

# Eco-Innovation and its Determinants: A Review of the Emerging Literature

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## Abstract

The aim of this paper is to enrich the existing research on eco-innovation and to provide an insight into the existing body of literature on eco-innovation determinants by analyzing the most significant publications in the area and the subjects of interest. The research adopts the document analysis method summarising definitions, classifications and recent developments in the area in order to develop insights into the evolution of eco-innovation and its main determinants. The findings are general and should be used by taking into account the specificity and local conditions within each country as well as the distinct environmental areas.

**Keywords:** eco-innovation, determinants, review of literature

**JEL classification:** O30, O31

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## Introduction

The world faces significant environment problems, such as climate change, depletion of natural resources, air pollution and biodiversity loss. All these aspects could have disastrous consequences for life on Earth. In the modern world, the globalization and liberalization as well as the rapid increases in consumption determine people to move toward a sustainable organic growth (Turkalj et al., 2013). Moreover, both producers and consumers are becoming eco-conscious.

To avoid or reduce the impact of such problems, innovative solutions and more technologies protecting the environment should be developed. In this regard, eco-innovation becomes the best option, providing complementary solutions to industrial production without sacrificing the resources of the future generations.

Eco-innovation represents a new way of response to environmental issues. While traditional environmental aspects had focused on specific issues such as water or soil pollution, elimination of dangerous products from the market, recycling or climate change prevention, eco-innovation plays a more active and decisive role, working to create new products and competitive services, new jobs as well as a change in the behavior of individuals in relation to the environment.

Although it has its own definitions, eco-innovation can be found under other names like sustainable innovation, green innovation, environmental innovation.

There are several accepted definitions regarding eco-innovation which have required a clarification process in the long run (Moisoiu, 2015). It is generally accepted that eco-innovation brings up all types of innovation, such as

technological and non-technological ones (Ciocoiu et al., 2014), new devices, materials and services as well as new business practices (James, 1997) which create new business opportunities, are environmentally friendly (Carrillo-Hermosilla et al., 2010) and optimize the use of resources, including energy (Diaconu, 2011; Melece, 2015). Eco-innovation is strongly linked to the improvement and use of environmental technologies as well as to the notions of eco-efficiency and ecological industry (OECD, 2012). The common purpose is to increase production and create more sustainable consumption patterns.

There are some studies (Porter and van der Linde, 1995; Belin et al., 2011) showing that eco-innovation generates a win-win situation both for the economy and for the environment: it contributes to increasing economic competitiveness as well as to improving the quality of life. Compared with other innovations, eco-innovation can help the companies to solve not only the economic concerns, but also the environmental protection issues.

Furthermore, the activities of innovation open up a new field, eco-innovation, which offers tremendous opportunities to the society, not only as regards saving the resources, but also from a social perspective (Bleischwitz, 2009; Sabanci Ozer, 2012). Eco-innovations that are most likely to succeed in terms of economic development are those that take into account the social and institutional dimension (Vollenbroek 2002; Smith et al., 2010; Gjoksi, 2011a). Moreover, even when eco-innovation leads to enhancing the production process, the social system with its entities, the consumption patterns and the society's lifestyle will establish some restrictions for the technological development.

Some international evidences show that eco-innovation leads to lower or constant costs, development of companies, increases turnover as well as competitiveness. However, eco-innovations that contribute to energy savings could generate an increase in energy prices in the long run. Therefore, the involvement in the eco-innovation process requires a good knowledge of the immediate benefits as well as of the long term effects (Kowalska, 2014). Moreover, both the determinants and the results depend on the field where eco-innovation is implemented. Furthermore, there are a lot of reports and studies that highlight the importance of the rules in every field, especially rules established nationwide.

However, eco-innovation has been promoted quite slowly, excepting the aspects of climate protection and energy saving. Moreover, according to the European Commission, eco-innovation processes should be hastened in order to promote resource productivity, protect the environment and create a climate of social welfare (European Commission, 2011; Voßwinkel and Reichert, 2012).

In conclusion, eco-innovation produces positive effects on one or more external dimensions of sustainable development. Despite the developments in the area, the concept suffers from the lack of a comprehensive theoretical framework which could allow the researchers to understand its evolution (Andersen, 2008b; Mathieu et al., 2015). Therefore, the researchers are forced to use various theories and studies in the literature in order to explain the phenomenon.

Another area of interest related to eco-innovation is that of the determinants/drivers for adoption of eco-innovation by companies. Identifying the role of eco-innovation determinants has been the subject of numerous studies since the 1990s. However, the studies are heterogeneous as regards the methods and techniques used, reaching different conclusions (Belin et al., 2011). Moreover, eco-innovation determinants are different depending on regional situation and position (Cainelli et al., 2011; Horbach, 2014) as well as on the different environmental areas (Horbach et al., 2012).

The structure of the paper is as follows: section two explains the objective of the paper and the methods used; section three is dedicated to the literature review which *presents* data and *findings* of studies and publication that pertain to the concept of eco-innovation and its drivers; the main determinants of eco-innovation targeting different environmental impact areas are also investigated; and the final section draws conclusions.

## Methodology

The purpose of this paper is a survey on the eco-innovation field by highlighting its increasingly important economic, environmental and social role over the past decades which makes it a significant element for ensuring the sustainable development objectives.

In order to accomplish the purpose, the paper has set the following objectives:

- to present the concept of eco-innovation in different approaches;
- to highlight the main developments in literature regarding eco-innovation;
- to identify the main drivers and motivation for companies' adoption of eco-innovation.

The contribution of this paper consists in summarising definitions, classifications and new developments in the field of eco-innovation as well as in providing an analysis of the various categories of eco-innovations determinants.

This descriptive, qualitative and exploratory research has used the document analysis method for data collection. In this context, the paper is focused on the study of a wide range of publications relating to the eco-innovation and their determinants which provide both theoretical and practical insights of relevance to researchers, professionals and academic environment.

In order to explore how 'eco-innovation' has been researched in the business literature was conducted an extensive search in the Web of Science Core Collection database, but also in Google and Google Scholar.

The key terms selected for searching in databases was 'eco-innovation', 'eco-innovation determinants' and 'eco-innovation enablers'.

Only papers, articles and studies of the past 10 years have been selected for the study because more than 95% of papers are published after 2007.

## Discussion: A conceptual approach of eco-innovation and its determinants

### *Eco-innovation: concept and categories*

The concept of eco-innovation is mostly discussed in the literature, a simple search using the word 'eco-innovation' generates about 1,900,000 results in Google and about 14,700 results in Google Scholar (in april 2017).

Similar to the previous research conducted by Bossle at al. (2016) we found out that some concepts are usually used synonymously in different papers, that is, 'green', 'environmental', and 'sustainable'.

In Web of Science Core Collection a total of 524 documents (1975-2017) met the preset criteria for eco-innovation as topic.

The new technologies for the sustainable development is one of the most debated issue in the context of eco-innovation (OECD, 2009; Gjoksi, 2011; Rusu, 2013).

As regards the effective and sustainable use of resources, there is a growing recognition of eco-innovation positive effects. The last decades have been marked

by numerous studies regarding the characteristics of eco-innovation and its results as well as the ways of improving the technologies (Fussler and James, 1996; Kemp and Arundel 1998; Kemp, 2010; Berkhout, 2011; Kemp and Oltra, 2011; Mathieu et al., 2015). However, there are authors (Klewitz and Hansen, 2014; Diaz-Garcia et al., 2015) who consider that this demanding field of research is still in its infancy.

Many authors in literature (Jang-Hwang et al., 2015; Davidescu et al., 2015; Pansera, n.d.) link the concept of eco-innovation to the concept of sustainable development. In fact, the literature offers four different words to present innovations aiming to protect the environment: eco, green, environmental and sustainable (Nidumolu et al., 2009; Diaz-Garcia et al., 2015; Mele and Russo-Spena, 2015). According to different authors (Schiederig et al., 2012; Diaz-Garcia et al., 2015), when comparing the four terms by taking into account the definition given by the Brundtland report, it can be concluded that the first one refers to the economic, ecological and social aspects, while the other three contain only the economic and ecological aspects.

Additional studies focus on the concept of eco-innovation and its two components: corporate social responsibility (CSR) and innovation (Dangelico and Pujari, 2010; Wagner, 2010; Peng and Liu, 2016). CSR turns into an essential component of the companies' activities aiming to promote values within the society and increase the market competitiveness. Furthermore, innovation is gradually becoming one of the main factors of competitiveness (Rexhepi et al., 2013).

Moreover, the literature highlights the importance of the social perspective when discussing about eco-innovation (Freeman, 1996; Hellstrom, 2007; Mele and Russo-Spena, 2015). On the one hand, eco-innovation contributes to enhancing social cohesion by promoting the change of the citizens' and companies behavior as regards environmental problems. On the other hand, eco-innovation building should be supported by social agreement as well as institutions in order to be successful (Arundel and Kemp, 2009; OECD, 2012; Xavier et al., 2015).

Few generic approaches to the classification of eco-innovation could be found in the literature. Thus, according to some researchers in the field (Kemp and Arundel 1998; Andersen, 2004; Andersen, 2008a), eco-innovation can be technical, organizational or marketing, provided that it does not lose its purpose of increasing the companies' green competitiveness. Other authors (Montresor, et al, 2013; Jakobsen and Clausen, 2014; Pinget et al., 2014; Kunapatarawong and Martinez-Ros, n.d.) consider that eco-innovation can be divided into two categories: environmental eco-innovation and non-environmental eco-innovation. The former type is very important in ensuring the sustainable development.

Another classification highlights four categories of eco-innovation: technological, organizational, social and related to business parks. The third one could be associated with an eco-friendly lifestyle as well as with innovations in consumers' habits (Esders, 2008). However, other authors consider (Gjoksi, 2011a) that eco-innovation is mainly oriented towards the ecological aspects of the market economy and not towards the social innovation. According to Vollenbroek (2002), the concept of eco-innovation requires technological solutions strongly connected with the social values and lifestyles contributing to the progress of the society.

### *Eco-innovation determinants*

Many areas of eco-innovation, such as renewable energy and electro mobility are relatively new, thus requiring more information and researches. Moreover, eco-innovation involves institutional changes, adoption of specific management systems and regulations compliance with various regulations (Horbach et al., 2012; Horbach,

2016). These changes along with other aspects such as different levels of research and innovation development, availability of knowledge infrastructure, cooperation networks creates differences as regards eco-innovation success in European countries (De Marchi, 2012; Ghisetti et al., 2015). In this context, the universities and the research institutes are the suited entities that could provide proper training for future employees in order to use new technologies and adapt to organizational changes.

According to different researches in the literature, some of which are mentioned below, eco-innovation could be influenced by numerous determinants, which in turn depend on geographic conditions as well as on various environmental fields. The authors separate them into several categories.

Horbach et al. (2012) and Kowalska (2014) highlight four categories of eco-innovation determinants: regulation, market factors, technology and company specific mechanisms. Most papers pay special attention to the first category (Cleff and Rennings, 1999; Brunnermeier and Cohen, 2003; Jacob et al., 2005; Popp, 2006; Khanna et al., 2009; Rennings and Rexhäuser, 2011; Lanoie et al., 2011) whose impact is closely related to the various environmental technologies used.

According to Horbach et al. (2012) regulations are used in all environmental areas and are adapted to the specific issues studied. Furthermore, Veugelers (2012) points out that eco-innovation occurred due to the companies' obligation to provide compliance with the environmental legislation. At the opposite pole, other authors (Belin et al., 2011) assert that eco-innovation has not emerged only as a systematic response to legislation because there are also other factors (market conditions, technologies) having a considerable influence in the development of this concept.

The market components influencing eco-innovation are the followings (Horbach, 2014): clients' demands, goods sent abroad and cost reduction. Another factor highlighted by Kammerer (2009) and Horbach et al. (2012) should be added to this list: the customers' benefits. However, although the production process complies with environmental standards and the product improves the consumers' lifestyle, the output is much more expensive (Rehfeld et al., 2007; del Rio, 2013).

The organization's technological capabilities and technical knowledge are extremely important, generating eco-innovations and reducing its deficiencies regarding the new environmental standards and requirements (Canon de Francia et al., 2007; Horbach et al., 2012).

Lastly, the company specific mechanisms have also a significant role in motivating eco-innovation decisions. There are few studies (Kammerer, 2009) highlighting that knowledge transfer mechanisms and involvement in networks are the main factors that act as drivers of eco-innovation.

Mazzanti and Zobloi (2008) conducted a survey of 257 SMEs from various industrial areas in Italy and have identified several determinants of eco-innovation: structural variables of the company, research and development focused on sustainability, compliance with the requirements imposed by environmental policy, the company's past performance as well as the quality and characteristics of labor relations.

According to Maçaneiro et al. (2013) there are certain key elements having a significant influence on obtaining favorable results when implementing eco-innovation: law on the environmental protection, incentives, support provided by leadership, company's reputation in the community, technological research and environmental formalization.

An overview of eco-innovation determinants described by various authors in the literature is given by Pacheco et al. (2017). The literature in the field is quite rich, the researcher identifying 23 determinants of eco-innovation in small and medium



enterprises. However, the heterogeneity of the studies cannot lead to a conclusion as regards the preponderance of certain factors in a particular field. Moreover, almost all the researches are recent and prove to be insufficient for reaching a reasonable conclusion.

Other authors divide the determinants influencing eco-innovation in two categories: internal and external. The internal ones include knowledge, expertise, experience and technological capabilities of the organization. As regards the external determinants, Kijek (2013) and Kowalska (2014) split them into two groups: economic-market and administrative-warrant elements.

There are several studies (Belin et al., 2011; Horbach, 2014) identifying three main categories of eco-innovation determinants: supply side, demand side as well as legislation and policy. Each category contains two or more determinants: the first is linked to technology, knowledge, research and development, productivity, etc; the second refers to the environmental consciousness of consumers, the necessity and responsibility to avoid pollution; the third is much more oriented towards environmental policy tools, environmental regulations and institutions involved in protecting the environment.

Moreover, the evolutionary approach to eco-innovation (Belin et al, 2011; del Rio, 2013) emphasizes that firms differ greatly in terms of size and external knowledge sources. The small companies consider innovation as a way to penetrate new markets, while the large ones own a comfortable position on the market and exploring new opportunities is not a priority. Therefore, eco-innovation determinants require particular attention when dealing with the size of companies, especially because small companies have a significant share in many countries' economy. Furthermore, the old companies pay significant attention to information provided by various institutions in order to increase eco-innovation, while the new ones stand at the opposite pole (del Rio, 2013; Alvarez and Iske, 2015). A similar situation refers to the difficulty of signing partnerships, considered an eco-innovation obstacle by the old companies. As regards the age, there are no significant differences between the companies, because the ones that have been recently established on the market are not more eco-innovative than the older ones.

## Conclusion

The environmental challenges, like climate change switched the policy makers' attention to eco-innovation, seen as a way to develop sustainable solutions. The eco-innovative technologies are widely used by the actors from various fields in order to improve the production process as well as the environmental performance of companies.

In this context, the paper has analyzed the concept of eco-innovation and its contribution to sustainable development highlighting that few generic approaches to the classification of eco-innovation could be identified in the literature. The review of studies on eco-innovation has revealed numerous determinants of eco-innovation and different categories in which they have been integrated by various authors. This systematic review of literature and the results obtained could be the starting point for further researches useful for the academic, policy makers and professionals.

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