The power of innovation and strategic sustainability positioning

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Abstract

The study investigates the relationship between the power of innovation and sustainability strategy of companies mining. The study is a survey research with companies associated with the Brazilian Mining Institute. The data analysis showed that companies with highly intensive characteristics of innovation have an offensive strategic approach towards sustainability

Keywords: Innovation, Strategic, Mining sector.

Introduction

Innovation management has become a key factor to the success and continuity of organizations that can take advantage (cost reduction, increased productivity and exploitation of new markets), getting ahead of competitors as a result of their investments in innovation. Moreover, it is observed that product and process innovations can be used to improve the environmental performance of firms (PORTER and VAN DER LINDE, 1995; VAN BOMMEL, 2011), depending on the visibility of environmental issues at the national and international scene.

The development of innovations that seek to implement technologies geared towards the principles of sustainability has become a major challenge for organizations. Sustainable innovation is defined as the innovation of products and production processes that address not only economic and social aspects, but also environmental ones (BARBIERI et al, 2010).

Thus, there is a great deal of internal and external pressure which requires companies to be engaged in favor of a type of management that takes into account economic, social and environmental aspects that can be associated with management coupled with sustainability innovation.

Some scholars, such as Barbieri et al. (2009) and Maçaneiro and Cunha (2010), have been discussing a type of innovation management that addresses the issue of sustainability and considers innovation as essential for business sustainability in the ecological, social, economic, cultural or spatial dimensions, where none of them is particularly prioritized to the detriment of the others.

For Van Bommel (2011), what determines the strategy adopted by a company is the characteristics of innovation and the characteristics of sustainable activities. The focus of the sustainability strategy is evidenced in three ways: focus on product, focus on process, and focus on product/process. The definition of the focus of the strategy may depend on many external and internal factors affecting the company. External factors include the following: the sector of activity and the company's relationship with the production chain, while internal factors may include the companies' ability to learn about the natural environment of business and put this knowledge into

practice in their strategy (VAN BOMMEL, 2011).

Innovation and sustainability are the result of a process of organizational learning and the key features used in this process involve information (on the advancement of technology, on markets, competitors, regulations) and knowledge (skills, know-how) in a favorable organizational environment (SENGE, 1990).

In this context, several scholars believe that business strategic positioning, thus, may be regarded as offensive, defensive, imitative, dependent, traditional and opportunistic (FREEMAN, 1974); defensive, prospective, analytical and reactive (MILLES and SNOW, 1978). Based on these generic types of business strategy, Van Bommel (2011) and Barbieri (2011) classified the sustainability strategy approach as “resign”, defensive and offensive. In comparson, the corporate sustainability strategy, according to Orsatto (2006), may be based on resource productivity, legal compliance, environmental cost leadership, or on eco-oriented products.

One possible cause of adopting different strategies, as reported in recent studies (Van Bommell 2011, Barbieri, 2011), is the power of innovation, which is defined by the features of innovation and sustainable activities. Thus, based on the theoretical constructs proposed by Van Bommel (2011) and Barbieri (2011), the underlying hypothesis in the present study is that the power of innovation is associated with the implementation of a sustainability strategy by companies in the mining industry.

For responding to the survey, companies in the mining industry have been selected. This industry was defined as the object of the study because the mining activity is characterized by high environmental and social impact. The extraction of non-renewable mineral resources causes a series of changes in flora and fauna, as well as significant environmental and social changes in the community. Mineral resources are essential to everyday life, and they comprise a basic industry for the processing of raw materials and goods used by society in general. It must be emphasized that studies of this nature in companies in a sector with high economic significance are still incipient in industries.

The study undertaken is relevant, especially in that few empirical studies have analyzed the relationship between the power of innovation (characteristics of innovation and environmental activity) and sustainability strategy, as proposed theoretically by some scholars. Based on this argument, this study suggests that the power of innovation may be associated with the sustainability strategy, whereby companies with the greatest potential for innovation have proactive strategic positioning with regard to sustainability.

This study is structured in four sections, in addition to this introduction. Section one corresponds to the bibliographic references and section two covers the methodological procedures of the study. Subsequently, the analysis and discussion of results and the final remarks of the study are presented.

The power of innovation and the choice of a sustainability strategy

Companies increasingly need to offer new solutions to their customers so that they can be ahead of their competitors. It is by implementing innovations that companies manage to create new consumer expectations and gain competitive advantage against other competitors (FLORIANI, BEUREN and HEIN, 2010).

In this context, Magalhães (2007, p. 42) defines innovation as "any evolutionary or disruptive change in any of the competitive dimensions, whose objective is to extend the life of organizations" [our translation]. There are other definitions of innovation based on different perspectives (economic, difusionist, and scientific, among others), proposed by several scholars (SHUMPETER, 1939; ROGERS and SHOEMAKER, 1982).

There is a wide range of studies (OCDE, 2005; BARBIERI and ÁLVARES, 2003; VILA and KUSTER, 2007) on the types of innovations that can occur in companies: radical, incremental, product-oriented, process- oriented technological, organizational and market- oriented.

Several authors (BARBIERI et al., 2009; MAÇANEIRO and CUNHA, 2010) have discussed a type of innovation management that takes sustainability into account. The implementation of innovations in organizational processes poses one of the major management challenges nowadays, as a result of pressure in the competitive environment (regulations) as regards sustainability (COSTA, SANTOS and OLIVEIRA, 2011).

It should be noted that corporate sustainability consists of three components: environment, society and economic performance. This view corresponds to the idea of triple bottom line, a concept developed by Elkington (2004) which considers the economic, environmental and social objectives from the microeconomic point of view.

Brito and Lombardi (2007) argue that sustainability issue is being widely discussed nowadays. However, according to the authors, for this discussion to be meaningful, organizations and society have to be sensitive to the fact that the environment is finite and its misuse will lead to a global collapse.

Thus, it can be observed that innovation and sustainability are critical in the competitive corporate environment. The integration of these concepts is fundamental to the creation of new products and processes with a view to minimizing impacts on the environment, ensuring environmental preservation for future generations.

There are studies that suggest that some features may highlight the power of innovation while the sustainability strategy is implemented. Van Bommell (2011) suggests the following characteristics: external orientation and transparency in processes of innovation, cooperation between departments; knowledge about the business environment and adaptation of this knowledge to the reality of the company; leadership in introducing new products and new processes in the market; autonomy and market leadership in innovative initiatives, and orientation to innovation results.

Besides the features of innovation activities, another variable that probably influences the choice of an environmental strategy is the set of characteristics of environmental activities. The choice of each activity can determine the type of business strategy. The situations in which a company operates in isolation, incorporating social and environmental aspects in order to reduce costs and environmental impacts in the production process caused by external pressure (public policies and legislation) may influence the adoption of a defensive strategy towards sustainability. In contrast, sustainable activities that help companies to reduce environmental impacts in the production process and engage stakeholders, thus trying to go beyond compliance with the law, may influence the adoption of an offensive strategy towards sustainability.

Given the importance of the mining industry to the world economy, the search for technologies for the improvement and rational use of processes makes companies aim at lesser environmental impact, either by means of waste reduction or reuse of processes, generating business opportunities that go beyond business skills.

Sustainable innovation in the mineral sector

In the 1970s, the mining activity was considered one of the strategic sectors of the economy from the perspective of the government, and it has been growing significantly ever since. This stems from the fact that the activity of mineral extraction can only occur at the place of occurrence and nature is finite and non-renewable. It is noteworthy that the location where this activity is developed will inevitably be closed and abandoned after being exhausted economically with its full exploitation (TEIXEIRA, STRAUCH AND FERNANDES,2010).

It is known that in any material or product marketed worldwide there is a percentage of components obtained from the extraction of minerals. These products contain minerals in their composition or are generated from ore, indicating the importance of mining in the life of the planet (IBRAM, 2011).

The search for technologies for the improvement and rational use of processes makes companies aim at lesser environmental impact, either by means of waste reduction or reuse of processes, generating business opportunities that go beyond business skills. Barbieri et al. (2009) argue that innovation is critical to the sustainability of businesses in the ecological, social, economic, cultural or spatial dimensions.

The incorporation of environmental aspects to the implementation of innovation in processes poses a major challenge to organizations when responding to the pressures that arise in the competitive environment during the discussion on sustainability and environmental, social and economic limitations. Historically, theories of strategy ignore the restrictions imposed by the natural (biophysical) environment, and emphasize the definition of the external environment for the political, economic, social and technological dimensions (COSTA, SANTOS and OLIVEIRA, 2011).

The choices of technologies for products are implemented at two levels: the first is aimed at competition in the industry, and the second level is focused on sustainability principles (GAJDZIK AND BURCHART-KOROL, 2009). Corroborating this thought, Hinrichs and Kleinbach (2003) argue that environmental issues have been central to current discussions on energy policy, which seek more sustainable energy technologies or the improvement of industrial environmental performance.

Thus, innovation and sustainability can be seen as crucial for the competitive business environment. The integration of these concepts is essential for creating new products and new processes with a view to minimizing impacts on the environment, ensuring environmental preservation for future generations. Although the mining industry seem unsustainable, mining activities are developed with a focus on the principles of sustainability. However, for this to occur, the investments must be profitable, environmentally sound and socially responsible, based on the triple bottom line.

Nevertheless, the importance of the mineral sector to the world economy is known. Therefore, the search for

technologies for the improvement and rational use of processes makes companies aim at lesser environmental impact, either by means of waste reduction or reuse of processes, generating business opportunities that go beyond business skills.

In this context, this study should help generate information on the impact generated by mineral production activity, seeking to identify how entrepreneurial posture is committed to reducing the environmental impact.

Another objective is to verify how the mining companies implement sustainability strategies resulting from the characteristics of innovation and environmental activities, i.e., how they seek to develop technologies that incorporate the concept of sustainability.

Choosing the Sustainability strategy

As discussed in previous sections, a great deal of pressure in the institutional and organizational environments have required the companies to establish a strategy process for sustainability. Organizations can include the issue of innovation and sustainability in corporate strategy, or use several strategies at the same time.

For Porter (1986, p. 68) "strategy is the creation of a unique and valuable position, involving a different set of activities". Parnell (2010) adds that each company has its own strategy and, thus, it is possible to identify groups of companies that perform similar generic strategies.

The current business context has been influencing companies to structure themselves and adapt the formulation of strategies to obtain competitive advantage in response to the needs of the environment. The choice of the best strategy for the company will provide improved practices of corporate environmental management, reducing the impacts caused by industrial activity.

Orsatto (2006) presented the types of environmental strategies that companies can adopt to optimize return on environmental investments. The industry in which the company operates, its positioning, market types and its competencies will determine the most appropriate competitive focus (organizational processes or products) and the potential source of competitive advantage (cost and differentiation) adopted by organizations.

With specific regard to the relationship between innovation in the supply chain and the choice of a sustainability strategy, Van Bommel (2011) identified three resulting types: resign, defensive and offensive. The resign strategy occurs when the process of implementing sustainability in the supply chain is not started, whereas the defensive strategy prioritizes the establishment of environmental requirements along the chain. Finally, the offensive strategy seeks to cooperate in the supply chain in order to innovate in a sustainability-oriented manner.

Corroborating this thought, Barbieri (2011) points out that the defensive and offensive approaches are ambivalent, i.e., the same company can adopt a offensive approach to a product line and a defensive approach to other lines and to support inputs. According to Barbieri (2011), both the defensive and the offensive approaches lead to a series of activities associated with the product which result in groundbreaking findings in the supply chain, for example: environmental quality awards associated with specific aspects of sustainability such as fair trade, sustainable management of natural resources, absence of child labor, among others, are applicable at the inter-and intra-organizational levels and may, in some cases, reach the entire supply chain. The defensive strategy, on the one hand, is underpinned by vendor evaluation. On the other hand, the offensive strategy is associated with the development of suppliers and the cooperation with the focus company for developing new sustainable products and services. The positive impact of activities can be assessed for their contribution to reducing negative environmental impact or generating sustainable value to the supply chain and society. According to the author, the resigned strategy, in turn, ceases activities.

The theoretical model proposed by Van Bommel (2011) states that the ability to develop a sustainability strategy is influenced by the company's power of innovation. The author also suggests that the relationship between the power of innovation and sustainability strategy should be tested empirically.

Thus, the method proposed by Van Bonmel (2011) is the basis of the hypothesis that will be investigated this study:

H1: The power of innovation is associated with the implementation of a corporate sustainability strategy.

In the following section, we present the methodological choices for the development of the study.

Method of the study

The objective is this study is to investigate the relationship of the power of innovation while implementing the strategy for the sustainability of companies in the mining sector.

The study has a quantitative approach and it was conducted through a survey by administering a structured questionnaire in industrial companies in the sector. According to Beuren (2003, p. 93), "This procedure is not as in-depth in the pursuit of knowledge of the reality of the phenomena, since it is concerned with the general behavior of the events". Hair Jr. et al. (2005, p. 100) add that it "provides brief information about various features, and it is useful for mapping trends".

The conceptual research model was designed taking into account the concepts and information obtained in the theoretical framework, based on the studies of Van Bonmell (2011), Barbieri (2011) and Orsatto (2006), as well considering the variables shown in Figure 1.

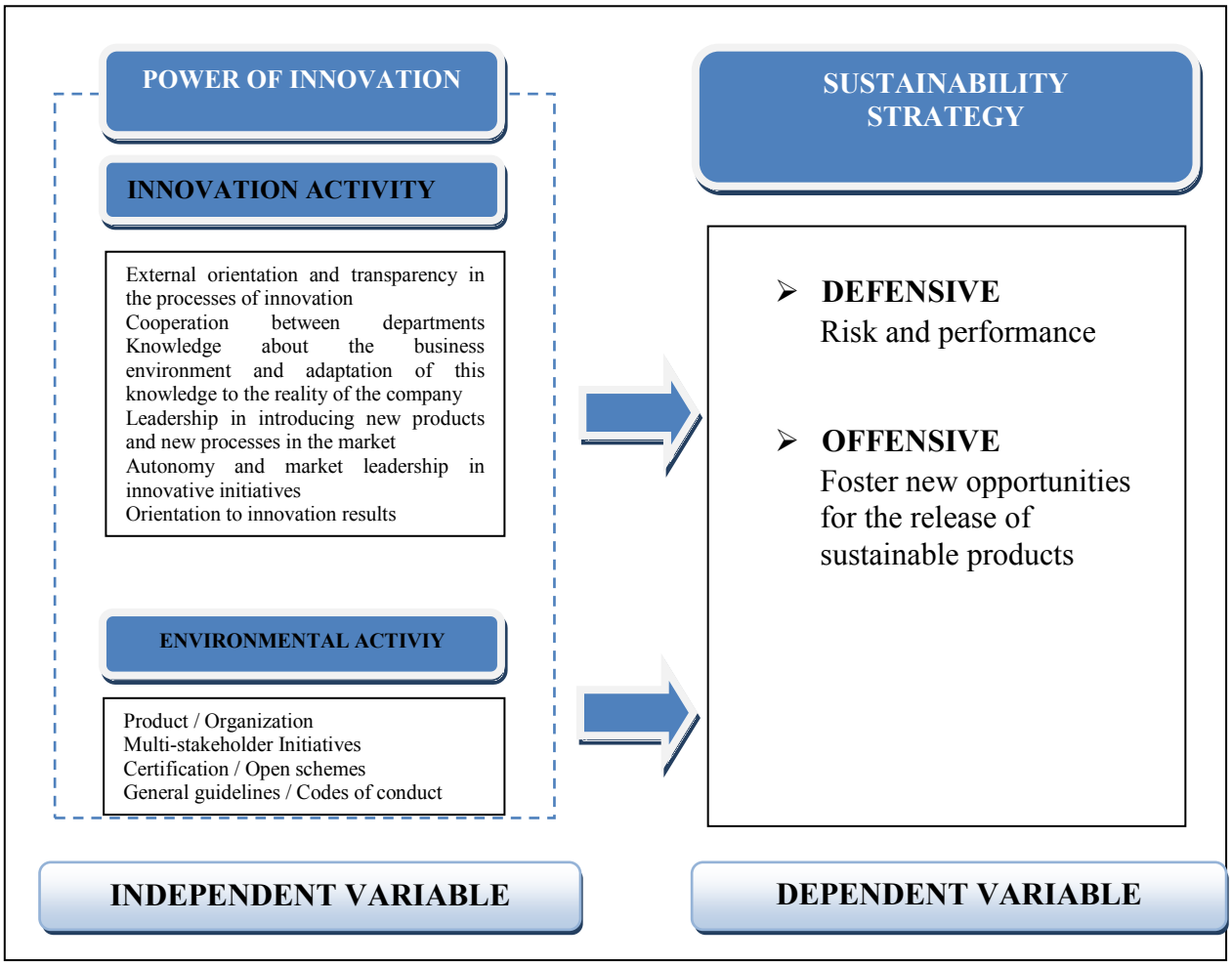

Figure 1: Conceptual research model

The central hypothesis of the study is based on the understanding that the choice of strategy (y) may be influenced by the characteristics of innovation (xi) (external orientation and transparency in the processes of innovation, leadership in the introduction of new products), and sustainable activities (xii) (code of conduct, certifications, etc.).

For the purpose of conducting the research, the independent variables were defined as characteristics of innovation and characteristics of environmental activities, and the dependent variable was categorized as sustainability strategy. The description of the main dimensions of analysis and evaluation indicators of the variables is shown in Figure 2.

Type	*Block*	*Variable*	*Description*	*Measurement*
Independent POWER OF INNOVATION	***Characteristics of Innovation***	**External orientation and transparency in the processes of innovation**	- The company is focused on differentiation and competition against other organizations.	Continuous range from 0 to 1, where: 0 = lowest degree of agreement 1 = highest degree of agreement
		Cooperation between departaments	- The company provides synergy and provides opportunities for good work performance between departments.	
		Knowledge of the business environment and adapting this knowledge to the reality of the company	- The company seeks to understand the competitive environment of organizations and adapt to the reality of each company.	
		Leadership in introducing new products and new processes in the market	- The company develops new products, which is the major competitive goal pursued by companies in search of new markets.	
		Autonomy and market leadership in innovative initiatives	- The company seeks to be on the lookout for new technologies, the first to create new products or improve the process.	
		Orientation to innovation results	- The company seeks to gain profit or achieve some kind of result, with a focus on innovation.	
	Environmental Activities	**Product/ Organization**	- Sustainable development as a priority in the design, operation and closure of mining operations. - Global and periodic evaluation of the direct and indirect environmental impacts of business activities on ecosystems and the community from exploring the project to closing mines.	Continuous range from 0 to 1, where: 0 = lowest degree of importance 1 = highest degree of importance
		Multi-stakeholder initiatives	- Incentives to stakeholders (customers, suppliers, employees, community, etc.) for the adoption of practices and based on sustainability principles. -Disclosure to stakeholders (customers, suppliers, employees, community, etc.) of its economic, social and environmental performance and its contribution to sustainable development.	
		Certification/ Open schemes	- Environmental management system in order to evaluate, prevent or mitigate adverse environmental impacts. - Environmental Certifications such as ISO 8000 /SA 14001.	
		General guidelines/Codes of conduct	- Policies and ethical business practices. - Introduction of the principles of sustainable development into company's policies and practices.	
Dependent	**Strategy**	**Defensive**	- Acting in isolation while defining strategies that incorporate social and environmental aspects of the production process. - Reduction of costs and environmental impacts in process product from external pressures.	Continuous range from 0 to 1, where:0 = lowest degree of importance 1 = highest degree of importance
		Offensive	- Incorporation of social and environmental aspects in the production process involving stakeholders. - Reduction of environmental impacts in the production process, seeking to go beyond compliance with the law.	

Figure 2: Main analysis dimensions and evaluation indicators for the variables

The respondents were industrial companies in the mining sector associated with IBRAM1 (290 companies). The choice of this population as an object of research was due to the representativeness of the sector in the Brazilian economy. There are several challenges with regard to innovation and sustainability for the sector, given its extractive nature and the use of non-renewable resources.

The instrument for data collection was developed based on the conceptual research model, and it was validated by experts in the field. The questionnaires were forwarded by email to staff responsible for the area of innovation

[1] IBRAM stands for *Instituto Brasileiro de Mineração* (Brazilian Mining Institute).

and sustainability in the companies.

Quantitative data were tabulated and analyzed based on the application of univariate analysis techniques with the aid of the software programs Microsoft Excel and Statistical Package for Social Sciences (SPSS). A totoal of 51 questionnaires were responded, representing 20% of the surveyed population, an appropriate return rate for analysis, according to experts.

One limiting factor of this study is the number of companies that agreed to answer the questionnaire, which caused the sample to be not as representative compared to the population surveyed. Thus, it is not possible to generalize the findings withinh the industries of the sector. The conclusions reported in this study refer only to the sampled companies. Another limitation refers to the size of the companies surveyed: most of which are small and midsize. A greater participation of larger companies could have brought other important elements for analysis.

Analysis and discussion of results

The characterization of the companies that participated in the survey is summarized in Figure 3.

Organizational Characteristics	
Founding date	37 years ago
Main products	Mineral aggregates, mineral coal, limestone and iron
Number of employees	Between 100 and 499 employees (midsize company)
Gross operating revenue	Above BRL2.4 million BRL 90 million (small and midsize company)
Introduction of innovation	Product-based and process-based
Responsability of innovation in the company	The company is the sole responsible for the innovation activity

Figure 3: Characteristics of companies

According to the data shown in Figure 1, it can be seen that the companies have been in the market for more than three decades, on average, which shows a high degree of maturity. They produce mineral aggregates, coal, limestone and iron, and they are midsize and small companies. Product and process innovation is the technological behavior of most companies. The observed results show that most surveyed companies are responsible for their innovation activities. This fact can be explained by the nature of the mining activity, whose gross product has little value.

The analysis of the power of innovation is based on the characteristics of the innovation activity and the environmental activity. The Table 01, shows data on the characteristics of the innovation activity.

Table 01: Characteristics of the innovation activity.

Innovative actions	Mean	Standard deviation	CV
External orientation and transparency in the processes of innovation.	0.5922	0.37462	63.25
Cooperation between departments	0.6686	0.35972	53.80
Knowledge of the business environment and adaptation of this knowledge to the reality of the company.	0.7020	0.35693	50.84
Leadership in introducing new products and new processes in the market.	0.4431	0.40411	91.20
Market autonomy and market leadership in innovative initiatives.	0.4451	0.39208	11.08
Orientation to innovation results	0.4882	0.39731	81.38
Overall mean	0.5565		
N = 51			

Knowledge of the business environment and adaptation of this knowledge to the reality of the company are the main aspects that characterize the activity of the companies. The companies also considered as significant cooperation between departments and external orientation and transparency in the processes of innovation. The results lead to the understanding that the main concerns of the company are the pursuit of business competitiveness, the synergy between departments, and differentiation.

Leadership in introducing new products and new processes and market autonomy and market leadership in innovative initiatives were aspects evaluated as less relevant by the companies. This finding can be understood due to the type of product sold (raw form).

One of the main aspects that influence the choice of a sustainability strategy is the environmental activity. The choice of each of the environmental actions will influence the strategic profile as regards sustainability: either defensive or offensive.

The survey results show that policies and ethical business practices is the main environmental action identified by companies, followed by an environmental management system to assess, prevent or mitigate adverse environmental impacts. In contrast, environmental certifications (ISO 14001/SA 8000) were considered to be an activity of minor importance.

Table 02: Characterization of the environmental activity

Environmental Activies	Mean	Standard deviation	CV
Sustainable development as a priority in the design, operation and closure of the mine operations.	0.7196	0.33587	46.67
Comprehensive and regular assessment of the direct and indirect environmental impacts of business activities on ecosystems and community from the project exploration to mine closure.	0.8020	0.30099	37.52
Incentives to stakeholders (customers, suppliers, employees, community, etc.) for the adoption of practices and principles based on sustainability.	0.7392	0.30403	41.12
Outreach to stakeholders (customers, suppliers, employees, community, etc.) Of its economic, social and environmental performance, and their contribution to sustainable development.	0.5963	0.34930	58.57
Environmental management system in order to assess, prevent or mitigate adverse environmental impacts.	0.8451	0.21662	25.63
Environmental certifications such as ISO 8000 14001/SA.	0.4608	0.46565	101
Policies and ethical business practices.	0.8941	0.21671	24.23
Integrating the principles of sustainable development into their policies and practices.	0.7784	0.25947	33.33
Overall mean	0.7294		
N = 51			

Based on the results of Table 02, it can be observed that the numerous pressures on organizational and institutional environments have been demanding the establishment of a process of strategy formulation seeking to include environmental practices and sustainability principles. Given the above, it is observed that the business context has influenced companies to structure and adapt regarding the process of strategy formulation, in order to obtain competitive advantage in response to the needs of the environment. Thus, the power of innovation (characteristics of innovation activity and environmental activity) are aspects that influence the choice of a sustainability strategy.

Based on the analyses, it can be concluded that companies seek to include the concepts of innovation and sustainability in their corporate strategy. The integration of these concepts is important for the creation of new products and processes in order to minimize impacts and ensure environmental preservation for future generations. The choice of the best strategy provides improved management practices for sustainable corporate innovation, reducing the impacts caused by industrial activity.

While implementing a strategy for the sustainability of companies, there are countless internal and external pressures. The definition of the type of strategy seems to be associated with a process of innovation management combined with sustainability. The data relating to definition of business strategy are shown in Table 03.

Table 03: Corporate Strategy

Characterization of the strategy used in relation to corporate sustainability.	Mean	Standard deviation	CV
Acting in isolation when defining strategies that incorporate social and environmental aspects in the production process	0.5784	0.33185	57.37
Reduction of costs and environmental impacts in the production process based on external pressures (legislation, public policies)	0.7039	0.28281	40.17
Incorporation of social and environmental aspects in the production process involving its stakeholders	0.7686	0.28460	37.02
Reduction of environmental impacts in the production process, seeking to go beyond compliance with environmental legislation.	0.8314	0.20542	24.70
Overall mean	0.7206		
N = 51			

The research results show that the variables with higher averages refer to the reduction of environmental impacts in the production process, seeking to go beyond compliance with environmental legislation, as well as to the incorporation of social and environmental aspects in the production process involving stakeholders, which leads to the understanding that the analyzed companies predominantly adopt an offensive strategy towards sustainability. In contrast, reduction of costs and environmental impacts in the production process based on external pressures (legislation, public policies) and acting in isolation when defining strategies that incorporate social and environmental aspects in the production process were considered to be of minor importance by companies, featuring, once again, the adoption of a defensive strategy towards sustainability.

Final Considerations

This research aimed to analyze the relationship between power of innovation and the implementation of the sustainability strategy of companies in the mining industry.

In order to achieve the objective of the study used the descriptive analysis. It was concluded that companies that have high power of innovation, defined by the characteristics of innovation and environmental activities, have an offensive strategic approach to sustainability, investing proactively in environmental aspects and in the introduction of technology in their products and processes. The adoption of such a stance is due to the fact that companies envision sustainability as a source of gaining competitive advantage with its introduction strategy.

With the data obtained , it was verified that the pressures in enterprise environments generally have required companies to establish a strategy process for sustainability. Sustainable activities are one of the variables that influence the environmental strategy choice. It can be seen in the data analysis that companies have an offensive stance on the type of strategy implemented.

Given this above, the current business context has influenced companies to structure and adapt the formulation of strategies to obtain competitive advantage in response to environmental needs. The choice of the best strategy for the company will provide improvement of corporate environmental management practices , reducing the impacts of industrial activity.

The integration of the concepts of innovation and sustainability is crucial in the competitive business environment, making it relevant to the creation of new products and processes with a view to minimizing impacts on the environment and ensuring environmental preservation for future generations. All things considered, the current business context has been influencing companies to structure and adapt the formulation of strategies so as to obtain competitive advantage in response to the needs of the environment. The choice of the best strategy for the company will provide improved practices of corporate environmental management, reducing the impacts caused industrial activity.

From the data obtained, it was possible to support the proposed hypothesis that the power of innovation is associated with the implementation of a corporate sustainability strategy. Numerous pressures on organizational and institutional environments have required the companies to establish a process for formulating a sustainability strategy, seeking a more proactive stance towards environmental issues.

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