THE ECO-INNOVATION CONCEPTS THROUGH A STRATEGIC PERSPECTIVE

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ABSTRACT

The eco-innovation has been playing a major role in the adaptation of organizations to climate changes. In this regard, several studies have been proposed in connection with the concepts and types of eco-innovation, as well as the effectiveness of environment management practices within companies. Although it is relatively simple to identify the concepts of eco-innovation which have achieved success, the analysis of the structure and content of potential eco-innovations has been a challenge - mainly regarding products development, which is more often associated with greater competitive advantage. With a focus on eco-efficiency, the eco-innovation presented in results of empirical studies seems to be far from the types of innovation that have the potential to achieve sustainable development. Despite of being broadly defined in a number of taxonomies and typologies, some conceptualizations of eco-innovation differ on the strategic nature that is directed towards environmental issues. Similarly, the approach of companies to the environmental dimension is not homogeneous, indicating different levels of practice, which can vary from mere compliance with applicable regulation, to the environmental pro-activity, which transforms environmental issues into business opportunities. These levels of practice are distinguished mainly by the articulation between environmental objectives and business strategy. This study aims to develop a theoretical framework through the analysis of taxonomies and typologies of eco-innovation comprising the definition of the term, the innovative potential and the patterns of corporate environment management. The research proposes a debate about the relevance of the environmental issues strategic nature in the concept of eco-innovation, in order to relate the strategic bias to its innovative potential - in terms of degree of novelty. Through the conceptual-theoretical research method, it could be verified that the inclusion of environmental issues as a guide to the development of an innovation, i.e. as part of the company strategic planning, brings greater possibilities for real sustainable potential. It was possible to confirm the importance of a strategic bias, in addition to the eco-efficiency, in the classification of eco-innovations. The proposed debate is extremely valuable to enrich the relevant field of knowledge and to stimulate changes in environmental perception and positioning within a organizational context.

Key words: eco-innovation, environmental management, business strategy, innovative potential.

INTRODUCTION

The eco-innovation concept has been an interest of scholars from different disciplines such as economics (RENNINGS, 2000), sociology (SPAARGAREN, 2003) and management (PUJARI, 2006), and its definition has been also widely discussed even in the dimensions of design, governance, users and supply chain (KARAKAYA *et al.*, 2014).

In summary, the term eco-innovation (environmental innovation, green innovation or sustainable innovation) has been often used to identify the innovations that contribute to a sustainable environment through the development of ecological improvements (KEMP & FOXON, 2007; CARRILLO-HERMOSILLA *et al.*, 2009; HALILA & RUNDQUIST, 2011). These environmental innovations may be grouped into some categories, as well as their determining factors. They may comprise not only environmental friendly products, processes and services, but also organizational management systems that incorporate environmental concerns and systems' innovations (PORTER & VAN DER LINDE, 1995; BELIN *et al.,* 2009).

However, according to Andersen (2008), the categorizations are often more rooted in the history of environmental policy than in innovation dynamics. In addition, the term has been used in diverse contexts and with different underlying connotations that may reduce its practical value. In general, these definitions emphasize that eco-innovations reduce the environmental impact caused by consumption and production activities, whether the main motivation for their development or deployment is environmental or not. The definitions seem to be quite general and, thus, many kinds of innovation can be defined as eco-innovations (CARRILLO-HERMOSILLA *et al.,* 2009).

It is important to have this issue raised mainly because the subject has been attracting an increasing attention from policy-makers and business actors because of its market potential and global concerns. With increased mass production and improved technology efficiency, eco-innovations become advantageous in different markets (KARAKAYA *et al.,* 2014). The questions is if the eco-innovations, focused mostly on eco-efficiency, really help society to make progress toward more sustainable societal patterns (HOFSTRA & HUISINGH, 2010).

Drawing much of its ancestry from the quality movement and its reliance on efficiency thinking, eco-innovation seems biased away from exactly the types of innovation that have the potential of realizing sustainable development (HELLSTROM, 2007). The long-term survival of the economic system depends on its ability to create and maintain sustainable economic processes, which do not involve short-term value creation at the expense of long-term wealth. However, eco-innovation as a strategic perspective is an approach that has not been sufficiently considered (CARRILO-HERMOSILLA *et al.*, 2010).

With respect to the environmental management strategic aspect, Porter & Van der Linde (1999), when discussing the possible dilemma between environmental adequacy and competition, state that an organization must have a strategic environmental positioning. The strategies for action in the environmental Field may occur at different levels, adopting reactive or proactive approaches (SOUZA, 2002). The strategic visions deals with a more advanced form of environmental management, in which the proactive and anticipative actions prevail, with a permanent and systematic involvement of the high management (BARBIERI, 2011), and considers the environmental aspects as business opportunities.

It becomes clear that the correlation between a complex system, driven by a new competitive scenario, will necessarily lead to difficult dilemmas. The “dilemma of the N-Curve”, proposed by Jänicke (2008), discusses this complexity associated with the limitation of eco-efficiency, stating that the increases in environmental efficiency do not lead to sustainability, provoking a rebound effect in the economy. That dilemma may be analyzed from the perspective of the exiting taxonomies of eco-innovation and its different approaches. Companies seeking eco-efficiency are rather focused on the increase of costs’ competitive advantage than in the environmental gains. The focus is rather in the result than in the environmental motivation and strategic perspective.

Therefore, the following research question is proposed: are companies eco-innovative because they produce eco-innovations or do they produce eco-innovations because they are eco-innovative? This question is based on two main perspectives that differentiate the eco-innovation definitions: the first is based on the result and the second on the motivation aspect (KEMP & PEARSON, 2007; HELLSTROM, 2007; CARRILLO-HERMOSILA *et al.*, 2009).

This dilemma may be seen as an analogy to the slogan of popular Brazilian crackers’ brand, named *Tostines*, in the eighties, which questioned as to whether their crackers “sell so much because they’re so fresh, or are if they are so fresh because they sell so much?”. This slogan has become known as the “Tostines paradox” and has certain resemblances with the chicken-egg dilemma. Regardless of any correct answer, this dilemma serves as a stimulus to discussion and has been used as an analogy in several researches of different fields (SANTOS, 2006; FIORUCCI, 2012; CERNICCHIARO, 2014). The implied concept of that slogan turns around two marketing aspects: the fact that large sales result in frequent stock renovation and in supplies of the products being always fresh; and the fact that the product quality and freshness result in an increase of sales. In brief, the motivation generate results and the results generate motivation.

This raises the important issue of analyzing the classifications of eco-innovations in order to better understand their specific characteristics and prospects (CARRILLO-HERMOSILLA *et al*., 2010). Thereby, this study aims to develop a theoretical framework through the analysis of taxonomies and typologies of eco-innovation comprising the definition of the term, the innovative potential and the patterns of corporate environment management. Through the conceptual-theoretical research method, the study proposes a debate about the relevance of the environmental issues strategic nature in the concept of eco-innovation, in order to relate the strategic bias to its innovative potential - in terms of degree of novelty.

ECO-INNOVATION: CONCEPTS AND CLASSIFICATIONS

Eco-innovation is a recent concept. One of the first appearances of the concept of eco-innovation in the literature is in the book "Eco-innovation: A Breakthrough Discipline for Innovation and Sustainability" by Claude Fussler and Peter James, published in 1996 (KEMP & FOXON, 2007). The term has been increasingly used in the environmental management and policy fields, although in different contexts and with different underlying connotations that may eventually diminish its practical value (CARRILLO-HERMOSILLA et al., 2010).

Eco-innovation is difficult to define because of the complexity of the subject and because greening is a moving target (ANDERSEN, 2008). Several attempts have been made in the literature, as detailed in the Table 2.1 (NETO, 2012). The terms used by a number of authors are equivalent, with prevalence of the term eco-innovation.

Table 2.1 - Eco-innovation definitions

Research	Terminology	Concept of eco-innovation
James (1997)	Eco-innovation	Process for development of new products, processes or services that offer value to clients and businesses with diminishment of environmental impact.
Hemmelskamp (1997)	Environmental Innovation	Innovations focused on reducing the negative environmental impacts caused by the production methods (process or product innovation).
Kemp & Arundel (1998)	Environmental Innovation	New or modified processes, techniques, systems and products to avoid or reduce the environmental impacts.
Rennings (2000)	Eco-innovation	All measures taken by the relevant players to develop new ideas, behaviors, products and processes, and to apply or introduce them; and which contribute to the reduction of environmental impacts or specific ecological goals related to sustainability.
VINNOVA (2001)	Environmental Innovation	Innovation that serves to prevent or reduce the anthropological impacts over the environment; to clean the existing damages or identify and control environmental problems.
Rennings & Zwick (2003)	Environmental Innovation	New or modified processes, equipments, products, techniques and management systems to avoid or reduce the environmental impacts.
Little (2005)	Sustainability-addressed innovation	Creation of new market spaces, products or services or processes guided by social environmental or sustainability concerns.
Bernauer *et al.* (2006)	Environmental Innovation or Green Innovation	All innovations with a beneficial effect over the environment, regardless of such effect being the main purpose of the innovation; including innovation in processes, products and organizational.
Europe INNOVA (2006)	Eco-innovation	Creation of new products, processes, systems, services and procedures, with competitive prices, conceived to satisfy human needs and offer a better life quality, with lifecycle that uses the minimum natural resources for production and minimum release of toxic substances.
METI (2007)	Eco-innovation	New field of techno- social innovations focused less on the products and more on the environment and people.
Charter & Clark (2007)	Sustainable Innovation or Eco-innovation	Process where sustainability (environmental, social, financial) is integrated to the company's systems and the generation of ideas, since the R&D to the marketing. It is applicable to products, services, Technologies and new business and organization models.
Kemp & Pearson (2008); Kemp & Foxon (2007)	Eco-innovation	Production, assimilation or exploration of a products, production process, service, management or business methods, which is new within the organization and results, throughout its lifecycle, in reduction of environmental risks, pollution and negative impacts of the use of natural resources when compared to the existing alternatives.
Horbach (2008)	Environmental Innovation	New or modified processes, techniques, systems and products that avoid environmental damages. It is possible to achieve a "win-win" situation: integration of economical and environmental benefits.
Oltra & Saint-Jean (2009)	Environmental Innovation	Innovations consisting of new or modified processes, practices, systems or products that benefit the environment and contribute to environmental sustainability.
OECD (2009)	Eco-innovation	Innovation that results in reduction of environmental impact (intentional or not); it may go beyond the conventional organizational boundaries of a company and involve wider social arrangements that change the socio-cultural customs and institutional structures.

Research	Terminology	Concept of eco-innovation
Carrillo-Hermosilla *et al.* (2010)	Eco-innovation	Innovation that increases the environmental performance; being the main characteristic the reduction of environmental impacts, whether intentional or not.
Del Rio *et al.* (2010)	Eco-innovation	Innovation that increase the environmental performance of production and consumption activities.

Source: Adapted from Neto (2012)

As a general rule, the concept definitions are based on the environmental performance, with focus on the positive environmental effects related to its use and not is purpose. In other words, they emphasize the form to reduce the environmental impact caused by the production and consumption activities, without taking into consideration the motivation for its development and implementation (CARRILLO-HERMOSILLA et al., 2010; KEMP & FOXON, 2007; VINNOVA, 2001).

The distinguishing feature is environmental gain (compared to relevant alternatives) (KEMP & FOXON, 2007). Moreover, just like any innovation, different dimensions of change can be identified, which together explain factors of success or failure (CARRILLO-HERMOSILLA et al., 2010). Thus, the novelty factor must be considered (VINNOVA, 2001; European Commission, 2008). Mainly because innovation is highly context-dependent: it may vary depending on moment, group and location (MORAND, 2008).

In this sense, the innovation may lower the costs of achieving an environmental improvement or it may offer a greater environmental gain than an old model (KEMP & FOXON, 2007). Consequently, most commonly eco-innovation refers to new technologies that improve economic and environmental performance. Nonetheless, some definitions include organizational and social changes for improving competitiveness and sustainability and its social, economic and environmental pillars (CARRILLO-HERMOSILLA et al., 2010).

So, eco-innovation must, in order to succeed, also build on relevant social structures, and in some cases the innovation should also be able to influence these structures. However, it is clear that only a minority of all technological development is geared towards change of this type (HELLSTRÖM, 2007).

There is a strong potential in the mixed ecological–economic instruction with regard to the systemic nature of innovation (CRAMER, 2000). It is clear that the systemic nature of the eco-efficiency (measured by the ratio between the value of the product or service and environmental influence) is an important one for understanding what eco-innovation is and what it can be. Despite that, there appears to be a certain bias in the way that eco-innovation has been conceptualized, that is mainly towards incremental improvements in processes, and towards substitution of components or already existing products with more environmentally friendly alternatives (HELLSTRÖM, 2007).

Blättel-Mink (1998) emphasizes that eco-innovations may include the development and introduction of new products (environmental technologies), new markets and new systems as well as very broadly the introduction of ecological dimensions in economic strategies. These types of improvement clearly allow for a creative and thorough transformation of the innovation space rather than just replacement or incremental innovation. Even so, there are many factors affecting eco-innovation and only one of those is environmental motivation (CARRILLO-HERMOSILLA et al., 2010).

Under these circumstances, Kemp and Foxon (2007) propose to not restrict eco-innovations to those innovations whose purpose is to reduce environmental harm. Therefore, the term could be used for all innovations that are less environmental harmful than relevant alternatives. This proposal is based on the argument that some definitions perhaps limit eco-innovations to innovations whose aim is to reduce environmental harm, thus excluding those innovations that are environmentally friendly but that are not specially designed to reduce pollution and waste.

CARRILLO-HERMOSILLA et al. (2010) argue that from the social point of view, it does not matter very much if the initial motivation for the uptake of eco-innovation is purely an environmental one. This approach avoids the discussion on whether the innovation was initiated or adopted as a result of environmental motivation.

But it is important to note that cost-saving technologies give rise to increases in real wealth that will translate in extra consumption and associated emissions and resource use (rebound effect) (KEMP & FOXON, 2007). Therefore, the widespread use of eco-innovations does not guarantee overall improvements in environmental quality. In this case, the environmental improvement depends on how one values different kinds of environmental impacts and the use of resources. Just like environmental performance, eco-innovation is a value-based concept open to discussion about its impacts on society (CARRILLO-HERMOSILLA et al., 2010).

In conclusion, most commonly eco-innovation refers to new technologies that improve economic and environmental performance, but some definitions also include organizational and social changes for improving competitiveness and sustainability and its social, economic and environmental pillars. As well, eco-innovation has also been studied as a strategic perspective to renew the business. In practice, these dimensions are often intertwined, but this approach has not been sufficiently considered yet (CARRILLO-HERMOSILLA et al., 2010).

Based on the synthesis presented hereby over the conceptions of distinct authors concerning eco-innovation, the next section will deal with the discussion as to the typologies and related aspects.

Eco-innovation Typologies

As discussed in the previous section, the definitions of eco-innovation seem to be quite general and, thus, many kinds of innovation can be defined as eco-innovations. This raises the important issue of further classifying eco-innovations in order to better understand their specific characteristics (CARRILLO-HERMOSILLA et al., 2010). As a result, a number of researches are focused on the construction and analysis of eco-innovation classificatory structures.

In practice, there are various types of eco-innovation, and each type has its own attributes, determinants and contribution to business performance. And knowing how different types of eco-innovation complement each other is critical for firms to effectively implement their entire innovation programs. Accordingly, an organization must take a holistic approach to developing and supporting its eco-innovation programs (CHENG et al., 2013).

Eco-innovation can be defined and studied within their external and internal boundaries. The external boundary of eco-innovation includes all external activities of the organization for green and sustainable activities, including suppliers, regulators, and market demand. The internal boundary is related to practices for effectively and efficiently managing eco-innovation processes within

organizations, including organizational management, production process, and new product development (CHENG et al., 2013).

The perspective of eco-innovation, therefore, passes through a classic approach, in which the environmental and resources economy predominates with the superiority of market instruments, until an evolutionary approach, which is interested in the transition and learning processes (RENNINGS, 1998). In this manner, the increase in the theoretical knowledge in eco-innovation produced proposals that evidence the plurality of possible new beneficial environmental solutions, whose similarities allow their systematization under a common denomination (NETO, 2012).

The main classification proposals for analysis of eco-innovation and the relation between these taxonomies are presented in the Table 2.2, as proposed by Neto (2012).

Table 2.2: Relation between common denomination and selected taxonomies

Research	Eco-innovation typologies					
Hohmeyer and Koschel (1995) apud Rennings (2000)	Addictive			Integrated		
	Production Process		Production Output	Production process inputs	Effects and emissions from production and consumption	
Hemmelskamp (1997)	Processes		Products			
	End-of-line technologies		Integrated Technologies			
James (1997)	Processes	Products				
Kemp and Arundel (1998)	End-of-line	Clean technologies		Organizational		
Rennings (2000)	Technological		Organizational	Social	Institutional	
Bernauer *et al.* (2006)	Process	Product	Organizational			
Europe INNOVA (2006)	Products/processes/services		System			
METI (2007)	Technology	Business Model	Social System (institution)			
Frondel, Horbach and Rennings (2007)	Processes		Products	Organizational		
	End-of-line technologies	Cleaner Production Technologies				
Charter e Clark (2007)	Incremental		Redesign	Functional	System	
Hellström (2007)	New production methods	New supplies/ processes	New products	New supplies/products	New markets	New forms of market organization
Kemp e Foxon (2007); Kemp e Pearson (2008)	Environmental technologies		Products and services		Organizational	Changes to clean systems
Andersen (2008)	Addictive	Integrated	Alternative products		Macro-organizational	General proposal
OECD (2009)	Technological changes		Non-technological changes			

Research	Eco-innovation typologies				
	Processes	Products	Marketing methods	Organizations	Institutions
Carrilo-Hermosilla *et al.* (2010)	Component addition	Subsystem change		System change	
Del Rio *et al.* (2010)	Process change	Products change	Services change	Organizational change	
Common denomination	**Processes**	**Products or Services**		**Organizational**	**Business Model**

Source: Adapted from Neto (2012)

According to the conventional understanding of innovation, as defined in the Oslo Manual (OECD, 2005), innovation is deemed as the implementation of a new or improved process (production or distribution method), product (good or service), marketing method (conception, positioning, markets) and organizational method (business, organization and relation practices). However, the traditional interpretation is not enough in the environmental management context, with the category of institution being included in that definition, referring to institutional arrangements, social customs and cultural values (OECD, 2009).

In an attempt to clarify the eco-innovation dynamic, Andersen (2005) proposes an operational taxonomy, that entails key types of eco-innovations reflecting their different roles on a (greening) market. He suggests five categories of eco-innovations:

i. Add-on eco-innovations: products, technologies and services that improve the environmental performance of the customer;

ii. Integrated eco-innovations: make either the production process or the product more eco-efficient (“cleaner”) than similar processes or products;

iii. Alternative product eco-innovations: represent a radical technological discontinuity and they are not cleaner than similar products but offer a different and more environmentally benign solutions to existing products;

iv. Macro-organizational eco-innovations: new solutions for an eco-efficient way of organizing society, i.e., new ways of organizing production and consumption in a more systematic level;

v. General purpose eco-innovations: refer to general purpose technologies that affect the economy and the innovation process.

In a similar line of categorization, Kemp and Foxon (2007) and Kemp and Pearson (2008) discuss a similar taxonomy, which classifies eco-innovations as: (1) environmental technologies (process and measurement technologies used for environmental purposes); (2) organizational eco-innovation (new organizational methods and management systems for dealing with environmental issues); (3) product and service innovation (new or environmental improved products and environmentally beneficial services); and (4) green system innovations (alternative systems of production and consumption that are more environmentally benign than existing systems).

Kemp and Foxon (2007) emphasize that the most important aspect of this classification scheme is perhaps the fact that eco-innovation is not limited to new or better environmental technologies.

Every environmentally improved product or service counts and organizational change for the environment as an eco-innovation.

A more specific typology that must be highlighted is the one proposed by Carrillo-Hermossila et al. (2009). The authors differentiate between four dimensions of eco-innovation: design, user, products/service and governance dimensions. The d**esign dimension** proposes three approaches to identify the role and impact of eco-innovation, namely:

i. Component addition: the aim is to minimize and repair negative impacts without necessarily changing the process and system that produces the problem;

ii. Sub-system change: the goal is to reduce negative impacts by creating more goods and services while using fewer resources and creating less waste and pollution

iii. System change: related to system redesign and changes in its components, with a view to both their negative and positive impacts on the ecosystem.

The **user dimension** intends to involve the users in a manner to benefit from the creativity and ensure they will accept and assimilate the new products and services, including a dimension for development and acceptance. The product/service dimension comprises the manner under which companies will add value and, also, it comprises the change in delivery, value network and other relations. Finally, the governance dimension refers to all new institutional and organizational solutions to resolve conflicts over environmental resources either in the public or private sectors (CARRILLO-HERMOSILA et al., 2009).

Due to the need to have a more operational eco-innovation taxonomy, which involves the key categories and reflect over its distinct roles, a new common denomination is proposed, according to the classifications selected in the literature (NETO, 2012) and according to Table 2.2. This classification comprises four categories: processes, products, organizations and business models.

The eco-innovation in business models implies new solutions and a more ecological form of business organization, with alternatives that create value to clients and the business, with reduction in environmental impacts (ANDERSEN, 2008). This stage is achieved through a more systematic vision of new paradoxes and complexities that are imposed to current society, which must be discussed in the business models (NETO, 2012). It means the adoption of alternative production and consumption systems, which comprise concerns with environmental preservation, production, safety, life quality, technological and economical development and social welfare (KEMP & FOXON, 2007).

To absorb that environmental awareness it will be necessary to change the organization practices. The category of organizational eco-innovation comprises the introduction of organizational methods and management systems to include the environmental aspect in the institutional goals and practices, mitigating the negative effects generated by the corporate activities (KEMP & FOXON, 2007; JABBOUR et al., 2010). This includes environmental training programs, Green products design, pollution prevention policies, partnership networks, as well as marketing strategies, promotions and new positioning (KEMP et al., 1998; SHRIVASTAVA, 1995; OECD, 2009).

More commonly the innovation targeted to sustainable goals is focused on technological-nature changes, through the adoption of environmental technologies (processes, products and services less pollutant and harmful to environment) (HELLSTRÖM, 2007; KUEHR, 2007). The eco-innovation in

processes may be defined as improvements in the productive processes that result in reduction in environmental impacts (BERNAUER et al., 2006).

In this context, the eco-innovation in products and services appears as a solution that offer environmental benefits, with projects and development being planned to have a minimized global impact on the environment during the whole product lifecycle or performance of the service (REID & MEIDZINSKI, 2008; BERNAUER et al., 2006; PUJARI, 2006). The product development process starts to incorporate the environmental concerns, with a number of possible methodologies and practices for its integration, such as *ecodesign* and *Life Cycle Analysis* (LCA).

Trajectory and dimensions of eco-innovation

The notion of eco-innovation is related to an innovation which is novel to the firm, i.e., things done in a different way, whether technologically and organizationally. This definition emphasizes the eco-innovation's institutional context, through the notion of novelty to a specific group. For the purposes of characterizing eco-innovation, addressing change is deemed a useful starting point (CARRILLO-HERMOSILLA et al., 2009).

In this manner, several typologies focused on analyzing the relation between the degree of novelty of innovation and its impact in the organization. In other words, this degree of change (a completely new output or some modifications implemented to a previous version of the object, according Goffin and Mitchel, 2010), is a way to categorize innovation through the basic trajectory that it may take (KURATKO et al., 2014).

The first typology and one of the more widespread was proposed by Schumpeter (1988) in two levels: radical and incremental. The changes are differentiated by their degree of innovation and the extension of derivatives in relation to the previous standard. These levels are used and proposed by several authors for the distinction between the changes brought by the eco-innovation (OECD, 2005; EUROPE INNOVA, 2006; HENDERSON E CLARK, 1990; HELLSTRÖM, 2007; CARRILLO-HERMOSILLA et al., 2009).

Incremental changes refer to gradual and continuous competence-enhancing modifications that preserve existing production systems and networks, creating added value in which innovations are rooted. Radical changes, in contrast, are competence-destroying, discontinuous changes that most often seek the replacement of existing components - or entire systems - and the creation of new networks, creating added value (CARRILLO-HERMOSILLA et al., 2009).

In summary, incremental eco-innovations refer to minor changes in production processes, while radical eco-innovations are more substantial changes at the production-system level, such as those involved in industrial ecology, including closed-loop systems in which wastes become inputs for new processes (DEL RIO et al., 2010).

Another distinction that is useful for understanding eco-innovation is between architectural and component innovation, sometimes referred to as systemic and modular innovation (Henderson and Clark, 1990). Component innovation takes place when one or more modules nested within a larger system are replaced, while the system itself stays intact. An architectural innovation on the other hand entails changing the overall system design and hence the way that the parts interact with each other (HELLSTRÖM, 2007).

The vast majority of innovations takes place in the incremental mode (PAGE, 1993; GRIFFIN, 1997; BARCZAK et al., 2009; MARKHAM & LEE, 2013), and eco-innovation is not the exception. With a few exceptions, eco-innovations represent mainly incremental process and component innovations (EDER, 2003; HELLSTRÖM, 2007). This category included the increasing of eco-efficiency in existing processes through introduction of replacement materials in production, improvements aimed at reducing waste from production and new measurement devices (HELLSTRÖM, 2007).

As supported by the empirical study of Hellström (2007), these available eco-innovations - in components of product or production processes - will not be able to help achieve truly sustainable emissions targets. Their concept is based on eco-efficiency, in the short-term in which it is assumed that nature exists for the convenience of man. Unfortunately, ecological successfulness (eco-effectiveness) is relatively unusual in fulfilling the requirement that the product is economically successful in the short-term (efficiency) and at the same time ecologically sound in both the short and long-term (HOFSTRA & HUISINGH, 2014). Moreover, these solutions are frequently considered as insufficient to the extent the increase in the environmental efficiency tends to be surpassed by the subsequent increase in the consumption and environmental impacts (rebound effect) (CARRILLO-HERMOSILLA et al., 2010).

Therefore, the available eco-innovation concepts seem biased away from the type of innovations which have the potential of realizing sustainable development (HELLSTRÖM, 2007). Instead, radical innovation is necessary, which is where technological products and systems are drastically reconstructed in order to facilitate a radical systems shift upwards in eco-efficiency. According to the Europe INNOVA panel (2006), radical innovations have a better answer to society needs, with environmental preservation and better life quality to citizens.

Therefore, it is important that the eco-innovation definitions and operationalization are clear, as well as the perspectives involved. The taxonomy is one of the main elements to measure eco-innovation (ANDERSEN, 2006) and requires coherent measures concerning the nature, as discussed in the previous topic, and the degree of eco-innovation use, on the practices of companies as to the environmental approach (ARUNDEL & KEMP, 2009; OECD, 2009).

Despite all the methods and tools available to improve companies' environmental management, companies are at different levels of maturity (ORMAZABAL & SARRIEGI, 2014). Kemp and Pearson (2007) believe that any company adopting a good, service, production process management or business method with environmental benefit is an eco-innovator. In this respect, it appears useful to distinguish different types of eco-innovators. There have been several studies defining different types of environmental strategy among companies (SHARMA & RUUD, 2003). Most classifications can be grouped into reactive or passive, preventive or active, and proactive. However, the literature in this field is still incipient, without a detailed definition of each stage and description of how to move forward from one stage to the next. This might explain why companies remain stagnant once they obtain an environmental certification (ORMAZABAL & SARRIEGI, 2014).

Kemp and Pearson (2007) suggest four mutually exclusive categories, depending on how each firm innovates (by developing innovations for other firms, adopting innovations developed elsewhere in a strategic or passive way). Following this logic, eco-innovators could be classified in the following categories:

i. Strategic eco-innovators: environmental innovation is deemed as the core business; active in eco equipment & services sectors, develop eco-innovations for sale to other firms;

ii. Strategic eco-adopters: intentionally implement eco-innovations, either developed in-house or acquired from other firms; the core business is not the production of environmental innovations;

iii. Passive eco-innovators: process, organizational, product innovation etc that result in environmental benefits, but no specific strategy to eco-innovate;

iv. Non eco innovators: no activities for either intentional or unintended innovations with environmental benefits.

The first two categories are considered as proactive companies' profiles. These are companies that develop or adopt environmental innovation as a strategic and planned move. They see an opportunity of financial gain and anticipate to environmental regulations. They are distinct from the reactive companies (third category), in which the adoption of an environmental innovation is made in a non intentional manner or to comply with a regulation, with such line of action not supported by a strategic plan. Kemp and Pearson (2007) propose a possible distribution of companies according to the eco-activities, as presented in the Image 3.1:

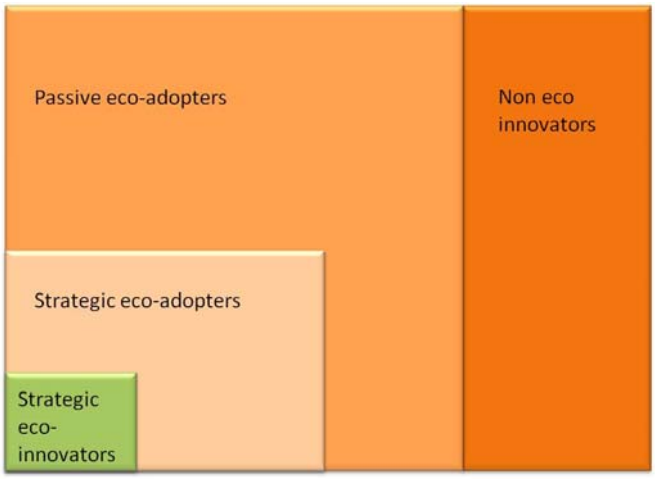

Image 3.1: Possible distribution of companies in accordance to the eco-activities, Source: Kemp & Pearson (2007)

Several studies state that regulatory pressure plays a significant role in driving eco-innovation (JAFFE & PALMER,1997; KNELLER & MANDERSON, 2012; CAI & ZHOU, 2014). This affirmative corroborates the distribution of Kemp and Pearson (2007), in which the large majority of companies have a reactive profile, with no environmental intention or strategy. According to Ormazabal and Sarriegi (2014), firms tend to start with the implementation of environmental management in their company due to legislation requirements. The companies that decide to go further start to innovate with products and processes where the environmental aspect is central. The last stage to reach is to be recognized as a green company and to be a reference for other companies.

Based on the reactive profile of companies, most environmental innovations arise in an incremental manner. However, as already discussed, incremental eco-innovations tend to be unsustainable. Therefore, this innovation will exhaust its differential (eco-efficiency) much faster than the

subsequent alternatives. Companies willing to find a business opportunity in environmental concerns, in addition to the financial gains and profitability, must have a proactive approach (HORBACH *et al.*, 2012). With a proactive approach towards environmental sustainability and a vision of the ecological dimensions as a strategic factor, a company will likely develop solutions with a positive impact in environment in which it is inserted. This would be a innovation with a higher degree of radicalism, distinct from a mere incremental and reactive approach (HELLSTRÖM, 2007).

In this sense, according to OECD (2009), to achieve a high environmental potential, it is necessary for companies to use eco-innovation mechanisms not only based on changes and redesign, but also on alternatives and specially creation. As a result, the company must step into a context where eco-innovations are also focused in terms of institutions, through systematic changes.

DISCUSSION: ECO-INNOVATION THROUGH A STRATEGIC PERSPECTIVE

Under an approach rather preventive than proactive for inclusion of environmental concerns into innovation, the eco-innovation is becoming even more inserted into the corporative field, lacking from more consolidated and operational definitions from the academic field, as well as a more rigid taxonomy of eco-innovations (ANDERSEN, 2008). In this sense, the definitions of eco-innovation seen to be quite generic and, therefore, several types of innovation may be deemed as eco-innovation (CARRILLO-HERMOSILLA et al., 2010).

In general, it is possible to state that the eco-innovation typologies are focused on three big groups: based on nature; based on degree of novelty; and based on application of environmental practices by companies. The image 4.1 illustrates these perspectives:

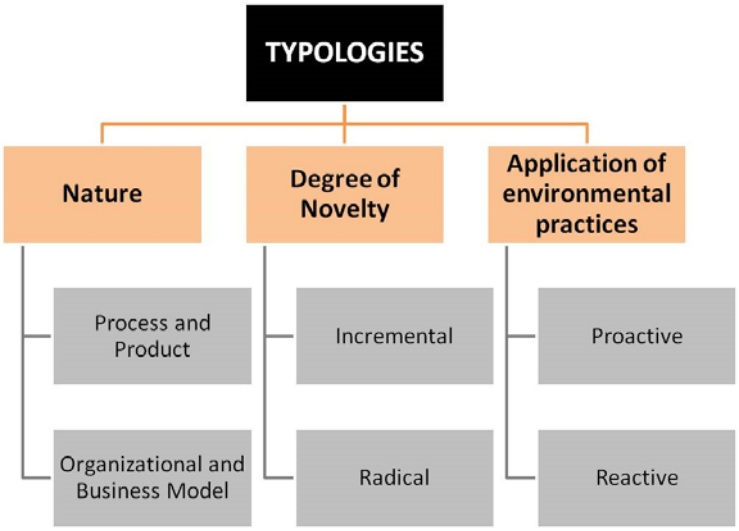

Image 4.1: Eco-innovation typologies, Source: Own elaboration

There are different definitions of eco-innovation (Table 2.1) and these definitions are based on motivation and on performance (KEMP & PEARSON, 2007; KEMP & FOXON, 2007). At on hand several definitions are based in the results, referring to eco-innovation as simply reducing environmental impacts through waste minimization (VINNOVA, 2001; BERNAUER *et al.*, 2006; KEMP & FOXON, 2007; CARRILLO-HERMOSILLA *et al.*, 2009). This approach avoids the discussion over whether the innovation was initiated or adopted as a result of environmental motivation

(CARRILLLO-HERMOSILLA *et al.*, 2009). However, as discussed, the notion of an eco-innovation is considerably broader than this.

On the other hand, therefore, there is the definition of eco-innovation as resulting from intentional actions. These environmental intentions are supported on ethical values that induce companies to make the 'right thing', regardless of regulations or external pressures. It may be deeply rooted in the managerial values, encouraging the company to adopt a more active role when compared o other productive agents (BANSAL & ROTH, 2000).

The intention, thus, refers to the corporate strategy. The main decisions are taken in the strategic planning phase, based on election criteria (motivation) supported on prospective analysis of the system in which the company is inserted and its global business vision. Based on this the aspects referring to sustainability may then be directed.

In addition to the question of environmental motivation and goals, other distinctive characteristic of eco-innovation is the degree of novelty (KEMP & FOXON, 2007). The environmental innovations may have distinct natures and represent different levels of impact in the environment where they are inserted, pursuant to their degree of novelty. As discussed, most commonly eco-innovation refers to new technologies (products and processes) that improve environmental performance based on eco-efficiency, whereas only a minority refers to organizational and social changes (CARRILLO-HERMOSILLA et al., 2009; HELLSTRÖM, 2007).

This aspect corroborates the taxonomy question, which has a generic perspective, either in the nature of eco-innovation (regarding its intentionality) or its degree of novelty, with no need of a big positive environmental impact to be adequate to the concept (KEMP & FOXON, 2007).

Moreover, the approach – based on the broadness of the concept – influence the analysis as to the applicability of the environmental practices by the companies. According to the researches previously presented, the vast majority of companies have a reactive approach, of simple adequacy to the environment and a purely incremental development. Therefore, it is noted that only a small portion of eco-innovations may be considered as radical, with a beneficial and sustainable potential to environment.

This question needs to be firmly analyzed, since it influence the measurement mechanisms. One of the crucial measurement elements is the existence of clear and congruent taxonomies. However, it is possible to observe that, although several studies are focused on the eco-innovation concepts, the existing taxonomies do not clearly and properly represent the concepts and classificatory schemes that, on their turn, would permit a long-term and actual environmentally sustainable perspective.

FINAL CONSIDERATIONS

Based on the discussion concerning the eco-innovation taxonomies ant the related perspectives - drivers, measurement, innovative and sustainable potential – it is important to recall the initial question of the research: are companies eco-innovative because they produce eco-innovations or do they produce eco-innovations because they are eco-innovative?

This research question rises two propositions. The first proposition is focused on the result, and not motivation. A company, therefore, may be eco-innovative provided that it produces a eco-innovations, even if the environmental aspect was not intentional. The second proposition is focused

on motivation, the strategic perspective. A company produces eco-innovations because the environmental aspects are inserted in its strategy, values, culture and practices. The eco-innovation, in this case, is intentional.

The vast majority of companies are reactive, with eco-innovations being purely incremental, mainly in processes, with focus on eco-efficiency. The organizational or business model eco-innovations are, on their turn, rare. However, the incremental eco-innovation do not demonstrate a great changing potential, especially when dealing with environmental improvements at a sustainable level. Companies need to change their approaches from reactive to proactive in order to become strategically eco-innovative.

This question enlightens the strategic perspective, under which the eco-innovations become intentional, with a motivation concerning the environmental aspects inserted in the business strategy. This proactive approach systematically changes the company, its goals, values, culture and, therefore, it will also involve the organizational and institutional levels.

Therefore, concepts based on generic approaches are actually opposite to radical and environmentally sustainable changes. Moreover, a generic perspective is an obstacle to the correct measurement of eco-innovation, since it makes simple to the majority of companies to include themselves in such a broad concept. This context is even more problematic when noticed that the current market context has a great tendency to sustainability, influenced by regulatory entities and even the customers, which results in a number of companies adopting green washing practices (distorted public image of environmental responsibility on an organization).

Finally, as a manner to stimulate the proactiveness of companies, their innovative potential and, as a consequence, the market drivers, it is proposed the use of concepts and typologies of eco-innovation that take into account the strategic perspective, with the search for sustainability occurring in an intentional manner. Therefore, it will be possible to change from a result-centered proposition, where companies are eco-innovative only because they produce eco-innovation, to a proposition based on motivation, in which companies produce eco-innovations because they are eco-innovative.

As a recommendation for future studies, it is suggested that the analysis proposed here are undertaken by the use of empirical research data, aiming to achieve conclusions about the influence of taxonomies in the measurements mechanisms. Also, it is proposed researches that discuss the relations between strategic perspective and environmental sustainability.

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