Green innovation and environmental and financial performance: trends and challenges for future research

Jaluza Maria Lima Silva Borsatto*

FAGEN/UFU School of Management and Business
of the Federal University of Uberlandia,
Av. João Naves de Ávila, 2121. Room 1F216 – Campus Santa Mônica,
Uberlândia, MG, 38400-902, Brazil
Email: jaluza.silva@ufu.br
*Corresponding author

Camila Lima Bazani

Faculty of Accounting Sciences (FACIC) of the
Federal University of Uberlândia (UFU),
Av. João Naves de Ávila, 2121, Room 1J218 – Campus Santa Mônica,
Uberlândia-MG, 38400-902, Brazil
Email: camilabazani@ufu.br

Abstract: The relationship between green innovation (GI) and company performance has received increasing attention from researchers in recent years. In this way, the present study aims to present a synthesis of the most relevant academic research that relate Green Innovation and the company's financial and environmental performance, knowing in a standardised way the scientific information on the theme. Through an integrative literature review, 66 academic papers published in the journals of *Science Direct, Scopus, and Web of Science* databases, between 2012 and 2019, were analysed. The results showed that most studies were carried out in industries in developing countries. In addition, the results also demonstrated a positive relationship both between GI and financial performance (55%) and between GI and environmental performance (48%) in most of the studies analysed. These findings can contribute to the researchers for the formation of a solid conceptual based on the subject, guiding for future research.

Keywords: green innovation; financial performance; environmental performance; integrative literature review; environmental innovation; environmental regulations; eco-innovation.

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Biographical notes: Jaluza Maria Lima Silva Borsatto, PhD in Administration from the FEA-RP/USP School of Economics, Business Administration and Accounting at Ribeirao Preto, University of Sao Paulo. She is a Professor of FAGEN/UFU School of Management and Business of the Federal University of Uberlandia.

Camila Lima Bazani, Master in Accounting Sciences, Controllership Research Line, by the Faculty of Accounting Sciences (FACIC) of the Federal University of Uberlândia (UFU). She is Administrative Technician in Education at the Federal University of Uberlândia (UFU).

1 Introduction

According to Chen et al. (2006), green innovation (GI) refers to product and process innovations where technologies for energy saving, pollution prevention, waste recycling and environmental management are used. It has become increasingly important for companies to improve their environmental awareness through the production of products that do not harm the environment (Chiou et al., 2011). In addition, it has been recognised as one of the key factors for simultaneously improving the environmental, social and financial performance of companies (Dangelico and Pujari, 2010).

In the literature, the number of studies that address the relationship between Green Innovation and company performance has increased, but the results are still contradictory (Ar, 2012; Lin; Tan and Geng, 2013; Aguilera-Caracuel and Ortiz-De-Mandojana, 2013; Ghisetti and Rennings, 2014; Li, 2014; Przychodzen and Przychodzen, 2015; Antonioli et al., 2016; Huang and Li, 2017; Stucki, 2019; Rezende et al., 2019). However, it is questioned whether Green Innovation positively or negatively affects the environmental and financial performance of companies. These inconsistencies may be related to drivers for green innovation, the role of regulatory and market standards, methodology used, the international context, the sector explored among other factors.

In addition, this relationship between Green Innovation and company performance involves interests for academia, governments, corporations, non-governmental organisations (NGOs), and others because of the relevance of environmental issues in the global context. In this way, this paper investigates advances in the available literature.

Thus, the problem of this research emerges: How are Green Innovation and the Environmental and Financial Performance of companies related? To answer this question, the following general objective was established: To present a synthesis of the most relevant academic research to know how Green Innovation and the Environmental and Financial Performance of companies are related.

This relationship will be investigated based on an integrative literature review from the following specifics objectives:

1 identify the most relevant papers that address the theme green innovation and environmental and financial performance

2 classify and codify the characteristics of these papers

3 organise a summary of the contributions of each paper

4 provide a research agenda addressing the main knowledge gaps on the topic.

The realisation of this integrative review of the literature is justified because it is necessary to analyse, critique and synthesise existing literature in an integrated way so that new perspectives on the theme are generated (Torraco, 2005).

Although there are already works of this nature about green innovation, the originality of this study is the union of the variables green innovation and performance variable in its environmental and financial aspects. In addition, the topic can still be better investigated and there is still a need to update these studies and incorporate a research agenda for future works.

2 Literature review on green innovation and performance

In international literature, the terms eco innovation, green innovation, sustainable innovation, and environmental innovation are synonymous (Bernauer et al., 2006; De Marchi, 2012; Veugelers, 2012). Several authors have tried to define the term Green Innovation. De Marchi (2012), based on seminal papers by Rennings (2000), Kemp et al. (2001) and Arundel et al. (2005), defined ecological innovations as applications in processes, techniques, practices, systems and new or modified products to avoid or reduce environmental damage. For Chen et al. (2006), Green Innovation is product and process innovations where technologies for energy saving, pollution prevention, waste recycling and environmental management are used and have been used efficiently to promote sustainability and meet the requirements of environmental protection. For Halila and Rundquist (2011), the term eco-innovation or sustainable innovation is used to identify innovations that contribute to a sustainable environment through ecological improvements.

In addition to the environmental benefits of Green Innovation, it also helps improve the quality of human life and can be very profitable for the company. According to Carrion-Flores, and Innes (2010), innovation can generate growth and competitive capacity, and increase productivity and economic wealth for companies. In addition, it can reduce waste and environmental damage to the planet, provide better goods and services at a cheaper price and create jobs for people.

The relationship between Green Innovation and company performance has been researched by several authors (Ar, 2012; Li, 2014; Lee and Min, 2015; Severo et al., 2017; Rezende et al., 2019; Zhang et al., 2019). According to Porter and Van der Linde (1995), green product innovation encourages the efficient use of raw materials, resulting in lower costs for raw materials and may lead companies to find new ways of converting waste into saleable products that provide additional revenue, thus resulting in better performance.

In the field of business, measuring performance is one of the most important issues for companies, and this study will address two types of performance and their relationship to Green Innovation: environmental performance and financial performance. According to Claver et al. (2007), environmental performance can be defined as the environmental impact of a company's activities on natural environments. Financial performance on the other hand, according to Venkatraman and Ramanujam (1987), can be classified into two distinct areas: growth (measured by indicators that provide the evolution of certain factors in a given period of time); and profitability (measured by net income).

In green innovation studies, a company's performance can be measured financially and non-financially. From the financial point of view, companies can cover their environmental costs by increasing resource productivity through green innovation. In addition, companies can develop new markets and increase their market share through environmental practices. From the non-financial point of view, performance can be measured by increased customer loyalty, obtaining new customers, improving the company's image, and reputation.

In addition, the factors that drive the adoption of green innovation in companies can also generate different impacts on companies' financial and environmental performance. Rennings and Rammer (2011) found that depending on the type of environmental regulations imposed by governments, the impact on companies' financial and environmental performance can be positive or negative.

In this paper we can see how the integration of these themes is being studied and whether scholars are linking the development and implementation of green innovation to an improvement in the environmental and financial performance of companies.

Table 1 presents a summary of the main studies on Green Innovation and Performance considered in the research.

Table 1 Description of the objectives and results of each study analysed

Author	*Abstract*
Ar (2012)	Verified that green innovation significantly and positively affects both the company's performance and its competitive capacity; and that environmental management concern moderates this relationship
Albino et al. (2012)	Demonstrated that inter-organisational collaborations with internal actors (suppliers and clients) and external actors (government agencies and NGOs) are beneficial to a company's overall environmental performance, to the management of its environmental footprint, and to its environmental reputation
Doran and Ryan (2012)	They found that there is no trade-off between eco-innovation and higher profit margins for innovative companies and suggest that regulators and policymakers can stimulate growth and create a greener society
Zhu et al. (2012)	The study demonstrated that different ways of adopting Green Supply Chain Management (GSCM) practices can cause improvements in the performance of companies in both environmental and economic dimensions, contributing to the theoretical advancement and diffusion of innovation theory
Aguilera Caracuel et al. (2013)	The authors verified that green innovative companies are situated in contexts characterised by stricter environmental standards and higher regulatory standards. In addition, the results showed that the intensity of green innovation is positively related to the profitability of the company
Sezen and Çankaya (2013)	The authors have identified that investments in green production have a positive impact on environmental performance and social performance. However, green product innovation does not have a significant effect on any of the three types of performance
Lin et al. (2013)	The empirical study showed that market demand is positively correlated for both green product innovation and company performance

Table 1 Description of the objectives and results of each study analysed (continued)

Author	*Abstract*
Wu (2013)	Explored the relationship between the green supply chain and green innovation (GSCI) and showed that suppliers, customers and internal integration have improved green product and processes innovations. The author also suggests that managers must constantly keep up with demand trends in the market and maintain tight technology networks among supply chain partners
Wong (2013)	The results indicated that knowledge sharing is a mediating factor in the relationship between green requirements and green product and process innovation. In addition, the study confirmed that there is a direct and positive association between the determinants of green innovation and knowledge sharing
Tessitore et al. (2013)	The research aimed to investigate the presence of a correlation between eco-innovation and competitiveness within the districts. The results showed that in only a few cases is there a link between ecological innovation and economic performance
Dragomir (2013)	The results did not present any definitive conclusions about the relationship between environmental and financial performance Responsible managers appear to make a negligible contribution to the true performance of sustainability as well as to the economic well being of the company
Leenders and Chandra (2013)	The results suggest that internal drivers, environmental management and quality management, play a greater role than external drivers (government and regulatory pressures) on the adoption of green innovation strategies. In addition, the use of organic products and processes and recycling activities has a direct positive impact on business performance
Marchi et al. (2013)	Empirical evidence suggests that companies develop green strategies to reduce environmental impacts by achieving economic benefits and competitiveness, which may be internal to the company, but also apply to value chains with different implications in terms of bargaining power and ownership of value
Ghisetti and Rennings (2014)	The results showed that both types of Green Innovation and the direction of their adoptions affect the relationship between competitiveness and environmental performance. Innovations drive the reduction of energy and material use per unit of output and positively affect business competitiveness. If we look at innovations leading to a reduction in the use of energy and resources, we can conclude that it definitely pays to be green
Li (2014)	The author verified that institutional pressures make them an instrument of command and control of government; and market pressures and competitive pressures have a significant positive impact on green innovation practices. The results also showed that green innovation practices have a significant positive effect on companies' environmental performance, while the effect on financial performance is mediated by environmental performance
Amores-Salvadó et al. (2014)	Empirical results have shown that the green corporate image positively moderates the relationship between environmental product innovation and company performance. These results seem to indicate that companies' environmental innovation efforts only pay when they are properly promoted

Table 1 Description of the objectives and results of each study analysed (continued)

Author	*Abstract*
Cheng et al. (2014)	Business performance is directly and indirectly affected by organisational eco-innovation, ecological process and green product innovations
Cai and Zhou (2014)	The study revealed that eco-innovation is triggered by a mix of internal and external controllers. However, in China, the external pressures of environmental regulations, green demands of customers, and competitors partially affect eco-innovation through internal drivers
Lin et al. (2014)	Political capital has a negative influence on the performance of green product and process innovation. Both regulations and suppliers positively promote innovations in products and processes. Consumers also have a positive relationship with green product innovation but negatively related to process innovation
Chen (2014)	The results showed that there is a positive relationship between green innovation operations and environmental performance
Ganapathy et al. (2014)	The results suggest that the role of management practice is more significant for eco-innovation than innovative practices. In addition, practitioners should seek to increase the rate of innovation by focusing on social aspects
Woo et al. (2014)	Empirical results have shown that green innovation for both company and customer benefit has a positive effect on labour productivity. This finding means that companies need to implement green innovation for the company as well as green customer-oriented innovation in order to increase their performance
Huang and Yang (2014)	The results indicate that the innovation of Reverse Logistics (RL) is positively associated with environmental and economic performance. In addition, three institutional pressures positively moderate the relationship between RL innovation and environmental performance
Albertini (2014)	The results showed that environmental innovations are presented as a means of increasing energy efficiency and gaining a competitive advantage in the green products market. However, the results show that the economic situation significantly influences how environmental issues are addressed
Hami et al. (2015)	The authors analysed the effect of sustainable manufacturing practice (SMP) on economic sustainability (ES) and the moderating effect of SMP in ES through innovation performance (IP). In general, the results have empirically proven the role of SMP and IP in influencing economic performance
Ai et al. (2015)	The results indicate that environmental performance in different regions of China has improved, but the rate of improvement is very different. This can be attributed to the heterogeneous characteristics and changes in the level of green technological innovation in different regions
Gabler and Rapp (2015)	The results suggested that a company that is environmentally oriented and innovative is more likely to develop an eco-capacity. In addition, the authors demonstrate that eco-capacity is positively related to two strategic results – market and financial performance, as well as the perceived quality of the company's offer

Table 1 Description of the objectives and results of each study analysed (continued)

Author	*Abstract*
Weng et al. (2015)	The research found that the pressure from competitors and government along with employee conduct had positive effects on green innovation practices. In addition, a moderating effect of the innovation orientation existed only on the relationship between green product innovation practices and employee conduct
Przychodzen and Przychodzen (2015)	The results indicated that eco-innovative companies are generally characterised by higher returns on assets and equity, and lower retention of profits. In addition, companies that introduce eco-innovation are significantly larger and more likely to face less exposure to financial risk and are more likely to have higher free cash flow than conventional companies
Rassier and Earnhart (2015)	The authors jointly evaluated the effects of environmental regulation (clean water) on two different aspects of profitability: return on sales (ROS) and expected profitability (Tobin's Q). The empirical results indicate that tighter regulation of clean water generates higher returns on sales to chemical companies. In contrast, this tighter water regulation reduces Tobin's q for chemical companies
Rubashkina et al. (2015)	Investigates the impact of environmental regulation on the economic performance of industries in European countries, analysing the strong and weak versions of Porter's hypotheses (PH). The authors found evidence of a positive impact of environmental regulation on exit from innovation activity as a proxy for patents, thus providing support in favour of the 'weak' PH
Lee; Min (2015)	The results show the presence of a negative relationship between green research and development and carbon emissions, while green research and development is positively related to financial performance at company level
Xia et al. (2015)	The results of the study showed significant relationships between green technology selection and certain task and macro oriented circumstances, which may facilitate appropriate action by companies regarding green practices. Based on the results, the authors presented some management implications and knowledge that may be useful for adopting green technologies and improving environmental and overall performance
Küçükoğlu and Pinar (2015)	The results of this study state that green innovation activities have a significant effect on the environmental performance and competitive advantage of a company. Especially, green process innovation explains changes in environmental performance and competitive advantage
Chen et al. (2015)	The results indicated that most environmental management practices (EMPs) do not have a positive correlation with financial performance, that is, employing EMPs does not necessarily improve the economic consequence of companies. However, a number of EMPs have a strong correlation with improving innovation performance across a number of companies. It is also interesting to note that there is a negative correlation between the environmental standard for suppliers and sales growth

Table 1 Description of the objectives and results of each study analysed (continued)

Author	*Abstract*
Jabour et al. (2015a)	The model proposed by the authors obtained with the goodness of the statistical adjustments (Goodness of Fit – GoF) indicated that the technological factors are demonstrated and have an influence on the adoption of environmental management practices, and these practices are related to the Economic, Operational and Market Performance of the companies
Chan et al. (2015)	The results of the study show that the pressure of environmental regulation has a positive impact on green product innovation, which in turn influences the company's efficiency and profitability. The results of this research also show that the dynamism of the environment has a relatively strong moderating effect on the relationship between green product innovation and cost efficiency and marginally moderates the relationship between green product innovation and company profitability
Zailani et al. (2015)	The authors have shown that environmental regulations, market demand, and internal enterprise initiatives have a positive effect on green innovation initiatives (GII), while GIIs have a positive effect on the three categories of sustainable performance (i.e., environmental, social and economic)
Huang et al. (2015)	Modelling results have shown that regulatory pressure has a significant positive impact on development and plays a direct role in green innovation performance, customer pressure has a significant positive impact on research and development investments and collaboration networks
Jabour et al. (2015b)	The results of the study indicate that the green supply chain management practices (GSCM) practice of 'internal environmental management' has the greatest positive effect on environmental performance indicators, and that the GSCM practice of 'customer cooperation' has the greatest positive effect on operational performance indicators
Weina et al. (2016)	This paper studies the relationship between green technological change (measured as green patent actions) and CO_2 emissions and emission efficiency (CO_2/VA). The results suggest that green technology has not yet played a significant role in promoting environmental protection, although it has significantly improved environmental productivity
Chen et al. (2015)	The study found that green absorption capacity has positive effects on green dynamic capabilities, green service innovation and company performance. Secondly, this study points out that green dynamic capabilities have positive effects on green service innovation and company performance. Thirdly, this study notes that green dynamic capabilities and green service innovation intercede for the positive connection between green absorption capacity and company performance
Lumbanbatu and Arvanto (2015)	Statistical results have shown that green product innovation, green management practices and the green corporate image have a positive effect in sustaining firm competitive advantages that are taken to improve long-term marketing performance
Cosimato and Troisi (2015)	Respect for environmental standards is essential to achieve not only the reduction of ecological damage, but also for global economic profit

Table 1 Description of the objectives and results of each study analysed (continued)

Author	*Abstract*
Galia eta l. (2015)	The results of the research indicated that the investment in environmental innovation is largely influenced by factors internal to the company. In particular, size, performance, training, cooperation and openness are shown to have a significant impact on green innovation
Stanovcic eta l. (2015)	The results also confirmed that for both types of Knowledge Management (KM) practices, a culture intended to promote the KM primer has a more substantial impact on green innovation than a written KM policy. Additionally, practical implications can boost environmental innovation and improve the performance of the company's business
Antoniolli et al. (2016)	We tested whether EI adoptions significantly increased the economic performance of companies and found that the productivity performance of some companies is positively related to the adoption of EI
Hojnik and Ruzzier (2016)	The results reveal that certain determinants (that is, competitive pressure, customer demand, managerial environmental concern, command and control instrument and economic incentive instrument) are conducive to the implementation of process eco-innovation. In addition, the results also revealed that the ecological innovation process is worthwhile in terms of the company's profitability, growth and competitive benefits
Xie et al. (2015)	The results show that clean technologies and cutting-edge technologies are positively related to the financial performance of the industry, therefore, it is worth being 'green'
Cegarra-Navarro et al. (2016)	The results indicate that, while companies are using innovation results to support economic and social achievements, they are only taking advantage of economic achievements to achieve higher financial performance
Huang and Li (2017)	The results indicate that dynamic capacity, coordination capacity, and social reciprocity are important drivers of green innovation, including green product innovation and green process innovation. Green product and process innovation have positive effects on environmental performance and organisational performance
Severo et al. (2017)	The research highlights that both cleaner production and environmental management positively influence the achievement of sustainable product innovation. The surveyed companies that develop Sustainable Product Innovation Financial outperformed other companies
Miroshnychenko et al. (2017)	The results show that internal green practices are the main environmental factors of financial performance, while external green practices play a secondary role in determining financial performance. The adoption of ISO 14001 appears to have a negative impact on financial performance
Zhu et al. (2017)	Relationship and trust can be detrimental to green innovation to bring environmental performance. If companies intend to improve economic performance through ecological purchases, they must establish relationships and trust with customers
Arfi et al. (2018)	Investigate a sample of small and medium-sized enterprises (SMEs) in France and suggest that the risk attendant in knowledge transfer regarding green innovation can impose negative effects on firms' performance

Table 1 Description of the objectives and results of each study analysed (continued)

Author	*Abstract*
Cai and Li (2018)	The results reveal that the adoption of eco-innovation, we show that the behaviour of eco-innovation can significantly improve a company's environmental performance and, through environmental performance, has an indirect positive impact on its economic performance
Stucki (2019)	He finds that green investment in the firms has insignificant or even negative impacts on returns
Jiang et al. (2018)	The results shows that green entrepreneurial orientation plays a positive role in the green innovation-performance relationship
Saunila et al. (2018)	They find that green innovation is driven by economic and social pressures to pursue sustainable growth
Tariq et al. (2019)	The findings reveal that GPIP has a significant influence on a company's financial performance, that is, the higher the GPIP, the higher the company's profitability and the lower financial risk of the company
Del Rosario et al. (2019)	The results show a positive and significant link between a PSA and eco-innovation and performance; eco-innovation shows a positive and significant link with environmental performance, as well as a negative and significant link with organisational performance
de Azevedo Rezende et al. (2019)	These findings provide empirical evidence that the return to green innovations is conditional on time, but not on how international a multinational company is
Fernando et al. (2019)	The results suggest that eco-innovations unlock better sustainable performance; service innovation capability has a partially significant positive mediating effect; and service innovation capability ultimately benefits companies by allowing them to differentiate through an emphasis on value creation
Zhang et al. (2019)	The authors find a positive and significant relationship between green patenting and firm performance

3 Materials and methods

As the purpose of the paper is to present a synthesis of the most relevant academic research to know how Green Innovation and the Environmental and Financial Performance of companies are related, an integrative review of the literature was carried out. According to Torraco (2016), the integrative literature review is a distinctive form of research that generates new knowledge about the topic reviewed. It reviews, critiques, and synthesises representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated.

For Broome (2000), an integrative review is a specific review method that summarises past empirical or theoretical literature to provide a more comprehensive understanding of a particular phenomenon or healthcare problem. A well-done integrative review meets the same standards as primary research regarding clarity, rigor, and replication (Beyea and Nicoll, 1998).

As the integrative review is a type of research focused on a specific issue, in this paper, it is possible to verify how the integration of green innovation and performance

themes is being worked on, and whether scholars are linking the development and implementation of this innovation with the improvement in the environmental and financial performance of companies.

The bibliographic survey on the subject was developed based on secondary data, where the studies were identified using the following procedures:

1 Iterative search of scientific papers related to Green Innovation and performance, where the expressions 'Green innovation and Performance' and 'Eco-innovation and Performance' were used. The research was conducted in the Science Direct, Scopus and Web of Science databases, limited to the period from 2012 to 2019, which corresponds to a recent period where studies on Green Innovation have grown considerably.

2 Categorisation of the character and content of these studies presenting the general characteristics of the papers.

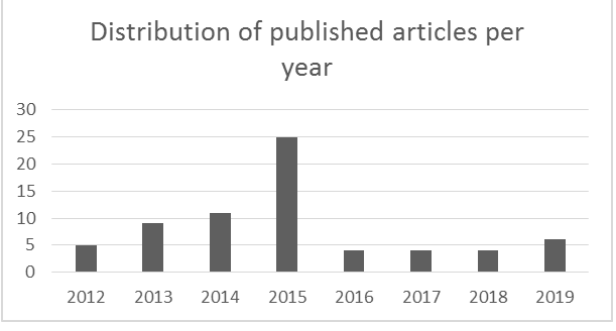
3 A qualitative analysis of the content of the papers obtained, identifying the main contributions of the studies in the interface between Green Innovation and performance, being the focus of this study.

To obtain the data, the papers were filtered using the keywords 'Green Innovation and Performance' and 'Eco-innovation and Performance', and the selection of the period from 2012 to 2019. As this is a broad field of study and because the research was carried out in three databases, we sought to delimit the analysed period. The choice of the words Green Innovation and Eco-innovation occurred because they are similar concepts used by academics when they refer to innovations that reduce negative impacts on the environment. Although the term Environmental innovation is relevant in studies that address this theme, the terms Green Innovation and Eco-innovation are the most used in scientific publications since 2005 (Schiederig et al., 2012).

Only papers were included in the selection, the searched keywords should be in titles and abstracts, and a possible relationship between the themes should be clear in the text. Following this step, 66 papers resulted.

In the survey it was verified that there are not many studies on the subject in relation to the total set of published papers, because although the papers contain the keywords researched, the studies did not fit the proposed objectives of this work. Despite this, it can be observed that in the year 2015 production on the theme had the largest number of papers in relation to the other years analysed (Figure 1).

Figure 1 Distribution of published papers per year



There was also a diversity of periodicals in which papers were published. The 66 papers selected were distributed in 33 different periodicals. Of these 66 papers 43 were published in periodicals with impact factor JCR greater than 3.000, and 13 papers with impact factor greater than 1.500, demonstrating the relevance of the research theme. The Impact Factor Journal Citation Reports) is one of the most legitimate indicators in the international scientific environment, published by Thomson Reuters and its purpose is to quantitatively assess the relevance of a given scientific journal in its respective area. The JCR of the year 2019 and papers from the business and management and engineering areas were used.

After collection and sorting of the main studies on the relationship between Green Innovation and company performance in the period 2012 to 2019, a classification structure was elaborated including 8 main themes numbered from 1 to 8, and each one of these numbers were encoded with letters of the alphabet. This classification involved the combination of numbers and letters, and some papers could receive more than one code for each item. This method was also used by Jabbour (2013) in a review of the literature on environmental training in organisations. Table 2 describes the structure and classification codes of the papers.

Table 2 Structure of classification and codification of the analysed studies

Classification	*Significance*	*Alternative codes*
1	Context	A – Developed Countries
		B – Emerging Countries
		C – Not Applicable
2	Focus	A – Green Innovation Only
		B – GI and Performance
3	Method	A – Quantitative
		B – Qualitative
		C – Conceptual
		D – Quantitative/Qualitative
		E – Survey
		F – Cases
4	Sector Analysed	A – Industry
		B – Services
		C – Not Applicable
5	Theory used	A – Institutional Theory
		B – Resource Based View (RBV)
		C – Natural Resource Based View (NRBV)
		D – Theory of Ecological Modernisation
		E – Theory of the Diffusion of Innovation
		F – Dynamic Capabilities
		G – Stakeholder Theories
		H – Porter Hypotheses
		I – Not Applicable

Table 2 Structure of classification and codification of the analysed studies (continued)

Classification	*Significance*	*Alternative codes*
6	Position of Green Innovation in the Analytical Model	A – Independent Variable
		B – Dependent Variable
		C – Mediator Variable
7	Relation GI and Financial Performance	A – Positive
		B – Negative
		C – Not Applicable
8	Relation GI and Environmental Performance	A – Positive
		B – Negative
		C – Not Applicable

Classification 1 identifies the national context analysed in the studies and was coded with an A-C scale, being 'A' – Developed Countries; 'B' – Developing and 'C' Countries – Does not apply, indicating studies that did not specify the country that was surveyed. Classification 2 refers to the focus of Green Innovation in studies, being coded on an A-D scale, being 'A' – Green Innovation Only; 'B' – Green Innovation and Performance; 'C' – Green Innovation and Regulations; 'D' – Green Innovation is not predominant in the analysis. Classification 3 is associated with the research method used, and was coded on an A-F scale, classified as: 'A' – Quantitative associated with category 'E' – Survey; 'B' – Qualitative associated with category 'F' – Case Study; 'C' – Conceptual; 'D' – combination of qualitative/quantitative methods. Classification 4 is related to the business sector analysed, being coded on an A-C scale, being 'A' – Focus on the industrial sector; 'B' – Focus on the service sector; 'C' – Not applicable, because the works of this category did not specify a specific sector studied. Classification 5 identifies the current theory underlying the study, it was coded on an A-H scale, being 'A' – Institutional Theory; 'B' – Resource Based View (VBR); 'C' – View Based on Natural Resources (VBRN); 'D' – Theory of Ecological Modernisation; 'E' – Theory of Innovation Diffusion; 'F' – Dynamic Capabilities; 'G' – Theory of Stakeholders; 'H' – Porter Hypotheses; 'I' – Not Applicable. Classification 6 is related to the position of Green Innovation as a variable in the study model. This classification is also coded on an A-C scale, being 'A' – Independent Variable, when it assumes that it influences other variables; 'B' – Dependent variable, when it is influenced by other variables; and 'C' – Variable Mediator, when it assumes an intermediate position in the relation between two variables. Classification 7 explores the relationship between Green Innovation and financial performance of companies, being coded on an A-C scale, where 'A' – Positive, when IV positively affects the financial performance of companies; 'B' – Negative when IV adversely affects financial performance; and 'C' – Not applicable, when no relationship was found between the variables. Classification 8 demonstrates the relationship between Green Innovation and environmental performance (A-C scale), where 'A' – Positive, when IV positively affects the environmental performance of companies; 'B' – Negative when IV adversely affects environmental performance; 'C' – Not applicable, when no relationship was found between the variables.

4 Results of the integrative literature review

Table 3 presents the codifications of each study reviewed in this work.

Table 3 Classification and codification of the analysed studies

Authors	*Country*	*National context*	*Focus*	*Method*	*Sector*	*Theory*	*Position GI in the model*	*Relation GI and financial performance*	*Relation GI and environmental performance*
Ar (2012)	Turkey	1B	2B	3A, 3E	4A	5I	6A	7A	8C
Albino et al. (2012)	USA	1A	2B	3A	4C	5B	6A	7C	8A
Doran and Ryan (2012)	Ireland	1A	2B	3E	4A	5G	6A, 6B	7A	8C
Zhu et al. (2012)	China	1B	2B	3E	4A	5D, 5E	6A	7A	8C
Aguilera Caracuel et al. (2013)	Spain	1A	2B	3A	4C	5A	6A	7A	8C
Sezen and Çankaya (2013)	Turkey	1B	2B	3A	4A	5I	6A	7A	8A
Lin et al. (2013)	Vietnam	1B	2B	3E, 3A	4A	5I	6A, 6B	7A	8A
Wu (2013)	Taiwan	1B	2A	3A	4B	5I	6B	7C	8A
Wong (2013)	China	1B	2A		4A	5I	6C	7C	8C
Tessitore et al. (2013)	Italy	1A	2B	3F	4A	5I	6C	7C	8C
Dragomir (2013)	Europe	1A	2B		4A	5I	6A	7C	8C
Leenders and Chandra (2013)		1A	2B		4A	5I	6A	7A	8A
Marchi et al. (2013)	Italy	1A	2A	3F	4A	5I	6A	7A	8A
Ghisetti and Rennings (2014)	Germany	1A	2B	3A	4A	5C	6A	7A	8A
Li (2014)	China	1B	2B	3A, 3E	4A	5A, 5B	6A, 6B	7A	8A
Amores-Salvadó et al. (2014)	Spain	1A	2B	3E	4A	5B, 5C	6A	7A	8C
Cheng et al. (2014)	Taiwan	1B	2B	3E	4C	5B	6A	7A	8A
Cai and Zhou (2014)	China	1B	2A	3E	4A	5I	6B	7C	8C
Lin et al. (2014)	China	1B	2A	3E	4A	5B, 5H	6B	7C	8C
Chen (2014)	Taiwan	1B	2B		4A	5I	6A	7A	8A
Ganapathy et al. (2014)	India	1B	2B	3A	4A	5A	6A	7C	8C
Woo et al. (2014)	Korea	1B	2A	3E	4C	5I	6A	7C	8C

Table 3 Classification and codification of the analysed studies (continued)

Authors	*Country*	*National context*	*Focus*	*Method*	*Sector*	*Theory*	*Position GI in the model*	*Relation GI and financial performance*	*Relation GI and environmental performance*
Huang and Yang (2014)	Taiwan	1B	2B		4A, 4B	5A, 5C	6A	7A	8A
Albertini (2014)	France	1A	2B	3B	4A	5I	6C	7C	8A
Hami et al. (2015)	Malaysia	1B	2B	3E	4A	5B	6C	7A	8C
Ai et al. (2015)	China	1B	2B	3A	4C	5I	6A	7C	8A
Gabler et al. (2015)	USA	1A	2A	3A	4A	5B, 5F	6A	7A	8C
Weng et al. (2015)	Taiwan	1B	2B	3A	4A, 4B	5H	6A, 6B	7C	8C
Przychodzen and Przychodzen (2015)	Poland/ Hungary	1A	2B	3A	4C	5C	6A	7A	8C
Rassier and Earnhart (2015)		1C	2B	3A	4A	5G	6A, 6B	7A	8C
Rubashkina et al. (2015)	Europe	1A	2B	3A	4A	5G	6A	7C	8C
Lee and Min (2015)	Japan	1A	2B	3A	4A	5B, 5C	6A	7A	8B
Xia et al. (2015)	China	1B	2A	3E	4A	5I	6A	7A	8A
Küçükoğlu and Pinar (2015)	Turkey	1B	2B	3E	4C	5I	6A	7C	8A
Salvadó et al. (2015)	Spain	1A	2B	3A	4A	5B	6A	7A	8A
Chen et al. (2015)	Sweden/ China	1A, 1B	2B	3B	4C	5A, 5E	6C	7B	8A
Jabour et al. (2015)	Brazil	1B	2A	3E	4C	5I	6A, 6B	7A	8A
Chan et al. (2015)	China	1B	2B	3E	4A	5I	6A, 6B	7A	8C
Zailani et al. (2015)	Malaysia	1B	2B	3E	4A	5A, 5B	6A, 6B	7A	8A
Huang eta l. (2015)	China	1B	2B	3A	4A	5A, 5B	6B	7C	8A
De Sousa Jabour et al. (2015b)	Brazil	1B	2B		4C	5I	6A	7C	8A
Huang and Li (2015)	Taiwan	1B	2B	3E	4A	5E, 5F	6B	7C	8A
Weina et al. (2016)	Italy	1A	2B	3A	4C	5I	6A	7C	8B

Table 3 Classification and codification of the analysed studies (continued)

Authors	*Country*	*National context*	*Focus*	*Method*	*Sector*	*Theory*	*Position GI in the model*	*Relation GI and financial performance*	*Relation GI and environmental performance*
Chen et al. (2015)	Taiwan	1B	2B	3E	4A	5F	6A, 6B	7A	8A
Lumbanbatu and Arvanto (2015)	Indonesia	1B	2A	3A, 3E	4C	5I	6B	7C	8C
Cosimato and Troisi (2015)		1C	2A	3F	4B	5I	6A	7C	8A
Galia et al. (2015)	France	1A	2A	3A	4C	5I	6B	7A	8C
Stanovcic et al. (2015)	France	1A	2A	3A	4C	5I	6B	7C	8C
Antoniolli et al. (2016)	Italy	1A	2B	3A, 3E	4C	5H	6A, 6B	7A	8A
Hojnik and Ruzzier (2016)	Slovenia	1B	2B	3A, 3E	4A	5I	6A, 6B	7A	8C
Xie et al. (2015)	China	1B	2B	3A	4A	5I	6A	7A	8C
Cegarra-Navarro et al. (2016)	Spain	1A	2B	3A	4A	5I	6A	7B	8C
Huang and Li (2017)	Taiwan	1B	2B	3A, 3E	4A	5D	6B	7A	8A
Severo et al. (2017)	Brazil	1B	2B	3A	4A	5I	6A, 6B	7A	8A
Miroshnychenko et al. (2017)		1C	2B	3A	4C	5I	6A	7B	8C
Zhu et al. (2017)	China	1B	2B	3A	4A	5I	6C	7C	8A
Arfi et al. (2018)	France	1A	2B	3B	4C	5I	6C	7C	8C
Cai and Li (2018)	China	1B	2B	3A, 3E	4A	5A, 5B	6A, 6B	7C	8A
Saunila et al. (2018)	Finland	1A	2A	3A	4A	5I	6B	7A	8A
Jiang et al. (2018)	China	1B	2B	3A	4A	5F	6A	7A	8B
Stucky (2019)	Austria, Germany, and Switzerland	1A	2B	3A,3E	4A	5B	6A	7B	8C
Tariq et al. (2019)	Thailand	1B	2B	3A	4A	5B	6A	7A	8A
Del Rosario et al. (2019)	Mexico	1B	2B	3A, 3E	4B	5F	6A	7B	8A
de Azevedo Rezende et al. (2019)		1B	2B	3A	4C	5I	6A	7B	8C

Table 3 Classification and codification of the analysed studies (continued)

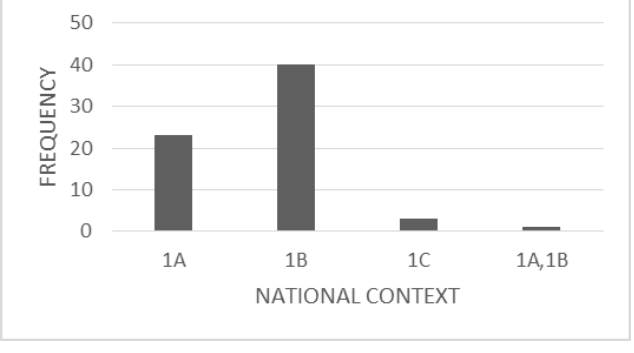
Authors	*Country*	*National context*	*Focus*	*Method*	*Sector*	*Theory*	*Position GI in the model*	*Relation GI and financial performance*	*Relation GI and environmental performance*
Fernando et al. (2019)	Malaysia	1B	2B	3A	4A	5B	6A	7A	8A
Zhang et al. (2019)	China	1B	2B	3A	4A	5H	6A	7A	8C

4.1 National context

The analysis of the national context in research on Green Innovation and performance has become relevant because of the influence of the environment on the mode of company management.

From the analysis of the studies, it was verified that the majority of papers were dedicated to understanding the behaviour of companies from a specific country, 59 % in Emerging Countries (Category 'B') and 34 % in Developed Countries (Category 'A'). This situation has shown that studies on the subject have been gaining prominence in emerging economies, especially in Asian countries, which represented 37 of the 67 papers analysed (Figure 2).

Figure 2 Category 1 frequency distribution

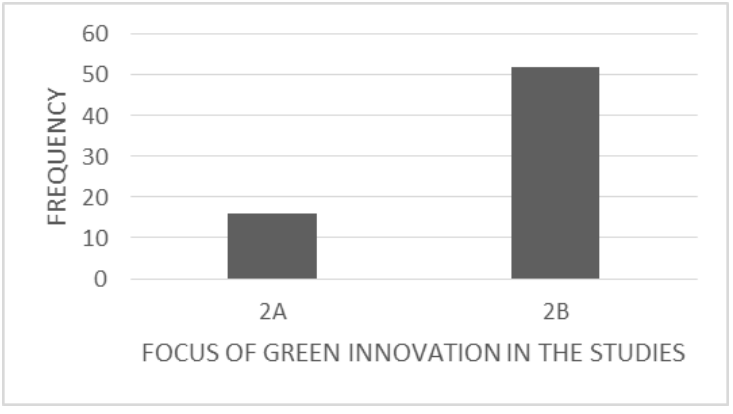


4.2 Focus of green innovation in the studies

The second classification refers to the focus of Green Innovation theme in studies (Figure 3).

In this category, 79 % of the papers dealt with the relationship between Green Innovation and Performance (Category 'B'), addressing both environmental and financial performance (Aguilera Caracuel and Ortiz-de-Mandojana, 2013; Przychodzen; Przychodzen, 2015; Cegarra-Navarro et al., 2016). The other 21% of the papers focused only on Green Innovation (Category 'A'), seeking to identify the factors that promote Green Innovation in companies (Wong, 2013; Cai and Zhou, 2014; Saunila et al., 2018), or exploring the impact of investments in sustainable actions on company competitiveness (Lumbanbatu, Arvanto, 2015; Gabler et al., 2015).

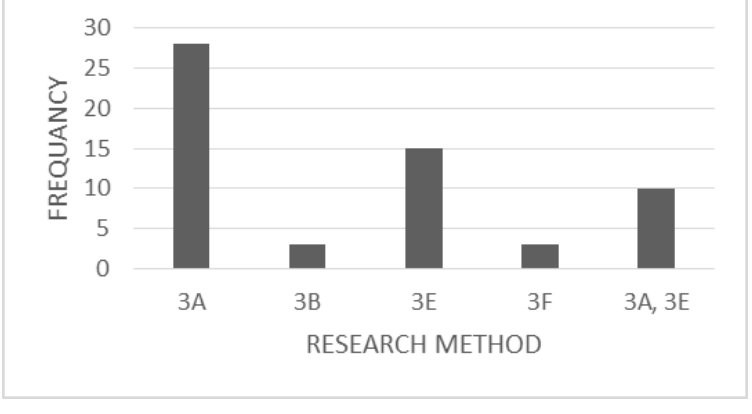
Figure 3 Category 2 frequency distribution



4.3 Research method

The research methods used in the papers were classified according to the scale shown in Figure 4.

Figure 4 Category 3 frequency distribution

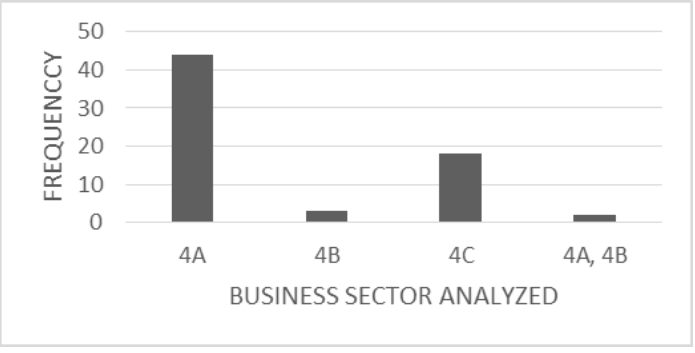


Analysis of the studies revealed that the majority of those dealing with Green Innovation and Performance were quantitative associated with Survey (Category 'A' and 'E') representing 80 % of the studies. In addition, only 10 % of the studies used the qualitative method, being 3 case studies (Tessitore et al., 2013; Marchi et al., 2013; Cosimati and Troisi, 2015).

4.4 Business sector analysed

For the analysis of the sectors surveyed in the works, the sectors were codified into three categories (Figure 5).

Figure 5 Category 4 frequency distribution

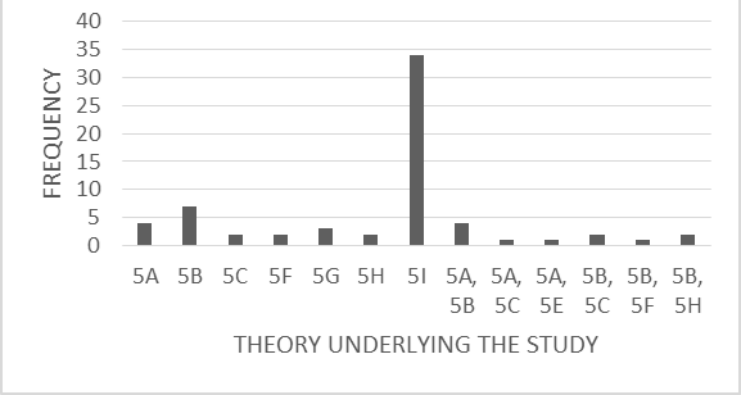


The results of the analysis revealed that most of the studies were conducted in companies in the industrial sector (Category 'A' – 64 %) and only 4 % in the service sector, which can be justified by the fact that the impacts of environmental innovations are greater in the industry sector and by this sector leading the development of sustainable actions, while the services sector end up following this trend.

4.5 Theory underlying the study.

This classification was used to identify the most used theories to base research on the Green Innovation and performance theme (Figure 6).

Figure 6 Category 5 frequency distribution

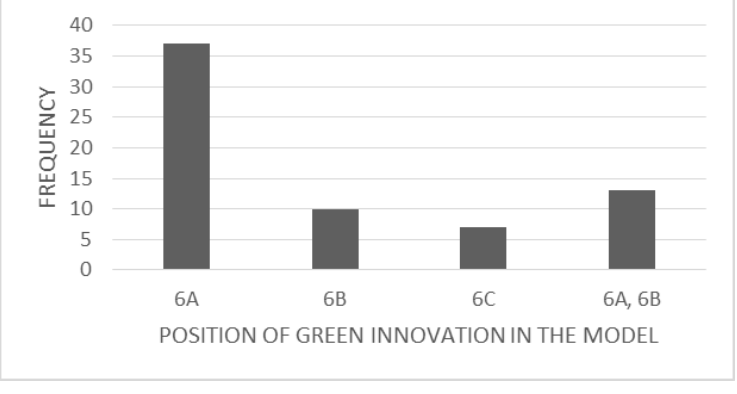


From the analysis of the results, it was verified that the most used theory in research on the subject was the Resource-Based View ('B'), being often used in conjunction with other theories such as Institutional Theory, View Based on Natural Resources, Dynamic Capabilities and others (Li, 2014; Chen et al., 2015; Lee and Min, 2015, Cai and Li, 2018).

4.6 Position of green innovation in the model

The variable Green Innovation was analysed in several aspects in the studies of this review and was classified as 'A' – Independent Variable, 'B' – Dependent Variable, and 'C' – Mediator Variable (Figure 7).

Figure 7 Category 6 frequency distribution

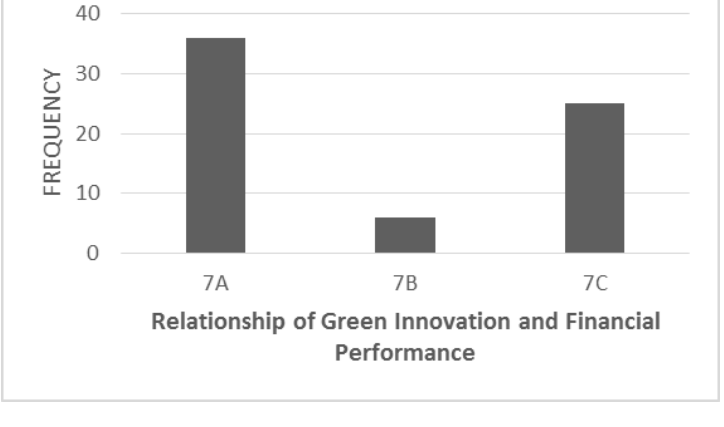


The results showed that in 55 % of the studies the variable Green Innovation was presented as an independent variable (category 'A'), from other variables such as performance and competitive advantage (Ar, 2012). In 20 % of papers, Green Innovation was both a Dependent Variable and Independent Variable, as in the research by Doran and Ryan (2012) who looked at the factors that drive eco-innovation and how it affects the company's performance. In another 15 % of the papers, Green Innovation was a dependent variable (category 'B') and in 10 % of the papers it was analysed as a mediator variable.

4.7 Relationship of green innovation and financial performance

This classification explored the studies that related the GI and the financial performance of the companies codifying into 3 categories (Figure 8).

Figure 8 Category 7 frequency distribution

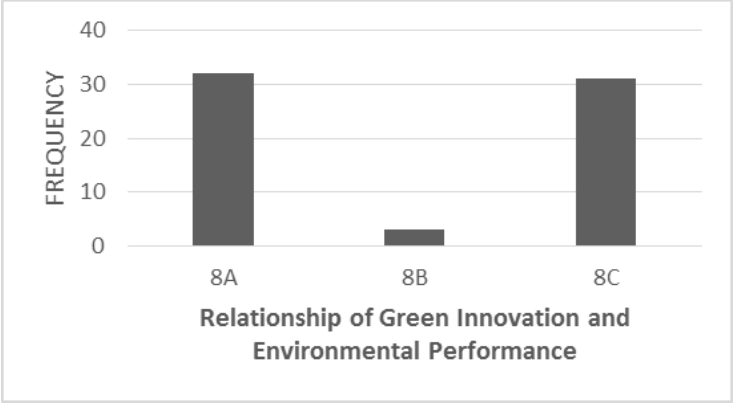


The analysis revealed that most of the studies found a positive relationship between the variables (category 'A' – 55 %), indicating that eco-innovative companies are characterised by higher financial performance (Li, 2014; Przychodzen and Przychodzen, 2015; Huang, Li, 2017). In 10% of the papers found a negative relationship between the variables (Tessitore et al., 2013; Cegarra-Navarro et al., 2016; Stucky, 2019). In 42 % of the cases the relationship was not applicable.

4.8 Relationship of green innovation and environmental performance

In this classification the studies that related Green Innovation and environmental performance were verified, and as in the previous section, were divided into 3 categories: 'A' – Positive; 'B' – Negative; and 'C' – Not applicable, as shown in Figure 9.

Figure 9 Category 8 frequency distribution



The results revealed that in 48 % of the papers reviewed, there was a positive relationship between GI and the environmental performance of companies (De Marchi et al., 2013; Ghisetti and Rennings, 2014; Tariq et al., 2019). In another 47%, this relationship was not applicable, because many studies focused only on Green Innovation, without relating its impact on environmental performance (Sezen and Çankaya, 2013).

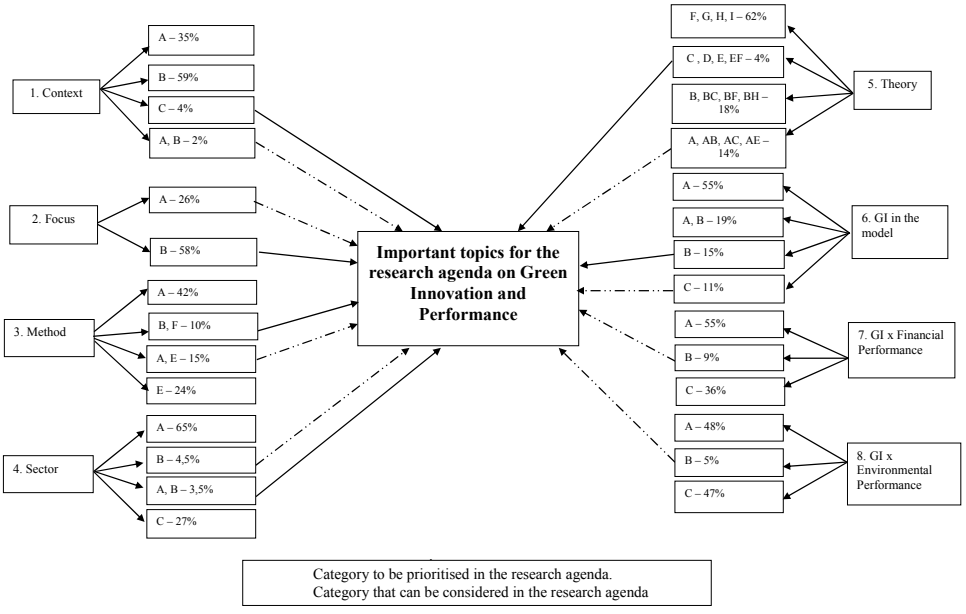
5 Discussion

From the analysis of the presented studies, it is possible to identify research opportunities on Green Innovation and performance. Figure 10 presents the main subjects discussed on the theme, and those points to be explored in future works.

In Classification 1, the categories 'A' and 'B' (national context) were the most discussed in the literature, being the studies carried out either in Developed Countries (DC) or Emerging Countries (EC) separately. Given the relevance of this analysis, contradictions in the drivers of green innovation, such as country regulations and different economic conditions, can affect companies' performance differently. It is noted that most of the studies analysed were directed to EC and presented divergent results in relation to the company's performance, some positively affecting them (Ar, 2012; Amores-Salvadó et al., 2014; Zailani et al., 2015; Jiang et al., 2018), and others with a

negative impact on company performance (Del Rosario et al., 2019;). Research carried out in DC companies also showed contradictions in the results, highlighting in this analysis studies where the GI did not affect the performance of the companies neither positively nor negatively (Tessitore and Daddi, 2013). In addition, researchers also analysed companies from different backgrounds and all found a negative relationship between green innovation and performance (Chen et al., 2015; De Azevedo et al., 2019; Miroshnychenko et al., 2017), demonstrating a different result from the studies carried out in companies with the same national context.

Figure 10 Distribution of analyses and classification of categories and points to be explored in future research



In this way, the first research recommendation would be to develop studies comparing different national contexts to verify if the impact of Green Innovation on company performance is different in the context of DC and EC.

In classification 2, most of the studies that analysed GI focused on the relationship between GI and Performance (category 'B'). Some surveys addressing only financial performance (Przychodzen and Przychodzen, 2015; De Azevedo et al., 2019), others only environmental performance (Chen, 2014; Weina et al., 2016; Jiang et al., 2018) and papers verifying the impact of investments in IM in both environmental and financial performance (Huang and Yang, 2014; Lee and Min, 2015; de Sousa Jabbour et al., 2015). It was found that the impact of environmental innovations on performance is ambiguous and that not only will innovation affect performance, but also factors such as regulation that can impose higher or lower costs on the company, the management style that can generate better results and differentiation in the market. Thus, these factors can be a gap in research relating GI, Government Regulations and Performance, this being the second recommendation for the development of studies proposed in this review.

Regarding the methods, quantitative studies using 'survey' predominated in the classification of the methodology (category 'A' and 'E'), and only 10% used qualitative

methods. Even the majority of studies using only quantitative or qualitative methods, the results showed to be divergent in the relationship between the GI and performance. In this way, the third recommendation would be to develop studies with integrated quanti/quali methods to verify whether the methodology interferes in this relationship.

The Industrial Sector (category 'A') was the most analysed category in the reviewed studies. Although the impact of environmental innovations is more evident in the industrial sector and this arouses a greater interest in researchers, the service sector is also seeking environmental innovation in its activities in order to reduce costs and improve its image and attract ecological consumers (Reyes-Santiago et al., 2019). Thus, there is a need for more research to examine the service sector (category 'B') or studies comparing the various sectors and how they would affect the relationship between GI and Performance. In view of this, the fourth recommendation would be the development of works that address the theme Green Innovation in organisations from other sectors.

In classification 5 on the theories that underpinned the reviewed studies, the categories 'A' (Institutional Theory) and 'B' (Resource-Based View) were the most used separately and in conjunction with other theories. Several studies on Green Innovation have used Institutional Theory as a reference, seeking to explain the relationship between institutional pressures on companies' sustainable actions (Seles et al., 2016; Rentizelas et al., 2018; Borsatto and Amui, 2019). RBV and NRBV have also been used as a theoretical basis to discuss the contribution of internal resources and capabilities to the performance of technological innovation (Dangelico and Pujari, 2010).

In addition to these two currents, other theories have been used in studies on Green Innovation but less frequently, such as Porter's Hypothesis (Rassier and Earnhart, 2015; Rubashkina et al., 2015; Antoniolli et al., 2016; Zhang et al., 2019), Stakeholder Theory (Lin et al., 2014; Hua-Hung et al., 2015), Dynamic Capabilities (Chen et al., 2015; Jiang et al., 2018; Reyes-Santiago et al., 2019), Ecological Modernisation Theory (Zhu et al., 2012; Huang and Li 2017).

In this context, and seeking to complement the arguments of these theories, we suggest to carry out research on the topic using theories such as the theory of ecological modernisation (TEM), and the Neoinstitutional Theory, which are little seen in this review. According to Murphy and Gouldson (2000), TEM has been offered as a possible solution to the conflict between industrial development and environmental protection. She believes that environmental problems can be mitigated by increasing resource efficiency, improving sustainability, and maintaining the basic system of capitalist production and consumption. According to Ntim and Soobaroyen (2013), the Neoinstitutional Theory suggests that institutional forces, such as political, economic and social institutions, can lead or shape a company's involvement with social and environmental performance.

Regarding the position of Green Innovation in the model analysed, in most studies, GI was considered as an independent variable (category 'A'), that is, when it assumes that it influences other variables. In this case, GI improved the financial performance of companies in 58% of the studies analysed in this situation (Zhu et al., 2012; Aguilera-Caracuel and Ortiz-de-Mandojana, 2013; Ghisetti and Rennings 2014; Xia et al., 2016; Tariq et al., 2019), but also presented divergent studies with a negative impact on performance (Cegarra-Navarro et al., 2016; De Azevedo et al., 2019; Stucky 2019). When the IG was presented as a dependent and independent variable, the results on the performance were also mostly positive (Chan et al., 2015; Hojnik and Ruzzier 2016; Severo et al., 2017), as well as the few studies where the IG was used as a variable

mediator (Hami et al., 2015). In this context, and considering the small portion of studies using the IG as a mediating variable for other organisational variables, there is an opportunity for future research.

In Classification 7, which verified the relationship between GI and financial performance, about half of the studies found a positive relationship between variables (category 'A'), demonstrating financial benefits of green innovation for companies (Ai et al., 2015; Huang and Li, 2017; Jiang et al., 2018; Saunila et al., 2018; Zhang et al., 2019) but in some studies this relationship was negative (Doran and Ryan, 2012; Sezen and Cankaya 2013; Chen et al., 2015).

Considering that Green Innovation initiatives can occur in several ways, such as innovation of green processes, creation of more sustainable products, innovation of environmental management, and moreover, it has been considered a determining aspect in the competitiveness and financial returns of companies, the divergence in the methods and results of this relationship shows that there is still a gap to understand these still contradictory issues in the literature. Furthermore, since there are several ways of measuring financial performance, it is suggested that studies should be developed considering other financial indicators that also take into account a temporal coverage of financial returns and the risk involved.

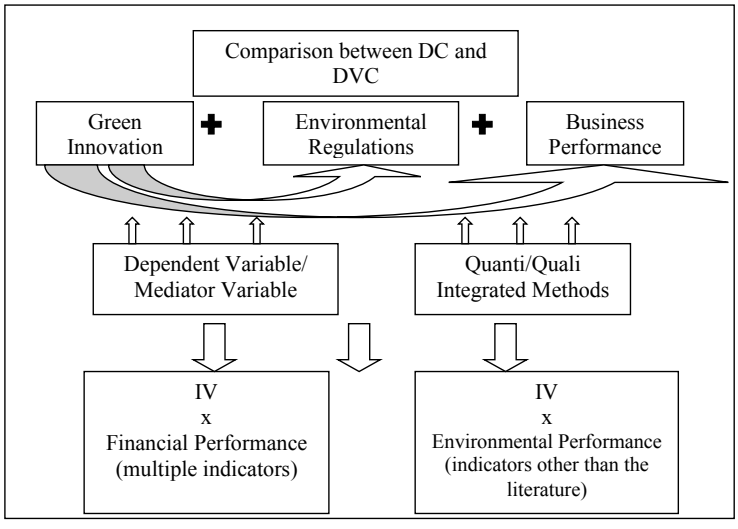
As in financial performance, the environmental performance of companies can also be measured in different ways, using different indicators. According to Aragón-Correa et al. (2008) environmental performance involves efficient use of resources, reduction of waste and energy consumption, reduction of carbon emissions and reduction of environmental risks. In this context, GI can contribute to improving this performance through new environmental technologies both in the process and in the development of new green products. In this classification, almost 50% of the studies found a positive relationship between the GI and environmental performance (category 'A') (Zhu et al., 2012; Jabbour et al., 2015; Antoniolli et al., 2016; Cai and Li, 2018; Fernando et al., 2019). However, in this same proportion, this relationship was not applicable (category 'C'), or clearly demonstrated in the research, because the studies focused only on the IG and not on the benefits generated by it (Doran and Ryan, 2012; Cai and Zhou, 2014; Weng et al., 2015; Arfi et al., 2018). Thus, studies that clearly demonstrate the analysis of this relationship and their respective indicators are suggested as a recommendation.

These recommendations should provide a research agenda on green innovation and performance and can be used individually or combined for research. The combination of these recommendations could generate more robust results that would contribute to the literature of the area.

6 Conclusions

The objective of this work was to present the results of an integrative literature review on the theme of Green Innovation and Performance. Reviews like this are relevant to the academic community, as they help researchers in developing research on a given subject to contribute to the literature by improving the level of evidence for decision making. The main studies in this area have been classified and coded. Then, a research agenda was presented with recommendations that can advance the discussions in this area from future works, as shown in Figure 11.

Figure 11 Suggestion model for future research on IV and performance



As a result of gaps in the current literature, these recommendations can guide and strengthen research on Green Innovation and Performance and therefore demonstrate to managers and academics how investments in environmental innovations can affect both the environmental and financial performance of companies. In addition, as demonstrated in the research, is a theme that shows a growth in interest in various academic institutions.

Briefly, the results show that further research is needed on the relationship of IV and company performance:

- Comparing different national contexts to verify if the impact of Green Innovation on company performance is different in the context of DC and EC.
- Consider mixed quanti/quali methodologies;
- Use theories such as Ecological Modernisation Theory and Neo Institutional Theory seeking to complement the arguments not addressed in the existing theories- Use other financial and environmental indicators not addressed in the literature.

A limitation to be considered in this research is the selection of papers. As the focus of the study was to address the relationship between green innovation and the company's financial and environmental performance, many studies on environmental regulations analyse the impacts of green innovation on the company's financial and environmental performance of regions, which is not the focus of this review. Another limitation of the study refers to the analysis of academic papers in journals of only three bases, in addition to delimiting the research of the works to the expressions 'Green innovation and Performance' and 'Eco-innovation and Performance' and for the period from 2012 to 2019.

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