



REUNIR:
*Magazine of Administration, Accounting
Sciences and Sustainability*

www.reunir.revistas.ufcg.edu.br




ORIGINAL ARTICLE: Submitted on: 01.07.2000. Evaluated on: 30.01.2023. Apt for publication at: 28.02.2023. Responsible Organization: UFCG.

Colaboração para Inovação e Sustentabilidade nas Indústrias de Transformação do Paraná

Collaboration for Innovation and Sustainability in the Manufacturing Industries of Paraná

Colaboración para la innovación y la sostenibilidad en las industrias de transformación de Paraná

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PALAVRAS-CHAVE

Inovação.
Colaboração.
Sustentabilidade.

Resumo: O objetivo deste estudo consiste em analisar de que forma é desenvolvida a colaboração para inovação e a sua relação com a sustentabilidade em indústrias de transformação do Paraná. O método de estudo foi quantitativo de natureza analítica e descritiva. Para análise de dados foi realizado um levantamento Survey, através de um questionário eletrônico junto as indústrias de transformação do Paraná. Foram obtidos dados de 64 empresas e por meio da Análise de Cluster e da Análise de Correlação, pode-se atender o objetivo deste estudo. Assim, verificou-se que na inovação as organizações têm buscado desenvolver melhorias nos atuais produtos e serviços. Na dimensão econômica as empresas têm buscado ações que objetivam evitar reclamações e devoluções, por parte de clientes; na dimensão social as ações estão voltadas a evitar lesões e doenças relacionadas ao trabalho; e na dimensão ambiental as ações das indústrias estão relacionadas a reduzir o consumo de material por produto produzido. O principal motivo para colaborar está direcionado ao acesso ao conhecimento, à informação e à aprendizagem. A principal fonte de colaboração são clientes ou consumidores. Os principais resultados dos testes estatísticos indicam que as empresas que colaboram mais também estão desenvolvendo ações proeminentes voltadas à sustentabilidade. Apesar da colaboração na inovação estar em desenvolvimento nas organizações, já que as médias de fontes ainda não possuem valores consideráveis, há uma preocupação em buscar novas fontes de conhecimento, recursos e/ou falhas em geral em fontes externas à organização, o que acaba fomentando, também, as dimensões da sustentabilidade.



KEYWORDS

Innovation.
Collaboration.
Sustainability.

Abstract: *The aim of this study is to analyze how collaboration for innovation is developed and its relation with sustainability in manufacturing industries in Paraná. The study method was quantitative of an analytical and descriptive nature. For data analysis, a survey was conducted, using an electronic questionnaire with the manufacturing industries of Paraná. Data from 64 companies were obtained and through Cluster analysis and Correlation analysis, the objective of this study could be answered. Thus, it was found that in innovation organizations have sought to develop improvements in current products and services. In the economic dimension, companies have been looking for actions that aim to avoid complaints and returns from customers. In the social dimension, actions have mainly aimed at preventing work-related injuries and illnesses; and in the environmental dimension, the actions of the industries have been related to reduce the consumption of material by produced product. The main reason for collaborating is directed to access to knowledge, information and learning. The main source of collaboration is customers or consumers. The main results of the statistical tests indicate that the companies that collaborate more are also developing prominent actions aimed at the sustainability. Although collaboration on innovation is under development in organizations, since the averages of sources still do not have considerable values, there is a concern to seek new sources of knowledge, resources and/or failures in general from sources outside the organization, which ends up encouraging also, the dimensions of sustainability.*

PALABRAS CLAVE

Innovación.
Colaboración.
Sostenibilidad.

Resumen: *El objetivo de este estudio es analizar cómo se desarrolla la colaboración para la innovación y su relación con la sostenibilidad en las industrias manufactureras en Paraná. El método de estudio fue cuantitativo de naturaleza analítica y descriptiva. Para el análisis de datos, se realizó una encuesta (survey), utilizando un cuestionario electrónico con las industrias manufactureras de Paraná. Se obtuvieron datos de 64 empresas y, a través de análisis de conglomerados y el análisis de correlación, se puede responder el objetivo de este estudio. Por lo tanto, se descubrió que en las organizaciones de innovación se ha buscado desarrollar desarrollar mejoras en los productos y servicios actuales. En la dimensión económica, las empresas han estado buscando acciones que tengan como objetivo evitar quejas y devoluciones, por parte de los clientes; en la dimensión social, las acciones están dirigidas a prevenir lesiones y enfermedades relacionadas con el trabajo; y en la dimensión ambiental, las acciones de las industrias están relacionadas con la reducción del consumo de material por producto producido. La razón principal para colaborar se dirige al acceso al conocimiento, la información y el aprendizaje. La principal fuente de colaboración son los clientes o consumidores. Los principales resultados de las pruebas estadísticas indican que las empresas que más colaboran también están desarrollando acciones destacadas centradas en la sostenibilidad. Aunque la colaboración en innovación está en desarrollo en las organizaciones, dado que los promedios de las fuentes aún no tienen valores considerables, existe la preocupación de buscar nuevas fuentes de conocimiento, recursos y / o fallas en general de fuentes externas a la organización, lo que termina alentando, también, las dimensiones de la sostenibilidad.*

Introduction

Innovation and sustainability in collaborative activities, covering social, economic, and environmental dimensions of sustainability, can be a competitive factor, which deserves attention from researchers and companies. Bos-Brouwers (2010) and Musiolik and Markard (2011) express that collaboration can be described as one of the facilitators for innovations aimed at sustainability.

The collaboration involves combining forces to achieve a goal that interests both parties (Awan & Sroufe, 2021), thus being able to generate economic advantage (Murray, Haynes & Hudson, 2010).

Innovating is a necessary action for companies that aim at competitive and strategic growth so that, from the collaboration between research/knowledge centers and companies, the promotion of products and services occurs (Rezk et al., 2016). "Innovation lends competitive advantage to companies, industries and ultimately economies [...], it has the potential to stimulate the growth of individual companies at the micro level and adds value to industries and economies at the macro level" (Subrahmanya, Mathirajan & Krishnaswamy, 2010, p. 1).

Based on this competitive perspective of collaboration, Halme and Korpela (2013) point out that, in order to have responsible innovation, collaboration becomes necessary, mainly in research and development (R&D) and resources so that common goals between the parties can be achieved. Thus, as much as companies have scarce resources, from collaboration, they can share these resources, allowing them to innovate in a sustainable way and then achieve the maintenance of social capital (Iturrioz, Aragón & Narvaiza, 2015; Halme & Korpela, 2013).

In addition, collaboration for innovation provides improved economic, social and environmentally development focused on sustainability. Collaboration compensates for the firms' shortcomings, facilitating the creation of

integrated value, going beyond an innovation that aims only at financial returns, worrying about the long-term social and ecological value (Bos-Brouwers, 2010).

Pacheco, Caten, Jung, Navas, and Cruz-Machado (2018) also point out that, in order to have an innovation focused on sustainability, the benefits, which the novelty intends, must be significant or not negligible in the three dimensions of sustainability (social, economic, and environmental).

Studies on collaboration for innovation indicate that there are advantages, both for the organization and for the other collaborating institution, which vary according to the objective of the innovative project, which can, in addition, promote sustainability (Van Horne, Poulin & Frayret, 2012; Bos-Brouwers, 2010), making unique collaborative studies for innovation and sustainability in industries.

Thus, based on innovation, collaboration, and sustainability, the question that guided this study was: How does collaboration for innovation and sustainability develop in the manufacturing industries of Paraná? Thus, the objective of this study is to analyze how collaboration for innovation is developed and its relationship with sustainability in the manufacturing industries of Paraná.

The focus of the study was the companies installed in the State of Paraná, more specifically in the manufacturing industry.

According to data released by IBGE, in 2018, referring to PINTEC/2016, there were, in Brazil, at the end of 2017, approximately 102,500 manufacturing industries, with more than ten employees, which implemented innovations in the period 2015 to 2017, and, of these, about 8,700 were located in the state of Paraná (IBGE, 2018).

The study contributes to the advancement of knowledge in the area because it aims to analyze the issue from a regional sample, not national or by segment, as other studies, focusing on a state that has excelled in industrial development in recent

years, which contributes to the evaluation of sustainable performance due to this evolution. In addition, it innovates in the sense of categorizing companies through Cluster Analysis, a fact not identified in other studies on the subject.

Theoretical elements of the research

Among the themes that support this study are innovation, collaboration for innovation, sustainability, and the social, economic, and environmental dimensions of sustainability.

Innovation is characterized by bringing "new products to market, through the more efficient combination of production factors, or by the practical application of some invention or technological innovation" (Schumpeter, 1997, p. 9).

Innovation can be understood as user-producer interaction, thus being an interactive process. It is seen as the result of efforts or as a side effect of ongoing activities, from the learning process (Lundvall, 2007). The innovation process can also be seen as a production process, together, in which one output is innovation and the other is a change in the competence of the agents involved in the process (Lundvall, 2007).

The Oslo Handbook, prepared by the OECD (2018), presents the concept of innovation based on the definitions described by Schumpeter. Neo-Schumpeterian Theory sees the organization as a creator of wealth, new products, and innovative services. For Schumpeter (1961) there is "creative destruction", which is innovation, incessantly destroying the old and creating new elements, and providing economic development. An innovation involves, according to the OECD (2018): uncertainty about the results that will be obtained by the new investment, substrate of spillovers of knowledge/use of the original innovation, use and combination of knowledge and intent to gain competitive advantage.

To better understand innovation, it is necessary to distinguish it, from its types/levels and intensities. The Oslo Handbook (OECD, 2018)

defines two levels of innovation, which can generate various types of change for the organization, increasing productivity and/or its business performance. Among the levels described are product innovations and process innovations.

Product innovation can be described as "a new or improved good or service that differs significantly from the company's previous goods or services and has been introduced to the market." (OECD, 2018, p. 21).

Innovations in process, according to Rennings (2000, p. 322) "occur when a given amount of output (goods, services) can be produced with fewer inputs"; that is, the potentialization of organizational processes.

Innovation can still be classified by its intensity and/or nature, and can be incremental, radical, or disruptive (Schumpeter, 1997; OECD, 2018; Klement, 2007; Gallouj & Weinstein, 1997; Bos-Brouwers, 2010; Zilber, Perez & Lex, 2009); and also structural (architectural) and modular (Klement, 2007; Henderson & Clark, 2001).

Incremental innovation occurs when "the overall structure of the system remains the same, but the system is modified marginally, through the addition of new elements, or the replacement of elements" (Klement, 2007, p. 27). Radical or disruptive innovation, according to Bos-Brouwers (2010), is directed to the development of products that are totally new to the market, with the possibility of collaboration between stakeholders.

Structural (architectural) innovation "is innovation through a new combination of final or technical characteristics, derived from a 'stock' of the knowledge of the organization" (Klement, 2007, p. 27). Finally, with regard to modular innovation, Henderson and Clark (2001, p. 11) state that "modular innovation is an innovation that changes a basic design concept without changing product architecture."

Turning to the topic of collaboration for innovation, according to Jones and Zubieli (2017), innovation can be associated with high organizational costs and risks; and collaboration generates competitive advantages for companies

and profitability for both parties involved, thus reducing part of the risks involved in this process. "New collaboration structures can combine to improve innovation and create value in the global knowledge economy" (Johannessen & Olsen, 2010, p. 503). Greco, Locatelli, and Lisi (2017, p. 322) say that "innovation plays a crucial role in improving intentional collaborations."

Within this theme, it is important to take into account some important variables, such as the reasons and sources that lead to collaboration for innovation.

Among the motivations that lead organizations to collaborate for the development of innovation are: facilitators for sustainable innovations in the social, economic, and environmental spheres (Bos-Brouwers, 2010; Halme & Korpela, 2013; Tachizawa & Wong, 2015; Manning & Roessler, 2013), the combination of resources (technological/financial) (Bos-Brouwers, 2010; Halme & Korpela, 2013; Iturrioz et al., 2015; Smink, Negro, Niester & Hekkert, 2015), supply of creativity deficiencies (Bos-Brouwers, 2010), access to R&D programs, new knowledge and learning (Musialik & Markard, 2011; Halme & Korpela, 2013), diffusion of technological innovation (Tachizawa, Alvarez-Gil & Monte-Sancho, 2015), integration of productive capacity (Iturrioz et al., 2015; Hawkey & Weeb, 2014), a strategic approach (Iturrioz et al., 2015), increase in share capital (Iturrioz et al., 2015; Halme & Korpela, 2013) in addition to reducing the risk and cost of the innovation process (Tidd, Bessant & Pavitt, 2008).

The sources of collaboration for innovation identified were: customers and suppliers (Bos-Brouwers, 2010; Tachizawa et al., 2015; OECD, 2018; Rezk et al., 2016; Marchi, Molina-Morales & Martínez-Cháfer, 2022; Martínez-Cháfer, Molina-Morales & Roig-Tierno (2022)), knowledge institutions, research institutes and/or universities (Bos-Brouwers, 2010; Halme & Korpela, 2013; Pacheco et al., 2018; Rezk et al., 2016; Branten & Purju, 2015; Marchi et al. 2022; Martínez-Cháfer

et al. 2022), formal or informal knowledge networks between companies (Bos-Brouwers, 2010; Musialik & Markard, 2011; Halme & Korpela, 2013; Pacheco et al., 2018; Tachizawa et al., 2015; Tachizawa & Wong, 2015; Sternberg & Norrman, 2017; Hawkey & Weeb, 2014), government (Bos-Brouwers, 2010; Manning & Roessler, 2013; Smink et al., 2015), joint venture (Bos-Brouwers; 2010), design companies (Bos-Brouwers, 2010; Tachizawa & Wong, 2015), consulting agencies (Bos-Brouwers, 2010), peer companies (Bos-Brouwers, 2010; Tachizawa et al., 2015; Manning & Roessler, 2013), public organizations (Halme & Korpela, 2013), competitors (Rezk et al., 2016; Marchi et al. 2022; Martínez-Cháfer et al. 2022) and Society (Manning & Roessler, 2013).

In this context, collaboration can stimulate and support the diffusion of innovation in niche innovation projects that prioritize Triple Helix, that is, projects aimed at orientation to sustainability (Brem & Radziwon, 2017).

Regarding sustainable variables, for the forerunner of the Theory of Sustainability, Elkington (2001, p. 20), sustainability is "the principle that ensures that our actions today will not limit the range of economic, social and environmental options available to future generations". Elkington is the precursor of the theory of the triple bottom line (TBL) or three pillars of sustainability (economic, social, and environmental).

Starting from the context in which the pillars are unstable and undergo constant changes, Rocha, Gomes, Kneipp, and Camargo. (2015, p. 293) consider that "the three dimensions of sustainability, presented by the TBL, must be integrated, so that, in the environmental sphere, natural resources are used in a way that does not harm future generations, reducing the impacts of the action of production processes".

The economic dimension "encompasses the general aspects of an organization that must be respected alongside environmental and social

aspects to remain in the market for a long time" (Baumgartner & Ebner; 2010, p. 78). The social dimension consists of the social aspect, related to the qualities of human beings, such as their skills, dedication, and experiences; and covers both the company's internal and external environment and the indicators vary in each company. (Claro & Amâncio, 2008). Finally, the environmental dimension is concerned with the environmental impacts generated by organizations, the use of natural resources, and pollutant emissions (Munck, 2014).

An innovation, which is concerned with social well-being and the impact linked to the customer, also aims at improvements related to the environment and, consequently, generates monetary benefits for the organization.

Methodological elements of the research

This is an analytical and descriptive study. Analytical research "aims to understand phenomena, discovering and measuring causal relationships between them" (Collis & Hussey, 2005, p. 24). Descriptive research, on the other hand, "is used to identify and obtain information about the characteristics of a particular problem in question" (Collis & Hussey, 2005, p. 24).

Data were collected using the Survey research and the questionnaire used was self-administered, constructed by closed questions of multiple choices, elaborated and validated by Kuhl (2018) and Kuhl and Costa (2019), which, in turn, was based on the works of Scandelari (2011), Kuhl (2012) and García, Torres, García, and Ramos (2018). For the analysis, the quantitative method was used, which, according to Flick (2012, p. 127), "is dedicated to the ideals of measurement and works with numbers, scales and index construction".

Based on the questionnaires applied in the manufacturing industries of the state of Paraná, this study allowed identifying and analyzing the collaboration relationship for innovation and sustainability.

The initial and representative sample for this study, based on sampling calculations, would be 95 valid questionnaires, answered by manufacturing industries from Paraná; however, only 64 questionnaires were obtained. The difference between the prospecting for valid questionnaires and those that were obtained is justified by the lack of feedback of the industries themselves, and contacts were made by e-mail and telephone calls, with approximately 300 companies, obtaining only 49 responses. Later, contact was made with a company specialized in data collection for research and, through this resource, 15 more valid questionnaires could be obtained. This process started in October and ended in December 2019, culminating in almost 3 months of data collection.

Having evidenced the difficulty in collecting a greater number of valid questionnaires and understanding that the effort would not be compensated by sending more questionnaires, it was decided to close the collection and start the analyses. Thus, the analyses were performed from the 64 questionnaires collected by the Google Docs Search System Site, which is totally safe and confidential.

For the analysis of the data obtained from the Survey research, several analyses and statistical tests were performed, through the statistical program SPSS® (Statistical Package for the Social Sciences): descriptive statistics using mean and standard deviation; verification of the trend towards normality of the data by verifying the asymmetry and kurtosis values, Cronbach's Alpha test to verify the internal consistency of the constructs defined a priori; Cluster analysis for respondents classification; t-test, for independent samples, for the verification of the statistical difference between the clusters; and Correlation Analysis to verify the relationship between constructions.

Presentation and discussion of results

Before starting the data verification itself, through statistical tests, the sample was

characterized. Representativeness was verified in relation to the responding municipalities in the state of Paraná, distributed by city (Boa Ventura de São Roque, Guarapuava, Turvo, Araucária, Campo Largo, Curitiba, Pinhais, Quatro Barras, São José dos Pinhais, Cafelândia, Palmeira, Ponta Grossa, Campo Mourão, Araongas, Londrina, Maringá, Cornélio Procópio, Figueira, Cianorte, Francisco Beltrão, Medianeira, and Palotina) and geographic region (South Center, Metropolitan, East Center, West Center, North Center, Pioneer North, Northwest, Southwest, West, and Southeast).

The sample is mainly concentrated in the metropolitan region of Curitiba (46.8%), in Araucária, Campo Largo, Curitiba, Pinhais, Quatro Barras, and São José dos Pinhais. The state capital (Curitiba) has the highest number of respondents (14.1%) in the same city. However, the sample is distributed in almost all regions of the state, except in the Southwest region, from which there were no respondents.

The size of the organizations was evidenced by the number of employees and the billing volume. The classification by size shows that, among the organizations' respondents, the large ones (21) prevailed and then showed up the small businesses (17), when classified by the number of employees. However, when classified by billing volume, the medium (24) and large companies (15) stood out, in addition to part of the sample (10) not having answered the question, related to revenue. Therefore, large companies predominated when considering the two variables

Other relevant aspects are the time of operation in the market, being 28.1% (between 31

and 50 years) and 26.6% (50 years or more). The representativeness of the sample by segment is located, according to the National Code of Economic Activities (CNAE in Portuguese), in subclass 2.3, directed to the manufacturing industries. The food/beverage/tobacco sector stood out with 13 respondents, followed by electronics and equipment (14).

In relation to the respondents, they belong to the most diverse positions, but 40.6%, the majority, occupy the management position, and 65.6%, together, occupy the position of Chairman, Board of Directors, or Management. Since they work, on average, up to 10 years in the company, they are equivalent to more than 50% of the sample.

The results of the variables innovation, collaboration for innovation, economic dimension, social dimension, and environmental dimension will be presented below, as well as the values referring to the mean and standard deviation. The values for asymmetry and kurtosis were also observed, considering the parameters indicated in the literature (Field, 2020; Hair, Black, Babin, Anderson & Tatham, 2009). After specific adjustments, it was found that the sample data tend to normality.

The internal consistency of the construct has still been verified, from Cronbach's Alpha, according to the parameters indicated in the literature (Field, 2020; Hair et al. 2009).

Table 1 presents the variables related to the innovation construct, showing how companies have sought, in recent years, factors related to innovation.

Table 1
Variables related to Innovation.

Variable	Mean	Standard Deviation
IN01 We seek to develop new products/services.	4.47	0.689
IN02 We seek to make changes or improvements in current products/services.	4.50	0.617
IN03 We seek to develop new production and/or management processes.	4.14	0.774
IN04 We seek to make changes or improvements in the current production/service processes.	4.25	0.797
IN05 We seek to develop or make changes or improvements in our management process.	3.98	0.882
IN06 We seek to develop or make changes or improvements in our purchasing and storage processes.	3.89	1.056
IN07 We seek to develop or make changes or improvements in our marketing and	3.91	0.995

Variable	Mean	Standard Deviation
sales processes.		
IN08 We seek to acquire or develop new equipment / software that enable the improvement in the production process or in the production of new products / services.	3.81	0.957
IN09 We seek to develop methods and/or tools to actuate the creation and/or improvement of products/services.	3.92	0.965
IN10 We seek to develop methods and/or tools to actuate the creation and/or improvement of productive or organizational processes.	3.72	0.951
IN11 We seek to invest resources in research and development of new products/services or improvements thereof.	3.69	1.052
IN12 We seek to invest resources in training our employees on the development and/or improvement of products/services and productive or organizational processes.	3.58	1.051
IN13 We seek relevant information about the development and/or improvement of products/services and productive or organizational processes.	3.91	0.868
IN14 We seek to establish partnerships or collaborations aimed at the development and/or improvement of products/services and productive or organizational processes.	3.64	0.932
IN15 We seek to know all the obstacles to the development and/or improvement of products/ services and productive or organizational processes.	3.78	0.806
IN16 We seek to know all the facilitating factors of the development and/or improvement of products/services and productive or organizational processes.	3.77	0.868
IN17 We seek to invest financial resources in the development and/or improvement of products/services and productive or organizational processes.	3.73	0.963
IN18 We seek to invest time in the development and/or improvements in products/services and productive or organizational processes.	3.91	0.938
IN19 We seek to maintain a strategy that supplies the development and/or improvement of products/services and productive or organizational processes.	3.97	0.975

Source: Prepared by the authors.

In this case, the averages (between three and four) indicate that the sample has invested in innovation, and has implemented something new or significantly improved, at the same time about a product, a process, a marketing method or organizational methods. The variables that deserve attention for innovation are IN01, IN02, IN03, and IN04. That is, organizations have sought to develop new products and services, but also to develop improvements in current ones and in process.

Compared to the studies presented by Kuhl (2018) and Kuhl and Costa (2019), it is clear that the averages that have reached highlights are also mainly related to incremental innovations, followed by radical ones, which is natural, according to the author, given that radical innovation requires a more complex organization.

Next, Tables 2 and 3 show the variables related to the sources and reasons for collaboration for innovation, according to the sample collected.

Table 2
Variables referring to Sources of Collaboration for Innovation.

Variable	Mean	Standard Deviation
CF01 Branches or other companies within the same business group.	3.28	1.578
CF02 Suppliers or supply chain organizations.	3.44	0.974
CF03 Customers or consumers.	3.91	0.971
CF04 Competitors or other companies in the same segment.	2.47	1.126
CF05 Universities or other higher education institutions.	2.78	1.091
CF06 Private research and R&D institutes, and private laboratories.	2.59	1.330
CF07 Public research or innovation support institutes and private non-profit institutes.	2.53	1.208
CF08 Professional training and technical assistance centers.	2.58	1.051
CF09 Consulting.	2.84	1.144

Source: Prepared by the authors.

In the case of collaboration sources for innovation, the averages are similar to those found by Kuhl (2018) and Kuhl and Costa (2019), being practically the same. These studies also highlighted the mean and standard deviation values referring to universities, which, in Brazil, are the main organizations with the potential to develop innovations (Kuhl, 2018; Kuhl & Costa, 2019); whose index, in this comparative study, is about 0.21 higher (CF05), indicating that collaboration with this type of organization is growing, at least within the State of Paraná. It is worth noting, at this point, that the State of Paraná has a very peculiar capillarity in Public Higher Education, a factor that may have contributed to this indicator being higher than that presented by Kuhl (2018) and Kuhl and Costa (2019), which covered the whole of Brazil. The study by Cunico, Cirani, and Jesus (2014) also shows a growth in the percentage of collaborative relationships with universities and research institutes in Brazil, even taking into account that data from the last PINTEC survey (2016) have

been reduced.

However, although this sample presents a better perception for collaboration with Universities, this result still seems to fall short of what it should be, since cooperating with universities can provide access to technologies and resources that are not achieved with other institutions, especially as highlighted by Kobarg et al. (2020), access to new technologies financed in basic research.

Cooperation with customers and suppliers was also identified as a path to the sustainable performance by Marchi et al. (2022), and cooperation with suppliers and universities, by Martínez-Cháfer, Molina-Morales, and Roig-Tierno (2022), both with a focus on Spanish companies. Table 3 shows the variables regarding the motivations that lead to collaboration for innovation.

Table 3
Variables referring to the Reasons for Collaboration for Innovation.

Variable	Mean	Standard Deviation
CM01 Reduction of risk associated with the innovation process.	4.13	0.678
CM02 Reduction of the cost associated with the innovation process.	4.25	0.735
CM03 Reduction of time associated with the innovation process.	4.16	0.739
CM04 Access to technological resources.	4.20	0.717
CM05 Access to financial resources.	3.88	0.984
CM06 Access to knowledge, information and learning.	4.33	0.644
CM07 Access to other resources.	3.78	0.745
CM08 Reach of economy of scale.	3.94	0.924
CM09 Stakeholder pressure.	3.42	1.081

Source: Prepared by the authors.

It is interesting to notice the growth of means and the standard deviation in all variables, compared to the study by Kuhl (2018) and Kuhl and Costa (2019), with the exception of the variable CM05, which decreased, showing that the possibilities of access to financial resources in Brazil have been increasingly difficult. Cunico et al. (2014) also point as an obstacle, according to PINTEC data, the lack of funding. The averages "access to knowledge, information and learning" and "reduction of the cost associated with the

innovation process" highlight as the highest. The study by Cunico et al. (2014, p. 158) also points out, "that among the companies that innovated there was an increase from 10% to 16% of companies that established collaboration relationships". In this study, the increase can be clearly evidenced in sources and motivations for collaboration for innovation, when compared to the study by Kuhl (2018) and Kuhl and Costa (2019).

Tables 4, 5, and 6 are related to sustainability and the economic, social, and environmental dimensions.

Table 4

Variables related to the Economic Dimension.

	Variable	Mean	Standard Deviation
DE01	We seek to adopt actions that aim to minimize risks of losses resulting from environmental, health and safety responsibility.	4.33	0.757
DE02	We seek to adopt actions that aim to avoid complaints and returns by customers.	4.69	0.467
DE03	We seek to adopt actions that aim to minimize the impact of financial losses.	4.67	0.473
DE04	We seek to adopt actions that aim to minimize the impact of financial losses.	3.97	0.942
	We seek to adopt actions that aim to avoid losses due to economic changes at the national level.		
DE05	We seek to adopt actions that aim to avoid losses due to economic changes at the international level.	3.70	1.281
DE06	We seek to adopt actions that provide growth in productivity.	4.48	0.591
DE07	We seek to adopt actions that provide growth in market share.	4.45	0.641
DE08	We seek to adopt actions that provide revenue growth.	4.70	0.460
DE09	We seek to adopt actions that provide growth in profitability (operating profit in relation to sales).	4.64	0.515
DE10	We seek to adopt actions that provide growth in overall performance (economic-financial).	4.55	0.561

Source: Prepared by the authors.

Table 4 showed the distribution tendency of the economic dimension variables. According to the respondents' perception, the variables "we seek to adopt actions that provide us with revenue growth" (DE08) and "we seek to adopt actions that aim to avoid complaints and returns by customers" (DE02) were the ones that stood out the most in their means and standard deviation. Compared to the results obtained by Kuhl (2012), which have variables similar to or equal to those analyzed, these have grown and are related to the prevention of organizational losses. It is important to highlight

that the study by Kuhl (2012) focused only on companies in the electronics sector throughout Brazil.

The relatively high averages, referring to the economic dimension, show that companies are constantly seeking success in billing, as well as striving to minimize and prevent losses. It is also noteworthy, with a lower average, the variable "we seek to adopt actions that aim to avoid losses due to economic changes in the international sphere" (DE05), which may indicate that not all the sample has international investments or relationships.

Table 5 shows the trends, in mean and standard deviation, referring to the social dimension.

Table 5

Variables related to the Social Dimension.

	Variable	Mean	Standard Deviation
DS01	We seek to adopt actions that prioritize the generation of job opportunities for the local/regional community.	3.78	1.175
DS02	We seek to adopt policies for the inclusion of groups considered minorities (blacks, people with disabilities, etc.).	3.39	1.364
DS03	We seek to make investments to improve the quality of life of the local community.	3.34	1.198
DS04	We seek to involve stakeholders (society, government, employees and other other interested parties) in the company's relevant decision-making.	2.73	1.102
DS05	We seek to offer training and qualification courses for all employees.	3.70	1.049
DS06	We seek to reduce the rate of workforce turnover.	4.11	0.838
DS07	We seek to implement actions that lead to better working conditions, in order to increase the well-being and satisfaction of employees with their work.	4.03	0.925
DS08	We seek suggestions from employees regarding the improvement of the products quality, processes and performance of the Health, Safety and Environment System.	4.03	0.908
DS09	We seek to emphasize, in our management, actions to prevent work-related injuries and diseases.	4.47	0.689

	Variable	Mean	Standard Deviation
DS10	We seek to adopt work accident prevention systems/programs.	4.59	0.526
DS11	We seek to make partnerships/agreements with other companies/institutions for social actions.	3.11	1.197
DS12	We seek to adopt social training programs for managers and employees.	3.19	1.220

Source: Prepared by the authors.

Observing Table 5, we can see that the highest variables are those aimed at the prevention of diseases and accidents at work (DS09 and DS10), showing the concern of companies with the internal environment. Kuhl (2012) also found the superiority of means in the concern with the internal environment, even if the analyzed variables are not exactly the same, but it can be observed that there was already this concern.

In addition, another variable that draws

attention because it is low, compared to the other ones, is the effort to involve stakeholders (society, government, employees, and other interested parties) in the relevant decision-making of the company that, in Kuhl's study (2012), was already diminished. The interest in this variable was also reduced in this research. According to the author, this is understandable because this variable represents a delicate process for the company because it involves other variables (Kuhl, 2012).

The data presented in Table 6 indicate the variables related to the environmental dimension.

Table 6
Variables related to the Environmental Dimension.

	Variable	Mean	Standard Deviation
DA01	We seek to reduce the water consumption per product produced.	4.11	0.928
DA02	We seek to reduce the material consumption per product produced.	4.31	0.653
DA03	We seek to reduce energy consumption per product produced.	4.30	0.810
DA04	We seek to replace conventional energy sources with energy from renewable (clean) sources.	3.27	1.348
DA05	We seek to reduce the use of packaging materials.	3.63	1,134
DA06	We seek to eliminate the use of persistent, bioaccumulative and toxic chemicals.	4.00	0.976
DA07	We seek to develop actions to reduce the amount of waste generated in its production process.	4.14	0.870
DA08	We seek to diffuse the practice of recycling in industrial and administrative operations.	4.20	0.876
DA09	We seek to develop products in order to facilitate their disassembly, reuse and recycling of their materials (reverse logistics).	3.61	1.121
DA10	We seek to use recyclable/biodegradable packaging.	3.47	1.259
DA11	We seek to offer products with take-back policy.	2.53	1.380
DA12	We seek to adopt actions aimed at reducing gas emissions (greenhouse and acids).	3.52	1.260
DA13	We seek to develop efficient products in relation to energy consumption, predicting savings in the use phase.	3.83	1.106
DA14	We seek to make partnerships/agreements with other companies/institutions for environmental actions.	3.11	1.274
DA15	We seek to adopt environmental training programs for managers and employees.	3.05	1.278
DA16	We seek to adopt programs/systems to prevent possible environmental accidents.	3.91	1.080

Source: Prepared by the authors.

The highest variables, according to Table 6, are: "we seek to reduce the material consumption per product produced" and "we seek to reduce energy consumption per product produced" (DA02 and DA03). As verified in the study by Kuhl

(2012), which analyzed these two same variables, we found that they are linked to the decrease in the cost of production, benefiting the company. In addition, the means DA02 and DA03 increased considerably in this sample, when compared to the Kuhl sample (2012).

Another variable that draws attention because it is extremely low, is DA11, which represents the concern to use products that return to the company after use. In the study by Kuhl (2012), this variable was higher, indicating the disinterest of this sample in packaging return policies. However, in this case, it is necessary to consider that in many sectors there is no need for return packaging and in others, in which there should be a return, this is not yet practiced by organizations, either because of the lack of own initiative or for the lack of specific regulation.

Afterward, the variables of each construct were considered as components of these, thus resulting in 6 constructs: innovation, sources of collaboration, reasons for collaboration, economic

dimension, social dimension, and environmental dimension. However, some of these constructs can also be grouped: collaboration for innovation (sources of collaboration and reasons for collaboration); sustainability (economic dimension, social dimension, and environmental dimension), bearing in mind that these are dimensions of those.

Thus, the mean of the variables will compose the mean of the constructs, as shown in Table 7, and the means of the constructs, referring to collaboration and the dimensions of sustainability, will compose the mean of these. In addition, the result of Cronbach's Alpha test is presented, which indicates the internal consistency of the constructs and should be greater than 0.7.

Table 7
Descriptive Statistics of Constructs.

Constructs	Mean	Standard Deviation	Cronbach's Alpha
INNOVATION	3.92	0.658	0.950
COLLABORATION	3.47	0.552	-
Sources of Collaboration	2.94	0.769	0.832
Reasons for Collaboration	4.01	0.548	0.847
SUSTAINABILITY	3.94	0.549	-
Economic Dimension	4.42	0.468	0.853
Social Dimension	3.71	0.704	0.891
Environmental Dimension	3.69	0.749	0.921

Source: Prepared by the authors.

Conbach's Alpha was not generated for the collaboration and sustainability constructs because they are very sensitive to a small number of elements; and in this case, it may not be consistent, especially in the case of collaboration, which is made up of only two parts. In the case of sustainability dimensions, because they have three parts, the result is even satisfactory (0.794).

Table 7 shows that the means of innovation (3.92) and sustainability (3.94) are close to each other and, when compared to collaboration (3.47), are also higher, indicating that collaboration may still be under development or in the process of organizational maturation when compared to innovation and to dimensions of sustainability.

When analyzing the constructs of the means of collaboration (sources and reasons), the reasons for collaboration are considerably higher (4.01). Thus, it can be affirmed that companies seek

collaboration to overcome disadvantages and increase revenue and knowledge, however, they may have difficulties to find the source for collaboration (2.94), to meet their needs and then actually develop collaboration for innovation and sustainability.

In sustainability, the highest mean is in the economic dimension (4.42), which is acceptable, since companies are constantly concerned with billing and gains in processes.

After this part of the analyses, were initiated the analyses that aim to answer the research question. Thus, the first part consists of analyzing how collaboration for innovation is developed. For this, it was decided to use Cluster Analysis to separate the responding companies according to their profile in front of the sources and the reasons for collaboration. For this analysis, it was decided to use the Ward Method as a clustering method and the squared Euclidean distance, as a measure of

distancing, to verify the existence of groupings of the respondents, according to the response characteristics of the constructs, sources of collaboration and reasons of collaboration. The

verification of the result of the Cluster Analysis indicated the existence of two clusters, as identified in Figure 1.

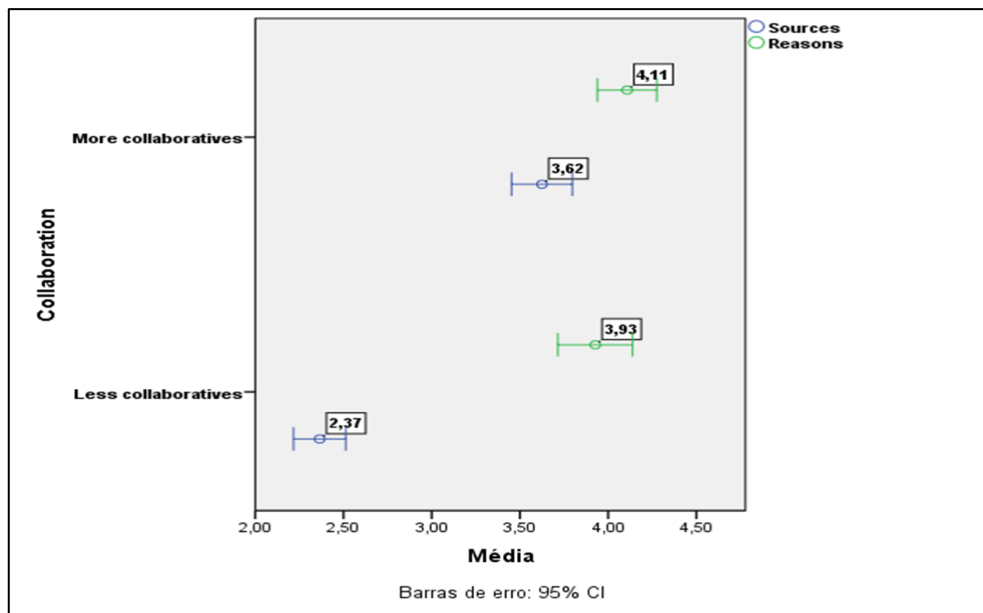


Figure 1 - Graph of collaboration groupings for innovation. Source: Prepared by the authors.

Initially, it was verified that the first grouping is composed of 35 responding companies and that the second grouping consists of 29 companies. It is noticed that the two groupings have a significant number of companies (approximately 55% and 45%, respectively).

It can be observed, in Figure 1, that the aspect that differentiates the two groupings are the sources of collaboration. Thus, it is noted that both groups are very close about the mean of the reasons for collaborating, without any statistically significant difference, indicating that the two groups attribute similar importance to the reasons for collaborating. On the other hand, concerning the sources of collaboration, there are differences between the means, indicating that collaboration itself is rare for the first grouping (less collaborative) and more

frequent in the case of the second grouping (more collaborative).

In this way, collaboration takes place differently, in terms of sources. This result also reinforces what Kuhl (2018a, p. 11) states, that "effectively collaboration is a factor that impacts innovation, but still in an incipient way".

The next step in the analyses consists of analyzing the rest of the general objective of the study, that is, the relationship of collaboration for innovation and sustainability of the manufacturing industries of the state of Paraná. For this, Pearson's Correlation Analysis was used, which aims to identify the existence and intensity of the relationship between variables (Field, 2020; Hair et al. 2009; Fávero, Belfiore, Silva & Chan, 2009).

The result of the Correlation Analysis is shown in Table 8.

Table 8
Correlation coefficients between constructs.

		Sustainability	Economic	Social	Environmental
Collaboration	Pearson's Correlation	0.558**	0.487**	0.589**	0.369**
	GIS (2 extremities)	0.000	0.000	0.000	0.003
	N	64	64	64	64

Source: Prepared by the authors.

Initially, it is noticed that the correlation coefficients are statistically significant in all cases, being higher, when analyzing the correlation between collaboration for innovation and the social dimension, and reduced, when analyzing the correlation between collaboration for innovation and the environmental dimension.

Thus, although the economic dimension presents higher means, when compared to collaboration, the social dimension occurs more significantly, as shown in Table 8. Even Awan and Sroufe (2021) find a very close coefficient (0.412) when analyzing the relationship between collaboration and social performance of industries in Pakistan.

In collaboration for innovation, the social dimension has greater relevance. This statement was highlighted by Gonçalves-Dias, Guimarães, and Santos (2012) when they affirm that the future of innovation lies in the capacity for dialogue and constructive social repercussion. Thus, this result can happen because the collaboration takes place

from the involvement between people, thus occurring in a more social way.

Another conclusion, based on the analyses in Table 8, is that innovation, when seeking collaboration, is not so focused on environmental issues, since it has less significance when compared to social involvement and economic revenue. Dellarmelin, Severo, and Lazzarotto (2017) affirm, in their studies, that information on the environmental sustainability of innovation does not significantly influence the consumer's purchase intention, which may justify the results found in this study.

Taking advantage of the classification of industries, obtained through the Cluster Analysis, it was verified the possibility that industries classified as more collaborative were also those with more accentuated sustainable development (considering the three dimensions). Thus, a graph was compiled (Figure 2) with the data from this analysis.

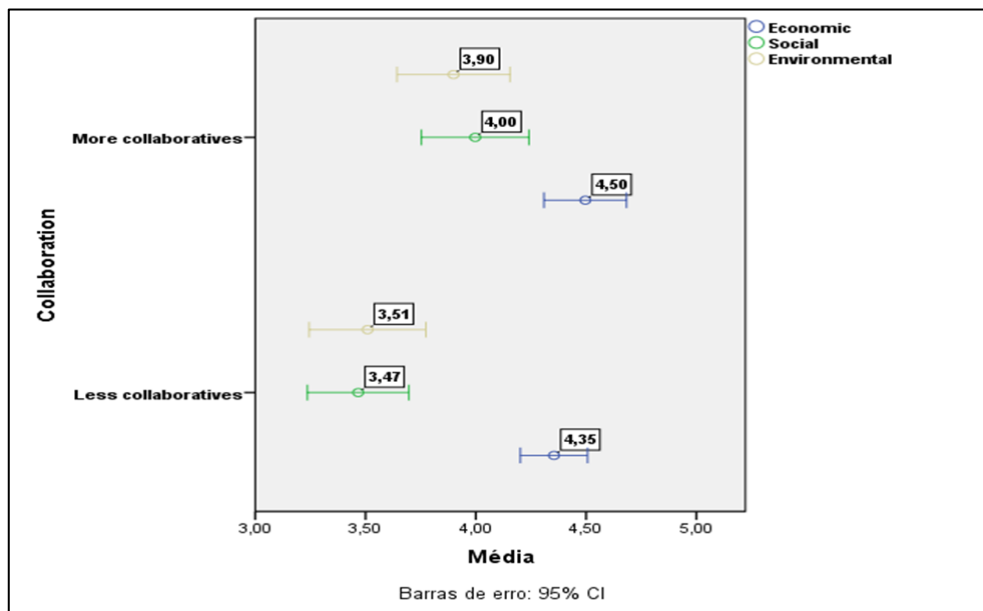


Figure 2 - Graph of the Collaboration groupings in relation to the Dimensions of Sustainability. Source: Prepared by the authors.

Analyzing Figure 2, a slight discrepancy in the means is perceived, especially in the case of the social and environmental dimensions. However, as it is not possible to visually confirm the existence of differences between them, the t-test for independent samples was performed, to confirm or not the difference in means. In the economic dimension, the significance in equal variances

assumed was 0.229, and in equal variances not assumed was 0.234; in the social dimension, the results were 0.002 and 0.002; and in environmental was 0.037 and 0.035, respectively.

The results presented confirm the suspicion of difference between the means of the two groupings about the social dimension and the environmental dimension, even confirming, as shown in Figure 2, that the means are higher in the three dimensions

for industries classified as more collaborative.

Thus, statistically, there are differences in means, especially in the environmental and social dimensions. The significance shows that, in the social and environmental dimensions, they are less than 0.05, confirming the difference between them.

In addition, the companies, which collaborate more, presented higher means in the economic, social, and environmental dimensions. This may indicate that collaboration can generate greater organizational sustainability in its dimensions. Kuhl (2012, p. 233) concluded in his studies that "organizations with a propensity to be more sustainable are also those with a propensity to be more collaborative and also more innovative." This may be associated with the fact that the collaboration contributes to increase opportunities and mitigate challenges (Silva et al. 2020).

Conclusions

The aim of this study was to analyze how collaboration for innovation and its relationship with sustainability in manufacturing industries in Paraná develops. From the data collected by a structured questionnaire, destined for the manufacturing industries of the state of Paraná, 64 valid questionnaires until the moment of the analyses for this study were collected.

In the analysis of the variables "innovation", "sources and reasons for collaboration" and "dimensions of sustainability", it was verified that, in innovation, organizations aimed to develop new products and services, in addition to developing improvements in current products and services and in organizational processes. The main reasons for collaborating were: the cost reduction associated with the innovation process, access to technological resources, and access to knowledge, information, and learning. The main sources of collaboration were: branches or other companies, within the same business group; suppliers or supply chain organizations; customers or consumers.

In order to characterize the dimensions of sustainability, with greater precision, its dimensions were analyzed separately. It was found that, in the economic dimension, companies have

sought actions that aim to avoid complaints and returns by customers and increase revenues. In the social sphere, the actions are aimed at implementing systems/programs for the prevention of accidents at work. And, in the environmental dimension, the prominent variables are related to reducing the consumption of material per product produced.

Regarding the means of the variables (innovation, collaboration, and sustainability) there is a similarity with the results found in the study by Kuhl (2012, 2018) and Kuhl and Costa (2019), and Cunico et al. (2014).

Regarding the results found in Cluster Analysis, from the grouping of variables, the initial grouping was for more collaborative and less collaborative companies and the two groupings attribute similar importance to the reasons for collaborating. On the other hand, with regard to collaboration sources, there are differences between the means, indicating that collaboration itself is rare in the first grouping (less collaborative) and more frequent in the second grouping (more collaborative). It can be affirmed, therefore, that collaboration itself does not occur frequently in the companies surveyed, since the difference in means from reasons for sources is considerable.

In the second grouping, the variables collaboration for innovation and sustainability were considered, to then answer the question regarding the relationship between them in the manufacturing industries of the state of Paraná. Although the economic and environmental dimensions present higher means, when compared with collaboration, the social dimension occurs more significantly, since there is a social involvement between the parties.

Another conclusion is that innovation, when seeking collaboration, is not so focused on environmental issues, because there are greater interests focused on the economic and social issues of sustainability.

From this grouping, it can also be affirmed, therefore, that the companies, which collaborate more, are also developing prominent actions, focused on the economic, social, and

environmental dimensions, demonstrating that they have a greater balance for sustainability. Thus, there are strong indications that collaboration for innovation can influence organizational sustainability, allowing the development of future studies, which can effectively verify this evidence.

the development of future studies, which can effectively verify this evidence.

However, in both groups, the means are not so high to allow concluding that collaboration is effectively the differential for sustainable performance since there are several factors that hinder collaboration, especially with a focus on innovation, such as scarcity of financial, intellectual, and technological resources (Silva et al., 2020), among others.

Thus, it is concluded that collaboration and sustainability are impact factors for innovation, especially when it comes to social sustainability, which has a greater relationship with collaboration for innovation. Although collaboration in innovation is under development in organizations, since the sources means still do not have considerable values, there is a concern to seek new sources of knowledge, resources, and/or failures in sources external to the organization, which also ends up promoting the dimensions of sustainability.

As the main limitation of this study, the difficulty of reaching a considerable sample can be highlighted; limiting factor, in Brazil, in research in the Administration Area, because many of the industries, to which the questionnaires were sent, did not answer and showed no interest in the subject. Despite the reliability of this study, some organizations did not answer for preserving their data and/or claiming they were not authorized to provide the information.

Another limitation is the indicators used since these come from measuring the perception of the respondents when the ideal would be indicators derived from the effective economic, social, and environmental performance. Economic performance indicators even exist but are not disclosed, except by companies obliged to do so, while social performance and environmental performance indicators are few and not disclosed.

Future studies may strive to analyze

collaboration for innovation and sustainable performance, based on effective indicators, and not on the perception of survey respondents. Also, they can analyze other states and compare the results.

Acknowledgment

Araucaria Foundation
CAPES

References

- Awan, U. & Sroufe, R. (2020). Interorganisational collaboration for innovation improvement in manufacturing firms': the mediating role of social performance. *Int. J. Innov. Manag.*, 24 (05), 2050049.
<https://doi.org/10.1142/S1363919620500498>
- Araujo, R. & Franco, M. (2021). The use of collaboration networks in search of eco-innovation: A systematic literature review. *Journal of Cleaner Production*, 314, 127975.
<https://doi.org/10.1016/j.jclepro.2021.12797>
- Baumgartner, R.J. & Ebner, D. (2010). Corporate sustainability strategies: sustainability profiles and maturity levels. *Sustainable Development*, 18(1), 78-80.
- Bos-Brouwers, H.E.J. (2010). Corporate sustainability and innovation in SMEs: evidence of themes and activities in practice. *Business Strategy and the Environment*, [s.l.], 417-435.
<http://dx.doi.org/10.1002/bse.652>
- Branten, E. & Purju, A. (2015). Cooperation projects between university and companies: process of formation and objectives of the stakeholders. *Entrepreneurship and Sustainability Issues*, 3(2), 149-156.
[http://dx.doi.org/10.9770/jesi.2015.3.2\(3\)](http://dx.doi.org/10.9770/jesi.2015.3.2(3))
- Brem, A. & Radziwon, A. (2017). Efficient Triple Helix collaboration fostering local niche innovation projects – A case from Denmark. *Technological Forecasting and Social Change*, [s.l.] (123), 130-141.
<http://dx.doi.org/10.1016/j.techfore.2017.01.002>
- Claro, P.B.O., Claro, D.P. & Amâncio, R. (2008). Entendendo o conceito de sustentabilidade nas organizações. *Revista de Administração - RAUSP*,

43(4), 292-300.

Collis, J. & Hussey, R. (2005). *Pesquisa em Administração: um guia prático para alunos de graduação e pós graduação*. Porto Alegre: Bookman.

Cunico, E., Cirani, C.B.S. & Jesus, J.S. (2014). Estrutura do SNI Brasileiro e Cooperação para Inovação na Indústria Nacional: Uma Análise Exploratória a partir da Pintec. *Ciências Sociais Aplicadas em Revista - UNIOESTE/MCR*, 14(27), 148-164.

Dellarmelin, M.L., Severo, E.A. & Lazzarotto, J. (2017). A Influência da Inovação Sustentável e do Luxo Sobre a Disposição a Pagar e a Intenção de Compra do Consumidor. *Read. Revista Eletrônica de Administração*, 23(2), 258-273. <http://dx.doi.org/10.1590/1413.2311.058.62218>.

Dosi, G., Marengo, L. & Fagiolo, G. (2001). *Learning in Evolutionary Environments*. Sant'Anna School of Advanced Studies, Laboratory of Economics and Management, Pisa: Italy.

Elkington, J. (2001). *Canibais com garfo e faca*. Trad. Patrícia M. Ramalho. Rev.Tec. Leonel S.Maia. São Paulo: Makron Books.

Fávero, L.F., Belfiore, P., Silva, R.L. & Chan, B.L. (2009). *Análise de dados: modelagem multivariada para tomada de decisões*. Rio de Janeiro: Elsevier.

Field, A. (2020). *Descobrendo a Estatística Usando o SPSS*. 5 ed. Porto Alegre: Artmed.

Flick, U. (2012). *Introdução à Metodologia de Pesquisa: um guia para iniciantes*. Porto Alegre: Penso.

Gallouj, F. & Weinstein, O. (1997). Innovation in services. *Research Policy*, 26(1), 537-556.

García, S. M., Torres, G. C. L., García, R. M. C. & Ramos, M. J. P. (2018). Tecnologías de la información e influencia en la aplicación de los principios de innovación – Information technology and influence on the application of innovation principles. *Mercados y Negocios*, 1(3), 07-34.

Gonçalves-Dias, S.L.F., Guimaraes, L.F. & Santos, M.C.L. (2012). Inovação no Desenvolvimento de

Produtos “Verdes”: Integrando Competências ao Longo da Cadeia Produtiva. *Review of Administration and Innovation - RAI*, 9(3), 129-153, <http://dx.doi.org/10.5773/rai.v9i3.782>.

Greco, M., Locatelli, G. & Lisi, S. (2017). Open innovation in the power & energy sector: Bringing together government policies, companies' interests, and academic essence. *Energy Policy*, 104(1), 316-324. <http://dx.doi.org/10.1016/j.enpol.2017.01.049>.

Hair Jr., J.F., Black, W.C., Babin, B.J. Anderson, R.E. & Tatham, R.L. (2009). *Análise Multivariada de Dados*. 6 ed. Porto Alegre: Bookman.

Halme, M. & Korpela, M. (2013). Responsible Innovation Toward Sustainable Development in Small and Medium-Sized Enterprises: a resource perspective. *Business Strategy and the Environment*, 23(8), 547-566. <http://dx.doi.org/10.1002/bse.1801>.

Hawkey, D. & Webb, J. (2014). District energy development in liberalised markets: situating UK heat network development in comparison with Dutch and Norwegian case studies. *Technology Analysis & Strategic Management*, 26(10), 1228-1241. <http://dx.doi.org/10.1080/09537325.2014.971001>.

Henderson, R.M., Clark, K.B. (2001). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firm. (3 ed.). *Strategic Management of Technology and Innovation*. McGraw-Hill.

IBGE – Instituto Brasileiro de Geografia e Estatística. *Pesquisa de Inovação – 2017*. (2018). Rio de Janeiro: IBGE. Disponível em [<http://www.pintec.ibge.gov.br>]. Acesso em 22/04/2022.

Iturrioz, C., Aragón, C. & Narvaiza, L. (2015). How to foster shared innovation within SMEs' networks: Social capital and the role of intermediaries. *European Management Journal*, 33(2), 104-115. <http://dx.doi.org/10.1016/j.emj.2014.09.003>.

Jones, J. & Zubielqui, G.C. (2017). Doing well by doing good: A study of university-industry interactions, innovationness and firm performance in sustainability-oriented Australian SMEs. *Technological Forecasting and Social Change*,

123(1), 262-270.
<http://dx.doi.org/10.1016/j.techfore.2016.07.036>.

Klement, C.F.F. (2007). *Inovação em serviços: estudo de casos em uma organização da indústria hoteleira brasileira*. (Tese de Doutorado). Universidade de São Paulo, São Paulo.

Kobarg, S., Stumpf-Wollersheim, J., Schlägel, C. & Welpel, I.M. (2020). Green together? The effects of companies' innovation collaboration with different partner types on ecological process and product innovation. *Industry & Innovation*, 27(9), 953-990.
<https://doi.org/10.1080/13662716.2020.1713733>.

Kuhl, M.R. (2012). *Interdependência entre a Colaboração para Inovação e o Desempenho Sustentável na Indústria Brasileira de Eletroeletrônicos*. Tese Doutorado. Universidade Federal do Paraná. Curitiba.

Kuhl, M.R. (2018). *Comportamento colaborativo de empresa brasileiras*. In.: XXI SEMEAD-2018, São Paulo. Anais do XXI SEMEAD.

Kuhl, M.R. & Costa, Z.F. (2019). Influence of interorganizational collaboration on the implementation of innovations. *International Journal of Innovation*, 7(3), 412-430.
<https://doi.org/10.5585/iji.v7i3.373>.

Lundvall, B. (2007). National Innovation Systems—Analytical Concept and Development Tool. *Industry & Innovation*, 14(1), 95-119.
<http://dx.doi.org/10.1080/13662710601130863>.

Manning, S. & Roessler, D. (2013). The Formation of Cross-Sector Development Partnerships: How Bridging Agents Shape Project Agendas and Longer-Term Alliances. *Journal of Business Ethics*, 123(3), 527-547.
<http://dx.doi.org/10.1007/s10551-013-1853-5>.

Marchi, V., Molina-Morales, F.X. & Martínez-Cháfer, L. (2022). Environmental innovation and cooperation: A configurational approach. *Technological Forecasting & Social Change*, 182, 121835.
<https://doi.org/10.1016/j.techfore.2022.121835>

Martínez-Cháfer, L., Molina-Morales, F.X. & Roig-Tierno, N., 2021. Explaining technological innovation of the clustered firms: internal and relational factors. *Journal of Small Business Management*, 1–32.

<https://doi.org/10.1080/00472778.2021.1883035>.

Morales, A.A. et al. (2018). Technology and Innovation Management in Higher Education—Cases from Latin America and Europe. *Administrative Sciences*, 8(2), 11-45.
<http://dx.doi.org/10.3390/admsci80200>.

Munck, L. (2014). *Gestão da sustentabilidade nas organizações: um novo agir frente à lógica das competências*. São Paulo: Cengage Learning.

Murray, A., Haynes, K. & Hudson, L.J. (2010). Collaborating to achieve corporate social responsibility and sustainability? *Sustainability Accounting, Management and Policy Journal*, 1(2), 161-177.
<http://dx.doi.org/10.1108/20408021011089220>.

Musiulik, J. & Markard, J. (2011). Creating and shaping innovation systems: Formal networks in the innovation system for stationary fuel cells in Germany. *Energy Policy*, 39(4), 1909-1922.

OECD/Eurostat (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg.
<https://doi.org/10.1787/9789264304604-en>

Pacheco, D.A., Caten, C.S., Jung, C.F., Navas, H.V.G. & Cruz-Machado, V.A. (2018), Eco-innovation determinants in manufacturing SMEs from emerging markets: Systematic literature review and challenges. *Journal of Engineering and Technology Management*, 48(1), 44-63.
<http://dx.doi.org/10.1016/j.jengtecman.2018.04.002>.

Rennings, K. (2000). Redefining Innovation – eco-innovation research and the contribution from ecological economics. *Ecological Economics*, 32(1).

Rezk, M.R.A. et al. (2016). Innovation magnitude of manufacturing industry in Egypt with particular focus on SMEs. *Entrepreneurship and Sustainability Issues*, 3(4), 307-318.
[http://dx.doi.org/10.9770/jesi.2016.3.4\(1\)](http://dx.doi.org/10.9770/jesi.2016.3.4(1)).

Rocha, A.C., Gomes, C.M., Kneipp, J.M. & Camargo, C.R. (2015). Gestão Sustentável da Cadeia de Suprimentos e Desempenho Inovador:

Um Estudo Multicaso No Setor Mineral Brasileiro. *Review of Administration and Innovation - RAI*, 12(2), 291-314. <http://dx.doi.org/10.11606/rai.v12i2.100343>.

Scandelari, V.R.N. (2011). *Inovação e Sustentabilidade: Ambidestralidade e Desempenho Sustentável na Indústria Eletroeletrônica*. Tese de Doutorado. Universidade Federal do Paraná, Curitiba.

Scandelari, V.R.N. & Cunha, J.C. (2013). Ambidestralidade e desempenho socioambiental de empresas do setor eletroeletrônico. *Revista de Administração de Empresas*, 53(2), 183-198. <https://doi.org/10.1590/S0034-75902013000200006>

Schumpeter, J.A. (1961). *Capitalismo, Socialismo e Democracia*. Rio de Janeiro: Editora Fundo de Cultura.

Schumpeter, J.A. (1997). *Teoria do Desenvolvimento Econômico: Uma Investigação Sobre Lucros, Capital, Crédito, Juro e o Ciclo Econômico*. São Paulo: Copyright.

Silva, L.R.; Silva, D.F.; Silva, J.C., Santos, J.S.P. & Mesquita, Q.G.A.O. (2020). Inovação colaborativa: uma proposta para gerenciamento de desafios e oportunidades para startups de base tecnológica. *FTT Journal of Engineering and Business*, (6), 24-42.

Smink, M., Negro, S.O., Niester, E. & Hekkert, M.P. (2015). How mismatching institutional logics hinder niche–regime interaction and how boundary spanners intervene. *Technological Forecasting and Social Change*, 100(1), 225-237. <http://dx.doi.org/10.1016/j.techfore.2015.07.004>.

Sternberg, H. & Norrman, A. (2017). The Physical Internet – review, analysis and future research agenda. *International Journal of Physical Distribution & Logistics Management*, 47(8), 736-762. <http://dx.doi.org/10.1108/ijpdlm-12-2016-0353>.

Subrahmanya, M.H.B., Mathirajan, M. & Krishnaswamy, K.N. (2010). Importance of technological innovation for SME growth: Evidence from India, World Institute for Development *Economics Research*, 1(3), 1-21.

Tachizawa, E.M. & Alvarez-Gil, M.J., Montes-Sancho, M.J. (2015). How “smart cities” will change supply chain management. *Supply Chain Management: An International Journal*, 20(3), 237-248. <http://dx.doi.org/10.1108/scm-03-2014-0108>.

Tachizawa, E.M. & Wong, C.Y. (2015). The Performance of Green Supply Chain Management Governance Mechanisms: A Supply Network and Complexity Perspective. *Journal of Supply Chain Management*, 51(3), 18-32. <http://dx.doi.org/10.1111/jscm.12072>.

Tidd, J., Bessant, J. & Pavitt, K. (2008). *Gestão da inovação* (3 ed.). Porto Alegre: Bookman.

Van Horne, C., Poulin, D. & Frayret, J. (2012). Innovation and value creation in university–industry research centres in the Canadian forest products industry. *Canadian Journal of Forest Research*, 42(11), 1884-1895. <http://dx.doi.org/10.1139/x2012-136>.

Zilber, M.A., Perez, G. & Lex, S. (2009). Inovação tecnológica e obtenção de vantagens competitivas: um estudo duplo qualitativo na indústria brasileira de equipamentos eletromédicos. *Organização & Sociedade – O&S*, 16(51), 707-723.