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Environmental innovation: in search of a meaning

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Abstract

Purpose – The purpose of this paper is to propose a definition of the term "green/environmental innovation", based on a systematic literature review.

Design/methodology/approach – The literature review conducted in this research was based on papers published in ISI Web of Science and Scopus databases.

Findings – Environmental innovations are organizational implementations and changes focusing on the environment, with implications for companies' products, manufacturing processes and marketing, with different degrees of novelty. They can be merely incremental improvements that intensify the performance of something that already exists, or radical ones that promote something completely unprecedented, where the main objective is to reduce the company's environmental impacts. In addition, environmental innovation has a bilateral relationship with the level of proactive environmental management adopted by companies. Increasing of environmental innovation tends to come up against many barriers.

Originality/value – Many researchers use the term "environmental innovation" but only a few articles present a complete definition of this concept.

Keywords Organizational culture, Governance, Ethos, Environmental management, Green innovation, Eco-innovation, Literature review

Paper type Conceptual paper

1. Introduction

Some global events led to the inclusion of the social-environmental issues in business. The report, *Our Common Future*, promoted by the World Commission on Environment and Development" (1987), and "ECO 92," in Rio de Janeiro, 1992, were two important world events that launched the environmental concerns as a priority in organizations (Côté *et al.*, 2006). Nowadays, environmental responsibility begins to be considered a fundamental issue for organizational management innovation and success (Hillestad *et al.*, 2010).

According to Seiffert and Loch (2005), environmental management is a process through which organizations define their environmental management expectations and goals. Corazza (2003) underscores the importance of green planning and orientation at companies in order to achieve environmental goals, reducing environmental impacts. Wehrmeyer (1996) underscores the ample, coordinated and duly organized involvement of business actions with the continuous objective of reducing the organization's environmental impacts.

Some studies identify different evolutionary stages of environmental management at organizations (Hunt and Auster, 1990; Corazza, 2003; Donaire, 1999; Jabbour, 2010). This study used the classification that divides them into: reactive (less evolved); preventive (intermediate); pro-active (more evolved) (Jabbour, 2010). Literature review

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reveals the importance of innovations for business environmental management proactivity, as well as the main barriers found along the way that could make their performance unfeasible (Eder, 2003; Ekis, 2010; Falk and Ryan, 2007; Galia and Legros, 2004; Yang and Chen, 2011; Berkel, 2007). The factors that constitute the complexity of this theme are associated with political, institutional, human, technological and economic reasons (Ekis, 2010). In face of this complexity, in this paper we will try to answer the following questions:

- What is environmental innovation?
- What is the terminology most used to refer to inclusion of green issues in the innovation process?
- What are the dimensions of environmental innovation? And the main barriers to its management?

2. Research methodology

This paper used the literature review method, which permits the review of previous research and established arguments, providing a synthesis and analysis of scientific knowledge concerning environmental innovation. Scientific articles were selected since available in their entirety, which address the terms "environmental innovation," "green innovation" and "eco-innovation" in titles or abstracts indexed in the ISI Web of Science and Scopus. The search was limited to the articles published over the past three years and in the journals tied to organizational environmental management. It is worth underscoring that the term "environmental innovation" involves 65 percent of all papers analyzed; "eco-innovation" 22 percent; and "green innovation" 13 percent (Figure 1).

This study is divided into four theoretical parts. First, environmental management and innovation concepts were revised (Section 3). Then, we identified the main terminologies of environmental innovation and analyzed the contexts in that it is used (Section 4). Third, the study identified the main dimensions of environmental innovation, and then, the main barriers for its management are presented (Section 5).

3. Environmental management and environmental innovation

Intent on conceptualizing environmental management, we can identify it as a process of organizational implementations that involves adaptation and internal change to

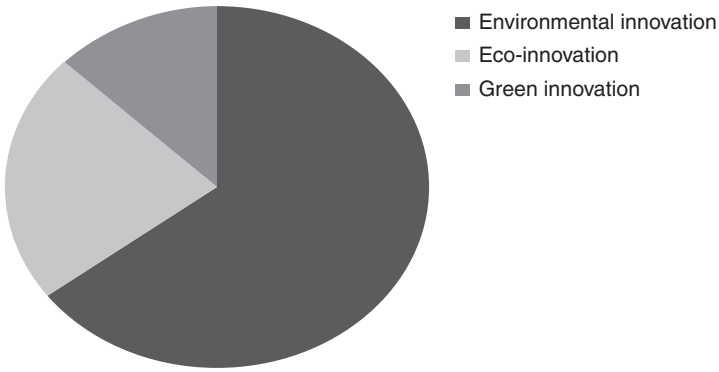

Figure 1.
Distribution of environmental/green/eco-innovation terms based on the literature search in ISI Web of Science and Scopus

reduce environmental impacts (Seiffert and Loch, 2005). However, Corazza (2003) underscores the importance of planning and orientation of the companies in order to achieve environmental goals. It can currently be understood that the matters related to this theme include resource efficiency, pollutant and CO_2 emissions and other innovative processes that increase companies' environmental performance (Pujari, 2006).

Some studies identify different evolutionary stages of environmental management at organizations (Hunt and Auster, 1990; Corazza, 2003; Donaire, 1999; Jabbour, 2010). This study used the classification that divides them into reactive, preventive, pro-active:

- the first stage, called reactive environmental management, has no environmental policies implemented. Its environmental management is limited to exercising obligatory functions, which are those stipulated by environmental legislation (Corazza, 2003);
- the second stage, called preventive, is a little more evolved in relation to the reactive, but it is still not considered strategic. It respects the interests of the organization, demand, market and legislation; and
- the last evolutionary stage, called pro-active, is an organizational concept with external and internal influence. Environmental activities are integrated strategically trying to explore new opportunities with applicability in different sectors/departments of companies. This stage obtains the greatest competitive advantages and maximum commitment with the environment (Donaire, 1999).

Green/environmental innovation can be the result of pro-active environmental management, which can develop innovation in products/services, processes or markets, but on the other hand, innovation can provide the evolution of organizational environmental management promoting their environmental pro-activity. Thus, environmental management and innovation have bilateral relations with cause and effect premises.

Pro-active environmental management can be initiated by governmental pressure, but also when seeking efficiency in internal processes and improvements in companies' reputation. There is also pressure in the supply chain, from clients and society in engaging companies in the reduction of environmental impacts (Zhang *et al.*, 2008). It is worth underscoring that environmental management can increase the organization's profitability because it permits reducing costs, increasing market demand (Côté *et al.*, 2006).

According to Tidd *et al.* (2008), innovation is a business advantage capable of mobilizing knowledge, technological advances and the concessions of novelties in their offers (products/services). It can contribute through new products and services or the change in manufacturing processes. The *Oslo Manual* (2004) subdivides the concept of technological innovation according to Table I.

Technological innovations in products and processes can be subdivided into technologically new or significantly improved implementations. A technologically new product is one with intended characteristics or uses that differ from already existing products. The technologically improved product is an existing one whose performance has been improved. Technological innovations in processes are adoptions of new or significantly improved production methods, including methods for delivering products.

Management of innovation does not occur spontaneously but rather through some motivation, such as regulations, new market needs, benefits from cost reductions,

competitive advantages, creations of new consumer needs, among others (Yuanhsu *et al.*, 2011). The strategies behind innovation seek to create new market segments, market positioning and opportunities for selling products and services. When managed efficiently, innovation can promote/collaborate with the search of pro-active environmental management (Ming-Ji and Ching-Hsun, 2009).

4. Defining environmental innovation

Conceptualizing environmental innovation is not an easy task, since there is a multiplicity of terminologies for this concept. Literature highlights three main terms related to environmental innovation: environmental innovation, green innovation and eco-innovation. In the literature review conducted for this paper, the quantitative distribution was identified according to the respective terms: environmental innovation (65 percent), eco-innovation (22 percent) and green innovation (13 percent) (Figure 1).

Côté *et al.* (2006) described the evolutionary process of eco-innovation terminology. In the 1970s, the term was used to designate pollution prevention and later the companies began to obtain advantages of production cost reductions. Over recent decades, the conception of eco-innovation considers greater environmental commitment of organizations, which are able to generate innovations to support the pro-active environmental management process.

Kammerer (2009) identifies that environmental innovation is every type of organizational innovation that generate benefits to the environment, encompassing all the changes and organizational novelties that seek to reduce their environmental impacts. It should be underscored that the authors, regardless of the terminology used, do not designate specific industrial business sectors (Del Brio and Junquera, 2003; Wagner, 2007; Brunnermeier and Cohen, 2003; Ming-Ji and Ching-Hsun 2009; Yu-Shan, 2008; Pujari, 2006; Carrillo-Hermosilla *et al.*, 2010), making the terminology appropriate in different organizational contexts/industrial sectors.

Based on the literature review conducted in this research (Section 2), and according to Table II, it is possible to see a predominance of empirical studies in relation to theoretical ones. In relation to the concept used in the reviewed papers, all of them consider environmental innovation as organizational improvements that promote a reduction in environmental impacts.

Based on the previous studies, in this research we define environmental innovation as follows in Table III.

5. Dimensions of environmental innovation

It is possible to verify greater speculation of environmental innovation in an organizational scope as an attempt at differentiating organizational environmental

Technological innovations in products and processes	Technologically new	Product
		Product process
		Delivery process
	Significantly improved technologically	Product
		Product process
		Delivery process

Table I.
Types of innovation

Source: Manual de Oslo (2004)

Research	Method	Term used	Context
Del Brio and Junquera (2003)	Theoretical	Environmental innovation	The study was a review of the literature that identified the main environmental management system barriers for environmental innovation
Wagner (2007)	Empirical	Environmental innovation	This study reveals the relations between environmental management, environmental innovations and patents. The study concluded that environmental innovation can be identified using patent data and that the environmental innovation defined in this manner is less consolidated than just as environmental innovation
Brunnermeier and Cohen (2003)	Empirical	Environmental innovation	The study reveals that it is more probable for environmental innovation to occur in sectors that are internationally competitive
Ming-Ji and Ching-Hsun (2009)	Empirical	Green innovation	The study identifies that the green learning process has a positive effect on the company's environmental ethics and a positive effect on green innovation
Yu-Shan (2008)	Empirical	Green innovation	The study identified that the investment in key competence development at companies on behalf of environmental commitment are fundamental factors for a company's capacity for green innovation
Hillestad *et al.* (2010)	Empirical	Green innovation	The study encompasses the importance of the manager's role, which influences the company's image, as well as his capacity for environmental innovation
Yang and Chen (2011)	Empirical	Eco-innovation	Eco-innovation offers technical support for different fields of technology to increase creativity in product innovation and environmental commitment
Pujari (2006)	Empirical	Eco-innovation	The product innovation process has been studied by researchers and the products have a good performance on the market
Carrillo-Hermosilla *et al.* (2010)	Empirical	Eco-innovation	The capacity for eco-innovation provides new business opportunities and contributes toward the transformation to a sustainable society, depending in the interaction of these dimensions and the engagement of interested parties in the innovation process

Source: Authors

Table II.
Some papers on environmental innovation (three papers from each term to environmental/ green/eco-innovation)

Environmental innovations are organizational implementations and changes focussing the environment, with implications to companies' products, manufacturing processes and marketing, with different degrees of novelty. They can be merely incremental improvements that intensify the performance of something that already exists, or radical ones that promote something completely unprecedented, where the main objective is to reduce the company's environmental impacts. In addition, environmental innovation has a bilateral relationship with the level of pro-active environmental management adopted by companies

Source: Authors

Table III.
Definition of environmental management adopted in this paper

management (Chapple *et al.*, 2011), therefore, according to the environmental innovation concept, we can group them into three dimensions: products/services; processes and market, such as, respectively, biodegradable products, new technologies that permit production with fewer natural resources (water, natural inputs, electricity); new demand and consumer market niche for specific green products – such as green consumers (Chapple *et al.*, 2011). Figure 2 shows the dimensions of organizational environmental innovation: products/services, processes and market, as well as its relationship with pro-active environmental management.

Authors consider "product" as a crucial dimension of pro-active environmental management (Carrillo-Hermosilla *et al.*, 2010). Product innovations require improvements in the internal management of companies and often culminate in the acquisition of new equipment or development of new productive and managerial structures, promoting not only product innovation, but also of processes and markets green improvements. But on the other hand, Kammerer (2009) considers product innovation one of the main villains for the environment, because the life cycle for these products is increasingly shorter and contributing toward an increase in waste, thus compromising the environment.

The innovation in products and in processes often finds new market opportunities, thus environmental innovations do not have isolated dimensions but rather a certain degree of interdependence (Pujari, 2006). Wagner (2007) also points out that environmental innovations mostly occur in internal processes and these are harder to patent, which justifies the low number of patents in environmental innovation.

In "market" innovations, companies explore green consumers and new ways to offer green products and innovations to these consumers.

6. Barriers to environmental innovation

Some studies (Del Brio and Junquera, 2003; Wagner, 2007; Ming-Ji and Ching-Hsun, 2009; Yu-Shan, 2008; Hillestad *et al.*, 2010) identify the main barriers to environmental

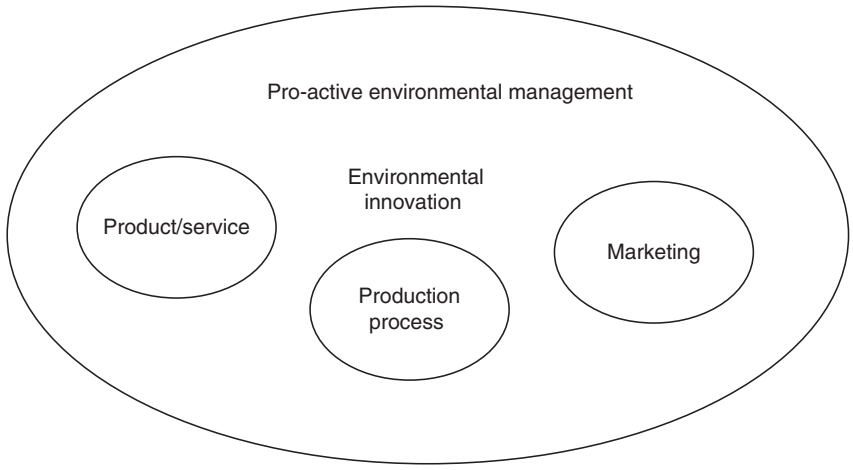

Figure 2.
The dimensions of environmental innovation

Source: Author

innovation as:

- inefficiencies in the internal communication process;
- lack of environmental training for companies' employees;
- managerial limitations to understanding the relevance of green issues;
- difficulties to build networks between partners and green teams;
- unskilled green team for research and development (R&D);
- poor economic perspective with low perception of green innovation gains;
- investment with long-term return;
- difficulties in obtaining financial resources; and
- sluggish environmental regulatory system based on governmental inefficiencies.

7. Final considerations

The term environmental innovation has been well disseminated in literature; however, advances are needed to consolidate it as a theoretical field of research, which requires advances in its conceptualization. It is worth underscoring the diversity of terminologies for this theme, which in itself is deserving of a systematized effort (Del Brio and Junquera, 2003; Wagner, 2007; Ming-Ji and Ching-Hsun, 2009; Yu-Shan, 2008; Hillestad *et al.*, 2010).

Environmental innovations are organizational implementations and changes focussing the environment, with implications to companies' products, manufacturing processes and marketing, with different degrees of novelty. They can be merely incremental improvements that intensify the performance of something that already exists, or radical ones that promote something completely unprecedented, where the main objective is to reduce the company's environmental impacts. In addition, environmental innovation has a bilateral relationship with the level of pro-active environmental management adopted by companies. Increasing of environmental innovation tends to suffer with many barriers, like as inefficiencies in the internal communication process, lack of environmental training for companies' employees, managerial limitations to understanding the relevance of green issues, difficulties to build networks between partners and green teams, unskilled green team for R&D, poor economic perspective with low perception of green innovation gains, investment with long-term return, difficulties in obtaining financial resources, and sluggish environmental regulatory system based on governmental inefficiencies.

The study's main originality was to propose an environmental innovation concept. Like any study of a theoretical nature, it is necessary to move forward with the integration of those concepts proposed and reviewed herein and with the organizational praxis.

References

Berkel, R.V. (2007), "Cleaner productions and eco-efficiency initiatives in Western Australia 1996-2004", *Journal of Cleaner Production*, Vol. 15 Nos 8/9, pp. 741-55.

Brunnermeier, S.B. and Cohen, M.A. (2003), "Determinants of environmental innovation in US manufacturing industries", *Journal of Environmental Economics and Management*, Vol. 45 No. 2, pp. 278-93.

Carrillo-Hermosilla, J., Del Río, P. and Könnölä, T. (2010), "Diversity of eco-innovations: reflections from selected case studies", *Journal of Cleaner Production*, Vol. 18 Nos 10/11, pp. 1073-83.

Chapple, K., Kroll, C., William Lester, T. and Montero, S. (2011), "Innovation in the green economy: an extension of the regional innovation system model?", *Economic Development Quarterly*, Vol. 25 No. 1, pp. 5-25.

Corazza, R.I. (2003), "Gestão ambiental e mudanças da estrutura organizacional", *Revista de Administração de Empresas (REA – eletrônica)*, Vol. 2 No. 2, pp. 1-23.

Côté, R., Booth, A. and Louis, B. (2006), "Eco-efficiency and Smes in Nova Scotia, Canada", *Journal of Cleaner Production*, Vol. 14, pp. 542-50.

Del Brio, J.A. and Junquera, B. (2003), "A review of the literature on environmental innovation management in SMEs: implications for public policies", *Technovation*, Vol. 23 No. 12, pp. 939-48.

Donaire, D. (1999), *Gestão Ambiental na Empresa*, Atlas, São Paulo.

Eder, P. (2003), "Expert inquiry on innovation options for cleaner production in the chemical industry", *Journal of Cleaner Production*, Vol. 11 No. 4, pp. 347-64.

Ekis, P. (2010), "Eco-innovations for environmental sustainability: concepts, progress and policies", *International Economics Policy*, Vol. 7, pp. 267-90.

Falk, J. and Ryan, C. (2007), "Inventing a sustainable future: Australia and the challenge of eco-innovation", *Future*, Vol. 39 Nos 2/3, pp. 215-29.

Galia, F. and Legros, D. (2004), "Complementarities between obstacles to innovations: evidence from France", *Research Policy*, Vol. 33 No. 8, pp. 1185-99.

Hillestad, T., Xie, C. and Haugland, A.A. (2010), "Innovative corporate social responsibility: the founder's role in creating a trustworthy corporate brand through 'green innovation'", *Journal of Product & Brand Management*, Vol. 19 No. 6, pp. 440-51.

Hunt, C.B. and Auster, E.R. (1990), "Proactive environmental management: avoiding the toxic trap", *MIT Sloan Management Review*, Vol. 31 No. 2, pp. 7-18.

Jabbour, C.J.C. (2010), "In the eye of the storm: exploring the introduction of environmental issues in the production function in Brazilian companies", *International Journal of Production Research*, Vol. 48 No. 21, pp. 6315-39.

Kammerer, D. (2009), "The effects of customer benefit and regulation on environmental product innovation. Empirical evidence from appliance manufactures in Germany", *Ecological Economics*, Vol. 68 Nos 8/9, pp. 2285-95.

Manual de Oslo (2004), *Manual de Oslo*, Oslo, available at: www.finep.gov.br/imprensa/sala_imprensa/manual_de_oslo.pdf (accessed May 12, 2011).

Ming-Ji, J.L. and Ching-Hsun, C. (2009), "The positive effect of green relationship learning on green innovation performance: the mediation effect of corporate environmental ethics", PICMET 2009 Proceeding, Portland, OR, August 2-6.

Pujari, D. (2006), "Eco-innovation and new product development: understanding the influences on market performance", *Technovation*, Vol. 26, pp. 76-85.

Seiffert, M.E.B. and Loch, C. (2005), "Systemic thinking in environmental management: support for sustainable development", *Journal of Cleaner Production*, Vol. 13 No. 12, pp. 1197-202.

Tidd, J., Bessant, J. and Pavitt, K. (2008), *Gestão da Inovação*, 3rd ed., Bookman, Porto Alegre.

Wagner, M. (2007), "On the relationship between environmental management, environmental innovation and patenting: evidence from German manufacturing firms", *Research Policy*, Vol. 36 No. 10, pp. 1587-602.

Wehrmeyer, W. (1996), *Greening People*, Human Resource and Environmental Management, Greenleaf, New York, NY.

World Commission on Environment and Development (1987), *Our Common Future*, Oxford University Press, Tokyo.

Yang, C.J. and Chen, J.L. (2011), "Accelerating preliminary eco-innovation design for products that integrates case-based reasoning and TRIZ method", *Journal of Cleaner Production*, Vol. 19 Nos 9/10, pp. 998-1006.

Yuanhsu, L., Ming-Lang, T., Chih-Cheng, C. and Anthony, S.F.C. (2011), "Positioning strategic competitiveness of green business innovation capabilities using hybrid method", *Expert Systems with Applications*, Vol. 38 No. 3, pp. 1839-49.

Yu-Shan, C. (2008), "The drives of green innovation and green image – green core competence", *Journal of Business Ethics*, Vol. 81, pp. 531-43.

Zhang, B., Bi, J., Yuan, Z., Ge, J., Liu, B. and Bu, M. (2008), "Why do firm engage in environmental management? An empirical study in China", *Journal of Cleaner Production*, Vol. 16 No. 10, pp. 1036-45.

Further reading

Bleischwitz, R. (2003), "Cognitive and institutional perspectives of eco-efficiency", *Ecological Economics*, Vol. 46 No. 3, pp. 453-67.

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