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INFLUENCE OF ORGANISATIONAL INNOVATION ON ECO-INNOVATION IN EUROPEAN COMPANIES

Abstract

Purpose

This research focuses on establishing relationships between eco-innovation and organisational innovation to characterise organisational eco-innovation in European Union companies. We also aim to investigate the forms of organisational innovation that eco-innovative companies use as well as the factors or determinants of eco-innovation in the corporate environment that impel the use of organisational innovation.

Design/methodology/approach

We use the estimation of different binary logistic regression models with maximum likelihood applied to a sample obtained from the Eurostat's Community Innovation Survey 2014 database as a starting point.

Findings

The results indicate that there is a link between organisational innovation and eco-innovation. The type of organisational innovation most linked to environmental innovation is innovating in work responsibility and decision-making methods. In conclusion, the results highlight some novel factors in the link between eco-innovation and organisational innovation.

Originality

The study seeks to observe what specific quantitative drivers (external or internal) are used for organisational eco-innovation, as a specific subtype of eco-innovation. This can improve our understanding of the ways in which organisational innovation can be used by corporations to provide environmental benefits. The academic literature provides information on the drivers and determinants for both organisational innovation and eco-innovation separately, but we believe this article offers a new approach by looking at the specific eco-innovation drivers achieved through organisational innovation.

Keywords: eco-innovation, organisational innovation, green-innovation, environmental innovation, drivers, leadership, decision making, management innovation.

Article classification: Research paper

1 INTRODUCTION

Eco-innovation is still a fairly new research area. However, recent literature reviews on the subject (Díaz-García *et al.*, 2015; Hojnik and Ruzzier, 2016; Salim *et al.,* Pham *et al*., 2019) show that policymakers, academics, and practitioners are increasingly embracing eco-innovation.

Eco-innovation can be defined as the production, assimilation, or exploitation of a product, production process, service, or management, which, throughout its lifecycle, reduces environmental risks, pollution, and other negative impacts of resource use compared with relevant alternatives (Kemp and Pearson, 2008). Within this concept, three categories could be highlighted: eco-product, eco-process, and eco-organizational (Triguero *et al.*, 2013).

Organisational eco-innovations are vehicles of corporate environmental self-regulation that facilitate the introduction of significantly different organisational structures, corporate environmental strategies, and new management methods (OECD, 2009; García-Quevedo *et al.*, 2020). Several innovation practices related to organisational innovation (i.e. teamwork, employee participation, decentralisation in decision making) and training for innovation are considered key human capital management factors to achieve environmental objectives (García-Marco *et al.*, 2020). These could also include more formalised environmental management systems (EMSs; Rennings *et al.,* 2006).

It is important to highlight the implications for management promoted by organisational eco-innovation as they have economic implications (such as saving energy and resources) due to green innovation (Bitencourt *et al*., 2020). It also influences the organisation's culture (beliefs, values, symbols) as well as its inner workings and governance (Arundel and Kemp, 2009).

We still know very little regarding the benefits of organisational practices for environmental innovation (Delmas and Pekovic, 2013; Antonioli *et al.*, 2013). In their literature review on eco-innovation, Díaz-Garcia *et al.* (2015) pointed to some important opportunities for future research, specifically focusing on the internal factors of firms (e.g. capabilities and resources).

This research focuses on establishing relationships between eco-innovation and organisational innovation to characterise organisational eco-innovation. We also aim to study the factors related to this type of eco-innovation and the forms of organisational innovation that eco-innovative companies use. This study mainly aims to answer the following questions: Q1: Is organisational innovation involved in achieving environmental innovations in European firms? Q2: Which type of organisational innovation is more likely to provide the company with environmental benefits? In this sense, we investigate the drivers of organisational innovation for environmental purposes.

The rest of the paper proceeds as follows. Section 2 sets the theoretical background of this research, detailing the findings from the academic literature regarding environmental and organisational innovation. Section 3 presents an empirical analysis; explains the research objectives, methodology, and composition of the sample. Section 4 presents the results which are discussed in Section 5. Section 6 presents the conclusions and limitations of the study and proposals for future research.

2 THEORETICAL BACKGROUND: ORGANISATIONAL INNOVATION ON ECO-INNOVATION

The Oslo Manual includes a widely accepted and commonly used definition of organisational innovation: ‘The implementation of new organisational methods. These can be changes in business practices, in workplace organisations or in the firm’s external relations’ (Oslo Manual, 2005, p.17). Therefore, we distinguish organisational innovation from product, process, or marketing innovation. Organisational innovations entail changes in the organisational structure and processes of a company with the implementation of new management methods or new practices to perform the company's activity (Bujidos *et al.,* 2019). In their systematic review of the literature, Crossan and Apaydin (2009) defined the concept of innovation as a process as well as a result that includes organisational aspects such as the development of new production methods and the establishment of management systems. Under this definition, innovation becomes more than just a creative process and forces us to consider the elements that produce a positive result and an improvement as a consequence of their application.

Most studies on organisational innovation focus on analysing its effect on productivity and business performance, which is a key factor for sustainable growth (Senge and Carstedt, 2001; McEvily *et al*., 2004; O'Reagan, 2005), and attempt to demonstrate the positive relationship between innovation and improvement in company performance (Camison and Villar-López, 2014; Naranjo-Valencia, 2016). In this case, the added value resulting from innovative effort is an improvement in the environment.

There are four types of innovation for environmental purposes or eco-innovation: technological, organisational, social, and institutional. These can be conducted by private or public companies and by non-profit organisations (Rennings, 2000).

Several theories have evolved regarding the process of eco-innovation and its drivers. Following the classification of theories proposed by Hazarika *et al.* (2019), they can be grouped into five main dimensions: 1) Design and technological eco-innovation, which includes the improvement and creation of existing and entirely new products/systems, respectively; 2) Demand/Market eco-innovation where the willingness of either private firms or consumers to acquire the new product or process drives the innovation effort; 3) Institutional eco-innovation, which is the active intervention of private and public institutions by setting standards and regulations or collaborating with government agencies; 4) Behavioural eco-innovation, which examines the socio-technical aspect of innovation and relates to the beliefs, values, and vision of both the decision makers and employees and how motivation factors play an important role in translating into behaviours and routines and proactively develop competitive eco-innovations; and 5) Product service network eco-innovation, which requires changes in the whole product supply chain from production to consumption, customer service, and recycling.

Organisational eco-innovations encompass the reorganisation of modes of operation, organisational structures, and the adoption of new forms of management (Klewitz and Hansen, 2014; Brasil *et al.,* 2016). Other authors (Arundel and Kemp, 2009; Pacheco, 2017) relate it to changes in the organisation and management methods of the company, the development of EMSs or audits, and new ways of organising the production and supply chain. The existing literature on eco-innovation has applied a large part of its research effort to demonstrate the relationship between this form of innovation and the economic results of the companies that conduct the respective form of innovation (Doran and Ryan, 2012; de Oliveira-Brasil *et al.,* 2016; Torugsa *et al.*, 2013; Cai and Li, 2018).

Although few, some studies that examine the main determining factors of eco-innovation are evoking interest and, hence, identifying a wide range of internal and external factors whose combined effect determines the success of the innovation (Kesidou and Demirel, 2012; Horbach *et al.*, 2012; Triguero *et al*., 2013; Cai and Li, 2018). Corporate sustainability literature differentiates between deliberate and emergent strategies; deliberate strategies are linked to intended top-down strategic planning while emerging strategies arise in the absence of intention (Mintzberg and Waters, 1985). Neugebauer *et al.* (2015) argue that wicked problems, which are characterised by their complexity, societal impacts, and long-term nature, are better addressed using emergent strategies. However, salient issues tend to be addressed using emergent strategies. Salient issues are characterised by the existence of powerful stakeholders that influence companies to address the problem (i.e. regulators); solving the issue is highly relevant to the society, and it has a high sense of urgency, thus requiring immediate attention. Eco-innovation conveys a high degree of complexity and presents a combination of both wicked and salient issues; therefore, there is a need for a continuum between planned and emergent strategies rather than relying on deliberate or planned strategies alone.

The literature has evolved from considering eco-innovation as a pure cost-benefit analysis to an evolutionary approach (Hazarika *et al.,* 2019), where interactions among different actors (managers and employees), institutions (public and private), and a wide array of internal and external factors dynamically interconnect to create eco-innovation (Carrillo-Hermosilla *et al.,* 2010). Further, the concept of organisational ambidexterity becomes relevant (Bodwell and Chermack, 2010) in order to balance deliberate and emergent approaches and allow companies to

focus on the current needs and future opportunities. The internal factors have a distinct relationship with the organisation. Furthermore, some of the external factors have a direct impact on the use of eco-innovative companies and how they work and organise themselves. Below are the main factors mentioned in the academic literature linked to eco-innovation. These are also reflected accordingly in Table I.

1) Cost savings: Often, the development of environmental innovation occurs for purely operational reasons and not so much for a defined strategic concept. Therefore, the need to reduce costs to maintain competitiveness in the market or being forced by external economic factors such as a recession will drive the company to find new and more efficient ways to use its resources (Dooley, 2018). In the application of savings measures, organisations frequently require internal restructuring, transformation of processes, and adaptation of the supply chain, among others. Therefore, the desire to save costs can prompt the company to seek inefficiencies and implement organisational innovations, such as the implementation of EMSs (Horbach *et al*., 2012).

2) Regulation and government stimulus: Among external factors, regulation is undoubtedly one of the most cited in the academic literature (Shahin *et al.,* 2020) given the need for companies to comply with the growing body of environmental regulations. Regulation has also been considered a lever to promote eco-innovation by forcing compliance with standards and limiting the harmful impact of companies and industrial sectors by law (You *et al*., 2019; Horbach *et al.,* 2012).
   Environmental regulations and legislation in the European Union (EU) have provided a stimulus for the business sector, promoting the detection of inefficiencies and obtaining economic benefits (Tamayo-Orbegozo, 2017; Eurobarometer, 2011). There is evidence of the positive effects of eco-innovation through cost reduction, efficiency improvements, and the generation of new business opportunities (O'Brien *et al*., 2013; Horbach, 2008).

3) Market demand requirements: The reasons for conducting this type of innovation are often determined by demand. Companies decide to conduct ecological innovation at the request of their clients (Pekovic, 2016). End customers are an important factor in the case of products that improve the use of materials (Arranz *et al.*, 2019; Arundel and Kemp, 2006), energy consumption, recycling, or hazardous substances (Horbach, 2012). These aspects constitute what has been called 'eco-value' (Stevels, 2007), which can be used to differentiate, advertise, and attract a society that is increasingly aware of the need for sustainability, thereby improving the corporate image of the company.

4) Supply chain: The focus on eco-innovation moves from optimising operations in a specific organisation to managing the entire supply chain in which they are integrated, adding additional complexity following the need to coordinate and collaborate with other stakeholders in the supply chain (Tamayo-Orbegozo, 2017; Wagner and Llerena, 2011; Linton, 2007). According to the natural resource-based view and proactive environmental management, compliance with regulations is insufficient. Furthermore, proactive guidance that includes the management of other stakeholders is needed to strengthen business competencies in environmental matters, such as supply chain partners (Mejia, 2012; Wu, 2013).

5) Management and leadership: The academic literature contains the concept of 'Green Management', which refers to the use of business practices aimed at protecting the environment (Florida and Davison, 2001; Shu *et al*., 2016). These types of practices can have an external objective—to minimise the direct effect that the company's

activity has on the environment—or an internal one of making more effective use of the necessary resources such as energy or raw materials (Chabowski *et al.*, 2011). Organisational structure and management support are key factors in incorporating environmental policy as an integral part of a company's strategy (Zhou *et al*., 2018; Boons *et al*., 2013)

The leader's figure is essential as a promoter of the business culture, which is necessary to foster innovation in general, facilitating the dissemination of knowledge obtained through the organisation (Fernandes Rodrigues Alves, 2016; Scott and Bruce, 1994). Top executives are decisive in the adoption of eco-innovation and integrate both innovation and sustainability into the company's strategy (Bossle *et al*., 2016).

The development of organisational capacities, an EMS, corporate social responsibility (Shahin *et al*., 2020), and quality certifications such as ISO 14001 can determine the success factors for eco-innovation (Klewitz and Hansen, 2014) as can changes in the organisational structure through the introduction of health and safety departments, interdepartmental committees or teams, and training for employees in environmental matters (Klewitz and Hansen, 2014). These transformations in the organisational structure, together with the drive and determined commitment of the management that contributes to capillarisation at all levels of the company, are key factors for success (Boons *et al*., 2013). Companies that are able to integrate environmental considerations into corporate strategy will be the most successful in establishing eco-innovation practices (Hazarika and Zhang, 2019) while contributing decisively to overcoming the resistance to changes in procedures inherent in all organisations, which is one of the main inhibitors of eco-innovation (Dooley, 2018).

Martin de Castro *et al.* (2016) demonstrated that the implementation and maturity of an EMS positively influence the corporate reputation and brand image of the company. Furthermore, the improvement of this green image positively influences the company's performance.

6) Collaboration with other companies and organisations: The exchange of knowledge and collaboration with other organisations also positively influences the development of environmental innovation. Authors such as Cainelli *et al.* (2013), Takala *et al.* (2014), Triguero *et al.* (2013), and Tamayo-Orbegozo (2017) highlight that collaborating with the industry and political agents as well as joint work with research institutes and universities are key for the acquisition and subsequent application of eco-innovation. Establishing collaboration agreements is a way of transferring the experience and knowledge that other organisations possess (Gilsing *et al.,* 2008) to the organisation and of sharing and, therefore, reducing the risk of their development (Hagedoorn, 2006). Cooperating with universities is also a more economical way to access knowledge (Koontz *et al.,* 2015).

   Due to the complex nature of eco-innovation, external cooperation is considered one of the external factors that foster environmental improvements (Carrillo-Hermosilla *et al.,* 2010). Different modes of eco-innovation require diverse technologies and knowledge. Recent studies highlight the importance of combining the external acquisition of knowledge with the company's internal capabilities, resources, and processes to achieve the full potential benefits of eco-innovation. Furthermore, collaborating with external partners is considered an additional mechanism to pursue the companies' strategic goals in terms of eco-innovation (Di Paola *et al*., 2020). However, the type of collaboration that is more efficient in terms of organisational eco-innovation has yet to be determined.

7) Intellectual capital and knowledge management: The intellectual capital of a company is an essential asset for the creation of companies based on knowledge (Roblek *et al.,* 2013). In the innovative process, companies must be able to value, assimilate, and use

(with business results) the knowledge acquired (Jabar *et al.,* 2011) positively. Intellectual capital has certainly been recognised as a strategic resource for improving organisational processes (Lerro *et al.*, 2014; Alvino *et al.,* 2020). However, less attention has been paid to the use of intellectual capital in relation to the 2030 Agenda's goals and established guidelines for companies.
Intellectual capital includes an organisation's processes; technologies; patents; employee skills; and information about customers, suppliers, and stakeholders. It is the knowledge that can be converted into value (Bueno *et al.*, 2014; Seleim *et al.*, 2011). Intellectual capital is composed of human, structural or organisational, and social capital. Human capital is the knowledge, capacities, and abilities of individuals (Schultz, 1961). Structural or organisational capital is the knowledge institutionalised within the company and, therefore, encoded in the form of databases, patents, methodologies, manuals, structures, systems, and processes (Youndt *et al.,* 2005). In conclusion, social capital arises from the interaction of individuals (Nahapiet and Ghoshal, 1998) and that of the organisation with other agents such as customers, suppliers, partners, competitors, and social stakeholders (Bontis, 1996, 1998).

Knowledge management is a knowledge flow process that improves a company's performance through learning (Wang, 2011); it includes knowledge acquisition, creation, documentation, transfer, and application. Knowledge management and intellectual capital influence each other (Seleim *et al.*, 2011). Furthermore, Marr *et al.* (2003) assert that knowledge management is fundamental for growing and maintaining a company's intellectual capital.
Some authors have already pointed out that, compared with internal resources and research effort, the acquisition of external knowledge can be a stronger source of innovation (Kotkova *et al.,* 2020). A study by Brio and Junquera (2003) showed that the level of development of a company's environmental practices is proportional to the number of employees trained in the relevant area. Garcia Marco *et al.* (2020) conclude that organisational innovation and training activities are highly complementary. This means that, to guarantee success in the implementation of this type of practice, a firm must ensure the knowledge and competencies of the staff related to the new procedures as well as the organisational structure necessary to roll them out.

One of the biggest obstacles faced when trying to promote eco-innovation is the management of human factors. Fear of change, organisational adjustments that will impact different teams, or the need for cross-functional coordination are some examples where the 'human' factor plays a key role in success (You *et al.*, 2019). Employee involvement becomes important as employees who are part of the initiative, if they have personally invested in the project, will act as champions of all the eco-innovation activities (De Buysee and Berveke, 2002). When considering human capital, environmental management significantly depends on the development of its capabilities and the business culture (Cramer and Roes, 1993; Hart, 1995). The mention of the human resources area in the academic literature on organisational innovation is not new, especially with regard to leadership. However, despite the human factor being consistently defined as relevant in the literature, it is not one of the areas that capture the interest of researchers (Fernandez Rodrigues Alves, 2016).

In addition to specific training activities, as part of an effective knowledge management to foster eco-innovation, other mechanisms must be put in place from the beginning to guarantee the result at the functional level of the organisation (Pujardi, 2006; Tamayo-Orbegozo, 2017). It requires actions that increase the motivation and involvement of the workforce, hence managing opposition to the change, ensuring the adequate allocation of resources to carry out the changes, and communicating them within the organisation while avoiding an excessively bureaucratic approach (Wagner and Llerena, 2011).

8) Company size. Arranz *et al*. (2019) claim that the size of a company is a key element in the development of eco-innovation practices with cost and financing being the determining and sub-determining factors, respectively. Thus, large companies will have a greater predisposition to adopt environmental objectives (Shahin *et al.,* 2020), confirming the positive relationship between size and eco-innovation (Lee and Klassen, 2008; Carrillo-Hermosilla *et al.,* 2009). If eco-innovation initiatives entail high costs and the benefits do not materialise until the medium to long term, small companies, with less possibility of accessing financing, will be less likely to adopt this type of measure (Bitencourt 2020; Torugsa *et al.*, 2013).

Today, the economic importance of environmental innovation is undisputed in both the policy and business realms, yet the implementation of eco-organisations by means of organisational innovation in the EU is yet to be studied. Furthermore, the importance of internal company factors, such as human resources or environmental management, to obtain sustainable competitiveness has not been extensively discussed in this context.

3 EMPIRICAL ANALYSIS

3.1 Methodology & Sample

The database of this research includes 98,809 firms that participated in the Eurostat Community Innovation Survey (CIS) 2014. It provides a comprehensive vision of the innovation of European companies in EU countries. As Damanpour (2014) indicates, CIS data can be considered the only effort to acquire systemic data on management innovation in EU countries.

On one hand, Spain and Norway did not complete the annex to the questionnaire on innovations with environmental benefits (Section 13); therefore, their organisational innovation cannot be related to environmental benefits. Furthermore, they have been excluded from the sample. On the other hand, although Germany and the Czech Republic indicate the environmental benefits achieved through innovation, they failed to explain the type of innovation they used. Therefore, environmental benefits cannot be linked to organisational innovation; they have also been eliminated from the sample. Therefore, our final sample consists of N = 8649 companies; the results of this work represent companies that respond to their situation regarding organisational innovation with environmental benefits. Twenty-six percent of these companies agreed that the environmental benefits were due to organisational innovation while 74% did not.

Table I presents the variables included in the data analysis according to the groups detailed in the theoretical background. Organisational eco-innovation (ECORG) is proposed as a dependent variable in the estimated models; this variable takes the value of one when the company relates the environmental benefits with the implementation of organisational innovation and zero when this connection is not established. The remaining variables are included as independent variables.

Table I. Variables description.

General information about the enterprise		
NUTS	BG, CY, EE, EL, HR, HU, LT, LV, PT, RO, SK	0:No 1:Yes
Organisational innovation		
ORGBUP	New business practices for organising procedures	0:No 1:Yes
ORGWKP	New methods of organising work responsibilities and decision making	0:No 1:Yes
ORGEXR	New methods of organising external relations	0:No 1:Yes
Marketing innovation		
MKTDGP	Significant changes to the aesthetic design or packaging	0:No 1:Yes
MKTPDP	New media or techniques for product promotion	0:No 1:Yes

MKTPDL		New methods for product placement or sales channels	0:No 1:Yes
MKTPRI		New methods of pricing goods or services	0:No 1:Yes
Product innovation			
INPDGD		Introduced onto the market a new or significantly improved good	0:No 1:Yes
INPDSV		Introduced onto the market a new or significantly improved service	0:No 1:Yes
Process innovation			
INPSPD		Introduced a new or significantly improved method of production	0:No 1:Yes
INPSLG		Introduced a new or significantly improved logistic, delivery or distribution system	0:No 1:Yes
INPSSU		Introduced a new or significantly improved supporting activities	0:No 1:Yes
DRIVERS FOR ORGANIZATIONAL ECO-INNOVATION			
Innovations with environmental benefits			
ECORG		Organisational innovations	0:No 1:Yes
Cost Savings			
ENCOST		High cost of energy, water or materials	0: Not important 1: Low 2: Med 3: High
Regulation and Government			
FUNLOC		Public funding from local or regional authorities	0:No 1:Yes
FUNEU		Public funding from the EU	0:No 1:Yes
ENEREG		Existing environmental regulations	0: Not important 1: Low 2: Med 3: High
ENETX		Existing environmental taxes, charges or fees	0: Not important 1: Low 2: Med 3: High
ENREGF		Environmental regulations or taxes expected in the future	0: Not important 1: Low 2: Med 3: High
ENGRA		Government grants, subsidies or other financial incentives for environmental innovations	0: Not important 1: Low 2: Med 3: High
ENREQU		Need to meet requirements for public procurement contracts	0: Not important 1: Low 2: Med 3: High
Market Demand			
ENDEM		Current or expected market demand for environmental innovations	0: Not important 1: Low 2: Med 3: High
	CO311	Collaboration w Clients or customers from the private sector: National	
	CO312	Collaboration w Clients or customers from the private sector: EU/EFTA/EU-CC	
CO31	CO313	Collaboration w Clients or customers from the private sector: US	0: all variables No 1: some variable Yes
	CO314	Collaboration w Clients or customers from the private sector: China or India	
	CO315	Collaboration w Clients or customers from the private sector: Other countries	
	CO321	Collaboration w Clients or customers from the public sector: National	
	CO322	Collaboration w Clients or customers from the public sector: EU/EFTA/EU-CC	
CO32	CO323	Collaboration w Clients or customers from the public sector: US	0: all variables No 1: some variable Yes
	CO324	Collaboration w Clients or customers from the public sector: China or India	
	CO325	Collaboration w Clients or customers from the public sector: Other countries	
Supply Chain			
	CO21	Collaboration w Suppliers of equipment, etc.: National	
	CO22	Collaboration w Suppliers of equipment, etc.: EU/EFTA/EU-CC	
CO2	CO23	Collaboration w Suppliers of equipment, etc.: US	0: all variables No 1: some variable Yes
	CO24	Collaboration w Suppliers of equipment, etc.: China or India	
	CO25	Collaboration w Suppliers of equipment, etc.: Other countries	
Management & Leadership			
ENREP		Improving the enterprise's reputation	0: Not important 1: Low 2: Med 3: High
ENAGR		Voluntary actions or initiatives for environmental good practice within the sector	0: Not important 1: Low 2: Med 3: High
ENVBF		Environmental procedures (Audits, EMS, Environmental Goals, Certifications) implemented before 2012	0:No 1:Yes
ENVBT		Environmental procedures (Audits, EMS, Environmental Goals, Certifications) implemented or significantly changed between 2012 and 2014	0:No 1:Yes
Cooperation arrangements			
	CO11	Other enterprises within enterprise group : National	
	CO12	Other enterprises within enterprise group : EU/EFTA/EU-CC	
CO1	CO13	Other enterprises within enterprise group : US	0: all variables No 1: some variable Yes
	CO14	Other enterprises within enterprise group : China or India	
	CO15	Other enterprises within enterprise group : Other countries	
	CO41	Competitors or other enterprises ...: National	
	CO42	Competitors or other enterprises ...: EU/EFTA/EU-CC	
CO4	CO43	Competitors or other enterprises ...: US	0: all variables No 1: some variable Yes
	CO44	Competitors or other enterprises ...: China or India	
	CO45	Competitors or other enterprises ...: Other countries	

	CO51	Consultants and commercial labs: National		
	CO52	Consultants and commercial labs: EU/EFTA/EU-CC		
CO5	CO53	Consultants and commercial labs: US	0: all variables No	1: some variable Yes
	CO54	Consultants and commercial labs: China or India		
	CO55	Consultants and commercial labs: Other countries		
	CO61	Universities or other … : National		
	CO62	Universities or other … : EU/EFTA/EU-CC		
CO6	CO63	Universities or other … : US	0: all variables No	1: some variable Yes
	CO64	Universities or other … : China or India		
	CO65	Universities or other … : Other countries		
	CO71	Government, public or private research institutes: National		
	CO72	Government, public or private research institutes: EU/EFTA/EU-CC		
CO7	CO73	Government, public or private research institutes: US	0: all variables No	1: some variable Yes
	CO74	Government, public or private research institutes: China or India		
	CO75	Government, public or private research institutes: Other countries		
Intellectual Capital				
PROPAT		Applied for a patent	0:No	1:Yes
PROEUM		Applied for a European utility model	0:No	1:Yes
PRODSG		Registered an industrial design right	0:No	1:Yes
PROTM		Registered a trademark	0:No	1:Yes
EMPUD6		Percentage of employees with university degree: 75% to 100%	0:No	1:Yes
Knowledge Management				
RTR	1	Engagement in training for innovative activities	0:No	1:Yes
ROEK	1	Engagement in acquisition of external knowledge	0:No	1:Yes
Size				
	SIZE(0)	If no employee information	0:No	1:Yes
SIZE	SIZE(1)	If number of employees under 250	0:No	1:Yes
	SIZE(2)	If number of employees above 250	0:No	1:Yes

Source: Own elaboration based on CIS 2014 questionnaire.

The explanatory variables refer to innovation activities that can occur in companies. Consequently, the variables that explain product, process, marketing, and organisational innovation are considered. Additionally, variables have been included that refer to the drivers of innovation activity such as cost savings, public funding and regulation, market demand, supply chain and cooperation arrangements for innovation, intellectual property rights and licencing, training in innovation, or acquisition of external knowledge. Innovations with environmental benefits together with other basic information on the enterprise were selected from the questionnaire.

Table II studies the presence of organizational eco-innovation in European firms based on the companies' location. Companies that acknowledge to obtain environmental benefits through organisational innovation account for only 26% of the total. However, this behaviour is not homogeneous among the countries studied; companies that recognise this relationship in Estonia, Hungary, or Lithuania account for less than 18%. However, in countries such as Bulgaria, Cyprus, Greece, or Latvia, more than 35% of their companies attribute environmental benefits to organisational innovation.

Table II: Percentage of firms by ECORG

Country	ECOORG: No	ECORG: Yes	Number
BG	57.58	42.42	759
CY	60.93	39.07	215
EE	82.56	17.44	344
EL	64.21	35.79	802
HR	69.72	30.28	687
HU	86.27	13.73	823
LT	89.05	10.95	1297
LV	62.30	37.70	244

PT	74.32	25.68	2734
RO	67.33	32.67	404
SK	75.29	24.71	340
Total (number)	6423	2226	8649

Notes: BG-Bulgaria; CY-Cyprus; EE-Estonia; EL-Greece; HR-Croatia; HU-Hungary; LT-Lithuania; LV-Latvia; PT-Portugal; RO-Romania; SK-Slovakia.

The methodology used is the estimation of a binary logistic regression model with maximum likelihood (1) where Y_i is a dummy variable that takes the value of one when firm *i* introduces organisational innovation with environmental benefits and zero otherwise. y *Xi* represents the vector of explanatory variables for each firm *i*.

$$p(Y_i) = \frac{e^{\beta_0 + \sum_{i=1}^{p} \beta_i X_i}}{1 + e^{\beta_0 + \sum_{i=1}^{p} \beta_i X_i}} \quad (1)$$

where:

$P(Y_i)$ is the probability that ECORG=1 for firm i.

X_i is the value of the explanatory variable for firm i

The empirical analysis proposes several models that can be used to analyse different scenarios in which the influence of the independent variables on organisational innovation with environmental benefits of the companies is analysed. All the models maintained the same dependent variable (ECORG) and modified the independent variables included in each model.

Different statistical tests were performed to analyse the adequacy of fit of the models. The significance of the estimated coefficients has been studied together with their standard error on one hand and the statistical significance of each model (chi-square) on the other. Additionally, the penalised-likelihood criteria of each model (AIC, BIC), likelihood ratio, and adjusted pseudo-R2 coefficients (Nagelkerke and McFadden) are provided, allowing the comparison of the logistic regression models estimated in this study.

4 RESULTS

This section presents the estimates of the proposed models, considering the 8,649 companies from the 11 countries available in the database. In all the models, the dependent variable was ECORG. Moreover, the independent variables were modified to study how their behaviour changes. Table III shows, by columns, the four models, the estimates of the coefficients of the explanatory variables, their corresponding odds ratios, and their standard errors.

Organisational innovation variables (ORGBUP, ORGWKP, ORGEXR), basic company information (SIZE, EMPUD6, NUTS), acquisition of external knowledge (ROEK), public funding innovation (FUNEU), existing established environmental procedures (ENVBF, ENVBT), and factors that influence the enterprise's decisions to introduce innovations with environmental benefits (ENEREG, ENETX, ENREGF, ENGRA, ENDEM, ENREP, ENAGR, ENCOST, ENREQU) were included as independent variables in model one (M1). In Model Two (M2), the variables in Model One have been maintained. Furthermore, variables of product innovation (INPDGD, INPDSV), process innovation (INPSPD, INPSLG, INPSSU), training for innovation (RTR), marketing innovation (MKTDGP, MKTPDP, MKTPDL, MKTPRI), cooperation arrangements for innovation (CO1, CO2, CO31, CO32, CO4, CO5, CO6, CO7),

intellectual property rights, and licencing (PROPAT, PROEUM, PRODSG, PROTM) have been added. In Model Three (M3), the variables that are not significant in M2 are ignored.

The estimated models (M1, M2, and M3) have good fit as the McFadden Pseudo R^2 takes values in the interval [0.2, 0.4] and allows us to compare logistic regression models (McFadden, 1973, 1977), noting that M2 and M3 are the best. These three models can explain approximately 40% of the information; see Nagelkerke Pseudo R^2 (Nagelkerke, 1991). Similarly, the test of the general model is also statistically significant (chi-square sufficiently large). Consequently, it is concluded that the models are statistically significant.

Table III: Logit regression models

Variable	M1		M2		M3		M4	
	Odds ratio	Beta	Odds ratio	Beta	Odds ratio	Beta	Odds ratio	Beta
nuts=BG	0,39*** (0,18)	-0,931	0,40*** (0,18)	-0,909	0,41*** (0,18)	-0,9	0,38*** (0,16)	-0,973
nuts=CY		0[b]		0[b]		0[b]		0[b]
nuts=EE	0,94 (0,22)	-0,061	0,97 (0,23)	-0,033	0,97 (0,22)	-0,034	1,42* (0,21)	0,353
nuts=EL	0,49*** (0,18)	-0,71	0,50*** (0,19)	-0,693	0,48*** (0,18)	-0,736	0,55*** (0,17)	-0,594
nuts=HR	1,06 (0,18)	0,059	1,21 (0,18)	0,192	1,17 (0,18)	0,155	0,98 (0,17)	-0,019
nuts=HU	1,74*** (0,19)	0,551	1,79*** (0,19)	0,58	1,79*** (0,19)	0,581	1,53** (0,18)	0,423
nuts=LT	1,54** (0,19)	0,434	1,56** (0,19)	0,446	1,53** (0,19)	0,424	1,44** (0,18)	0,363
nuts=LV	0,51*** (0,22)	-0,666	0,54*** (0,23)	-0,608	0,53*** (0,22)	-0,627	0,45*** (0,2)	-0,789
nuts=PT	0,96 (0,16)	-0,039	1,08 (0,17)	0,081	1,06 (0,16)	0,056	1,09 (0,15)	0,09
nuts=RO	0,65** (0,2)	-0,433	0,67** (0,21)	-0,406	0,66** (0,2)	-0,411	0,56*** (0,18)	-0,576
nuts=SK		0[b]		0[b]		0[b]		0[b]
orgbup	2,94*** (0,07)	1,08	2,83*** (0,07)	1,04	2,83*** (0,07)	1,04		
orgwkp	5,07*** (0,07)	1,624	4,84*** (0,07)	1,576	4,82*** (0,07)	1,573		
orgexr	1,44*** (0,07)	0,363	1,37*** (0,07)	0,317	1,37*** (0,07)	0,315		
mktdgp			1,09 (0,07)	0,088			1,15** (0,07)	0,138
mktpdp			1,08 (0,07)	0,075			1,29*** (0,07)	0,251
mktpdl			0,93 (0,08)	-0,071			1,29*** (0,07)	0,255
mktpri			1,22*** (0,07)	0,202	1,24*** (0,07)	0,217	1,66*** (0,07)	0,51
inpdgd			0,71*** (0,07)	-0,339	0,72*** (0,07)	-0,326	0,70*** (0,06)	-0,36
inpdsv			1,16** (0,07)	0,145	1,15** (0,07)	0,142	1,17** (0,06)	0,159
inpspd			0,84** (0,07)	-0,17	0,85** (0,07)	-0,157	0,86** (0,06)	-0,147
inpslg			1,42*** (0,08)	0,35	1,43*** (0,07)	0,357	1,64*** (0,07)	0,497
inpssu			1,02 (0,07)	0,015			1,32*** (0,06)	0,275
encost(0)	1,58*** (0,12)	0,457	1,65*** (0,12)	0,501	1,62*** (0,11)	0,484	1,46*** (0,11)	0,378
encost(1)	1,20* (0,1)	0,18	1,25** (0,1)	0,223	1,24** (0,1)	0,216	1,15 (0,1)	0,141
encost(2)	0,95 (0,08)	-0,054	0,97 (0,08)	-0,027	0,96 (0,08)	-0,041	0,95 (0,07)	-0,055
encost(3)		0[b]		0[b]		0[b]		0[b]
funloc	1,15 (0,15)	0,137	1,12 (0,15)	0,117			1,06 (0,14)	0,059
funeu	0,70*** (0,09)	-0,36	0,73*** (0,09)	-0,311	0,75*** (0,09)	-0,293	0,70*** (0,09)	-0,358
enereg(0)	1,74*** (0,15)	0,556	1,86*** (0,15)	0,622	1,85*** (0,12)	0,617	1,57*** (0,14)	0,451
enereg(1)	1,11 (0,12)	0,103	1,15 (0,12)	0,142	1,12 (0,1)	0,114	1,17 (0,11)	0,157
enereg(2)	1,14* (0,08)	0,134	1,16* (0,08)	0,147	1,13 (0,07)	0,121	1,17** (0,07)	0,16
enereg(3)		0[b]		0[b]		0[b]		0[b]
enetx(0)	0,95 (0,14)	-0,052	0,91 (0,14)	-0,095			0,9 (0,12)	-0,102
enetx(1)	0,97 (0,11)	-0,032	0,92 (0,12)	-0,081			0,96 (0,1)	-0,04
enetx(2)	0,89 (0,09)	-0,114	0,88 (0,09)	-0,13			0,91 (0,09)	-0,089
enetx(3)		0[b]		0[b]				0[b]
enregf(0)	1,09 (0,14)	0,085	1,09 (0,14)	0,089			1,18 (0,13)	0,163
enregf(1)	1 (0,11)	-0,005	0,98 (0,12)	-0,019			1,03 (0,1)	0,033
enregf(2)	1,1 (0,09)	0,095	1,1 (0,09)	0,099			1,11 (0,08)	0,106

enregf(3)			0[b]			0[b]			0[b]
engra(0)	0,95	(0,11)	-0,046	0,92	(0,11)	-0,086	0,96	(0,1)	-0,042
engra(1)	1,09	(0,11)	0,087	1,05	(0,11)	0,053	1,04	(0,1)	0,038
engra(2)	0,96	(0,11)	-0,046	0,93	(0,11)	-0,077	0,97	(0,1)	-0,034
engra(3)			0[b]			0[b]			0[b]
enrequ(0)	1,1	(0,1)	0,099	1,03	(0,1)	0,03	1,03	(0,1)	0,03	1,01	(0,09)	0,015
enrequ(1)	1,26**	(0,11)	0,234	1,21*	(0,11)	0,191	1,23*	(0,11)	0,211	1,1	7 (0,1)	0,157
enrequ(2)	1,21*	(0,1)	0,188	1,18*	(0,1)	0,168	1,18*	(0,1)	0,169	1,08	(0,09)	0,082
enrequ(3)			0[b]			0[b]			0[b]			0[b]
endem(0)	0,70***	(0,11)	-0,353	0,74***	(0,12)	-0,303	0,71***	(0,11)	-0,336	0,84*	(0,11)	-0,174
endem(1)	0,71***	(0,11)	-0,343	0,74***	(0,11)	-0,299	0,74***	(0,1)	-0,301	0,77**	* (0,1)	-0,264
endem(2)	0,79***	(0,09)	-0,24	0,82**	(0,09)	-0,197	0,81**	(0,09)	-0,21	0,87*	(0,08)	-0,143
endem(3)			0[b]			0[b]			0[b]			0[b]
CO31				0,85	(0,11)	-0,16				0,97	(0,1)	-0,035
CO32				0,98	(0,15)	-0,017				1,05	(0,14)	0,046
CO2				0,71***	(0,1)	-0,34	0,69***	(0,09)	-0,376	0,67***	(0,09)	-0,405
enrep(0)	1,73***	(-0,15)	0,547	1,73***	(0,15)	0,551	1,75***	(0,15)	0,558	1,55***	(0,14)	0,441
enrep(1)	1,44***	(-0,12)	0,366	1,41***	(0,12)	0,341	1,39***	(0,12)	0,332	1,27**	(0,11)	0,24
enrep(2)	1,08	(-0,08)	0,077	1,06	(0,08)	0,063	1,06	(0,08)	0,062	0,96	(0,07)	-0,038
enrep(3)						0[b]			0[b]			0[b]
enagr(0)	1,73***	(-0,12)	0,551	1,74***	(0,13)	0,556	1,76***	(0,12)	0,563	1,92***	(0,11)	0,652
enagr(1)	1,41***	(-0,1)	0,343	1,42***	(0,1)	0,348	1,43***	(0,1)	0,356	1,57***	(0,09)	0,449
enagr(2)	1,34***	(-0,08)	0,295	1,34***	(0,08)	0,291	1,34***	(0,08)	0,294	1,43***	(0,07)	0,36
enagr(3)			0[b]			0[b]			0[b]			0[b]
envbf	0,98	(-0,08)	-0,019	1,01	(0,08)	0,012			0	1,01	(0,07)	0,007
envbt	1,15*	(-0,07)	0,137	1,15**	(0,07)	0,142	1,15**	(0,07)	0,142	1,36***	(0,06)	0,305
CO1				0,94	(0,1)	-0,063				1,09	(0,09)	0,082
CO4				1,11	(0,12)	0,108				1,13	(0,12)	0,121
CO5				1,32**	(0,11)	0,281	1,33***	(0,1)	0,282	1,45***	(0,1)	0,369
CO6				0,93	(0,12)	-0,073				0,96	(0,11)	-0,046
CO7				1,2	(0,14)	0,184				1,2	(0,13)	0,183
propat				1,02	(0,13)	0,022				1,01	(0,12)	0,015
proeum				0,88	(0,2)	-0,13				0,93	(0,18)	-0,07
prodsg				1,03	(0,17)	0,026				1,06	(0,15)	0,054
protm				0,97	(0,09)	-0,034				0,94	(0,08)	-0,06
empud6	0,96	(0,11)	-0,038	0,91	(0,11)	-0,097				1,08	(0,1)	0,078
RTR				1,15*	(0,07)	0,141	1,16**	(0,07)	0,148	1,44***	(0,06)	0,363
roek	1,06	(0,07)	0,057	1,05	(0,08)	0,051				1,16**	(0,07)	0,147
size(0)	0,66*	(0,23)	-0,414	0,85	(0,24)	-0,16	0,83	(0,23)	-0,184	0,8	(0,22)	-0,225
size(1)	0,85*	(0,08)	-0,162	0,88	(0,09)	-0,13	0,87*	(0,08)	-0,14	1,02	(0,08)	0,025
size(2)			0[b]			0[b]			0[b]			0[b]
Intercept			-0,573**			-0,792**			-0,810***			-1,128***
-2Log-likelihood			7070,922			7035,519			7026,237			8356,475
Nagelkerke Pseudo R^2			0,397			0,409			0,407			0,232
McFadden Pseudo R^2			0,276			0,286			0,284			0,151
AIC			7166,922			7175,519			7112,237			8490,475
BIC			7506,051			7670,083			7416,04			8963,844
Chi-square			2.719,7***			2.821,60***			2.804,43***			1.484,75***
Observations			8649			8649			8649			8649

(b)This parameter is 0 because it is redundant.

*Odds ratio and robust standard errors (in parentheses) of logit regression models (M1, M2,….);***(**;*)indicates significance beyond the 99% (95%; 90%) two-tailed confidence level.*

Source: Own elaboration

Organisational innovation variables (ORGBUP, ORGWKP, and ORGEXR) were significant in these three models. While all of them significantly influence ECORG, the analysis shows ORGWKP as the type of organisational innovation that is more conducive to environmental benefits while highlighting that, if a company applies new business practices for organising procedures, it increases the probability of organisational innovations with environmental benefits by a factor of five.

In Model Four (M4), a sensitivity analysis is performed to study how the significance of the variables in M2 changes when the variables related to organisational innovation (ORGBUP, ORGWKP, ORGEXR) are eliminated.

The four estimated models coincide in that companies that anticipate a high market demand for environmental innovation (ENDEM) are less likely to use organisational innovation with environmental benefits. The probability of conducting organisational eco-innovation is higher for companies with environmental regulations (ENREG), with high energy, water, or material costs (ENCOST). Probability is high also for companies seeking to improve its reputation (ENREP), companies carrying out voluntary actions or initiatives for environmental good practice (ENAGR) or needing to meet requirements for public procurement contracts (ENREQU). This last variable ENREQU, however, is insignificant in M4. It is also observed that variables referring to local funding (FUNLOC), governmental incentives such as grants or subsidies (ENGRA), and environmental taxes (ENETX) are insignificant in all the models. Furthermore, companies that receive funds from the EU (FUNEU) are less likely to pursue organisational eco-innovation. Similarly, none of the variables linked to intellectual property rights or licencing were significant.

From the new variables included in M2, M3, and M4, it is observed that, in process innovation, introducing a new or significantly improved production method (INPSPD) into the market decreases the probability of organisational eco-innovation; conversely, introducing a new or significantly improved logistics, delivery, or distribution system (INPSLG) favours organisational eco-innovation, and introducing new or significantly improved supporting activities also has an effect (INPSSU). Furthermore, companies that introduce a new or significantly improved service in the market (INPDSV) are more likely to pursue organisational eco-innovation while those that introduce a new product into the market through process innovation are less likely to pursue to organisational eco-innovation.

Companies that have cooperation arrangements for innovation with suppliers of equipment, materials, components, or software (CO2) are less likely to pursue organisational eco-innovation. However, those that have cooperation arrangements for innovation with consultants and commercial labs (CO5) as well as those using new methods of pricing goods or services (MKTPRI) and engaging in training for innovative activities (RTR) are more likely to carry out organisational innovation with environmental benefits.

In M4, it is observed that, when the variables of organisational innovation are not considered, organisational eco-innovation is also explained by marketing innovation, process innovation, and product innovation related to the introduction of improved services. In other words, there are variables, particularly marketing-related variables, that were insignificant in the previous models but become significant in M4. Additionally, companies that introduce new or significantly improved supporting activities (INPSSU) or engage in the acquisition of external knowledge (ROEK) increase the probability of applying organisational innovation with environmental benefits.

5 DISCUSSION

The results clearly indicate that companies can achieve environmental benefits through organisational innovation. Regarding Q1, Table II shows that organisational innovation is still not widely used to achieve eco-innovation in European firms. Only 26% of the total sample

recognised the environmental benefits from organisational innovation, ranging from 11% of companies in Lithuania to 42% in Bulgarian firms. The analysis also shows that organisational eco-innovation is unequally linked to the different types of organisational innovation. For Q2, all of the models conclude that organisational eco-innovation is significantly related to innovations in work responsibility and decision-making methods (ORGWKP). This is because this type of organisational innovation is up to five times more likely to provide environmental benefits. Other types of innovation are also significant. Innovation in new business practices (ORGBUP) ranks higher than new methods for organising external relations (ORGEXR). This seems reasonable because a lower impact of external relations is expected. This seems to indicate the true importance of management (decision making, leadership) in promoting eco-innovative activities as a crucial factor for their development as it is also important in organisational innovation. Environmental innovation is complex and challenging due to its high level of uncertainty and the associated risks; therefore, managerial concerns, beliefs, and behaviours, especially those of the CEO, are decisive factors in encouraging eco-innovation initiatives (Delgado *et al.*, 2011; Arena *et al.* 2017; Segarra-Oña *et al.* 2012).

Interestingly, in M4, which does not consider the three types of organisational innovation, other relationships that could be masked by these three variables can be observed. In this sense, the relationship with marketing innovation is notable and significant for each of its four types. This could be expected, because innovation in marketing and organisational innovation go hand in hand. As the literature indicates (Bujidos-Casado *et al.* 2019), there is a strong positive correlation between marketing and organisational innovation.

This positive relationship of the dependent variable is also observed with new or significantly improved supporting activities (INPSSU) and with improved methods of manufacturing, logistics, delivery, or distribution methods as well as the improved supporting activities for the processes (INPSLG). These are ultimately innovations in processes and activities and, as such, are closely related to organisational innovation. The analysis shows that organisational eco-innovation is closely linked to both process and marketing innovation initiatives.

Among the results, it is relevant to highlight the most influential factors of decision making to implement innovations with environmental benefits and their relationship with organisational eco-innovation. The empirical analysis aligns with the existing literature when observing the relationship with high energy, water, or material costs (ENCOST), as already suggested by Horbach (2012). Additionally, the influence of environmental regulations (ENREG) is significant, as indicated by the existing literature (Triguero *et al.*, 2013; Shahin *et al*. 2020). However, no significant relationship could be found between organisational eco-innovation and other types of government stimulus such as grants, subsidies, or taxes.

All four models indicate a negative effect of market demand (ENDEM) on organisational eco-innovation, confirming that different factors trigger different eco-innovation types (Hojnik and Ruzzier, 2016). This could also indicate that companies that anticipate a high market demand for environmental innovation are more prone to other types of innovation, such as product or marketing innovation, rather than organisational innovation.

More novel is the relationship with the need to improve the enterprise's reputation (ENREP) as well as the voluntary actions or initiatives for environmental good practice within a sector (ENAGR), which is less frequent in previous studies.

Additionally, another significant factor for organizational eco-innovation is when the enterprise has already put procedures or an EMS in place (ENVBF), like environmental audits or ISO certifications. This result confirms the assumption that the implementation of environmental procedures facilitates eco-innovation by increasing awareness and operational efficiency (Cai and Li, 2018). It also reveals that corporate interest in environmental and sustainability aspects can be assumed.

Regarding cooperation with third parties in active participation with other enterprises or organisations, only cooperation with suppliers of equipment, materials, components, or software

and consultants or commercial labs appeared significant. The results concerning consultants are quite novel and could be explained as collaboration with consultants in the environmental field as consultants are usually a source of knowledge for innovation or support for management (Tether and Tajar, 2008). This could be interlinked with relational capital to focus on how firms can absorb, exploit, and explore new knowledge from their environment to obtain and sustain competitive advantage positions (Martín-de-Castro *et al.,* 2011). Green innovators perceive the lack of appropriate cooperation partners as an important innovation barrier; therefore, a suitable knowledge partner becomes a key asset (González-Moreno *et al.*, 2019).

Specific training to implement and develop innovative activities is also a determinant factor (RTR). Furthermore, the relationship between the study variable and personnel training is not new in the academic literature (Brío and Junquera, 2003). The results that highlight the positive association between environmental innovation and organisational innovation in the presence of training practices align with those of Garcia Marco *et al.* (2020).

According to the results in Table III, the main external factors of organisational eco-innovations are regulation, willingness to improve the firm's reputation, acquisition of external knowledge, and collaboration with consulting firms. Internal factors such as the need for cost reduction on energy, water, or materials, a pre-existing EMS, audits or certifications, the commitment of both management and personnel, and investment in innovation training are also relevant when achieving environmental benefits through organisational innovation. All these factors seem more linked to the adoption/diffusion stage of eco-innovation than to the development/innovation stage (Hojnik and Ruzzier, 2016). This, together with the relationship between organisational eco-innovation and other types of eco-innovation, especially marketing or process innovation, could indicate that organisational innovation acts as an enabler or catalyst for the adoption of innovations aimed at achieving environmental benefits through changes in the firm's work responsibilities and decision making; these are significantly influenced by the personal beliefs and choices of the company's top management.

In this sense, in the field of knowledge management, a significant positive relationship is found between organisational eco-innovation and the acquisition of existing know-how, which could be in the form of copyrighted works and patented and non-patented inventions from other enterprises or organisations. Conversely, there is no relationship between organisational eco-innovation and the firm's own development of intellectual property rights and licencing (applying for a patent or a European utility mode, registering an industrial design right or trademark).

Table IV:Summary of significant results

Relationship with Organizational Eco-Innovation (ECOORG)	***Main Findings***
Marketing Innovation	*Positive and significant relationship between organizational innovation with all 4 types of Marketing innovation: changes to design or packaging (MKTDGP); new techniques for product promotion (MKTPDP), new methods of product placement (MKTPDL) and new pricing methods (MKTPRI).*
Prod & Serv Innovation	*Positive relationship with service innovation (INPDSV).* *Negative relationship with product Innovation (INPDGD).*
Process Innovation	*Positive relationship with process innovation by improving logistics, delivery or distribution methods (INPSLG) and with process innovation in supporting activities for processes (INPSSU).* *Negative relationship with process innovation by improving methods of manufacturing or producing (INPSPD).*
Cost savings	*Positive relationship with high cost of energy, water and materials (ENCOST).*
Regulation & Government	*Positive relationship with environmental regulations (ENEREG).* *Negative relationship with public funding from EU (FUNEU).*

Market Demand	*Negative relationship with current or expected market demand for environmental innovations (ENDEM).*
Supply Chain	*Negative relationship with cooperation with suppliers of equipment, materials, components, or software (CO2).*
Management & Leadership	*Positive relationship with the willingness to improve the enterprise reputation (ENREP); with voluntary actions or initiatives for environmental good practice within the sector (ENAGR) and with the existence of already implemented procedures to identify and reduce the environmental impacts(ENVBT).*
Cooperation Agreements	*Positive relationship with cooperation with Consultants and commercial labs (CO5).*
Knowledge Management	*Positive relationship with training for innovation activities within the company (RTR) and with the acquisition of other external knowledge (ROEK).*

Source: Own elaboration

6 CONCLUSIONS

The contributions of the study are threefold: First, it confirms the link between organisational innovation and eco-innovation. Second, it reveals that the type of organisational innovation most linked to environmental innovation is innovating in work responsibility and decision-making methods compared with other types of innovation. Our findings seem to provide two suggestive features; our insights significantly share the implications of the role of management (decision-making, corporate reputation, cost-efficiency, EMSs). In many cases, they have a human capital component (training, external consultants, knowledge acquisition), highlighting the importance of human capital and talent management. Third, the results highlight some novel factors in the link between eco-innovation and organisational innovation. These findings will allow practitioners to drive eco-innovation through the organisation and its innovation. Furthermore, our results will encourage researchers to analyse multiple intangible, organisational, and knowledge management aspects that are interrelated with environmental aspects.

Along with the link between organisational and environmental innovations, especially with the implementation of new ways of work and decision making, the study also highlights other factors that are relevant to this relationship. Some are evidently common to all the eco-innovation types. Others, however, are novel and infrequent, which is an original contribution of this research.

The study confirms the significance of some external factors such as compliance with environmental regulations or the need to meet public contract requirements, which have been largely mentioned in the existing literature. It also reveals how organisational innovation is linked to achieving environmental benefits when these drivers are present.

Similarly, the findings are in line with previous studies demonstrating how the reduction of energy costs or the introduction of new logistics and delivery systems are important determinants of eco-innovation that require changes in organisational practices, routines, and systems. We also found that companies that seek to improve their supply chain through cooperation with external companies are less inclined to innovate through organisational innovation, leveraging their partners' abilities rather than changing their internal structure, resources, and practices.

The study also contributes to previous research by demonstrating that organisational innovation can be effectively used to retrieve environmental benefits, especially when driven by management and leadership. Factors such as willingness to improve the company's reputation, setting the ground for proactive and voluntary activities towards environmental improvement, embedding environmental goals in the company's strategy, establishing EMSs and certifications such as ISO 14001, and training employees in environmental topics are significantly correlated with organisational eco-innovation and significantly linked to managerial concerns and beliefs. It is no coincidence that human capital and talent management, organisational culture, as well as relational issues, reputation, and image (Bueno *et al.*, 2012) can contribute to developing eco-strategies. The inter-linkage between reputation and the voluntary desire to work for the sector is also significant. The findings support Martín-de Castro (2020), who asserts that reputation and legitimacy, as well as related issues, such as corporate image and branding, play a key role in

implementing new successful sustainable business models and in the construction of a corporate environmental reputation (Martín-de Castro *et al.,* 2020; Martín-de Castro *et al.*, 2016).

6.1 Implications

As a first impression, from outside this field of research, it could be expected that the introduction of environmental innovation in companies would go hand in hand with new business practices as a form of organisational innovation. However, the analysis shows that, although this type is significant, innovation in work responsibility and decision-making is more important. This suggests that determined leadership, innovative decision-making, and an assumption of responsibility in the process are more relevant, beyond just good practices. This has obvious implications for management.

A good and proactive environmental approach can be more sustainable if driven in conjunction with the implementation of a true eco-organisation in which processes, internal systems, structures, and employees are aligned and prepared to deal with environmental issues.

According to our study, organisational eco-innovation is important when companies acquire external know-how, suggesting the need to adapt the internal structure and work procedures to absorb this knowledge. This finding regarding the acquisition of external knowledge and organisational eco-innovation is closely related to the relevance of internal training for innovation, as shown by the statistical model, highlighting the importance of knowledge management factors when seeking environmental benefits through organisational innovation. Furthermore, the study shows that organisational eco-innovation is achieved through collaboration when cooperating with external consultants. This finding, although new, can be explained by the fact that the company is trying to acquire external knowledge on how to best reorganise internally. Furthermore, consulting firms are a well-known source of innovation knowledge and top management support for organisational transformation initiatives.

The identification of the main internal and external drivers of organisational eco-innovation directly affects the selection of management strategies to drive environmental benefits. On one hand, external drivers for eco-innovation usually drive reactive strategies, which lead to incremental benefits as a response to external requirements (regulation, public contracts, etc.). On the other hand, internal drivers are associated with more proactive strategies, which can lead to more radical innovations (He *et al.*, 2018). Management implications are key to the integration of environmental goals into the company's strategy. Seeking environmental leadership and enhancing corporate reputation through the voluntary adoption of improved processes and organisational capabilities will make innovation more sustainable in the long run. In any case, management should consider both external and internal drivers as the combination seems to be conducive to realising the full potential of environmental innovation. Regarding aspects related to knowledge management, there have been notable indications of the importance of acquiring existing know-how from others (copyrighted works, patented and non-patented inventions) versus the in-house generation of knowledge (intellectual property rights and licencing). Management should consider the collaboration and acquisition of external knowledge as a source of innovation in addition to internal investment and resources in R&D. In the case of environmental innovation, collaboration with expert consultants, who can provide broad industry best-practice knowledge and help shape the internal organisational structure and capabilities, can be a great complement to internal efforts.

6.2 Limitations

The study is not without limitations, most of which come from the nature of the data. The dichotomous nature of many of the variables makes it difficult to obtain more robust results. Likewise, some European countries had to be excluded because they did not answer the questions on eco-innovation. The variables are limited to the questions included in the survey, and their correspondence with the factors driving innovation can be, in some cases, subject to interpretation and even overlapping. Nevertheless, given the volume of the sample and the inclusion of data

from many EU countries, the results continue to be valuable. The statistical approach has not allowed us to establish causal relationships but merely to link organisational innovation and eco-innovation. Additionally, the task of processing and normalising the data provided by Eurostat implies that a more recent sample cannot be used (we have analysed the latest available data). However, we believe that the insights and findings presented here make an interesting contribution to knowledge about sustainable innovation and its organisational implications in Europe.

6.3 Future Research

Continuing to investigate when new data become available is a clear opportunity for future research. In this sense, understanding and studying environmental innovation is an important topic for further research. It may also be interesting to continue working on all the aspects related to intangibles, and the underlying immaterial component when talking about innovation must be better understood.

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