



Analysis of brazilian scientific development in the field of strategic sustainability

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Abstract

Due to changes occurred in the world since the industrial revolution, especially the ones that have taken place since the second half of the twentieth century, environmental issues have emerged as a central theme for countries and societies. Ripening of these demands resulted in enterprises being expected to take on a more responsible role. This led researchers to deepen their studies to help companies overcome the challenges of sustainability. Accordingly, to the extent that this knowledge has reached, the need for embedding social and environmental issues in the central business strategy arose, thus strategic sustainability was born. This study seeks to understand how research on strategic sustainability in organizational environment is being developed in Brazil. To reach this objective, a bibliometric survey was conducted with the aim of identifying academic publications in the field and also a sociometric study was performed to verify in which way researchers and higher education institutions (HEIs) are working. The results indicate that this research is becoming increasingly common, but there is still a long road ahead in the development of studies that mix companies' strategies with sustainable practices. Researchers who publish with coauthors are the majority, but the fact that they publish collectively does not increase their productivity. The networks formed by these authors are scattered and some researchers exert key role in their development. The networks formed by HEIs are denser and less dispersed, but also depend on a few institutions to be formed.

Keywords: Sustainability. Strategy. Research. Social network analysis.

Introduction

Sustainable development is construed as the capacity of addressing the needs of the current generation, regarding the capacity of next generations to satisfy their own necessities (CMMAD, 1988, p. 46). Based on this definition, Elkington (1997) affirmed that organizational performance should not be assessed by financial results, but rather by the environmental and social results, because these factors are closely related to the survival of humanity.

The Europeans were pioneers in this field of study. A group of researchers, known as the Club of Rome, began a study in the late 1960s, aiming to identify the limits of growth of our planet. Given the importance of the issue, in 1972 the United Nations (UN) promoted the Stockholm Conference in order to discuss environmental issues globally. Besides these two movements, many others followed, which brought significant social and legal consequences to participating countries.

Since then, the result of research and agreements between countries is that environmental and civil rights laws have become stricter while raising awareness among consumers about their rights and means of exerting pressure on organizations. As a result, since the 1980s, sustainability has become a popular subject in the field of business administration.

Due to these movements, companies were forced to consider aspects in their planning they had simply ignored before. This phenomenon is known as internalization of externalities and it brought profound challenges to the way companies are managed. This new reality has become a novel field of organizational studies which is expanding until today, mainly through the studies on corporate social responsibility (CSR) and environmental management systems (EMS).

Given the magnitude of the challenges imposed by sustainability, companies are being forced to reschedule their activities under this new paradigm. Accordingly, isolated sustainable actions are no longer effective to meet these new demands. The established picture is complex and requires stronger actions, i.e., those associated with the business strategy, which considers aspects of greatest impact and in the long term. Therefore, in the present paper, strategic sustainability is considered as being the fueling action of sustainable development that is embedded in organizational strategy.

Based on the above, this study aims to understand how research on strategic sustainability in the organizational environment is being developed in Brazil. To that end, two studies were conducted: a bibliometric study aiming to identify the academic publications and a sociometric study to verify the work of researchers and higher education institutions (HEIs). As a secondary objective, the intention is to verify if researchers in the field who publish along with other authors are more productive than authors who publish alone, identifying if the network of researchers is a factor that contributes to the development of the topic.

Theoretical and empirical support Strategic sustainability

Environmental degradation resulting from industrial activities of the twentieth century has called attention of various sectors of society and imposed a series of restrictions on supply chains. Such restrictions arrived to companies in the form of legal changes or as shortages of raw materials. Associated with this, various crises and accounting scandals shook public confidence in companies, especially in large corporations. Thus, from the 1970s on, various movements for social and environmental awareness have begun to influence companies through their stakeholders.

Because of the importance of the topic, many studies have been conducted in order to see how companies can overcome challenges posed by sustainability. Elkington (1997) argues that companies or industries that are unable to adapt may be doomed to failure. Hart (2006) defends the idea that the capitalist world is going through a period of creative destruction in which the current consumption patterns will be supplanted by new ones.

The term strategic sustainability is related to social and environmental investments, made directly in the core business of a company. In this way, organizations that are able to integrate sustainability into their strategies are better able to seize opportunities and neutralize threats from social and environmental demands, ensuring competitive advantage (CLARO; CLARO, 2014).

Porter and Kramer (2011) argue that most companies have a myopic view on value creation. Thus, they are still stuck in an old way of thinking in which the creation of economic value is incompatible with social progress. For these authors, creating shared value, i.e., the one that considers the needs and social challenges together with the creation of economic value, is the perspective that works to enhance the competitiveness of enterprises.

In this sense, there is a growing concern in organizations related to the merger of corporate social responsibility actions into their business strategies in order to develop products, rebuild processes and implement business guided by the principles of sustainability, while also responding to the pressures and expectations of stakeholders (SANTOS; DA SILVA; GÓMEZ, 2012).

Social Network Analysis

Scientific development is responsible for finding solutions to existing problems. Thus, many organizations strive to improve their products and processes through the knowledge gained from research and development (R & D) activities. In addition, universities and researchers contribute to the development of scientific innovations. Nowadays, due to the complexity and scope of existing challenges, the dynamics of R & D is increasingly plural, causing researchers and institutions to form collaborative networks in order to disseminate knowledge, learning and technological development (BULGACOV; VERDU, 2001).

According to Yayavaram and Ahuja (2008), in a dynamic technological environment, the knowledge structures that are characterized by dense groups of researchers

and institutions, which are connected by weak ties to other dense groups of researchers and institutions, are more likely to develop the most useful innovations than the structures only characterized by dense groups or only by isolated groups.

This finding may support the concept of structural holes. The same idea was developed by Burt (1992) and is based on the work of Granovetter (1973), who believes that the weak ties between two actors in a social network generate a paradoxical effect. Even though it is speculated to be otherwise, this apparent weakness of the bonds is essential in harnessing opportunities and integration between communities. This is because weak ties do not require the same energy to be maintained, but allow equal access to knowledge. Thus, an efficient actor is the one that has many structural holes in his network.

Social network analysis (SNA) is a methodology used in analyzing the behavior of individuals connected by specific bonds, reflecting the present interactions and interconnectedness. Therefore, the focus of analysis is not on the individual himself, but on his role and on the role played by the group (SOUZA; QUANDT, 2008).

According to Carpenter, Li and Jiang (2012), several studies have used SNA in organizational environments, on the interpersonal level, as well as on the inter-organizational one. For these authors, there are basically two types of such studies: those focused on research on social capital and those focused on research into the development of the network. Naturally, depending on the focus and the desired level of depth, the researcher is required to use specific methods, indicators and constructs.

Methodology

To achieve the proposed objectives, a longitudinal analysis of 37 events was performed. Between the years 1997 and 2013, academic articles published in the Meetings of National Association for Graduate Studies and Research in Administration (EnAN-PAD) were analyzed. Between 1998 and 2013, academic articles published in Seminars in Administration (SEMEAD) hosted by FEA-USP were also studied. Between the years 2001 and 2013, academic articles published in International Conference on Management and Environment (ENGEMA) were targeted. Between the years 2003 to 2013, academic articles published in the Meeting for Studies in Strategy (3Es) were observed, and finally, between years 2004 and 2013, academic articles published in the Symposium for Excellence in Management and Technology (SEGET) were analyzed.

The idea to select only articles published in conference proceedings was due to the fact that these papers are considered the birth of those that came to be published in journals and periodicals after undergoing revisions and debates. Therefore, duplicate counting of authors and papers is avoided. Furthermore, Walter and Bach (2013) argue that this type of selection favors the homogeneity of the sample and ensures greater amount of data.

The selection of articles was made in the strategy field of the mentioned events and also in specific areas (sustainability, EMS or CSR), when appropriate. For this, a search engine was used in which the words - sustainability, sustainable, environment, environmental or social, as well as their corresponding terms in Portuguese and Spanish languages, were present in the title or keywords in articles in the area of strategy. In

addition, the words – strategy or strategic - and their Portuguese and Spanish equivalents were present in the title or keywords in articles in the areas of CSR, sustainability or EMS, if applicable. After this first filter, the abstracts of articles were read in order to verify if they actually dealt with the subject under analysis.

After this selection phase, applied descriptive statistics was applied to the articles and, through the Mann-Whitney nonparametric test, it was sought to identify if the authors who write collectively are more productive than the authors who write alone. For these analyses, a version 17.0 of SPSS software was used. In addition to these analyses, the authors and their institutions were identified and squared matrices were elaborated with them to identify the network of researchers and the network of HEIs. Thus, the present study analyzed two networks; one where the actors are the authors of articles and one where the actors are the HEIs. Ties of co-authorship formed both. Beyond the squared matrix, graphical presentation of the network was developed. The social network analysis was performed using Ucinet software, version 6.507, and aimed to: 1) identify the centrality of actors and their acting as gatekeepers, considering that prominent actors are those involved in many relationships with other actors; 2) identify the amount of structural holes and compare efficiency between actors, whereas redundant contacts tend to be unnecessary; 3) identify blocks of researchers through analysis of structural equivalence.

Results

Table 1 shows the total number of articles in the events analyzed, as well as the quantity of articles in the areas of strategy and sustainability-related topics (the sum of these areas is presented). Besides this information, in the penultimate column, we can observe the quantity of items that meet the criteria presented in the former paragraph and were selected for the study.

Table 1 – Quantitative of Articles

Event	Total of Articles	Articles in Strategy and/or Sustainability fields	Selected Articles
3Es	679 (100%)	679 (100%)	17 (2.5%)
EnANPAD	11495 (100%)	1404 (12.2%)	52 (0.5%)
ENGEMA	1232 (100%)	1232 (100%)	58 (4.7%)
SEGeT	3550 (100%)	1103 (31.1%)	22 (0.6%)
SemeAd	4554 (100%)	764 (16.8%)	24 (0.5%)
TOTAL	21510 (100%)	5182 (24.1%)	173 (0.8%)

Source: Research data.

Based on data presented in Table 1, it is observed that the fields of strategy and sustainability represent almost a quarter of the studies presented in the analyzed events (24.1%), however, by the filtering criteria in the survey, only 0.8% of articles deal with both issues at hand. This indicates that both the theme of Strategy and the

theme of Sustainability attract researchers, but few undertake research that takes into account how the interaction between these two areas occurs.

Altogether, 394 researchers were responsible for the publication of the selected articles. Of these, 94% (371) have written their articles with coauthors and only 6% (23) have published separately.

Table 2 presents the number of articles per event over the period analyzed. Dashes indicate no event in the year, while the number "0" indicates that the event occurred, but no article that meets the search filters was published in it.

Table 2 – Quantitative of Articles published per event

Event\year	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Total	%
Engema	-	0	0	0	2	0	4	0	0	0	0	5	0	17	12	11	7	58	34%
Enanpad	1	0	0	0	3	5	4	1	3	3	3	1	4	8	4	8	6	54	31%
Seget	-	-	-	-	-	-	-	0	4	5	3	2	0	2	1	3	2	22	13%
Semead	-	0	0	0	0	0	0	1	4	0	1	2	4	1	2	5	2	22	13%
3Es	-	-	-	-	-	-	0	-	0	-	0	-	3	-	7	-	7	17	10%
Total	1	0	0	0	5	5	8	2	11	8	7	10	11	28	26	27	24	173	100%
%	1%	0%	0%	0%	3%	3%	5%	1%	6%	5%	4%	6%	6%	16%	15%	16%	14%	100%	

Source: Research data.

Analyzing data in Table 2, it is observed that most of the articles (60.7%) are concentrated in the last four years (2010-2013). From 1997 to 2000, only one article was published (0.6%) and between 2001 and 2009, there was a gradual increase in the number of published articles (38.3%). These numbers indicate that this field of research presents significant growth and they also corroborate the importance sustainability is gaining within organizations.

The most targeted events by researchers are ENGEMA (34%) and EnANPAD (31%), whereas, in the past four years, the first one has 80.8% more articles than the second. This fact indicates that ENGEMA is becoming the largest Brazilian event in research on strategic sustainability. This conclusion may be based on the fact that this event is the only one of the five analyzed presenting exclusivity in environmental issues.

Table 3 shows, in descending order, the number of articles that the 10 most productive research institutions published. A few stand out as centers of research on strategic sustainability - UFSM, USP and UFSC. Together, they represent 27% of all published articles. It is observed that the total number of published articles present in the table is 249, even though the total number of articles selected is 173. This discrepancy occurs because the same article can be written by researchers from different institutions.

Table 3 – Quantitative of Articles Published per Higher Education Institution

HEI	3Es	Enanpad	Engema	Seget	Semead	TOTAL
UFSM	2	5	6	1	5	19
USP	1	4	6	1	4	16
UFSC	-	4	5	2	1	12
UFRGS	-	7	1	-	-	8
UNIVALI	-	4	2	2	-	8
EAESP-FGV	-	2	4	-	1	7
UFBA	-	5	2	-	-	7
UFC	-	5	2	-	-	7
UFLA	1	1	2	1	1	6
UFPB		3	2		1	6
OTHER	19	34	57	24	19	153
TOTAL	23	74	89	31	32	249

Source: Research data.

Table 4 shows the productivity of authors who have written more than one article. Based on this, it is observed that in absolute terms, the authors who published their articles with coauthors were much more productive than authors who published by themselves. This indicates that the network of authors should have correlation with the productivity of its members. To test this assumption, the Mann-Whitney test was used. This test was chosen because the sample used does not meet the assumptions of analysis of variance (ANOVA), but also serves to verify that the group means are statistically equal. Thus, it follows that:

Ho= mean between groups is equal

Ha= mean between groups is different

Table 5 shows the results of Mann-Whitney test. It is observed that the value of significance (p-value) was above 0.05 indicating the failure to reject the null hypothesis. Thus, even if assuming the contrary, we conclude that the means are statistically equal and there is no difference between the productivity of authors who write in isolation from authors who write collectively.

Table 4 – Authors who have published two or more articles

ISOLATED AUTHORS	QTY	AUTHORS IN GROUP	QTY
José Milton de Sousa Filho	2	Clandia Maffini Gomes	8
		Jordana Marques Kneipp	5
		Luciana Aparecida Barbieiri da Rosa	5
		Mônica Cavalcanti Sá de Abreu	5
		José Milton de Sousa Filho	4
		Elaine Ferreira	3
		Flavia Luciane Scherer	3
		Luana das Graças Queiroz de Farias	3
		Lucas Veiga Ávila	3
		Luciano Barin Cruz	3
		Maria de Fátima Barbosa Goés	3
		Samuel Carvalho De Benedicto	3
		Adilson Carlos da Rocha	2
		Alexandre de Almeida Faria	2
		André Gustavo Carvalho Machado	2
		André Luis Rocha de Souza	2
		Andréa Cardoso Ventura	2
		Attus Pereira Moreira	2
		Carla Regina Pasa Gómez	2
		Carlos Ricardo Rossetto	2
		Christiane Madalena Matheus de Alcântara	2
		Edilei Rodrigues de Lames	2
		Edison Fernandes Polo	2
		Eliete Pozzobon Palma	2
		Geraldo Sardinha Almeida	2
		Gesinaldo Ataíde Cândido	2
		Gilnei Luiz de Moura	2
		João Fernando Zamberlan	2
		João Serafim Tusi da Silveira	2
		Jorge Cunha	2
		José Célio Silveira Andrade	2
		Josiane de Andrade Pereira	2
		Josuéilton da Costa Silva	2
		Larissa Teixeira da Cunha	2
		Lúcia Rejane Da Rosa Gama Madruga	2
		Lucia Santana de Freitas	2
		Marcos Antonio Gaspar	2
		Marcos Cohen	2
		Paulo Mauricio Selig	2
		Rafael Barreiros Porto	2
		Rivanda Meira Teixeira	2
		Roberto Schoproni Bichueti	2
		Rodrigo Belmonte da Silva	2
		Soraya Giovanetti El-Deir	2
		Uiara Gonçalves de Menezes	2

Source: Research data.

As seen in Table 5, there is no significant difference between the average of published works by individual authors or in groups. Regardless of that condition, this study considered the effect of networks among researchers. This is because increasingly, science is becoming a collective enterprise. Thus, authors and research institutions

form groups with the aim of improving the production of papers. This phenomenon is already very recurrent in the natural sciences, but is becoming increasingly present in the social sciences (MOODY, 2004). In terms of this theme, Watanabe, Gomes and Hoffmann (2013) found that co-authorship is the main attribute to configure a network among researchers.

Table 5 – Mann-Whitney Test

	Number of published articles
Mann-Whitney U	3928,50
Wilcoxon W	4204,50
Z	-1,145
Sig. of asymmetry (two tailed)	0,252

Source: Research data.

Considering the exposed information, Figure 1 graphically presents the networks formed by the authors. To facilitate viewing, the components are indicated by different colors according to their size.

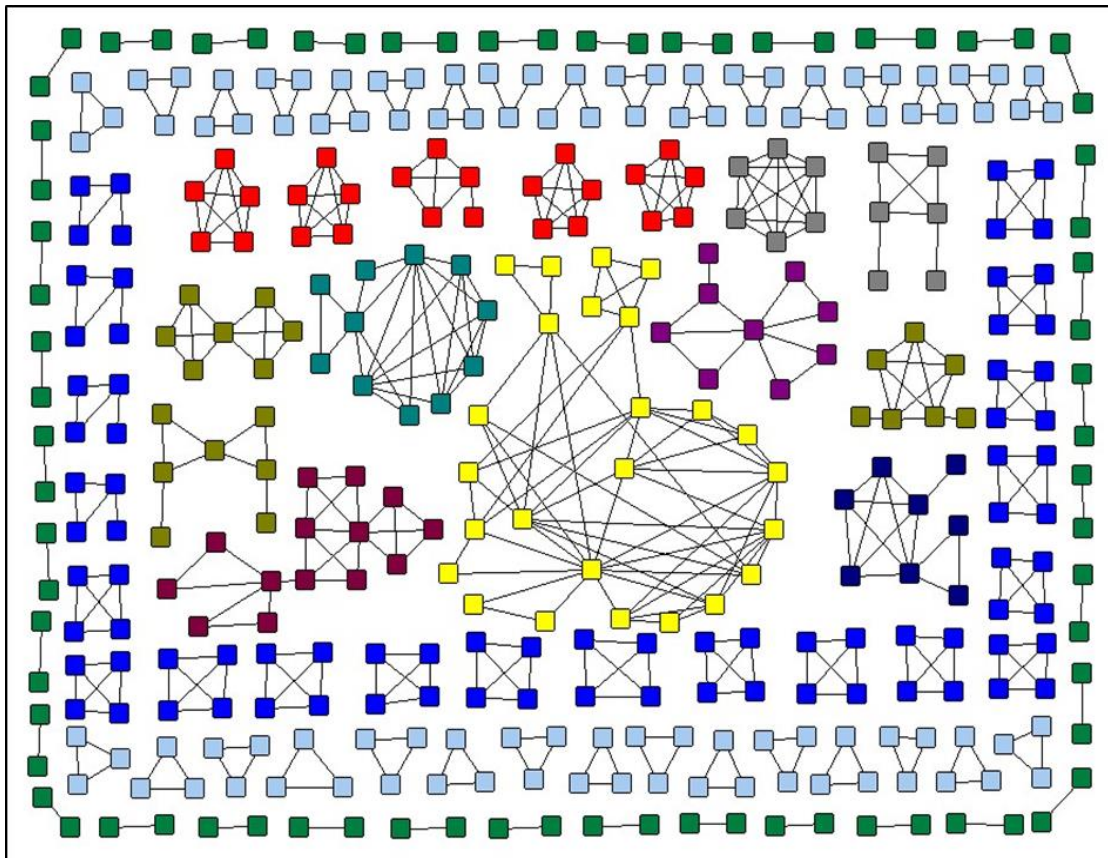


Figure 1 –Network of Authors

Source: Research data.

Analyzing Figure 1, we arrive at the conclusion that the academic production in the areas of strategy and sustainability is composed of several sub-networks of researchers, often isolated, as well as some isolated authors (not shown in the Figure). 104 components were generated, 37 being with two authors, 32 with three authors, 20 with four authors and the remaining with five or more authors. The main component has 25 actors. Figure 2 graphically presents the main component.

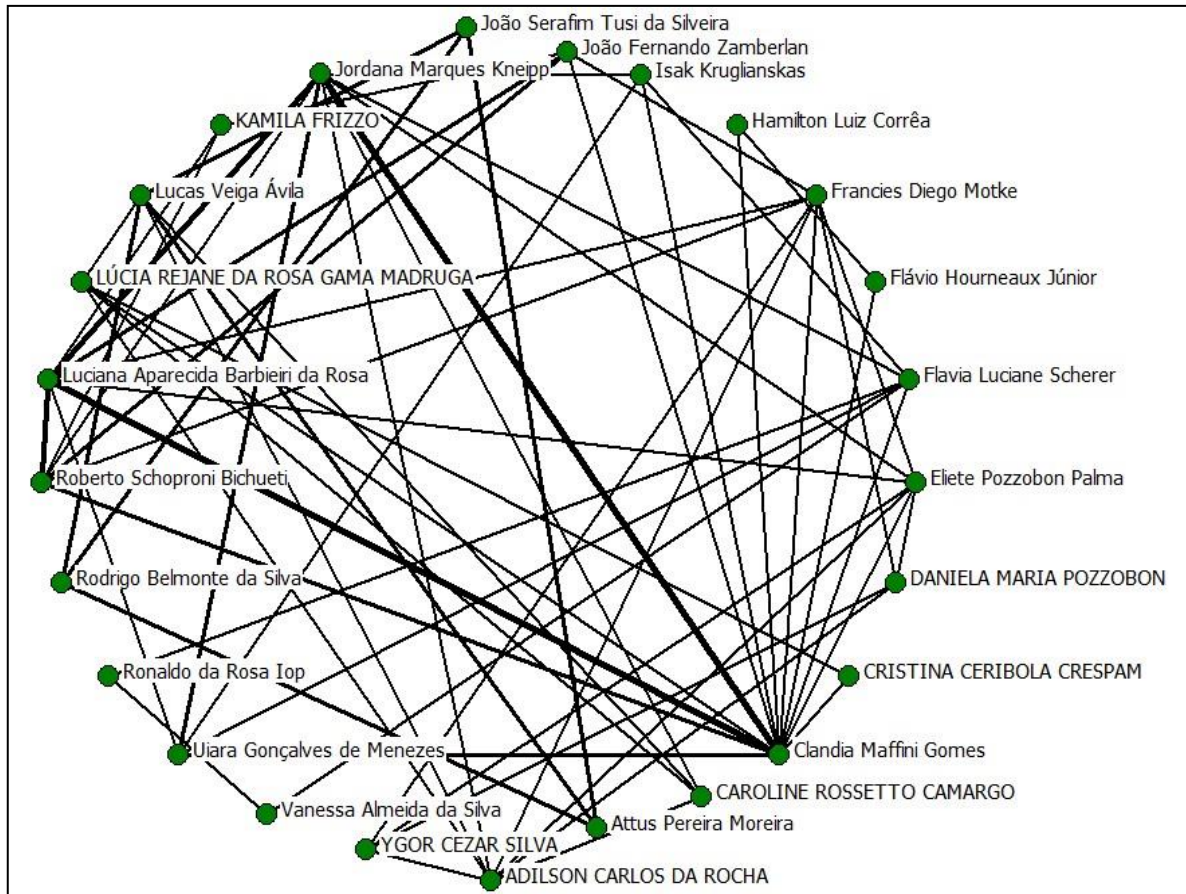


Figure 2 – Main Component of Network of Authors

Source: Research data.

In this diagram, it is possible to see that authors Cláudia M. Gomes, Luciana A.B. Rose and Jordana M. Kneipp have greater quantity of papers in common, a fact evidenced by the width of the ties.

The density of a network is calculated by the ratio of the maximum number of possible links and the number of existing links. This measure is used to indicate the level of closeness among the actors in the network (SOUZA; QUANDT, 2008). The average degree indicates the value of the arithmetic mean of the number of links of the network actors (HANNEMAN; RIDDLE, 2005). Component is considered a subnet of a

larger network. Diameter indicates the greatest possible distance between the points of a network and is measured in the number of links (SOUZA; QUANDT, 2008).

Table 6 presents the network data. It is observed that there is low bulk density (0.6%), confirming the graph presented in Figure 1. The average degree of the network is also low (2.45), indicating that the authors have little authorship together. The average distance between authors is 1.75 ties and the diameter of the network is 5 ties.

Table 6 – General Data

Network of authors	
Average Degree	2,45
Density	0,006
Components	104
Average Distance	1,75
Diameter	5

Source: Research data.

Regarding the centrality of the authors, the findings explained in Figure 2 are corroborated by the data in Table 7.

Table 7 – 10 Most central authors

Author	Degree	Closeness	Betweenness
Clandia Maffini Gomes	13	0,41	102,41
Jordana Marques Kneipp	9	0,34	48,15
Adilson Carlos da Rocha	8	0,24	44,48
Francies Diego Motke	8	0,31	21,59
Luana das Graças Queiroz de Farias	8	0,00	13
Luciana Aparecida Barbieiri da Rosa	8	0,33	13,97
Samuel Carvalho De Benedicto	8	0,00	37
André Luis Rocha de Souza	7	0,00	8
Eliete Pozzobon Palma	7	0,30	13,78
Monica Cavalcanti Sá de Abreu	7	0	21

Source: Research data.

Prominent actors are those heavily involved in relationships with other actors (WASSERMAN; FAUST, 1994). For this variable, there is no explicit concern with the direction of the relationship. What counts is in how many links the actor is involved. Basically, there are three types of centrality: degree, closeness and betweenness. The first relates to the number of ties that the actor has with others. The second has to do with the relationship between the distances of an actor with others. The third indicates how many times an actor can mediate the relations between other actors (FAUST; WASSERMAN, 1992).

It is observed that the three measures of centrality have slightly jarring results. This means that the most central authors also play the role of gatekeepers, i.e., serving as a bridge between less prominent authors. They can also access more easily all the other actors in the network.

In addition to this analysis, Table 8 lists the gatekeepers alphabetically, who according to Hanneman and Riddle (2005), are the actors responsible for the connection of sub-groups within the network components. Because of their strategic position in the network, they are considered relevant actors.

Table 8 – Gatekeepers

Actor		
Alexandre de Almeida Faria	José Milton de Sousa Filho	Monica Cavalcanti Sá de Abreu
Carla Regina Pasa Gómez	Josias Jacintho Bittencourt	Paulo Mauricio Selig
Carlos Ricardo Rossetto	Lucas Veiga Ávila	Rafael Barreiros Porto
Clandia Maffini Gomes	Luciano Barin Cruz	Rivanda Meira Teixeira
Edison Fernandes Polo	Luciel Henrique de Oliveira	Roberto Bazanini
Elaine Ferreira	Marcos Antonio Gaspar	Samuel Carvalho De Benedicto
Flavia Luciane Scherer	Marcos Cohen	Soraya Giovanetti El-Deir
Geraldo Sardinha Almeida	Maria de Fátima Barbosa Goés	Monica Cavalcanti Sá de Abreu
Gesinaldo Ataíde Cândido	Minelle Enéas da Silva	Paulo Mauricio Selig
Gilnei Luiz de Moura	José Milton de Sousa Filho	Rafael Barreiros Porto

Source: Research data.

Only three actors presented in Table 8 are among the 10 most central ones. This shows the characteristic dispersion and low network density because actors with lower centrality play roles considered important and relevant in the network.

In general terms, the expressions structural hole or structural gap are used to define the separation and connection between non-redundant contacts of a network. As a result of the existence of structural holes, two contacts provide benefits that are additive rather than repetitive (GRANOVETTER, 1973; BURT, 1992). Table 9 presents data about the efficiency of actors to structure their network.

Table 9 – 10 Biggest Structural Holes (Network of Authors)

Researcher	Efficiency	Gaps	Density
José Milton de Sousa Filho	0,84	4,2	0,2
Monica Cavalcanti Sá de Abreu	0,836735	5,857143	0,190476
Elaine Ferreira	0,777778	2,333333	0,333333
Geraldo Sardinha Almeida	0,777778	2,333333	0,333333
Gesinaldo Ataíde Cândido	0,777778	2,333333	0,333333
Luciano Barin Cruz	0,777778	2,333333	0,333333
Marcos Cohen	0,777778	2,333333	0,333333
Paulo Mauricio Selig	0,777778	2,333333	0,333333
Rafael Barreiros Porto	0,777778	2,333333	0,333333
Clandia Maffini Gomes	0,763314	9,923077	0,25641

Source: Research data.

Analyzing the structural gaps, we can observe there is good efficiency on the part of the selected actors. This fact can be explained by the low density of the network and by the large number of individual components. The researchers Monica Abreu Gomes and Cláudia Maffini Gomes stand out from other researchers for their good efficiency even with large numbers of gaps and smaller density than most researchers.

In SNA, the analysis of the position can be more useful than the analysis of individual agents and their connections. The key concept behind this positioning is known as structural equivalence, that is, relates to a specific type of relationships established by a particular category of agents. The most relevant feature of this approach is highlighted in the relationships between these groups of points, called blocks, in the matrix (SCOTT, 2000). The first algorithm for the investigation of structural equivalence was developed by Breiger, Borrahn and Arabie (1975) and Schwartz (1977) and was called CONCOR (CONvergence of iterated CORrelations). The result of this procedure is shown in Figure 3.

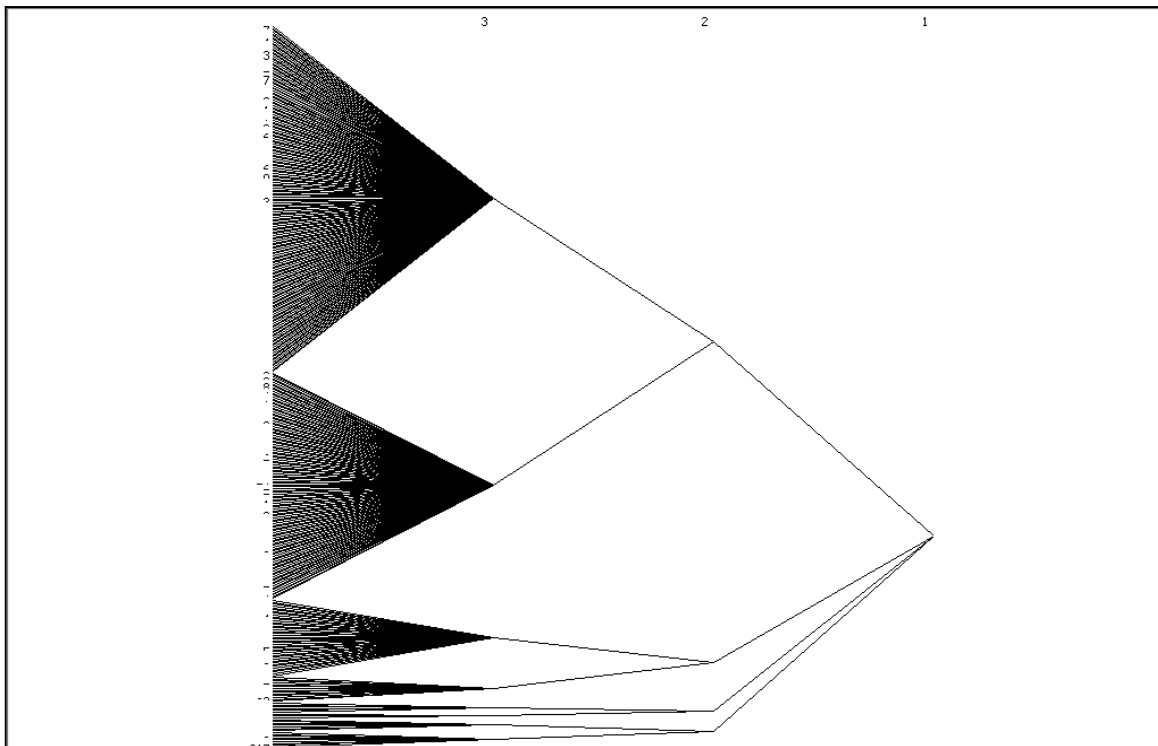


Figure 3 – CONCOR Dendrogram of Structural Equivalence

Source: Research data.

By observing Figure 3, it can be seen that there are eight equivalent groups on level 3 and four groups on level 2. This means that these actors have the same role in the level of analysis performed. Observing that the first two groups have formed over 50% of the researchers, we concluded that there is not much heterogeneity among actors in the network, indicating that, in general, authors work in accordance and their networks have relatively similar configurations. When analyzing Figure 1, it is inferred that the roles of higher recurrence in this network are those of the components of two or three researchers.

Considering the research institutions to which the researchers belong, a diagram (Figure 4) with the networks formed by them has been drafted. Ties were determined by the joint production, so the affiliation of the researchers was considered in the preparation of the matrix. Redundant cases, where more than one researcher at the same institution participated in the writing of an article, were disregarded.

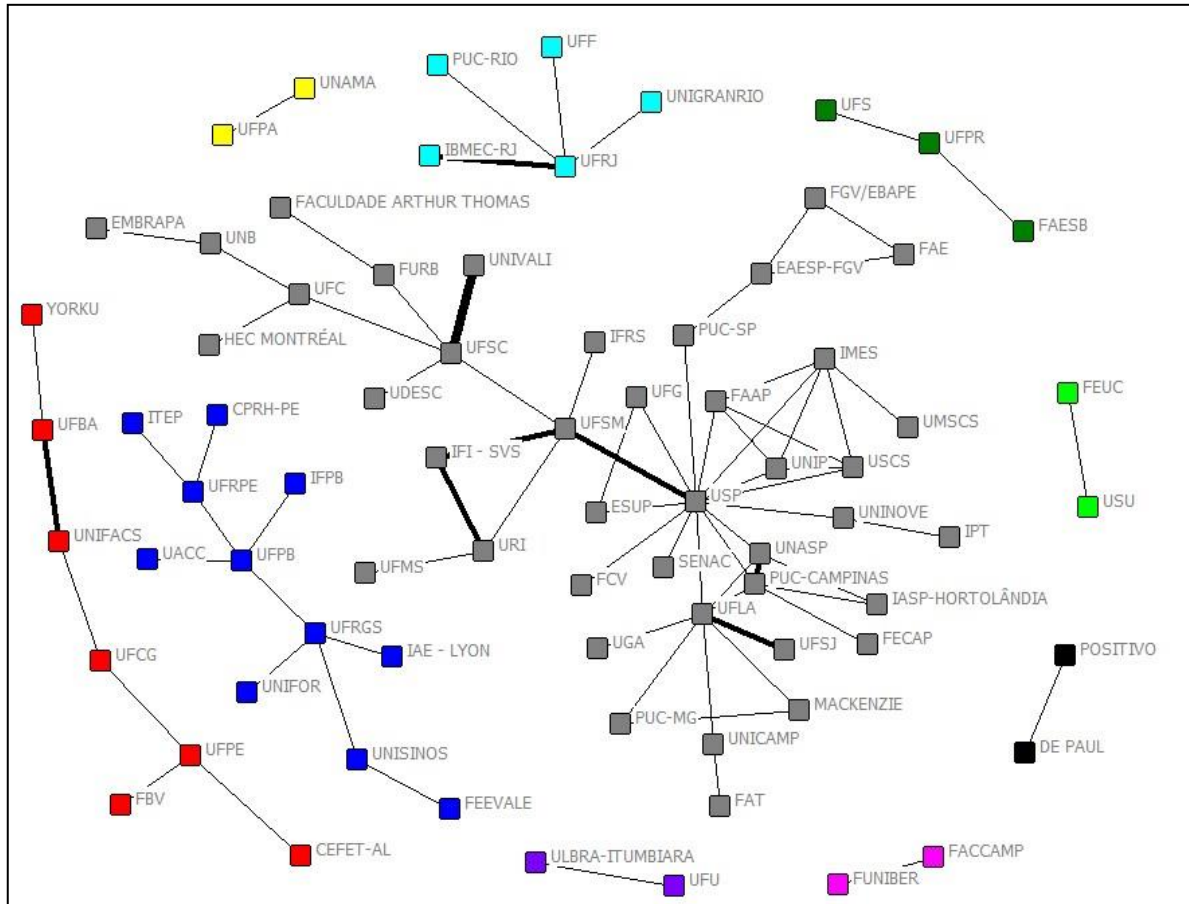


Figure 4 – Network of Research Institutions

Source: Research data.

Each component is represented by a different color. The width of the links is determined by the amount of articles in common. As in the net of authors, isolated institutions were abolished in Figure 4.

It is observed that the network of institutions has far fewer components and actors than the network of authors. This fact is explained by the fact that each institution may have several affiliated researchers, acting as a proxy of scientific development in the area. In general, 10 components were found. Of the 97 institutions evaluated, 20 had not published together with other HEIs.

Figure 5 shows the main component of the Network of Research Institutions which comprises 41 institutions as actors. This means that 42% of the surveyed institutions participate in the same network of research on strategic sustainability. Com-

pared to the network of researchers, only 6.4% researchers were in the main component. This indicates that, in general terms, institutions play a significant role in sharing knowledge on the theme analyzed. It is observed that the institutions that publish more jointly are UNIVALI and UFSC (3 articles), UFPA and UFSJ, UFSM and USP, UFSM and IFI-SVS, IFI-SVS and URI, UNASP and PUC-Campinas (2 articles).

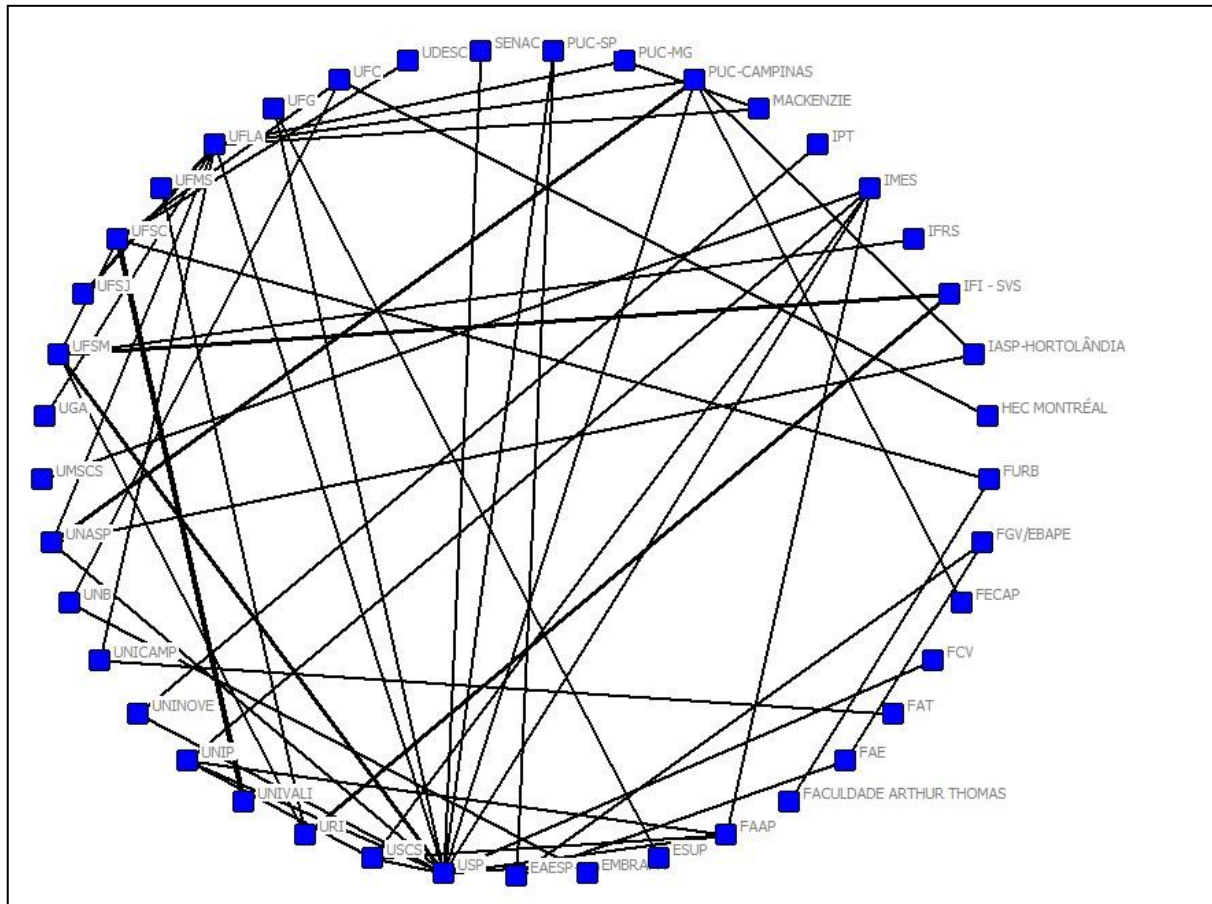


Figure 5 – Main Component of Network of Research Institutions

Source: Research data.

Table 10 presents the general data of the network. It is observed that the average degree of the network is smaller than the average degree of researchers' network. This can be explained by the smaller number of actors in the network. In contrast, the network density is three times greater than the density of the network of authors. The average distance and diameter are also larger, indicating that this network appears more distributed and reliant on gatekeepers.

Table 10 – General Data

Network of institutions	
Average Degree	1,65
Density	0,017
Components	10
Average Distance	3,44
Diameter	8

Source: Research data.

Regarding the centrality of institutions, the data presented in Table 11 show that the USP is the most central HEI. This implies that this institution enjoys more prestige in publishing papers on the topic. In terms of intermediation capacity, USP is also a leader, but what also draws attention is the performance of UFSM and UFSC, which occupy the second and third place respectively. This indicates that these institutions act as gatekeepers, and thus, also have high prestige and consequent access to knowledge.

Table 11 – 10 Most Central Institutions

Institution	Degree	Closeness	Betweenness
USP	14	0,56	616
UFLA	8	0,27	217
IMES	5	0,30	39
PUC-CAMPINAS	5	0,24	57,5
UFSM	5	0,14	390
UFSC	5	0,03	277
FAAP	4	0,29	0
USCS	4	0,29	0
UNIP	4	0,29	0
UNASP	4	0,24	18,5

Source: Research data.

Data presented in Table 12 confirm the findings discussed in the previous paragraph. UFSM is the most efficient HEI in relative terms. This means that among the institutions surveyed, it can take better advantage of its ties. It does not mean, in absolute terms, that it has superior performance to other HEIs in sharing knowledge. In general, the five largest structural gaps demonstrate high level of efficiency by the HEIs surveyed, showing that there is good potential for innovation in research developed in the area.

Table 12 – 10 Biggest Structural Holes (Network of Institutions)

Institution	Efficiency	Gaps	Density
UFSM	0,92	4,60	0,10
USP	0,90	12,57	0,11
UFLA	0,88	7,00	0,14
EAESP-FGV	0,78	2,33	0,33
URI	0,78	2,33	0,33
PUC-CAMPINAS	0,68	3,40	0,40
IMES	0,52	2,60	0,60
ESUP	0,50	1,00	1,00
FAE	0,50	1,00	1,00

Source: Research data.

Figure 6 shows the CONCOR dendrogram of structural equivalence. Unlike the network of researchers, where there were two major groups accounting for more than 50% of the researchers, the network of research institutions has four relevant groups, which shows that this network is more heterogeneous regarding the role of HEIs in the development of research on strategic sustainability. It is concluded that research institutions behave more on their own and independently in forming their ties based on academic production.

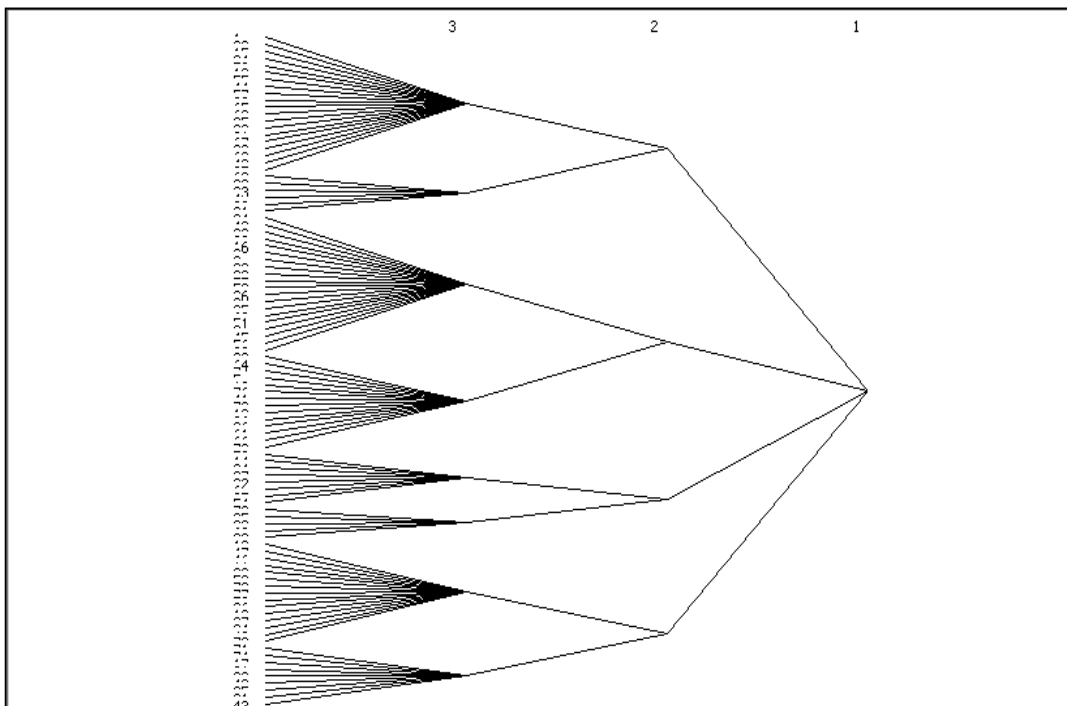


Figure 6 – CONCOR Dendrogram of Structural Equivalence

Source: Research data.

Conclusions

The objective of this study was to understand how research on sustainability in the organizational environment is being developed in Brazil. Based on sample size, when compared with the total number of articles published in the period, it is concluded that there is still a long way to go in developing research that combines companies' strategies with sustainable practices.

Regarding the productivity of the authors in the field, it is observed that most of them published their works with co-authors, which is considered positive in any scientific development. However, it was observed that authors who publish jointly are not more productive than those who publish alone.

The network of co-authors in the area has low density and many components, and most of these are isolated. This structure indicates that there is still little exchange between these authors, evidencing the role of centrality and/or gatekeepers of some researchers.

This sparse configuration favors the onset of structural gaps, considered positive in a network of this kind. In this sense, we observe authors with high efficiency, even playing the role of centrality. The structural equivalence analysis showed that, in general, authors play slightly different roles throughout the network, which supports the need of growth in this area.

Regarding the network of research institutions, there was a reduced number of components and the presence of most of these institutions (42%) in the main component. The density of the network is three times larger than that of the network of authors, but its diameter is also larger, which indicates that the network is better distributed, yet still dependent on gatekeepers.

Some institutions have played a more important role in the development of research than others. USP, UFSC and UFPA are HEIs that have a better ability to mediate the academic production between further research institutions.

USP and UFSC were able to maintain a high rate (greater than 90%) of efficiency in network construction. This indicates that besides their centrality, these HEIs can extract the maximum from their linkages, making their academic production more enriched in the light of knowledge exchange.

The behavior of the institutions showed a more heterogeneous pattern than the behavior of the authors. This shows that when considering a more macro (institutional) approach, there is greater diversity and consequently, a greater capacity for scientific development.

Observing both the network of authors and the network of institutions, it is concluded that there is still a long way to go in developing research on strategic sustainability. The main indicators that support this finding are the excessive number of components with a low number of actors and the lack of correlation between academic research and co-authorship.

For future studies, it is suggested to perform the analysis of the effect of time on the development of networks of researchers and institutions in order to verify their growth rate and changes in their structures. Furthermore, it is considered important to deepen studies about the degree of expertise of the leading researchers in the field,

seeking to identify how long they have been publishing on strategic sustainability and whether they publish exclusively on the theme.

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