innovations you intend to adopt the current:

- |  |     |
|--|-----|
| 1. Technological skills of the company             |     |
| 2. Organisational skills of the company            | IR1 |
| 3. Managerial skills of the company                | IR2 |
| 4. Material and financial resources of the company | IR3 |

S. In the immediate future, does your firm plan to invest in eco-innovations in order to?

- |  |     |
|--|-----|
| 1. Reduce the cost of energy and other raw materials   | EP3 |
| 2. Increase economic and financial performance         | CA2 |
| 3. Improve the image or differentiate from competitors | CO2 |
| 4. Reduce the environmental impact                     | ST2 |
| 5. Contribute to respecting European targets           | R3  |
| 6. Receive incentives                                  | PA3 |

T. Has your company requested any incentives for investments in eco-innovation? Dropped

- |                               |  |
|-------------------------------|--|
| 1. Requested and received     |  |
| 2. Requested but not received |  |
| 3. Not requested              |  |
| 4. I am not aware of it       |  |