The role of manager in eco-innovation decision in the firm: Perceived Behavioural Perspective (PBC)

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Abstract

The overall aim of this study is to investigate the incentives and inhibiting factors of eco-innovation in the firm. From a psychological perspective (Perceived Behavioural Control), this paper examines the decisional process that leads to an eco-innovation process from managers' perspective. We test our hypotheses using a panel data from the Community Innovation Survey (PITEC, 2013), containing 12,817 Spanish firms. Our results show how the complexity of the eco-innovation development process negatively affects the manager in the decision to develop eco-innovations. However, we see that the institutions and organizations of the business environment are making efforts to compensate for these obstacles and incentivize the manager the decision to develop eco-innovations. Also, our results highlight that the experience acquired in pass eco-innovations facilitates the decision of the development of future eco-innovations.
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Introduction

Over recent years, environmental innovation (eco-innovation) has become one of the main drivers of economic development (Ambec et al., 2013; Borghesi et al., 2015). In this context, the growth of demand for environmental improvement jointly with the importance in the society of sustainable development has caused an increase in the supply of techniques, products and services respectful with the environment. According to Kemp et al. (2006), eco-innovation consists of new or modified processes, techniques, systems and products to avoid or reduce environmental damage. Environmental innovation does not limit developing new or modified processes, techniques, systems and products to avoid or reduce environmental damage (Kemp et al., 2006); it also includes new organizational methods, products, services and knowledge-oriented innovation (OECD, 2009).

Authors highlight the important role that firms play in the development of eco-innovations (Noci and Verganti, 1999; Rehfeld et al., 2007; Moore et al., 2014). The European Union (Eco-Innovation Observatory, 2018) points out that this sector represents a business volume for companies of around 2.2% of the GDP of the European Union. Moreover, eco-innovation and sustainable development are considered crucial drivers in determining the competitiveness of companies. In fact, the eco-innovation allows fostering and encouraging competitiveness in companies through the improvement of operations and reduction of costs.
Thus, the control of pollution and waste management and the improvement of the company's corporate image are the main environmental actions developed by companies.

The firms materialize the objectives of eco-innovation in the selection of activities and the degree to which they are developed (Aragon-Correa, 1998; Sharma and Vredengurg 1998, Buysse and Verbeke, 2003). In this context, managers set objectives from a reactive attitude to external pressures, to a more proactive one that implies the voluntary adoption of eco-innovation activities (Henriques and Sadorsky, 1999). Thus, we can find objectives based on compliance with legislation, such as, for example, the development of eco-innovations that aim to control waste (discharge and high toxicity emissions) and compliance with environmental standards, until the development and implementation of environmental management systems, such as TQEM\textsuperscript{1}, or creation ecological products for new market.

Previous literature has addressed the role of the manager and its effect on the positioning of the company in the development of eco-innovation, concluding that the lack of commitment of managers on environmental issues has an impact on their positioning (Cuerva et al., 2014; Kesidou and Demirel, 2012; Bossink, 2007). However, Manzzanti and Zoboli (2006) and Horbach et al. (2012) point out that the literature is still scarce and scattered, without fully explaining what factors influence the manager to have a more proactive position in setting eco-innovations objectives in the firms. With this backdrop, our research focuses on identifying the factors that facilitate or hindering the decision of the manager in the development of eco-innovation.

Our study employs the psychological foundations of intentional theory (Ajzen 1991; 2002), more concretely, the perceived behavioural control (PBC) perspective to explore the intention of the manager to make a decision (Ajzen 1991; 2002). PBC has been characterized as insightful in its ability to understand and explain individual behaviours and intentions (Hill et al., 1996; Kilber et al., 2014), and as a theoretical lens for examining these difficulties. From the PBC viewpoint, the intention to develop an action is conditioned by the degree of control that the manager has on that action, which is based on factors that facilitating conditions or hindering to develop the task and the control over personal resources. Therefore, we consider that the decision of the manager will be the result of ease or difficulty of performing the behaviour, as a consequence of factors that facilitate or hinder the development of eco-innovation.

\textsuperscript{1}Total Quality Environmental Management.
We test our hypotheses using a panel data from the Community Innovation Survey (PITEC, 2013), containing 12,817 Spanish firms. For this, we will analyse, first of all, how the complexity of the development of the eco-innovation process affects the manager in the decision. Thus, the uncertainties of the process as well as that of the market, plus the management of the process itself, are the main factors to be analysed. Second, we analyse how different policies and actions are being developed from the various institutions in the company’s environment that overcome these drawbacks, and how these affect the manager's decision. Thus, we can consider the facilitating elements such as the availability of the information sources, the facilities for establishing cooperation agreements, and the public financing. Moreover, the experience acquired in past eco-innovations should facilitate the decision of the development of future eco-innovations. On the other hand, we have chosen the case of Spain. Spain ranks sixth after Sweden, Finland, Germany, Denmark and the United Kingdom, in terms of ISO-14001 and EMAS\(^2\) certification for the implementation of Environmental Management Systems (EMS), and percentage of employment associated with eco-industries (Eco-Innovation Observatory, 2018); however, in the development of eco-innovations it is below the European average\(^3\). Therefore, from a regional perspective, addressing the main difficulties that the Spanish firms face in the development of the eco-innovation process, it is a question of vital importance for the Spanish economy.

In the next section, we present a concise overview of relevant literature on international collaboration in order to generate hypotheses. The following section describes our research methodology, including data collection and measures. Afterwards, our data analysis and results are provided. Then, we present the discussion and managerial implications of the findings, and we conclude with limitations and suggestions for future research.

**Conceptual Framework and Hypotheses**

*Eco-innovation in the firm*

In the literature there are several definitions that have a common basis, emphasising different aspects of the term eco-innovation. In Carrillo-Hermosilla et al. (2010) and Andersen (2010), eco-innovation is defined as an innovation that is capable of attracting

\(^2\) The EU Eco-Management and Audit Scheme (EMAS) is a premium management instrument developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance (European Commission, 2018).

\(^3\) In 2017, Spain ranks fifth in the world in ISO 14001 certification after China, Japan, Italy and the United Kingdom with 13,717 certified sites. Regarding accreditation in the EMAS regulation, Spain is in fourth in terms of the number of sites accredited after Germany, Italy and Greece.
green performances in the market. On the other hand, Rennings (2000) and Kemp (2006) affirm that eco-innovation is the development, assimilation or exploitation of a product, process, service or organizational/business method that is novel for the organization, and whose results are the reduction of environmental risk, pollution or other negative impacts of the intensive use of resources. Therefore, following Horbach et al. (2012), eco-innovation is an innovation that has an environmental benefit.

However, in contrast to other innovations, environmental innovations have some differences with the innovation. The first difference is that eco-innovation may lead to a so-called ‘win-win’ situation characterised by both economic and environmental benefits (Ambec et al., 2013; Porter and der Linde, 1995). As a consequence, Porter (1991) pointed out the need for the integration of environmental policies in the management of companies. This would force companies to invest in new technologies and more efficient production processes, thereby saving costs and social benefits from a more sustainable environment.

The second difference between environmental and innovations is the combination of an urgent environmental problem that needs a solution with an associated cost for the private company (Foulon et al., 2002; Cuerva et al., 2014). In fact, while social costs would be reduced by such innovation, private costs would increase. In innovation studies, it is often assumed that innovations are good per se and signify a relatively easy and cheap solution to environmental problems; however, this is not necessarily (Mazzanti and Zoboli, 2006; Rehfeld et al., 2007). Innovation takes much time, requires costly investments in R&D, and involves many failed efforts to realise market up-scaling. Authors have called this effect double externality. This effect highlights the lack of incentives to invest in eco-innovation. On the one hand, the reduction of environmental impact by innovators reduces the pressure on other polluting companies, since there is a social benefit, without the latter having to adopt measures. On the other hand, due to the characteristics of the public good that environmental knowledge has, it is relatively easy to avoid or copy the first innovators without including in their research costs and risks.

The last difference is that the technology solves the environmental problems, but nevertheless, it is also observed that it is the environmental regulation that in the majority you solve them (regulatory push/pull effect). Economic studies show that the major part of reduction of emissions in the coming decades is unlikely to come from innovation but instead from environmental regulation that changes decisions about inputs and outputs by producers and consumers, which will alter the sector and demand structure of the economy (Jorgenson et al., 2009; Popp, 2003). Popp (2003) concludes that environmental regulation has a strong
incentive effect on innovation. Thus, the role of policies in stimulating innovation is a long-debated issue at theoretical and empirical level (Grubb and Ulph, 2002). The reason is that environmental innovations are inspired not only by market opportunities but also by health, environmental and ethical concerns.

**Perceived behavioural control (PBC)**

PBC perspective analyses the behavioural control in the context of the decision process (Ajzen, 1991), considering the easiness or difficulty perceived by individuals in the intention to make a decision. Kidwel and Jewell (2003, p. 626) point out that *PBC specifies that the likelihood of successful behavioural performance will vary as a function of the perceived controllability towards performing a behaviour*. These authors highlight that the important thing is the sense of control regarding the fulfilment individual behaviours. In this way, Conner and Armitage (1998) point out that the notion the control has two dimensions: internal control, based on factors that come from within the individual, such as self-efficacy, experience and motivation to develop an action. It is a concept quite similar to perceived self-efficacy (Bandura, 1997), and it is also very close to Shapero and Sokol’s (1982) vision about perceived feasibility. Thus an individual with higher perceived internal control should display a higher likelihood to perform the behaviour (Kidwel and Jewell, 2003). Therefore, following Kidwel and Jewell (2003), the behaviour could be internally controllable when the individual has the perception to control over personal resources. External control is based on factors that come from outside the individual, such as task difficulty and access to necessary resources. This conceptualization of external control is similar to facilitating conditions of Bagozzi and Kimmel (1995), which is considered as environmental conditions that make the act easy or difficult.

**Hypotheses**

The model for the study of eco-innovation and manager-decision combines the PBC model with innovation theory in a complementary manner. The eco-innovation decision will involve the evaluation of an eco-innovation developing process by the manager and the formation of a decision. The model postulates that the development of an eco-innovation is influenced by the perception to external control as consequence of the facilitating or hindering factors found in the process, and internal control that manager has over personal resources. Therefore, the perception of manager control in eco-innovation developing refers to the ease or difficulty of performing the decision as a consequence of the existence of facilitating or hindering factors.
**Hindering Factors: the complexity of the eco-innovation process and manager decision.**

The innovation development process has been characterized as a complex process in its management (Rothaermel and Deeds, 2004; Lundwall, 2007; Arranz and Arroyabe, 2009;). In this sense, the uncertainty of the process itself and the market, as well as the management of company resources and cooperation agreements for the development of eco-innovation, are a set of difficulties and obstacles that must be overcome in this process (Patel and Pavitt, 1977; Buesa et al., 2006; Arranz and Arroyabe, 2006; Lundwall, 2007).

The first group of obstacles and difficulties arises the uncertainty of the process. Thus, the uncertainty of the results of innovation, as well as the time invested in its realization, are sources of difficulties and obstacles to develop innovation in the firms (Buesa et al., 2006; Arranz and Arroyabe, 2006). The manager perceives that this uncertainty in the development of innovations, can suppose a deviation in the budget, as a result of which the technical solutions sought have not been achieved and more resources need to be allocated and/or more time than expected. This is perceived as an increase in costs that must be financed. Moreover, Lee et al. (2006) point out that this extra cost implies an added problem for the manager. On the one hand, it is necessary to finance this extra cost, incurring an additional cost. On the other hand, the search for financing supposes an additional difficulty to the management of the innovation process, considering that the resources are allocated and are limited to the firm (Lee et al., 2006; Lundwall, 2007). Therefore, the manager perceives the loss of control as a consequence of the management of the cost and financing of the development of eco-innovation, having a negative decision in the manager's decision. Hence, we propose:

**Hypothesis 1a: The obstacles derived from the management of costs and the financing of the eco-innovation process have a negative effect on the manager in decisions.**

The second group of obstacles arise from the complexity of managing the eco-innovation process. Rothaermel and Deeds (2004) point out the innovation process involve the management of exploration and exploitation activities in the firm. On the one hand, exploration requires experimenting and searching activities to find new and emerging innovations capable of generating future sources of profits, for this the manager needs to develop management systems for the acquisition of information on markets and furtive technologies (Gilising et al., 2008). On the other hand, exploitation consists of the extension and refinement of existing technologies, paradigms and competencies (March 1991; Rothaermel and Deeds, 2004). In this case, the manager must manage an adequate staff, with a level of competence appropriate to the needs of exploitation. Moreover, the management of both functions (ambidexterity function), has been highlighted as a difficult function to
combine in the manager (Gibson and Birkinshaw, 2004; Raisch et al., 2009). This involves managing different organizational and strategic requirements, generating tensions in the manager. Raisch et al. (2009) point out that both orientations compete for the scarce resources of the companies, which generates the need for the manager to manage the exchanges between the two, in an adequate balance (Tushman and O'Reilly, 1996, Gibson and Birkinshaw, 2004). Otherwise, the development of innovation is currently assumed in the literature, as a collaborative process with other companies or institutions (Miotti and Sachwald, 2003). Hagedoorn et al (2000), and Cassiman and Veugelers (2002) point out that the use of cooperation agreements entails several obstacles, for example, the necessary coordination of two or more partners, the emergence of goal conflicts, the lack of trust and understanding, and cultural differences, among others. In this sense, Miotti and Sachwald (2003) point out that it is important that the manager must manage the search for a suitable partner with the aim of mitigating the subsequent problems of the management of cooperation agreements. Therefore, the manager perceives the loss of control in the management of the eco-innovation process, as a consequence of the need to generate information, capabilities in the firm and management of the search for partners, having a negative impact on their decision. Hence, we propose:

**Hypothesis 1b**: The difficulties of managing the eco-innovation process have a negative effect on the manager in eco-innovations decisions.

Finally, another group of obstacles that managers usually find in the development of innovations are those derived from the uncertainty of the market. Hagedoorn (1993) pointed out that the uncertainty occurs in the face of ignorance of the reaction of the consumer to the innovative product. In this line, an example of the characteristic reaction is the organic products in the agro-food sector (Ilbery and Maye, 2005). In this case, the product has an extra cost on the same non-ecological product. The consumer will be willing to pay more if his perception of the relation quality of cost is acceptable. Although it is observed that there is an increase in the valuation of the intangibility of the products (Mirata and Emtairah, 2005; Gray and Shimshack, 2011), the additional cost generates uncertainty in the manager, implying developing additional actions to achieve the acceptance of the product (Rehfeld et al., 2007). This situation becomes more complicated if the market is dominated by established companies, which will be perceived by the manager as a difficulty added to the entry of new products/companies (Noci and Verganti, 1999; Theyel, 2006). On the other hand, derived from the double effect, the ecological advantages usually disappear as a consequence of the disincentive that exists to ecological research. Porter and der Linde
(1995) point out that due to the characteristics of the public good that knowledge about the environment has, it is relatively easy to copy the first innovators without affecting their research costs and risks. Therefore, the manager perceives the loss of control in the management of the eco-innovation process, as a consequence of the uncertainty of the market, having a negative impact on its decision. Hence, we propose:

**Hypothesis 1c**: The uncertainty of the market has a negative effect on the manager in eco-innovations decisions.

**External facilitating factors in the eco-innovation and manager decision.**

As we have pointed out, firms are embedded in a geographical environment, fostering the development of innovations (Buesa et al., 2006; Lundvall, 2007). In this sense, the institutions and companies interact with the objective of developing and implementing innovation (Lundvall, 2007). In this context, the interactions allow the sharing of risks and resources, reduces development times, improve employee participation, and increases access to new knowledge, technologies, and markets (Kumar et al., 2012; Parida et al., 2014), therefore facilitating factors of innovation development.

A first factor considered in the literature of innovation is the availability of information that the manager has in his environment. Carrion-Flores and Innes (2010), and Horbach (2008) point out that the information sources can be assumed to have a positive influence on the adoption of eco-innovation objectives. Thus, Rogers (2003, p 172) describes the innovation-decision process as "an information-seeking and information-processing activity". The manager becomes aware of the necessity of developing eco-innovation, evaluating the feasibility of this development (Rogers 2003). In this context, the environment of the firm enables a continuous flow of information and knowledge exchanges between actors, about the market and eco-innovative possibilities (Wang et al., 2012). This information may come from the market, different institutions, trade fairs, seminars, and journals, among others (PITEC, 2013). Therefore, the eco-innovation decision may be affected for the information, for example, about the existence of new regulations and certifications, new environmental technologies, or new market necessities, which will be perceived as an incentive by the manager, which will allow increasing their perception of control in the development of the eco-innovation process. Hence, we propose:

**Hypothesis 2a**: The available information has a positive effect on the manager in eco-innovation decisions.

A second factor is the establishment of collaboration agreements with other firms, organizations or institutions. Gilsing et al. (2008) argue that one of the main ways of
accessing the experience and knowledge acquired by other firms in their innovation activities is by establishing cooperation agreements with them. Thus, the development of cooperation agreements allows the sharing of risks of innovative development (Hagedoorn et al., 2000; Miotti and Sachwald, 2003). In this sense, and following a parallel with regular innovation, it is to be expected, these cooperation agreements have a positive impact on the manager in the development of eco-innovations. It is well known, for example, how cooperation with clients allows the development of new ecological products (Horbach et al., 2012; Kemp et al., 2006). Moreover, the agreements of cooperation with regard to the incorporation and development of innovations in energy saving or the reduction of waste and pollution (Mazzanti and Zoboli, 2006, Rehfeld et al., 2007). Finally, cooperation with universities has been considered a source of low-cost innovation (Koontz et al., 2015; Rennings et al., 2006; Rommel, 2015). Therefore, these cooperation agreements allow companies to generate a stock of shared knowledge on technologies and risk sharing, having a favourable effect on the manager, as a consequence of increasing their perception of control on the decision of eco-innovations. Hence, we propose:

*Hypothesis 2b: The cooperation agreements have a positive effect on the manager in eco-innovations decisions.*

Finally, financial facilities have been used to incentivize the innovation in enterprises (Lundvall, 2007). As we have seen previously, the innovative development requires that companies have adequate financial resources to develop this process (Arranz and Arroyabe, 2006). In this context, the various institutions, whether local, national or international, develop financing lines for innovations and eco-innovation, encouraging the incorporation of environmental objectives in the firm, using financial incentives to facilitate these actions (Horbach, 2008). Therefore, we can find a positive impact of financial incentives in the manager's decision in the process to develop eco-innovations. Thus, the manager finds the need to finance the eco-innovative development, and the existence of financing allows increasing his perception of control. Hence, we propose:

*Hypothesis 2c: The finance facilities have a positive effect on the manager in the eco-innovations decisions.*

*The experience of the manager as facilitating factors in the eco-innovation decision.*

The role of experience in the business has been a controversial subject (Smith et al., 2009; Ucbasaran et al., 2010). The literature is unanimous in affirming that the manager learns about their abilities through running to business and changing their behaviour in response to their experience (Ucbasaran et al., 2009). However, there is some controversy in the direction
of how the experience of manager affects. Some have argued that the learning that results from this kind of inclines manager to greater optimism in their behaviour and therefore a greater self-efficacy (Mitchell et al., 2000; Smith et al., 2009; Ucbsaran et al., 2010). Indeed, researchers have observed that experienced managers do sometimes over-estimate their own capabilities in managing the business (Levinthal and March, 1993). Alternatively, DeTienne et al. (2008) and Dawson and Henley (2013) have pointed out that this is not always the case: some managers realise that they were initially too optimistic, adjust their thinking, and consequently adopt a more realistic outlook in their self-efficacy. In this way, Fraser and Greene (2006) point out that experienced managers may be less inclined towards optimism in their own capabilities those novice managers. In this context, Ucbsaran et al. (2010) have tried to reconcile these two positions, pointing out that the type of experience, whether it is successful or unsuccessful, conditions their perception on capabilities of the manager.

From innovation perspective, Pavitt (1991) pointed out that innovative development is a cumulative process, meaning that continuous learning facilitates the development of subsequent innovations. In this line, the eco-innovation process needs the generation of firms' capabilities, including the development of tasks, routines and teams in the firm (Azzone and Noci, 1998; Bossink, 2007). In fact, there are several studies that report the potential synergistic effect of previous and futures innovations (Doran, 2012). This complementary effect derives from sharing competencies, resources, and routines in the process of innovation, as a consequence of the generation of economies of scale and learning (Camisón and Villar-López, 2014). This learning on the part of the company will have a positive impact on the manager, founding that the cognitive frameworks of experienced managers become clearer and richer with experience (Mitchell et al., 2000). Therefore, the experience in the eco-innovation and innovation are a facilitator of the development of futures eco-innovation (Kemp and Pearson, 2008, Segarra-Oña et al., 2011). We conclude that the manager will positively perceive the experience in the development of both innovation and previous eco-innovation; having a positive effect in future developments of eco-innovations, as a consequence of the increase of his capacities of management of the process of eco-innovation, increased your perception of control. Hence, we propose:

Hypothesis 3a: The innovation experience has a positive effect on the manager in eco-innovation decisions.
Hypothesis 3b: The eco-innovation experience has a positive effect on the manager in eco-innovation decisions.


**Context and Research Methodology**

*Spain and the development of eco-innovation*

According to the report of eco-innovation of the European Union, Spain appears in the 9th place in 2017 with respect to the countries in Europe (Eco-Innovation Observatory, 2018). Following this report, the most important areas of eco-innovation in Spain include eco-design, ecological engineering, energy efficiency, sustainable construction, urban greening systems, urban water systems and the efficiency of water. However, Spain is below the European countries average in terms of the products generated from eco-innovation and the inputs for eco-innovation. In this way, Eco-Innovation Observatory (2018) points out that the main weaknesses and barriers to ecological innovation in Spain are: the generation of organic products by companies, the lack of public and private funds for support eco-innovation and the loss of qualified human capital, as a result of emigration.

*Unit of analysis and target study population*

In this research, the unit of analysis is the firm, and the data is collected from the Spanish Technological Innovation Panel (PITEC). This survey is conducted annually by National Statistics Institute (INE) since 2001 and replicates for Spain the questionnaire used by the Community Innovation Survey (CIS), following the guidelines of the Oslo Manual (OECD, 2005) using a standardised questionnaire. PITEC contains firm-level data and it provides information about the company (employment, sales, geographic market, industry sector, etc.) as well as detailed information regarding its innovation activity (innovation expenditures, different kinds of innovation output, cooperation between firms, public financial support, barriers to innovation, and so on).

The reference period for our study is 2008-2012, containing 12,817 firms, from which 5,461 firms have conducted some eco-innovation over the period of study.

3.2. Measures

*Dependent Variables*

The PITEC questionnaire measures the development of eco-innovation in the firm, including a question as to whether the innovative activity (product, process, organizational or marketing) carried out in your company has been oriented towards the following environmental objectives, measured on a scale of 1 to 4. The objectives considered are: i) Lower environmental impact; ii) Improvement in health and safety; iii) Compliance with regulatory, environmental, health or safety requirements; iv) Lower energy per unit produced (Cronbach Alpha: 0.974).

*Independent variables: Facilitating or Incentives factors*
The first variable is the *information sources* used. The intensity of the use of the sources and the diversity of the sources consulted are considered. The intensity of the use of sources is rated on a scale of 1 to 4: a value of 1 is assigned if the degree of utilisation is high; 2 if it is intermediate; 3 if it is low; and 4 if it is null. The PITEC questionnaire distinguishes between ten different external sources: i) Suppliers; ii) Customers; iii) Competitors; iv) Consultants and commercial laboratories; v) Universities; vi) Public research bodies; vii) Technology centres; viii) Conferences, trade fairs and exhibitions; ix) Scientific journals; and x) Professional and industry associations (Cronbach’s alpha: 0.979).

The second external exogenous factor is the *cooperation for innovation* (*Cooperation*). The value is taken by the variable for cooperation will be 0 if the firm does not cooperate during the research reference period and 1 otherwise.

The third variable is the use of external *public funding* to develop innovation processes. PITEC distinguishes public funding according to origin: i) from local or regional governments; ii) from the national government; iii) from the European Union.

*Independent variable: Obstacles and Difficulties factors*

In the PITEC survey (2012) the importance of the following factors is measured by hindering their innovation activities or projects or influencing to innovate. The factors were classified into cost and finance factors, which contained three items: i) Lack of funds in the company or group of companies; ii) Lack of funding from sources outside the company; iii) Innovation has a high cost (Cronbach Alpha: 0.778). The following group of factors corresponds to the management of the innovation process. In this case, there are four items: i) Lack of information on technology; ii) Lack of information about the markets; iii) Lack of qualified personnel; vi) Difficulties in finding cooperation partners for innovation (Cronbach Alpha: 0.752). And finally, market factors, with two items: i) Uncertainty regarding the demand for innovative goods and services; ii) Market dominated by established companies (Cronbach Alpha: 0.930).

*Independent variable: Innovation Experiences*

The PITEC questionnaire measures innovations with four variables (product, process, organisational and marketing). The first, *product innovation*, is a dummy variable that equals 1 when the company has successfully completed a product innovation. The second variable is *process innovation*. The survey also defines *process innovation* as a dummy variable that measures whether the company has successfully concluded innovation processes in the reference period. The third is *organisational innovation*, which is categorised in three ways: (i) By the internal functioning of the firm (including methods/systems of knowledge
management); (ii) By the organisation of the workplace; (iii) By the external relations the firm has not previously used. Each category is measured by a dummy variable that takes the value of 0 if no activities have taken place in that particular category and 1 otherwise (Cronbach alpha: 0.790). The last variable is marketing innovation, which is also a dummy variable that takes a value of 1 when the company has successfully concluded one of four types of innovation in the reference period: (i) Significant changes to the aesthetic design or packaging of a good or service using manufacturing methods; (ii) New media or techniques for product promotion; (iii) New methods for product placement or sales channels; (iv) New methods of pricing goods or services (Cronbach alpha: 0.752).

Control variables

Previous empirical studies have found firms’ size to be a determining factor in the adoption of new technological innovations. Larger firms are more likely to engage in technological innovations as compared to smaller firms (Damanpour, 1991). We measure the firm size with the log of the number of employees (Size).

We also include a dummy variable to control whether the company belongs to the manufacturing or services sector. Being 0 if it belongs to the manufacturing sector, and 1, to the service sector.

A common variable in studies on innovation is whether the firm belongs to a group (Authors). In this case, the questionnaire includes a dummy variable (Group): 0 if it does not belong to a group and 1 if it does.

The final control variable is the international scope of the firm. PITEC questionnaire distinguishes four different geographical markets: i) Local; ii) National; iii) EU; or iv) Other countries (China and India). We include the dummy variable International to control whether the firm operates abroad or not: 0 if it is in the local or national market, 1 if in the EU exclusively, and 2 if it operates in the US and other markets (China and India).

Analysis and Results

In Table 1, we can see the descriptive values of the variables used in our analysis. We note that 5,461 companies, less than half of the sample (42.7%), claim to have at least one eco-innovation objective. Our data show that the percentage of companies that develop eco-innovation in the manufacturing sector is greater (65.5%) than in the service sector (52%). Also, companies that declare a greater degree of internationalization in their activities assume eco-innovation objectives more frequently (76.7%). In addition, 67.7% of the companies that are framed in a group of companies are carrying out eco-innovation activities. Regarding the
impact of the size of the company in the realization of eco-innovation, we observe that between 60 and 70% of SMEs and large companies assume eco-innovation objectives; however, in the case of micro-companies (1 to 9 workers), the eco-innovation objectives are less frequently. Finally, we see that 100% of the companies that establish cooperation agreements to develop innovations declare to carry out at least one eco-innovation activity. Likewise, companies that have at least one eco-innovation objective use external sources of information or have an R&D department in the development innovations.

To test the research question that explores the effect of facilitating and obstacles factors on the adoption of eco-innovation objectives in the firm, we use an Ordinal Logit Regression Model. Based on the questionnaire, we use four different specifications to analyse the effect of factors on eco-innovation objectives. Specifications (1) to (4) have as dependent variables the four different types of environmental objectives. Moreover, the last specification uses the encompassing dummy variable total objectives as the dependent variable. This variable is measured as the degree of penetration of environmental objectives in the firm, which is ranked on a scale of 0 to 4; 0 is assigned when there has been no type of environmental innovation objective; 1 if only one type of objective has been introduced; 2 if two objectives have been introduced; 3 if three objectives have been introduced; and 4 if four objectives have been introduced. As explanatory variables for these specifications, we include facilitating factors as Information source; Cooperation; Public funding, obstacles factors as Cost and Finance, Capacities and Market, and control variables.

Table 2b shows the effect of the facilitating factors on the adoption of eco-innovation in the firm. We observed that cooperation agreements and sources of information have a positive impact on the development of environmental objectives (β = 0.123, p <0.05) and (β = 0.246, p <0.01). Also, financing has a positive effect on the development of eco-innovation, both locally (β = 0.223, p <0.05) and nationally (β = 0.329, p <0.01). However, EU funding is not significant in developing eco-innovations, in spite of the fact that these policies have been mainly aimed at financing projects for new environmental technologies (especially in SMEs), as well as encouraging the creation of European business and technology centres (Mazzani and Zoboli, 2006). Therefore, our results show that the regional or national levels have a positive impact on the development of environmental objectives in companies. These findings support Hypotheses 1a, 1b and 1c.

Table 3b shows the factors that hinder the development of eco-innovation in the firm. First, we analyse the costs and financial factors that hinder the adoption of eco-innovation objectives. We observed that the costs and finance factors of the company (lack of external
and internal financing, and innovation costs) have a negative impact ($\beta = -0.554$, $p < 0.01$) on the adoption of environmental objectives in the four models. On the other hand, we observe that the market factors (lack of market information and the uncertainty of the market) are a factor that has a negative impact ($\beta = -0.463$, $p < 0.01$) on the development of eco-innovations. Finally, our results show that the management of the eco-innovation process is a factor that has a negative impact ($\beta = -0.449$, $p < 0.01$) on the development of eco-innovations. These findings support Hypotheses 2a, 2b and 2c.

To test the last research question, as the experience in innovation and eco-innovation affect to eco-innovation objectives, we used a Panel Ordinal Logit Regression (2008-2010). We used four models to analyse the effect innovation has on eco-innovation. In all models (Table 4), we have used as the dependent variable the eco-innovation developed in the period 2010-2012, and control variables. More specifically, in Model 1, we have included the dependent variable with control variables. In Model 2, we have four innovations (product, process, organisational, marketing) developed in 2010-2012, as independent variables. In Model 3 and 4 respectively, we analyse the impact of innovation and eco-innovation in the previous period (2008-2010) on the eco-innovation developed by companies in the 2010-2012 period. Looking at the results from Models 2 and 3, we find that regular innovation carried out both in the previous period (2008-2010) and in the same period (2010-2012) had a positive effect on the development of eco-innovation. More specifically, we see that product innovation ($\beta = 0.030$, $p < 0.10$), process ($\beta = 0.109$, $p < 0.01$), and organization ($\beta = 0.130$, $p < 0.01$) developed in the previous period had a positive effect on the development of eco-innovation. Not so, the innovation of a commercial nature. We also observe how product innovation ($\beta = 0.063$, $p < 0.01$), process ($\beta = 0.136$, $p < 0.01$), organization ($\beta = 0.121$, $p < 0.01$), and marketing ($\beta = 0.074$, $p < 0.01$) have an impact on the development of eco-innovation in the same period, supporting Hypothesis 3a. Additionally, in model 4, we see that the realization of eco-innovation in previous periods has an impact on the development of subsequent innovations. Thus, eco-product innovation ($\beta = 0.254$, $p < 0.01$), eco-process innovation ($\beta = 0.210$, $p < 0.01$), and organizational eco-innovation ($\beta = -0.041$, $p < 0.05$), have a positive effect on innovation more generally. This is not the case for eco-innovation in marketing. These findings support partially the Hypothesis 3b.

**Discussion and Conclusions**

The overall aim of this study was to investigate the incentives and inhibiting factors of eco-innovation in the firm. In doing so, this paper has addressed the decisional process that
leads to an eco-innovation process from managers’ perspective. Our results show how the complexity of the eco-innovation development process negatively affects the manager in the decision to develop eco-innovations. However, we see that the institutions and organizations of the business environment are making efforts to compensate for these obstacles and incentivize the manager the decision to develop eco-innovations. Also, our results highlight that the experience acquired in pass eco-innovations facilitates the decision of the development of future eco-innovations.

Firstly, our results are in line with the literature that shows the cost and finance of innovation is a disincentive for the development of eco-innovation. These results are reinforced by the “double externality” hypothesis, which states that the costs of innovating are a disincentive for the manager due to the social nature of environmental developments, which will subsequently allow access to these eco-innovations (Ambec et al., 2013).

Moreover, our highlight the importance of market information for eco-innovation shows how the potential viability of a product affects the development of eco-innovation. Thus, the uncertainties in consumer perception and market saturation have been highlighted in the literature as an obstacle on eco-innovation (Bossink, 2007; Cuerva et al., 2014). Additionally, our result corroborates that ambidexterity management and the establishment of cooperation agreements for eco-innovative development are perceived as difficulties in this process.

Secondly, our results corroborate previous studies that highlight the necessity to obtain scientific information from universities and research institutes, environmental standards from specific agencies, and information regarding the availability of sustainable production inputs from suppliers in the developing of eco-innovations (Kemp, 2006). Moreover, our results show the importance the cooperation in the eco-innovation decision. Previous literature has shown that vertical and horizontal cooperation is very important in terms of reducing overall environmental impacts and ensuring the eco-friendly features of inputs (Brunnermeier and Cohen, 2003; Theyel, 2006; Bossink, 2007; Cai and Zhou, 2014). Exchanges of information and reciprocal learning between customers and suppliers have shown to be key in reaching environmental targets, combining with the collaboration with universities and research centres considering the complexity of developing environmental innovations. Also, in line with Lundvall (2007), Horbach (2008), and Manzini and Zoboli (2006) our results show as financial incentives an incentive in the decision to develop eco-innovation.

Lastly, the experience in the development of both innovations and eco-innovations is an incentive in the manager. Our results are compatible with the point of view of the theory of resources and dynamic capacities, which indicates that the development of previous
innovations generates capacities and resources that facilitate the development of eco-innovations. Otherwise, our findings show that the knowledge and skills acquired in the process of innovation have a greater impact on the manager decision-making of the company than the costs of eco-innovation development. This approach supports the strategic nature that companies are giving to the development of eco-innovation (Carrillo-Hermosilla et al., 2010).

Additionally, we can observe a positive impact of size on environmental objectives. Although we observe that there are small and medium companies that have assumed at least one environmental objective, our analysis reinforces the hypothesis that size is a fundamental factor in the development of eco-innovation in the company. This has been a classic result in the environmental literature, showing that large companies have a greater predisposition to the adoption of environmental objectives. Yet, Azzone and Noci (1998) showed that SMEs are companies with limited financial resources. Therefore, they cannot develop long processes of accumulation of competences, nor even allocate funds for ecological initiatives (Noci and Verganti, 1999). Moreover, the result shows that the manufacturing sector is more sensitive to the adoption of eco-innovation objectives than the service sector. This corroborates that the manufacturing sector has a greater incidence of environmental problems, such as the long-established issue of the elimination of toxic waste (both gaseous and liquid), as well as the challenge of energy saving. Finally, we see that belonging to a group has a positive impact on the adoption of certain types of innovation objectives. This is explained by evidence that shows the group determines environmental policies. Thus, it is well known that the corporate environmental strategy determines the adoption of environmental quality standards, management, and clean production processes. All this is part of the corporate social responsibility policy of the company (Horbach et al., 2012).

In addition, this research makes two theoretical contributions. First, it adds significant new empirical knowledge to the eco-innovation literature (Cai and Zhou, 2014; Cuerva et al., 2014; Horbach et al., 2012). In previous studies on eco-innovation, we have focused on the drivers that support eco-innovation. A number of empirical studies have attempted to identify the determinants of the adoption of environmental innovation at the firm level (Cai and Zhou, 2014; Cuerva et al., 2014; Horbach et al., 2012; Kesidou and Demirel, 2012; Rennings et al., 2007; Brunnermeier and Cohen, 2003; Rennings, 2000). Most studies have focused on the effect that factors policies and regulations (Porter and Van der Linde, 1995; Kemp, 2010; Moore et al., 2014; Novellie et al., 2016) have on the adoption and development of eco-innovation in the firm. Thus, companies assume environmental objectives of innovation such
as anticipation of future regulation, public image, corporate responsibility, or the need to take environmental certifications (Borghesi et al., 2015; Triguero et al., 2013; Mazzanti and Zoboli, 2006). We provide empirical evidence, as managers in companies play a vital role in developing eco-innovation. In this sense we provide empirical evidence, to understand what factors affect the proactiveness of the company in its development of environmental actions. Thus, we see that the control of the decision, affected by factors that facilitate or hindering, are the keys to the adoption of eco-innovation objectives in the company. Therefore, this study demonstrates the importance of the manager’s in the intentions of developing eco-innovation and responds to the call for new research to analyse from a cognitive and social psychological perspective how such processes affect the environmental strategies in the firms.

Second, our study contributes to the literature on the innovation. In previous literature, authors proposed what was the relationship between innovation and eco-innovation (Rennings, 2000). From the first approach of assimilation, which treats the innovation and eco-innovation as similar, to a second approach, which suggests that eco-innovation requires novel theories and analytical instruments to study patterns of eco-innovation, our contribution raises a parallelism between the development of conventional innovation and eco-innovation (Foulon et al., 2002; Cuerva et al., 2014). However, we must not forget the differential aspects such as the double externality and the regulatory effect of the administration. Therefore, in terms of developing a taxonomy, we consider that eco-innovation can be incorporated into the classical classification of technological and non-technological innovations, with its own category.

From our results, we can propose management actions for the companies and administration. Firstly, we have seen that an obstacle for companies is the lack of market information. It will be necessary to develop push and pull policies that involve companies. On the one hand, companies must take advantage of the fact that consumers are positively valuing of intangible aspects of products and services, developing a new market for the eco-innovation. European Union (2015) points out that this market is growing above the average 17 (1975) at 84% (2015). On the other hand, companies must assume the eco-innovation as a strategic decision, seeking not only to reduce costs or gain efficiency but also to gain competitive advantages through the positioning of products, services and brands. In this sense, Boston Consulting Group (2009) shows that consumers perceive the products with better environmental performance are of higher quality and consequently, their willingness to pay more is higher. Second, our results we highlighted the lack of external financing as an
obstacle to companies to develop eco-innovation activities. In this sense, specific programs must be developed for companies, encouraging and supporting the development of eco-innovations. In addition, the permeability of environmental actions and development must be increased in the rest of the R&D and innovation policies. Third, the lack of knowledge of the company to develop innovation requires a series of measures. The companies should investigate new eco-innovative developments. In this sense, vertical cooperation is very important both with customers and with suppliers for the development of new products and services. The cooperation with clients provides complementary skills or knowledge and mitigating the risks and difficulty in being associated with the development of the eco-innovation (Hagedoorn et al., 2000). In addition, cooperation with suppliers is necessary for the development of eco-innovation. In this sense, eco-innovation translates into an increase in environmental requirements over suppliers, exerting traction on the entire supply chain. The tractor companies that are leading this process transfer their environmental requirements through the implementation of environmental management systems (ISO 14001 and EMAS) to the supply chain. Lastly, these findings indicate two requests that can be made of the policy-maker. Firstly, to increase the permeability of eco-innovation in R&D and innovation programs. The proximity of the two types of innovation should facilitate eco-innovative development. Our results show that there exists a parallelism between the knowledge and skills necessary for the development of eco-innovation and those needed for innovation more generally—highlighting the interrelationship of both processes which makes companies that already develop innovations more prone to the development of eco-innovations.

Geographically, limiting our study to Spain, leaves open the question of the generalizability of our results. There may be differences across countries and institutional environments with respect to the internationalisation of small firms. This issue needs to be explored in countries in which eco-innovation may be more important. It remains to be seen in future research whether our Spain-based findings can be generalised to other countries.


### Tabla 1. Exploratory Analysis

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## Table 2a. Correlation analysis

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**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).
**Table 2b. Causal Analysis between exogenous and endogenous incentives and eco-innovation objectives**

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-2 Log Likelihood: 15553.828, 15178.983, 15001.842, 15008.376, 26196.655
Chi-Square: 11534.478, 11932.412, 12013.633, 11978.430, 12557.869
df: 9, 9, 9, 9, 9
Sig.: .000, .000, .000, .000, .000
Cox and Snell: .716, .728, .730, .729, .746
Nagelkerke: .755, .768, .771, .770, .757
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### Table 3b. Causal Analysis between obstacles and eco-innovation objectives

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**. Correlation is significant at the 0.01 level (2-tailed).  
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### Table 4. Panel Causal Analysis among Innovation, eco-innovation and eco-innovation objectives

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<th>Environmental Objectives</th>
<th>Model 1 Estimated</th>
<th>Model 2 Estimated</th>
<th>Model 3 Estimated</th>
<th>Model 4 Estimated</th>
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Model 2: $R^2$: .152; p< .000; Durbin-Watson (1.942)
Model 3: $R^2$: .127; p< .000; Durbin-Watson (1.942)
Model 4: $R^2$: .278; p< .000; Durbin-Watson (1.968)