

The integration of corporate and operations Strategies: an analysis of scientific publications using bibliometrics

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Abstract

When researching the integration of corporate and operations strategies, an exhaustive number of academic articles appear. As such, filtering and selecting the most relevant articles related to Industrial Engineering becomes an arduous task. Bibliometrics, which includes a set of methods to analyze scientific literature, was the research methodology chosen for this study, in order to choose and evaluate publications dealing with the integration of corporate and operations strategies. Starting with a keyword tree, 1174 scientific papers were analyzed with Refviz® software, and, ultimately, 270 papers were chosen. Using several indicators, such as the conclusions from the principal authors, economic sectors and publication channels, the institutions and countries that have published were inferred, allowing a consistent evaluation of this important topic.

Keywords: Bibliometric analysis, Corporate strategy, Operations strategy.

1 Introduction

In the globalized and highly competitive setting which characterizes modern life, one observes the evolution of organizations and the constant search for improvements in business through strategy and productive systems. In this sense, the integration of corporate strategy and operations strategy is fundamental for the growth of organizations through competitive differentials.

Up until the end of the 1970s, North American hegemony was easily perceived in the industrial world setting. In that era, the price of products was considered a key factor in discussions about operations, thus serving as competitive differential for companies. However, in the beginning of the 1980s, the arrival of foreign competitors, mainly from Asian countries, modified this setting and put the concept of quality in the spotlight, leading North American industries to rethink their models.

In the current setting, several authors point to a new discussion, arising from the need to treat the management of operations strategically. Companies are increasingly trying to select strategies that allow them to exploit their internal capacities, so as to be in line with and respond to external opportunities, thus building their competitive differential.

The aforementioned major milestones of changes in the industrial setting, as well as discussions along that thematic axis, can be analyzed through their direct reflexes in the academic production in this area. As organizations evolve and employ new concepts, methods and tools to support the process of improvement, they also generate a new set of studies, research and publications in that area of knowledge.

Based on these premises, this article implements bibliometric research with the intention of identifying discussions about the integration of

corporate and operations strategies from the viewpoint of scientific production, thus permitting the study of knowledge concerning the subject of this article's title.

According to Vanti (2002), bibliometrics is defined as a combination of research methods used to map the knowledge structure in a scientific field of study through a quantitative approach and the use of statistics from diverse bibliographic data. In this way, through various data – information related to the authors of research, the publishing, research institutes and keywords – trends and behavior of scientific production on a specific topic can be observed.

A current topic is trying to understand how effective corporate strategies are, in order to guarantee that companies reach and obtain, sustainably, an independent competitive advantage from their strategic orientation of competitive choices and practices. element of this understanding is the evaluation of how wide-ranging are companies' strategic choices is and how much these choices influence and alter the direction inside the corporate context, from a strategic level to a more operational level. Additionally, another concern is related to how much internal forces of the organization are aligned with one another in the aim of reaching strategic objectives. In a complementary manner, companies should know the strategic integrity of their businesses as a whole, in order to put into practice a corporate strategy and reach their strategic objectives.

In this way, this article strives to implement a bibliographic study on published scientific research, through relevant publishing channels, within the thematic context of “the integration of corporate and operations strategies,” with the aim of analyzing the evidence in this field, the main findings, the links that are being made between the conceptual theories and the concepts. The objective then is to verify the existence and the

formation of research groups, as well as to evaluate the trends that could be appearing. As such, a bibliometric study will be utilized to assist in the analyses that are made.

1.1 Problems and Objective of the Study

Having as a base the context in which organizations are situated and the importance of perfecting methodologies and practices which further the continual process of improvement, this article concentrates on the need to obtain a current structural analysis of scientific knowledge concerning the subject, “the integration of corporate and operations strategies,” with the purpose of identifying what the scientific community is discussing and studying on this topic.

In this way, this article’s goal is to carry out an analysis through a base of bibliographic data formed by defined keywords. The aim of this research is to construct a relational bibliographic database to enable the posterior use of analysis tools contained in bibliometric studies. The purpose of these tools would then be the evaluation and the integration of corporate and operations strategies, which are becoming more understood by researchers in terms of both the conceptual and methodological aspects and driven by organizations in the competitive environment through scientific articles from the database. Following this line of thinking, the specific objectives of this article were organized into four main groups:

(a) The evolution of scientific production concerning the integration of corporate and operations strategies:

To demonstrate the evolution of scientific production dealing with the topic, making possible the analysis of trends in publications dealing with the topic at hand, and to organize them by scientific field and relate them to the keywords uti-

lized. The focus is to discover the behavior of the most cited researchers.

(b) Research centers and publication channels:

To present which research centers and publication channels stand out the most and, with this information, analyze the performance of the previously mentioned research institutions in providing findings backed up by solid scientific research practices, as well as point out the main publication channels and the relevance of each one within the scope of this article.

(c) Researchers:

To distinguish the researchers who produce the most and those who have the most cited works, with the intention of analyzing the productivity of the authors and identifying those who shape scientific opinion through the importance of their works.

(d) Networks of study:

To identify and name the networks of studies, by the institutions of origin of the researchers. In this way, the study reveals the existence of research groups and the formation and expression of partnerships among distinct institutions.

1.2 Theoretical Grounding

According to Pao (1989), bibliometrics was developed by the field of library and information sciences and characterized as a way of quantifying scientific knowledge so as to generate analyses of the behavior of academic research on a certain topic or subject matter. Aside from this, he highlights that what was attributed to Allan Pritchard (1969) as the definition of bibliometrics, “all studies that try to quantify the processes of written

communication,” refers to the connotation of statistical analysis of bibliographical references.

In his study, Pao (1989) points out various items which can be used as parameters to quantify the literature under examination, such as publication channel, authors, keywords used, citations, and publications.

The Internet has made it possible to minimize one of the biggest difficulties of scientific research: the access to information, publications, newspapers and other works. On the other hand, nowadays we have exactly the opposite problem of our focus: an excess of information. In most of the research that is currently carried out, a great amount of cited academic production appears; however, the researcher’s concern becomes the evaluation of those publications so as to categorize what is actually relevant.

In this context, bibliometrics allows the construction of indicators that can serve as the foundation for evaluation, thus making it possible for a sound quantitative analysis of the most interesting publications on a given subject. Table 1 shows some of the main bibliometric laws.

Table 1: Main Bibliometric Laws (Source: adapted from Guedes and Borschiver, 2005)

Bibliometric Laws	
Bradford Law	Analyzes the relevance of a journal in certain field
Lotka Law	Analyzes authors’ productivity through the frequency of publications
Zipf Law	Analyzes the frequency of words in a certain text
Elitism Law	Analyzes the size of the elite of a certain population of authors
Half-life/ Obsolescence	Analyzes the decrease of the use of the literature over time
Goffman’s Theory	Analyzes the diffusion of written knowledge, establishing an analogy with epidemic processes

Bibliometric analysis also takes into account the citations made by a certain researcher; in other

words, the group of bibliographical references that served as foundation for the construction of his/her publication.

From the studies of Vergara (1995), it is salient that the bibliographical references used by a certain author, aside from reflecting the foundation used for the study to be elaborated, also allow the identification of which preceding authors contributed to the development of a research field. Thus, the examination of citations allows not only the classification of how much a certain material is used but also points out the interrelations among authors, institutions, and research areas.

Additionally, a bibliometric indicator that deserves mention is the impact factor, in light of the fact that it is currently considered the most utilized index to evaluate the relevance of scientific magazines, as it extends analysis for the evaluation of publications, research institutes, and authors. Created by the Institute for Scientific Information (ISI), this indicator is calculated by the division of the number of times the articles published in a magazine were mentioned in the last two years as reference by the total number of articles published by a magazine in the same time frame.

It is worth highlighting that, despite that the Impact Factor is an index used by countless countries to evaluate scientific production, this indicator is strictly quantitative. According to its method of calculation, it is observed that the indicator reflects the premise that the more the number of times a certain magazine is referenced, the larger is its impact, according to the scientific point of view. In other words, the use of the bibliometric indicator analyzes quantity and not the quality of the academic piece at hand.

In terms of analysis of the already existing scientific production in the area of this article, the studies done by Arkader (2003) in Brazil on scientific research in operations management stands out. These studies indicate the trend that

the methods of lean production and quality have reached a level of maturity and have given space to the growing methods that emphasize current interest in more strategic issues and on the management of the supply chain.

Hill (1991) also identified that it is increasingly noted in literature that studies about operations have emphasized a strategic focus, which indicates the trend of adopting a managerial approach that deals with the issues of operations from a wide perspective of the group formed by the company, its strategies, and functions.

1.3 Research Methodology

This study can be characterized as quantitative, as it tests developed methodology and implements a statistical analysis of the data collected using a structured methodology. The study is also quantitative because it is concerned with the quantity of information and uses specific tools for the gathering and the analysis of data. Furthermore, it can be said that the reasoning used to analyze the data in this article is logical and deductive, as it allows the creation of relationships among the findings.

As for its manner of addressing the problem, the present study can be characterized as exploratory, given that it emphasizes bibliographical research about publications of a certain theme, as well seeking a broad-brush view about the way of carrying out a bibliometric analysis.

In this article the investigation of publications was done to evaluate the development of scientific research dealing with the topic of title of the study, "Integration of corporate and operations strategies."

The first stage of the study was the determination of the research structure, through a keywords tree (see Annex I), organized by amplitude (vertical) and specificity (horizontal).

With the keywords defined, the search of publications was done by word combinations, in the time span of 1999 to 2009, using the Thomson - ISI Web of Knowledge® on the whole database. The time period was thus limited in order to obtain the most recent information for the study of the current behavior of the integration of corporate and operations strategies. The database was managed using Endnote® software.

The second stage for the treatment of the data consisted of refining it, in order to keep only the studies that were most relevant to the subject at hand. Taking into account the information presented in the abstract and using RefViz® software, which is based on the formation of clusters through the keywords defined by level of importance, all works that were not fully related to the theme or that did not present complete information were excluded from the base. For the selected works the following data were tabulated: authors, institutions, year of publication, citations, type of publication, impact factor (Journal Citation Report – JCR), country of origin of the publication, field of study, and economic sector.

For the analysis of the country of origin of the publication, the country of the host institutions was considered, and, in the case of partnerships, both were considered in the research. For research of the impact factor, which is the average number of times that the articles of the magazines published in the last two years were mentioned, annually, in the Journal Citation Report (JCR), the year of publishing is relevant; however, for the purposes of this research, the year 2009 of this factor was considered. Some of the publication channel were not evaluated and were not ranked for the study at hand.

Lastly, the crossing of this data was used for the construction of eighteen indicators, which demonstrate the behavior of the publications regarding the topic. The co-occurrence of words

consisted of the identification and the counting of keywords and terms that appeared in the selected works. With this information a trend map was elaborated in order to evaluate their repetition and frequency of appearance. The classification of the most cited authors by hierarchical order was based on the bibliometric analysis presented by Caldas (2005), which deals with Brazilian scientific production in the 1990s. Since the information regarding the institutions of origin of each cited author was not available, the classification by hierarchical order was mainly based on the analysis of self-citations by the authors. The Elitism Law, according to the works of Guedes and Borschiver (2005) on bibliometrics, was based on the works of Price (1965), which affirms that every N-sized population has an effective elite, whose size can be defined by the square root of N. In this sense, the Elitism Law was applied to the population of authors and citations in the realm of our research.

2 Analysis of the Results

2.1 Evolution of the Academic Production on the Topic

A great challenge faced by businesses throughout the last century has been how to integrate corporate strategy with operations strategy. Although the topic is recognized as fundamental in the search for increased competitiveness and success, it was only in 2003 that it began to become prominent in regard to the quantity of articles and publications produced, displaying considerable growth from 2003 to 2008.

In the graph (Figure 1), it is also observed that the curve of production dealing with the inte-

gration of corporate and operations strategies is in a growth phase.

It is worth noting that in the 1980s and 1990s all companies in the world went through a period of prosperity, which was followed by a phase of stagnation at the beginning of the twenty-first century. New thoughts and economic strategies were necessary to face a new phase of the world economy, based mainly on new emerging technologies. According to Hayes (2005), “the key for lasting success started being operations excellence and that demanded coherence and consistence in the production and technology strategies.” In such a setting, one would expect scientific research to focus progressively on a theme that involves, among other things, items related to strategic planning, supply chains, and information technology.

In this same context, in 2000 the world economy experienced a time of heightened rates of growth, until the economic crisis at the end of the decade. It is important to highlight in this period the BRICS's contribution among emerging countries. These factors produced very large consumption, bringing the need for businesses to concern themselves with operations management and business strategy and making the development of distinct applied research and experiments necessary, which explored the integration of these issues, with the intent of finding out how to best manage performance through gains in efficiency

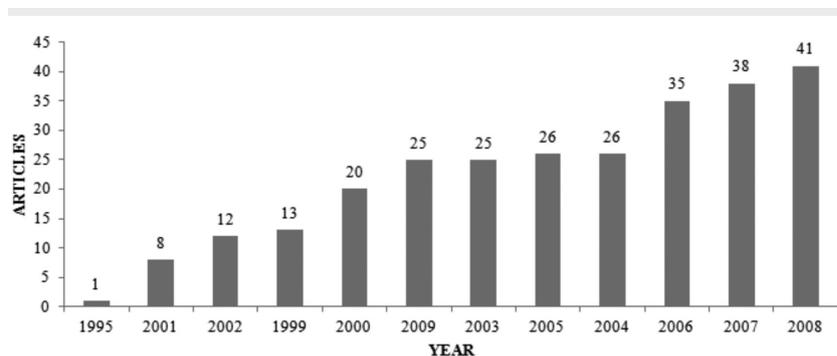


Figure 1: Total number of annual publications on the topic of the current study

and productivity. These aspects were evidenced in the growth of publications (Figure 1), mainly from 2003 to 2009.

In analyzing the created material on a deeper level (Figure 2), it is possible to perceive that the discussion about these issues is rather theoretical, consisting mainly of academic articles (90%).

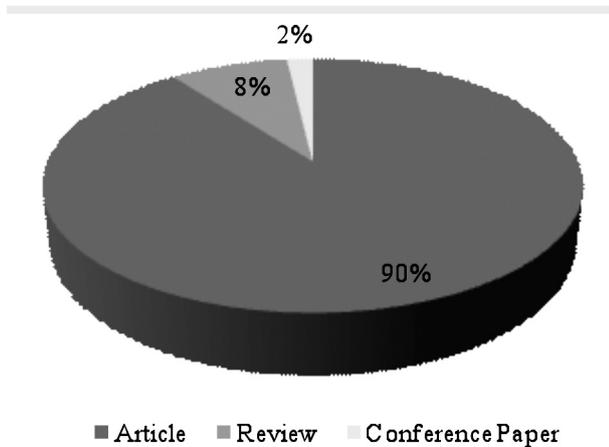


Figure 2: Types of publications identified for the research

In relation to the areas involved (Figure 3), it is seen that the great majority of articles, around 30% of the total, belong to the fields of Business, Management, and Accounting, followed by approximately 20% that can be classified as Decision Sciences and Engineering Systems. In the

sequence, it is observed that these areas together correspond to 95% of the total of topics related to the target articles of this study. It is worth noting that the same article can be related in more than one classification area, available on the site used for this study.

In terms of distinct approaches already taken on the topic of operations and strategic integration, keywords and clusters searches were done on the database, thereby completing the thematic analyses through the declared keywords from the documents selected for the study. The graph, in Figure 4, brings together the keywords cited by at least fifteen articles, among them, the most found when searching for the topic of this article, “Integration of Operations and Corporate Strategies,” which were Strategic Planning, Supply Chain Management, and Industrial Management. Next, the terms Information Technology, Decision Making, Societies and Institutions, Marketing, Operations Research, Competition, Mathematical Models, Operations Management, Customer Satisfaction, Performance, Manufacturing Strategy, and Industrial Economics, appeared less frequently. This reveals the main areas tackled by the subject, and those most sought-after for publication and intellectual production.

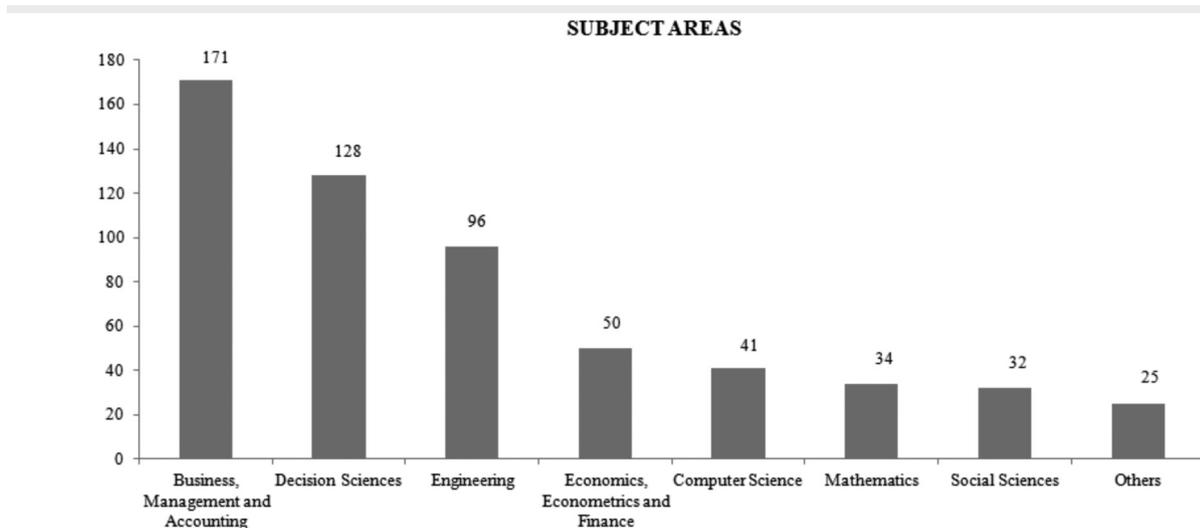


Figure 3: Main fields of study identified by research

Keywords

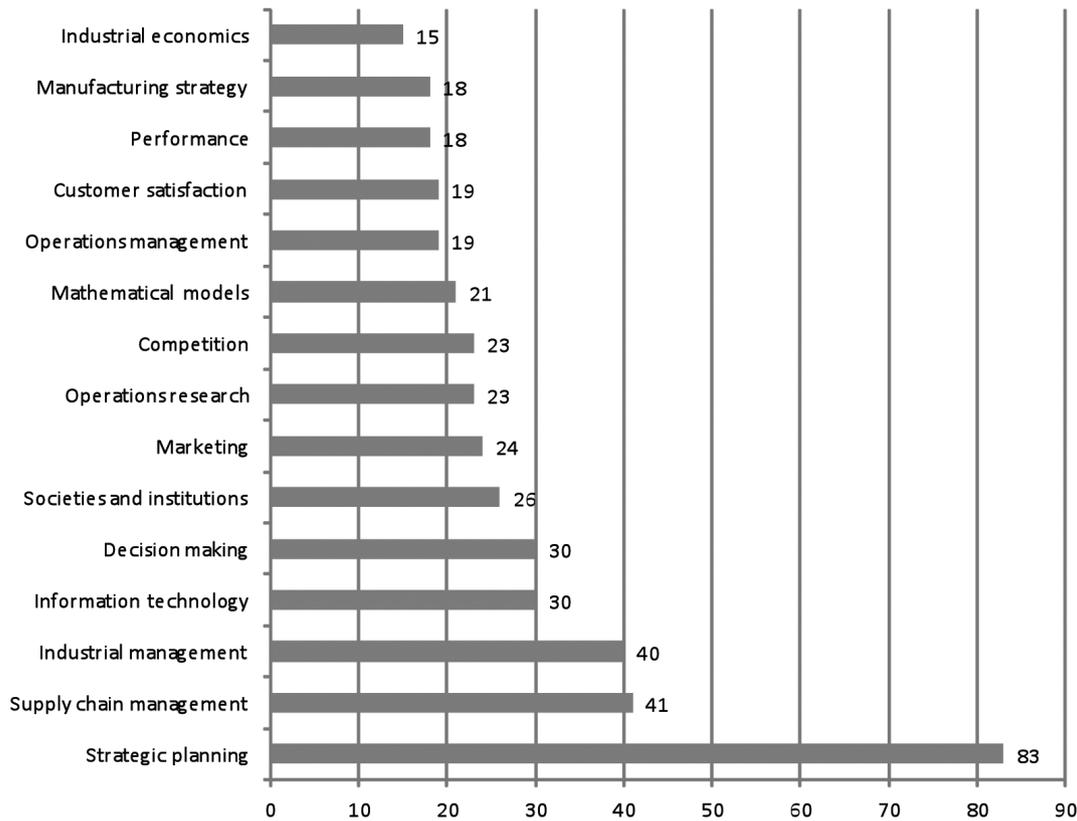


Figure 4: Occurrence of keywords

The analysis of the graph (Figure 4) shows that the keywords which appear the most are aligned with the corporate industrial sector, with a large focus on strategic operations management, manufacturing, and supply chain logistics.

Another way of interpreting the discussions about the topic at hand is through the lexical analysis of the article abstracts, performed by TreeCloud™ software, which generates a tree of the most frequent words organized according to their proximity to one another, as illustrated in Figure 5. In this way, it was possible to structure the main thematic axis taken up in this study.

In the Figure 5, the frequency of the words is represented by size; the most frequent words are the largest and the least frequent are the smallest. The words are also separated in four main

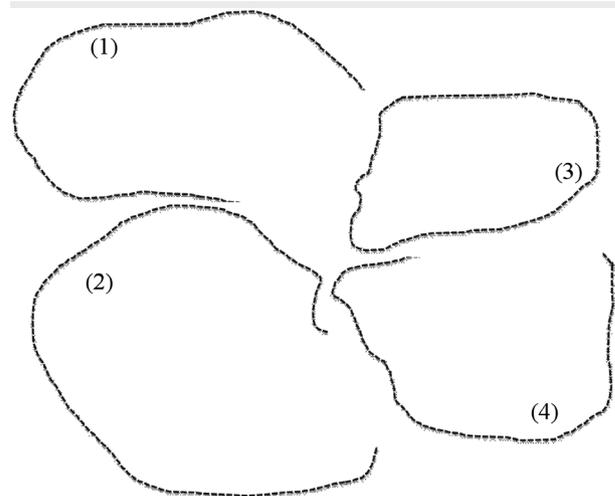


Figure 5: Tree of most frequent and interrelated words (Source: Gambette and Veronis, 2009)

branches according to their proximity and interrelation to the topic. The explanation of these main groups is found through the figure generated by the software:

- (1) This group contains the majority of the most cited words, involving the topic of integration of operations and strategy, as well as the alignment of the main concepts related to supply chains, systems integration, managers, processes, technologies, and planning. In this sense, the word “integration” is seen as the most important in this group, representing the interface amongst the concepts.
- (2) This group consists of external business results, found from these integrations. Keeping in mind that these articles deal with applied research, the words in this group present the findings related to clients, new models, decision making support, projects, and production.
- (3) The third group is related to internal business results, representing the influences of these themes, the necessary adjustments, the organizational environment, and the processes, among other aspects.
- (4) Lastly, the fourth and final group tackles potential aspects, which represent businesses’ concern with prospective competitors, demonstrating discussion of competitive market advantage.

2.2 Research Centers and Publication Channel

In terms of research centers, more than 80% of publications originate from developed countries (Figure 6). These countries are home to a sizeable part of large-company headquarters, as well as the most well-known and advanced research centers in the world. In the graph, in the sequence, the amount of publications by country from 1999 to 2009 is shown, identifying the United States, England, and Canada as the main countries with potential in terms of publications dealing with integration of operations and corporate strategies. This situation is due, among other factors, to the

large economic growth in these countries during this time period and the presence of renowned universities and academic centers located in these countries. These institutions concentrate article publication in distinct parts of the world, as they are universities with an elevated sense of internationalization, which permits the congregation of research networks in diverse parts of the world.

Another interesting fact is the presence of Asian countries, such as South Korea, Hong Kong, China and Singapore. This presence reflects the need for these new powerhouses in the development of strategic definitions through not only academic institutions in these countries but also in virtue of being today the main locus for factories and operations. Aside from this, these countries currently have a very high rate of innovation, thus representing an alignment with the publications written to attain economic development.

Despite the development of the BRICS, countries such as Brazil and India, which characterize emerging economies, still do not appear on the official list. This is so in spite of the fact that during this time period their research centers were maturing and their researchers often had contributed research through international institutions in countries that were powerful during this period.

Another relevant analysis appears when researching the chief publishing institutions (Figure 7). The 270 articles used in this current study were published by a total of 160 different institutions, representing a great dominance by publications related to the theme of the study. It can be considered that the object of research is quite dispersed and that the low number of publications per institution demonstrates that the range of the topic cannot be attributed to a limited number of institutions.

In the general context, the participation of North American institutions stands out. The most prominent of these institutions is Michigan State University, with ten published articles.

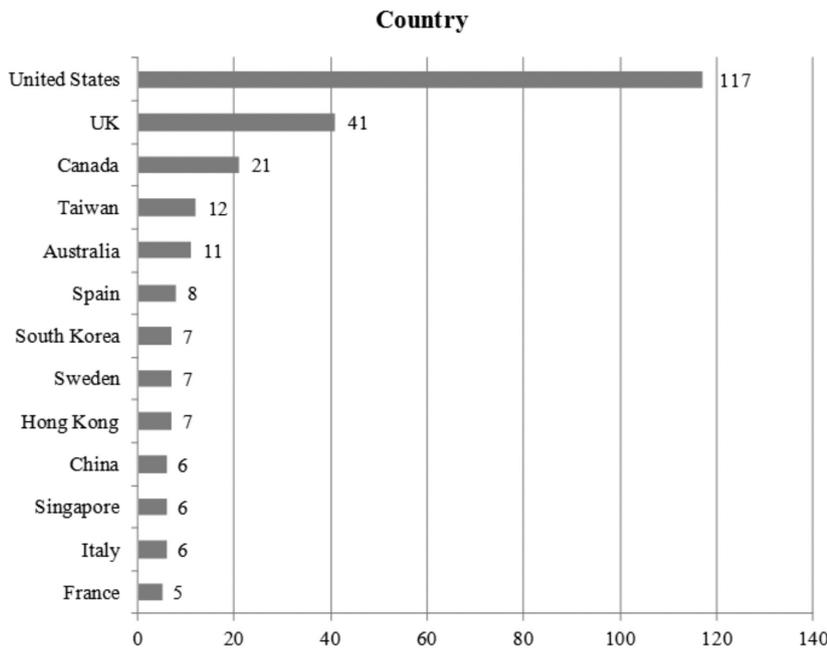


Figure 6: Quantity of publications per country

Despite having twice as many publications as the second place institution, it can be considered that even the dominance by this institution of the topic is limited, as its total number of publications is low when compared with the universe of the study. On the other hand, such data demonstrates the relevance of the USA as the main research producer, which may be related to the fact that Michigan is one of the main industrial poles and also the principal producer of automobiles and trucks, besides the second biggest pro-

ducer of iron ore of the country. In a secondary manner, Chinese institutions are appearing, which shows the growing participation of Asian schools in the study of this topic.

In view of the domination articulated above, the definition of a clear trend for the quantity of annual publications becomes complex. However, it can be verified that the leading institution in publications, Michigan State University, carried out all of its ten publications between 2002 and 2007, which was the last year with the biggest number of inci-

dences. In 2007, three of the five publications of the institution were indeed about supply chain integration, which is one of the branches of the research tree established by the authors of this study. It is worth pointing out that this institution has had a department dedicated to the research of supply chain management for more than 25 years.

In terms of the origin of publications (Figure 8), the USA and England stand out once again, as together they are responsible for approximately 70%

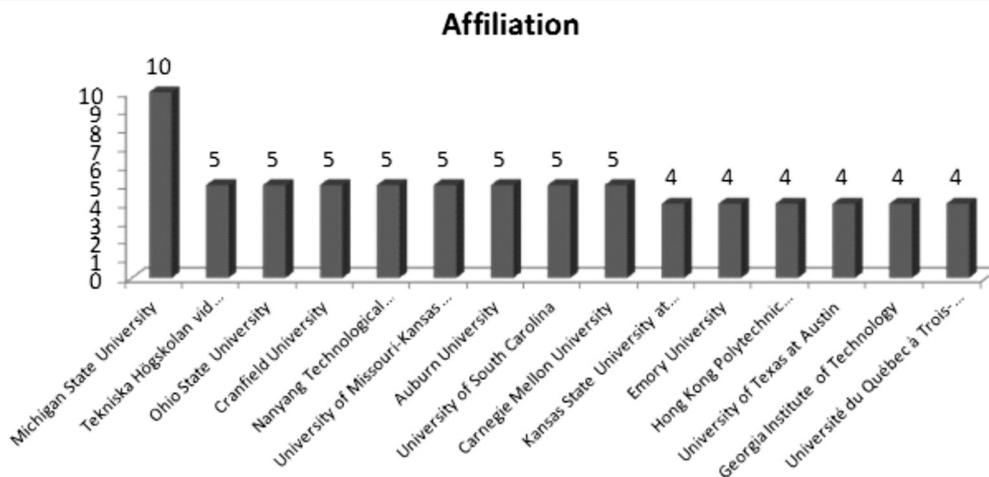


Figure 7: Quantity of publications per offering institution

of the total of publications identified, as the chart below illustrates. They are also responsible for most of the publications of this kind of article in the last ten years, as can be seen in the sequence (Figure 9).

Lastly, it can be noted that the factor of impact of publications grew in 2003, and has remained constant ever since. This occurrence is mainly explained by the regularity of the publications

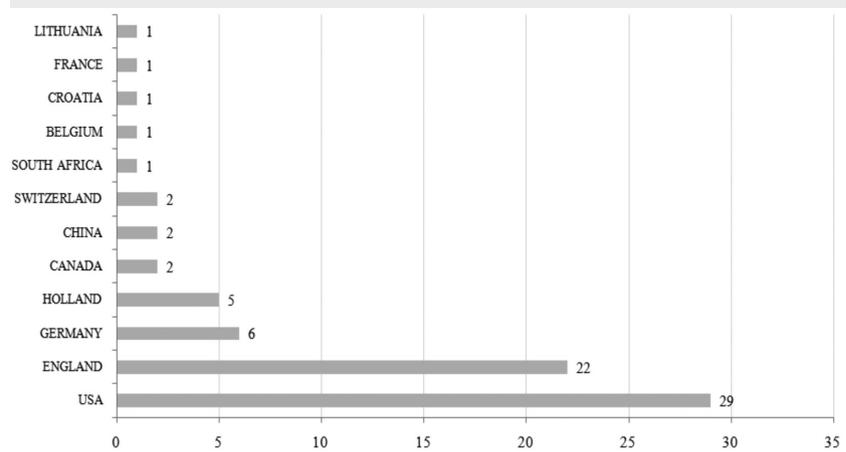


Figure 8: Quantity of documents per country of origin of publishing media

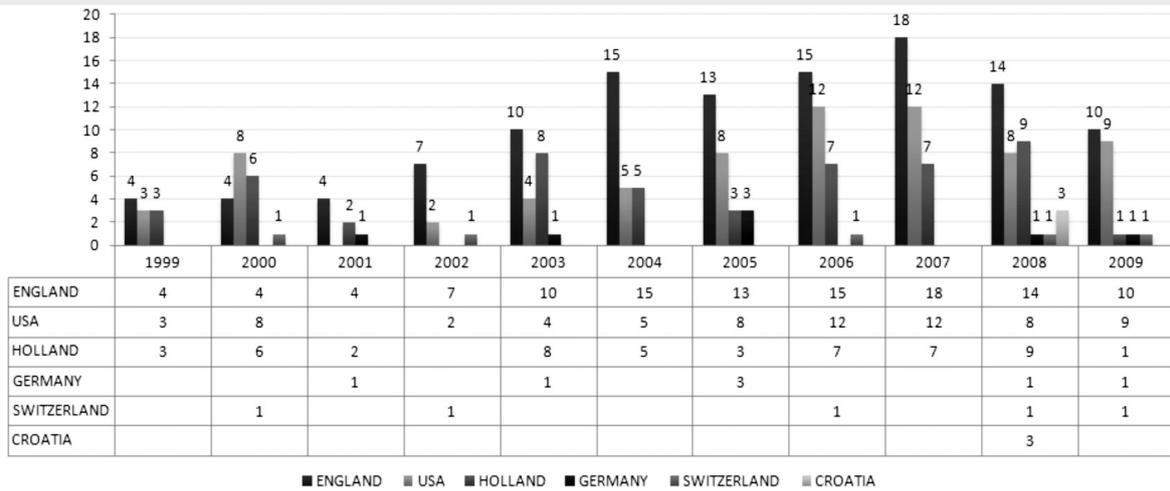


Figure 9: Annual evolution of publications per country of origin

of the chief journals in the last years, as can be seen in the chart in Figure 10. It is also possible to see next the main publications on the topic and their respective impact factors (Figure 11).

It is also discerned that although it is the largest publisher, the *International Journal of Operations & Production*, has an impact factor close to 1.0, while the second largest publisher, the *Journal of Operations Management* has a result close to

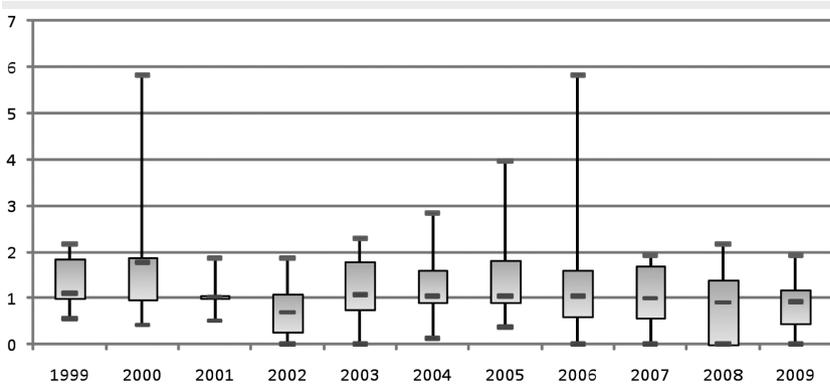


Figure 10: Relevance of publishing media

2.0, which earns it the rank of the main research source for the topic at hand.

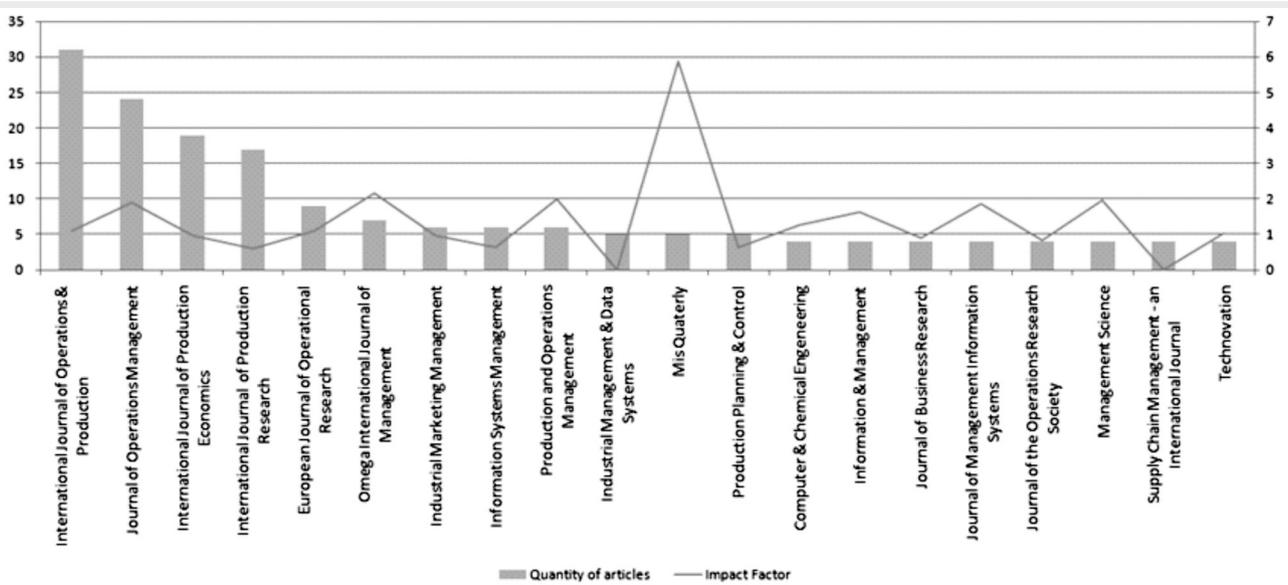


Figure 11: Quantity of articles versus impact factor

3 Researchers

Another subject of this study was the analysis of the authors that are most cited by researchers (Figure 12). The classic names in the study of the strategy and operations management, such as Porter, Hayes, Skinner, Mintzberg and Kaplan were employed. However, when identifying the quantity of annual citations (Figure 13), it is possible to verify that the works of Professor Hayes are gaining importance as a theoretical reference and have already started to become, along with

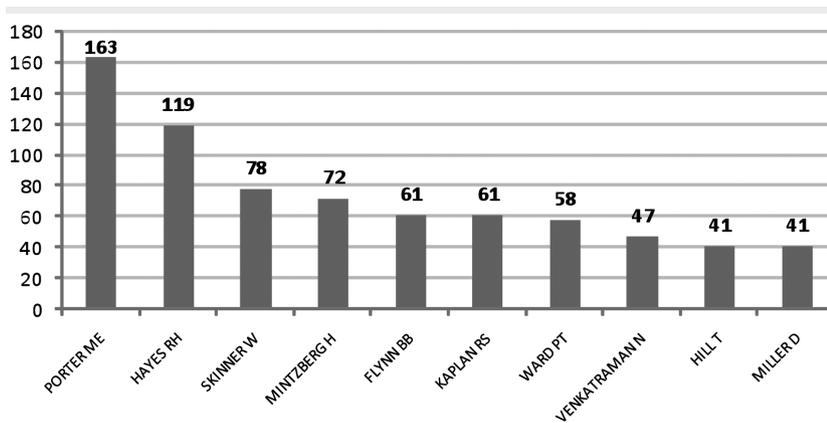


Figure 12: Ten most cited authors by documents researched

Porter’s literature, obligatory reading for researchers of the topic.

In a complementary fashion, the Sciverse Scopus database (<http://www.scopus.com>), used with the Wordle application, makes word networks according to the latest publications of a specific author in the database. Figure 14 represents Porter’s publications, which focuses on publications concerning topics related to competition and competitive advantage.

Figure 15 represents the words referring to Hayes’ publications, which are more related to operations strategy, operations management, manufacturing, technology and productivity.

It is worth emphasizing that the topic corresponding to the object of research of the present article is more in line with the issues addressed by Hayes. As such, his presence as the second main source of theoretical reference shows that the research that is being done is foundational material of sources acknowledged by academia.

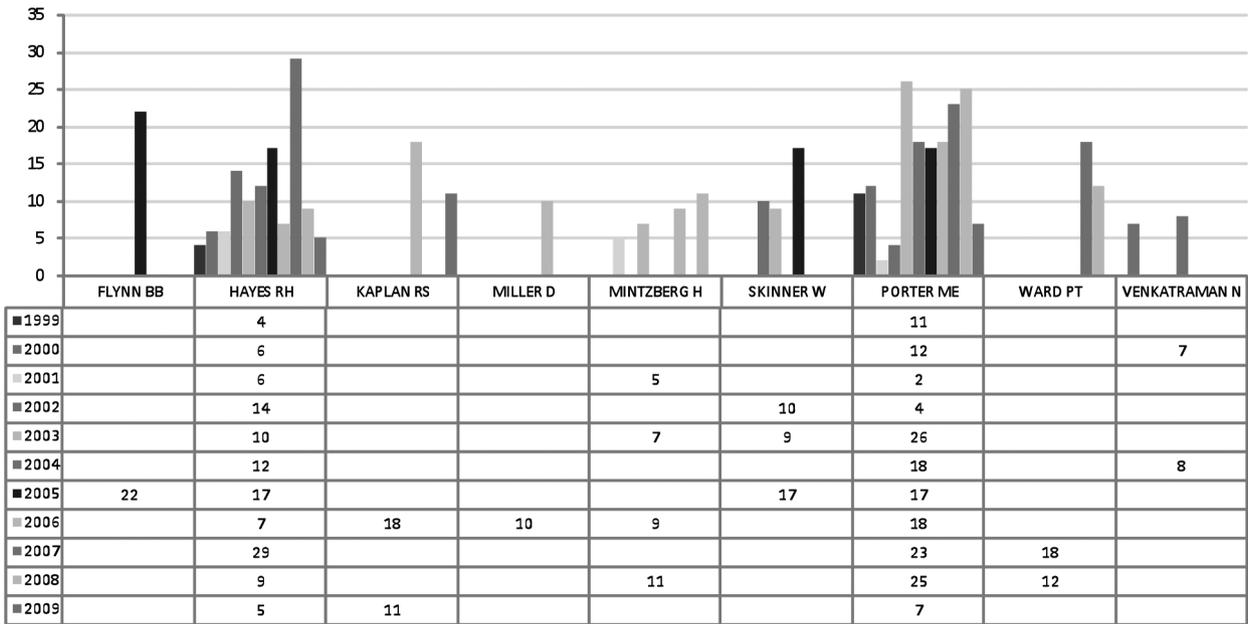


Figure 13: Evolution of citations per year



Figure 14: Words most frequently related to Porter's publications.



Figure 15: Words most frequently related to Hayes' publications.

Aside from the identification of authors that are most cited by the published documents, a more detailed study was executed in order to identify if there was, among the most cited authors, an excessive number of self-citations, which could distort the previous analysis. This indicator was based on the bibliometric analysis introduced by Caldas (2005) on Brazilian scientific production. As it was not possible to extract the information regarding the institutions of origin of each mentioned author, the classification by hierarchical order was specifically based on the analysis of the self-citations by the authors.

Among the most cited twenty authors in the research, nine cases of self-citation were found, causing a few changes in the hierarchical classification. The six self-citations by Swamidass, P. M. and Voss, C.A. were prominent, making those authors drop four and six positions, respectively, after the reclassification. Table 2 shows the result of the analysis, which reaffirmed the relevance of Porter and Hayes as the main authors on the topic. As such, both these authors should be considered relevant in the development of research on the integration of corporate and operations strategies.

Table 2: Total of citations and self-citations per author.

Cited Author	Total Number of Citations	Ranking	Self-citations	No Self-citations	Ranking
PORTER ME	109	1		109	1
HAYES RH	103	2		103	2
SKINNER W	78	3		78	3
MINTZBERG H	72	4		72	4
FLYNN BB	61	5	5	56	6
KAPLAN RS	61	5	1	60	5
WARD PT	58	7	4	54	7
VENKATRAMAN N	47	8	3	44	8
HILL T	41	9		41	9
MILLER D	41	10		41	9
VICKERY SK	39	11	3	36	11
BOYER KK	37	12	3	34	13
EISENHARDT KM	35	13		35	12
NARASIMHAN R	34	14		34	13
FERDOWS K	33	15		33	15
SWAMIDASS PM	33	15	6	27	21
ANDERSON JC	32	17		32	16
BARNEY J	31	18	4	27	21
MILLER JG	31	18		31	17
VOSS CA	31	18	6	25	26

Subsequently, a study on which institutions mentioned each author was carried out, in an attempt to identify a trend in the research line. In Table 3, it can be noticed that Michigan State University stands out, with 104 citations of the most cited authors. Of these citations, 15 were of studies by Flynn and 11 were of those by Boyer. Michigan also stands out for citing nearly almost all cited authors (19 of 20), failing only to cite H. Mintzberg. The institution is also substantially based on the ideas of Hayes. Such data can be attributed to the more operations-related focus of his approach, as he discusses several factors such as location, capacity, and implantation of operations routines in line with the strategy of operations. On the other hand, Porter is more focused on topics regarding the competitive advantages and analysis of the external environment.

Other institutions can be pointed out for citing the vast majority of the twenty most cited authors, including: North Carolina (19), Utah (17), Emory (16) and South Carolina (15). This can be an indicator of the quality of the publications of those institutions, as the most prominent authors on the topic at hand were cited in their research. Once again, Michael Porter stands out in this table. His works were mentioned by thirteen of the fourteen institutions that published the most, reinforcing his fame as the authority on the topic of integration of corporate and operations strategies. Quebec University was the institution that most mentioned Porter's studies.

Lastly, the Elitism Law was evaluated (Table 4), according to the work of Guedes and Borschiver on bibliometrics. Based on the works of Prince (1965), these authors affirm that the Elitism Law proposes that every N-sized population has an effective elite, whose size is the square root of N. In this sense, the Elitism Law was applied to the population of authors and to authors cited in the universe of our research, so as to determine the quantity of authors that would be considered of greater relevance for the study of the topic and for reading with a focus on learning concepts and possible new approaches. From the population of 544 authors, an elite of approximately 23 authors was estimated. As for the population of 6,823 cited authors, an elite of approximately 83 authors was estimated.

Analyzing the evolution of the average number of citations per year (Figure 16), its growth since 2003 is apparent. That year is also marked by a considerable increase in the quantity of publications. It is also possible to detect that the maximum quantity of citations in a specific article grew considerably, which can reveal that after that phase the topic truly gained prominence and that researchers have seemingly started to spend greater time reading the existing material.

Table 3: Most cited authors by research institution.

	Michigan State Univ.	Auburn Univ.	Carnegie Mellon Univ.	Emory Univ.	Hong Kong Polytech Univ.	Linköping Inst Technol.	Nanyang Technol Univ.	Univ. Missouri	Univ. N. Carolina	Univ. Penn.	Univ. Quebec	Univ. S. Carolina	Univ. Texas	Utah State Univ.
PORTER ME	5	3	2	2	3	4	5		2	3	8	3	2	1
HAYES RH	9	1		2		6		1	5		2	3		4
SKINNER W	9	2		2		4		1	4			2		2
MINTZBERG H			1	2			1	1	3	3	1	4		1
FLYNN BB	15			1		1		5	1			2		4
KAPLAN RS	2			7					1					8
WARD PT	9	1		1		2		5	8			6		1
VENKATRAMAN N	1	1		2			1	6	1	1	4	1	1	1
HILL T	2		1	2		6			2			1		2
MILLER D	1						9		5		1	2		
VICKERY SK	9			4		1		3	5			4		2
BOYER KK	11	1		3				1	4				1	4
EISENHARDT KM	1		1	1			1		1	2	1	2		
NARASIMHAN R	9			2	2				1			3	1	3
FERDOWS K	7			2		5			2					4
SWAMIDASS PM	2	6				1		1	2			2		
ANDERSON JC	4		1	1	1				1	1	1			4
BARNEY J	1		1				1		1	1				1
MILLER JG	5		1	1					2	1		4		2
VOSS CA	2	1				3						2		1

Table 4: The Elitism Law.

Population of authors	544
Elite of authors	23,32
Cited population	6823
Cited elite	82,60

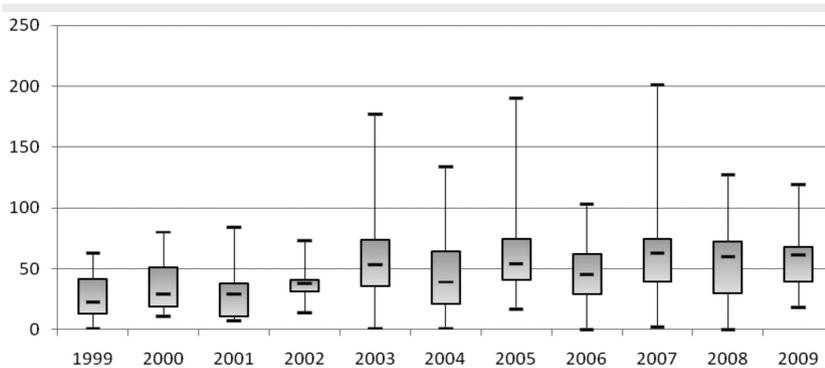


Figure 16: Citations per article

Finally, concerning the publication year used as a reference, a trend toward the use of material elaborated between 1990 and 2005 is clearly noticed (Figure 17), making the articles current, as relates to concepts. This also favors the application of the content to the market, which is always looking for a more efficient way to solve current problems. These applications would not be discussed in articles or publications prior to that period in which the internet did not even exist, for instance, and computers were not sufficiently advanced to effectively implement automation or other types of operations in industries.

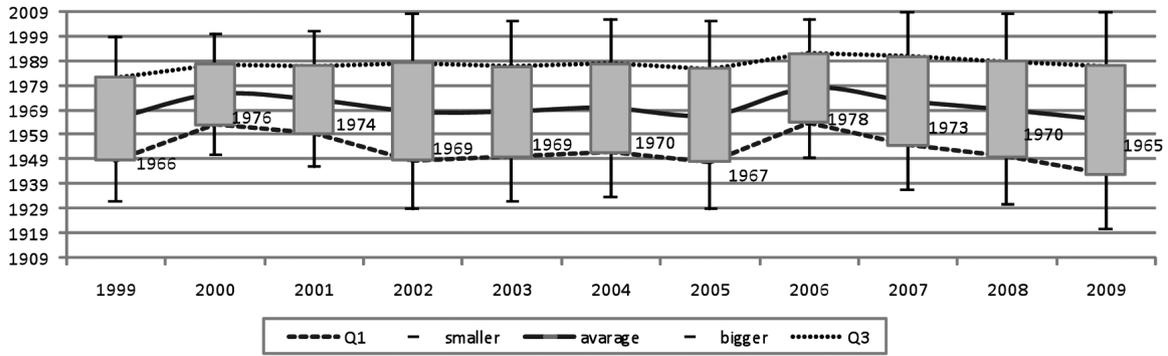


Figure 17: Analysis of citation time periods

3.1 Study Networks

In spite of the history of increase of publications on the topic, there are still few linkages among institutions for the implementation of joint studies. As can be verified in Figure 18, 39% of the offered documents come from the same academic center, reducing the multi-disciplinarity in the presentation and argument of facts and data.

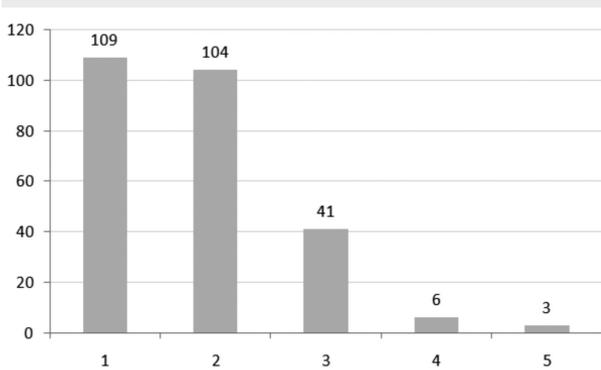


Figure 18: Quantity of articles published by offering institution groups.

On the other hand, the structuring of documents by two or more researchers is common, and the indicator shows the number of articles published either individually or in groups of N researchers (Figure 19). From the 270 articles considered in this study, approximately 43% were written by two researchers. Next are groups of three researchers, which represented 28% of the articles, followed by single-author publications

(19%) and publications of groups of four or more researchers (10%).

These numbers indicate that, although the quantity of studies by groups of researchers exceeds that of individual researchers in the publication of articles connected with the topic of this research, the groups formed include few participants.

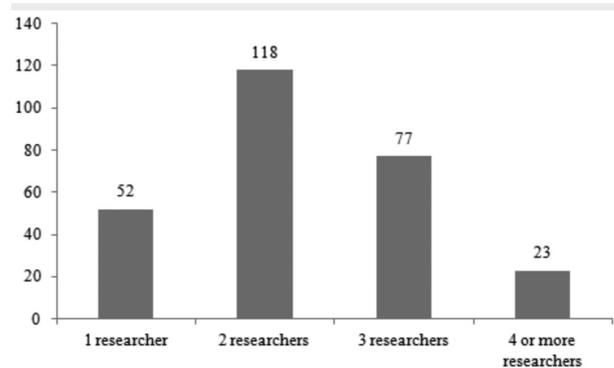


Figure 19: Amount of articles published by research groups

4 Conclusions and final considerations

From what was explored in this article, it is observed that the initial objectives proposed were duly met. This is taking into consideration that the methodology employed to direct the bibliometric study done in this study allowed the elaboration of a diverse set of indicators. These indicators al-

lowed for analyses of various factors as well as the mapping out of what was being scientifically discussed on the topic: “the integration of corporate and operations strategies.”

In this sense, in analyzing the evolution of academic production on this topic, the study concludes there has been a large increase in the number of publications, mainly over the last fifteen years. The industrial sector is the main focus of these academic studies, mostly in the areas of engineering, economics, business and management. These results reflect an important paradigm shift in companies, which increasingly need to manage operations in an aligned fashion and integrate them with corporate strategies, thus striving for a competitive differential and, ultimately, to reach and obtain a sustainable competitive advantage.

Another aspect that could account for the increase in publications could be the strong global economic growth during the fifteen years cited in this study. In this historic moment, the growth of developing countries has not only been due to sales of normal goods, but also of products with added value. This situation has moved the economic axis from the North Atlantic (The United States of America and Europe) to the North Pacific (The United States of America and Asia). A complementary issue is the emerging of new global actors with large populations and with considerable economic growth, as well as the formation of groups with common economic orientations, such as the BRICS countries (Brazil, Russia, India, China and South Africa). This growth has meant more infrastructure projects in general, industrial development, the strengthening of agribusiness and the forming of mega cities in developing countries. These countries have a need for information access, means of transport, energy supply, increased security, potable water, sewage treatment and solid waste solutions, housing and many other needs. Thus,

a very large field has opened up so that researchers can develop research strategies, communicate theories and verify and validate their findings.

From the point of view of the current main research centers in this area of research, this study highlighted that a mere three countries account for 80% of the publications on the integration of operations and corporate strategies. These countries are the USA, England, and the Netherlands. The tendency towards the increase of publications in Asian countries was also observed, mainly in those with more economic activity and educational incentives, reflecting the world industrial panorama. The University of Michigan is home to the main research center, a fact which is attributed to the industrial characteristics of the area surrounding the university, and principally, to the consolidation of a research group existing there for more than twenty-five years and also serving as a reference in this field of research. This finding reinforces that in order for research to develop, many factors are necessary, including: an environment favorable to development, a motivating organizational culture for scientific development, continuous growth and advancement of research practices, understanding on the part of researchers that a consistent integration with the real world is necessary and that good research practices and good results provoke interest in new challenges to be overcome and, lastly, a mature research team at the frontlines of the research project.

In terms of researchers, Michel Porter's works are the most cited, confirming the relevance of the publications of this author, who is highly reputed in the field of strategies concepts. Also, a growth trend in the number of citations of Hayes' studies was noted, which reflects the growth of the operations management approach as a competitive differential through an alignment with corporate strategies. In the field innovation, we can highlight the fact that authors have been demonstrating a

shift of the economic axis and in the generation of academic research and knowledge.

Aside from this, this study found little development of the research networks in this area, as the majority of articles were written by just two researchers, and there is only slight communication among different institutions. This situation also reflects a need, on the part of researchers and the research institutions of the most central countries, to take more action to form partnerships and look to follow the shift of the world economic axis, which is leaving the central countries (USA and Europe) and heading towards Asian countries and groups of developing countries (BRICS countries, for example). Lastly, this finding also helps to explain the concentration of scientific knowledge in the most central countries and the most mature research institutions.

Some considerations about the bibliometric research completed in this study are also interesting and deserve mention. Currently, one of the main difficulties in carrying out bibliometric studies lies in the retrieval of desired data. Another relevant factor is the lack of standardization in existing publications, which make it even more difficult to analyze data. This being so, it is observed in the research a large need to create mechanisms or software that facilitate the treatment of data from publications. This would make possible a large increase in the distribution of knowledge and also incentivize academic production, on a global scale.

It is important to emphasize that all knowledge generated undergoes the influence of distinct aspects, such as culture, access to information, societal characteristics, level of education, technological domain, and economic development. These aspects present large variations, in accordance with countries and field of study. In this way, it is useful to note that this research topic, the integration of corporate and operations strategies, in-

involved various regions of the world and it is a field of study that embodies various areas: engineering, business and economics. As such, the topic of this research paper experienced significant contextual interference. With this mind, despite that bibliometrics allows innumerable analyses of the collected data, these are not considered intrinsic factors in the local context and the multiplicity of possibilities are considered as statistical and mathematic, of a purely quantitative character.

A more in-depth analysis, employing bibliometric laws as the lens, and Bradford, Zipf and Lotcka's law is recommended for future studies. Another interesting study would be the implementation of bibliometric research on the same topic as this paper, but strictly in the Brazilian context, thus allowing the generation of comparisons of knowledge produced worldwide. Lastly, we recommend a more specific study of research centers and publication channels, which contribute the most to knowledge building. A study of these centers would make it possible to identify the differentials that lead these centers to distinguish themselves.

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