# Cost Management: Bibliometrics In the Annals of The National Production Engineering Meeting

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## Abstract

*The National Meeting of Production Engineering (ENEGEP) is an event organized by the Brazilian Association of Production Engineering (ABEPRO) in which brings together the academic community of researchers working in the sector of Production Engineering and constitutes one of the leading promoters of technical and scientific production in the area. Among the various topics transiting the meeting, cost management is one of those who has relevant interaction. This article aims to analyse the academic contributions published in the Annals ENEGEP from 2008 to 2018 and trends in the area of Economic Management, Cost Management subarea. Methodologically it made the use of bibliometric analysis techniques, analysing, quantitatively and qualitatively, 219 articles, considering the following variables: quantitative evolution of publications; authoring features per article; authors; educational institutions; keywords; and themes. The main results identified an average of twenty papers per year with the cost management issue, the vast majority of publications were carried out with two or more authors, in relation to the authorship, 71% of authors had only one article, the southern region is the one most representative authors of publications, and as to the keywords which is evident most frequently are "Cost Management" and "costs".*

**Keywords:** Costs; Cost Management; Bibliometrics.

## 1. Introduction

Faced with a scenario in which the domestic market is undergoing a significant stagnation related both to the political crisis, as the economic recession of 2015-2016, the factors are associated with an economic policy enacted from the end of 2014 and the downturn in the economy since 2010 (Santos & Aruto, 2018). To the holders of knowledge fits enjoy the best of their potential, pulling up data, abstracting information to generate awareness, and through this make vital decision seeking a better marketing performance. In a crisis scenario and intense competition, it is natural that organisations focus their efforts on cost-based management because it is a tool to make decisions, which uses the cost to develop competitive strategies (Gollo, Bazi, Mazzioni, & Kruger, 2017).

Now, it is salutary to know the possibilities of cost management in the organizational context, through an analysis of scientific literature that deals with the subject since researching this subject can inspire new information and generate knowledge on the subject (Pasa, Nascimento & Correio, 2017).

The Cost Accounting has as its primary function the generation of accurate and timely information for decision-making and use their technique to identify, measure and report the cost of goods/services (Aparecido Crepaldi & Simões Crepaldi, 2018). Under the same point of view and increasing the

understanding, it is emphasized that the modern cost accounting goes far beyond the numbers. Cost accounting is fundamental in managerial decision-making. Their study provides a better understanding of the activities of managers and accountants within an organization (Horngren, Datar & Foster, 2004).

In a highly competitive environment, which is the case of business organizations, the costs should be treated not from the perspective of traditional analysis, where the focus was to measure stocks and the calculation of the cost of goods for tax purposes, but with an approach geared more to the strategic company. Strategic positioning is the key to creating and sustaining a competitive advantage, and strategic cost management is the way it uses the cost data that will produce this sustainable advantage (Hansen & Mowen, 2013) help organizations in the continuous improvement of competitiveness.

In science, it is necessary to disseminate knowledge coming from the work carried out by researchers and scientists in this context scientific communication is born. One of the outlets for the academic community is employing scientific publications. No communication is not science and therefore, could not add up the individual efforts of its members in pursuit of knowledge (Oliveira, 2002). The primary means of communication used by researchers to disclose the results of their research are academic journals (Urbizagastegui, 2016). Know the main topics researched and explore trends in published scientific productions can contribute to the emergence of new management models, methodologies and innovative organizational practices.

Recent studies point to the interest of researchers for bibliometric studies in accounting (Voese & Mello, 2013; Cavalcante, Granja, Sousa & Bernardes, 2017; Oliveira, Luz, Albuquerque, Cirne & Sampaio, 2017), as they are relevant and is helping more and more to understand the scientific production in the areas of accounting (Magalhães & Araújo, 2017).

The National Meeting of Production Engineering (ENEGEP) is an event organized by the Brazilian Association of Production Engineering (ABEPRO) and is in its 38th edition. It is an event that brings together the academic community of researchers and professionals working in the sector of Production Engineering and constitutes one of the leading promoters of technical and scientific production in the area. Among the various topics transiting the meeting, cost management is one of the protagonists of this interaction.

Given this context, this paper presents a literature review on cost management, with the guiding research question: What are the main issues and trends related to the field of Economic Management, subarea published Cost Management in National Meeting Proceedings Engineering Production (ENEGEP), the last eleven years?

The overall objective of this research was to analyze the academic contributions published in the Annals ENEGEP from 2008 to 2018. This study also aims to identify issues and research trends in the area of Economic Management, Cost Management subarea; quantify the production of authors per article, and

measure the impact of disseminated publications in academia.

This work is split into five parts, the first this introduction. In the second part of the theoretical framework on cost management will be presented. The third part concerns the field of research and the methodological procedures that guided the completion of data collection, and then the fourth part describes the results of the search. Finally, the conclusions and contributions of this study will be presented.

## 2. Brief contextualization of the ENEGEP

The National Meeting of Production Engineering (ENEGEP), is an event that follows since 1981, the organization was independently sponsored by the institutions that hosted the event. Later, in 1986, it came to be organized by the Brazilian Association of Production Engineering (ABEPRO, 2018). The ABEPRO is a representative institution of teachers, students and Production Engineering professionals, which was established on October 9, 1987, in the case of an organization classified as a legal entity of private, non-profit, for an indefinite time and based in the capital of the State of Rio de Janeiro.

The association has been operating for over 30 years and his efforts began in 1981 when the first ENEGEP - Undergraduate Studies Meeting in Production Engineering, later in 1986, during the VI ENEGEP, already under the name National Meeting of Engineering production, there was the founding General Meeting of ABEPRO - Brazilian Association of Production Engineering. The ABEPRO born of these meetings and was conceived as a national discussion forum for discussions of academic, scientific and technical policies (Meirelles & Assumption, 2016).

The entity brings together professionals, researchers, students, and teachers interested in the development of production engineering in Brazil and among its functions assumes the role to clarify the duties of the production engineer in society and its market. It performs the task of being an interlocutor with governmental institutions related to the organization and evaluation of undergraduate courses; close relationships with funding agencies as well as private organizations and non-governmental organizations that deal with research, teaching, and extension of engineering.

Organized by the Brazilian Association of Production Engineering (ABEPRO) National Meeting of Production Engineering (ENEGEP) is in its 38th edition and is a reference for the academic community of researchers and professionals working in the sector of Production Engineering. It constitutes one of the leading promoters of technical and scientific production in the area.

The scientific production of ENEGEP is classified into various classes of production engineering problems, distributed in eleven areas: Production Management; Quality management; Economic Management; Ergonomics and Safety; Product management; Operational Research; Strategic and Operational Management; Organizational Knowledge Management; Environmental Management of Production Processes; Education in Industrial Engineering; Production Engineering, Sustainability and Social

Responsibility, which unfold in fifty-nine subareas and a guided session. Cost Management, the subject of this research, is a subfield of Economic Management.

## 3. Cost Accounting

The Industrial Revolution began in England in the mid-eighteenth century. It was a period that was characterized by the transition from manufacturing to mechanized industry, in which the tools gave way to machines; human power has been replaced by motive power. The shift occurred between feudalism and capitalism, and the production method is no longer becomes domestic and industrial.
Before the Industrial Revolution, the products were handcrafted. Shortly there was a figure of the industry, much less concern about the factors related to the cost of products. With the advent of mechanized industry, the concept of production is no longer manufactured to be machinery. Comes the idea of assembly line and manufacturing activities are now substantially repetitive and large-scale.

Until then it used the General Accounting also Financial Accounting call, to determine the results for the year and its main application was given in the commercial segment, but with the growth of productive activity comes the need for cost estimate for stockpiling (Ferreira, 2007; Viceconti & Neves, 2013; Martins, 2018). Accounting drifting costs, so the general accounts and manifests itself at the time that organizations feel the need to monitor more efficiently the resources allocated in the productive process of the company. There arises the Cost Accounting, which traditionally focused on determining the cost of inventory and goods produced (Hansen & Mowen, 2013).

The results for the year were obtained, the cost of goods sold was subtracted from revenues; thus, it came to gross profit. From the gross profit, other fees were deducted and thus met the profit or loss for the period. In the commercial segment, the cost of goods sold was more natural to calculate, since its composition consisted of the amount paid for the goods, more taxes, freight, insurance, and other expenses. If this happens, some variation in stock applied the formula involving, initial inventory, purchasing and final stock to meet the Cost of Goods Sold (COGS).

**COGS = Initial stock + Purchases - Final stock**

However, in the industrial sector to produce consumer goods, the process is more complicated. The manufacturer buys materials and transforms them. In addition, this transformation is paid labor, and a myriad of other costs (energy, water, etc.). To work around this situation and account for Cost of Goods Manufactured (COGM), the way computing income in the industrial business was similar to that used in business accounting, namely: the starting and ending stocks are valued, and the shopping account is replaced by expenses incurred in the production (Viceconti & Neves, 2013).

**COGM = Initial stock + Expenses in Production - Final stock**

With the same purpose of measuring the produced inventory and determine the outcome of the exercise, but with a higher level of difficulty, there is the cost accounting. The degree of complexity in calculating

the cost of significantly increased with industrialization.

With industrial development, cost accounting has undergone considerable evolution. Due to the need to improve the mechanisms of planning and control of the companies, there was a more significant concern in determining the outcome of production enterprises. It was this development that the merchant, the industrial and the service began to know how much they were earning effectively.

The knowledge and art of managing are critical factors in the success of any business, especially in highly competitive markets. As a result, we can not relegate the management costs to a secondary plane, as they form auxiliary of proper administration tools in that sense there is no way to conduct business without knowing, understand and control their costs. This is vital for the enterprise, regardless of the type - commercial, industrial or service provider - and size - small, medium or large (Megliorini, 2012; Cortiano, 2014).

Cost accounting is a field of accounting that has as the primary purpose of generating management information related to the cost of goods/services subsidizing decision making. To create information is necessary to collect, classify and record operational data of the various activities of the entity, following the generally accepted accounting principles and is focused on the organization's spending analysis in the course of its operations (Aparecido Crepaldi & Simões Crepaldi, 2018).

It is worth noting the importance of cost accounting as a management tool for better planning and control of business activities, emphasizing the decision-making process due to the growth and complexity of companies. Thus, cost accounting has to be seen as an efficient technique to assist in the performance of this new mission, management (Martins, 2018). In this context, Horngren et al. (2004) assert that modern cost accounting is much more than numbers. They stand out as being an essential management process in decision-making.

Over the years, the need for reporting for administrative purposes increased, and thus accounting turned service managers (Ferreira, 2007). The primary purpose of cost accounting is the calculation of the cost of goods sold. However, another critical aspect of the business costs of the analysis is to serve as a tool in support of the management process, especially when it comes to planning, control, and information. The planning will allow the company to identify the alternatives and then choose the best option that can thus maximize the profit of the company.

The control serves for the company to know precisely what it has concerning its stocks, as gains concerning its sales, which is the star product at the time of sale, etc. As for information, this will be useful for the company to position itself in making strategic decisions such as quantity to be produced/sold, if the company should buy or manufacture, etc.

In addition to these objectives the analysis of the costs of a company provides a variety of information that allows support decision making, such as determining the cost, and the results, products, goods, and services;

determining the profitability and efficiency of their products; allow to analyze the performance of various sectors of the company; seeks to optimize results; creates parameters for fixing the selling price; raises the maximum discount percentage to be granted; among others. (Sebastião Leone & José Leone, 2010; Megliorini, 2012; Aparecido Crepaldi & Simões Crepaldi, 2018).

The initial concern of accountants, auditors, and tax on the use of cost accounting was to solve the problems related to the monetary measurement of inventories and results. There was no intention to turn it into a management tool (Ferreira, 2007). Thus, in recent decades, accounting costs increased from mere aid in the assessment of global stocks and profits to play an essential role in the control and management decisions (Martins, 2018). In this context, the cost analyst is assuming a new role, a role with broader implications, and a less narrow definition. It is in this scenario that accounting is evolving to cost management (Hansen & Mowen, 2013).

Table 1 shows the evolution of cost accounting in three perspectives: financial, operational, and strategic and changes that have been happening over time.

**Table 1.** It shows the evolution of cost accounting in three perspectives

*Note*. Source: Compiled from "Cost Accounting" of JAS Ferreira, 2007 Sao Paulo: Pearson Prentice Hall, 2007. p. 9.

| | **Financial Perspective** | **Operational perspective** | **Strategic Perspective** |
|---|---|---|---|
| **Purpose** | Register | Run | to plan |
| **Time dimension** | Yesterday | Today | Tomorrow |
| **Users of information** | external agents | Management of operations | investors Strategic plan |
| **Function Information** | financial | Value Analysis Management of activities | Cost target prices contracts |
| **Information aggregation level** | aggregated information | Detailed information | specific information |
| **Frequency Reports** | spaced | immediate | when necessary |
| **Type measures** | financial | Physics | Financial and Physical |

In designing Ferreira (2007), there was a marked evolution of cost accounting at the time it was realized that there was a considerable mismatch between the concepts and practices about the calculation of costs and the reality of the companies themselves. The term Strategic Management Accounting (SMA) was first created by Kenneth Simmonds, who, in general, defined as an analysis of information from a company and its competitors to use in the development and monitoring of business strategy. This interface between strategic management and accounting implies a higher contribution from counters to the formulation and implementation of the plan, suggesting that accountants move away from purely financial concerns going to broader business issues, thus maintaining the role of the counter in the center of activity business (Tayles,

2011).

Strategic Cost Management (SCM) is a tool-making decisions using the costs for the development of competitive strategies, is an instrument that systematically analyzes the company's value chain, from procurement of raw materials to the arrival of the product to the final consumer (Gollo, Bazi, Mazzioni & Kruger, 2017). These two movements, SMA and SCM, emerged almost simultaneously. The first in England and the second in the United States. Both the SMA, the SCM have some similarities with each other, therefore, can be considered synonymous, the first of which is considered to be broader than the latter (Sedevich-Fons, 2018).

Strategic Cost Management (SCM) is essential to the success of any business, as it can make the most efficient production processes and thereby increase profitability and business profitability. In accordance to Drucker (2017), we now have the knowledge society, the information age, the network society, among other expressions, in an attempt to define the transition from an industrial condition to the speed of culture and technological economy.

The Ministry of Education has advanced in pursuit of quality education. There are several strategies used by the government to make HEIs fit the indicators. The new models of on-site assessment and through the National Student Performance Examination (ENADE) have brought society closer to the Higher-Education Institutions, because before it was not chosen a course by the evaluation that it received from the MEC, but this factor became to be a competitive differential in the market.

In this sense, according to Silva Júnior *et al.* (2014), the regulatory processes to which higher education institutions are submitted evaluate the Institutional Development Planning (PDI) where planning is the act by which the future of the institution is decided and the monitoring of what is under construction.

## 4. Method

The purpose of this research was to analyze the academic contributions, the main issues and trends related to the field of Economic Management, Cost Management subarea ENEGEP published in the Annals of the period from 2008 to 2018, for it was adopted bibliometric analysis techniques.

The bibliometric is a research methodology in the field of library and information science. A statistical analysis of quantitative and academic achievement includes not only descriptive statistics but also network analysis of keywords, text, quotes, authors, institutions, frequency and its connection (Liang & Liu 2018). Researchers use this type of methodology to explore the publishing trend, knowledgebase, citation standard, author network, player usage, impact and importance of the matter.

The research analyzed 219 articles published in the Annals of the Brazilian Association of Production Engineering (ABEPRO). Quantitatively and qualitatively analyzed the following variables: quantitative

evolution of publications; authoring features per article; authors; educational institutions; keywords; and themes.

Data were collected on the website of ABEPRO and drew up a spreadsheet using Excel software from Microsoft, which was structured with the following fields: year, title, author, number of authors, educational institution, keywords, and subject line. Graphical representations were made using Excel software from Microsoft® and the cloud of keywords Pro Word Cloud®. The processing of data served as input for analysis, resulting in information that will be presented later.

## 5. Results

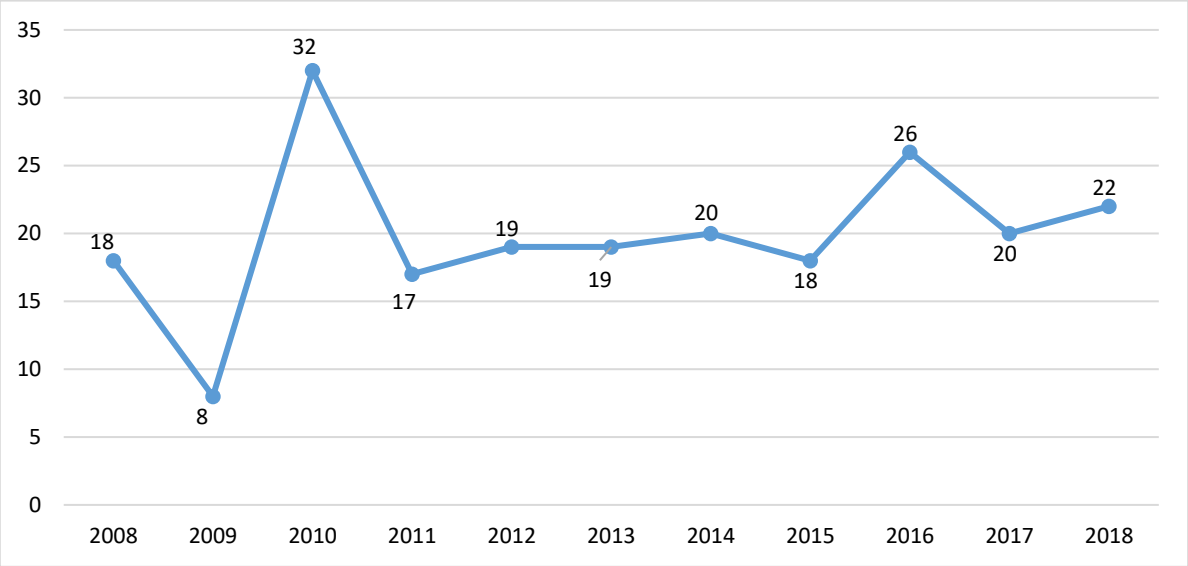
The purpose of this study was to analyze the academic contributions published in the Annals ENEGEP from 2008 to 2018. Therefore, we collected a total of 219 articles, in which the data analysis is to examine how quantitatively given the evolution of publications, authors, and their educational institutions, keywords, topics, among others.

It is worth noting the critical study of Alfred James Lotka, published in 1926, in his article The Frequency Distribution of Scientific Productivity that is a reference to the science of bibliometric. In his Lotka research (1926) shows that the number of authors who make "**n**" contributions in a particular scientific field is approximately "**1/n2**" of those who make a single contribution and asserts further that the proportion of those who make an individual input is around 60% (Machado, Souza, Santos & Palmisano, 2016; Maz-Machado, Madrid, Jiménez-Fanjul & León-Mantero, 2017; Ribeiro, 2017). This study became known as Lotka Law of Inverse Square Law.

Graph 1 is exposed to the quantitative development of publications that occurred from 2008 to 2018. In the 11 years interval observed an average of twenty (20) publications per year with a standard deviation of approximately six (6) and publications draw attention the years 2009, with 8 posts, below the standard deviation. Already in the year 2010, with 32 papers and 2016 with 26 releases were above the standard deviation, in other years, remained a standard close to twenty annual editions.

**Graphic 1.** Quantitative development of publications

*Note*. Source: Survey data (2019)




It is also observed in Graphic 1, the thematic studies on costs have maintained an average of 20 articles per year in the last 11 years, with a significant drop in 2009, with 8 published materials, and the considerable increase in the following year with 32 publications, however, since the thematic studies on costs have maintained an average of 20 articles per year in the last 11 years.

The average index of articles published opposite the articles submitted to all areas and sub-areas of ENEGEP, in the eleven years surveyed, is 0.55. By confronting the graph 1 data with the general data of issues, Table 2, it is clear that in 2010, the ratio was 0.60, but to analyze in terms of absolute numbers, this was the year with the second-highest amount of articles submitted, reaching 2,294 articles. These suggest that the sharp increase of publications in 2010, the cost area (32 articles), is directly linked to the total amount of articles submitted and converted into publishing that year.

Table 2: Articles submitted and published articles

| YEAR | Submitted articles | Published articles | Index |
|---|---|---|---|
| **2008** | 1,670 | 945 | 0.57 |
| **2009** | 2,198 | 788 | 0.36 |
| **2010** | 2,294 | 1,366 | 0.60 |
| **2011** | 1,776 | 1,072 | 0.60 |
| **2012** | 1,686 | 1,035 | 0.61 |
| **2013** | 1,491 | 832 | 0.56 |
| **2014** | 1,836 | 1,009 | 0.55 |
| **2015** | 2,091 | 1,062 | 0.51 |
| **2016** | 2,007 | 1,118 | 0.56 |
| **2017** | 2,081 | 1,301 | 0.63 |
| **2018** | 2,747 | 1,435 | 0.52 |
| **Average** | **1,989** | **1,088** | **0.55** |

*Note*. Survey data (2019)

In a literature review study on the Lotka Law, Potter (1981), we conclude that when the covered period is ten years or more and the authors of community is defined broadly, author productivity to approaches the various distribution Lotka noted. This research was conducted in a period of eleven years, from 2008 to 2018; in this sense, it is worth considering some evidence based on the Lotka Law.

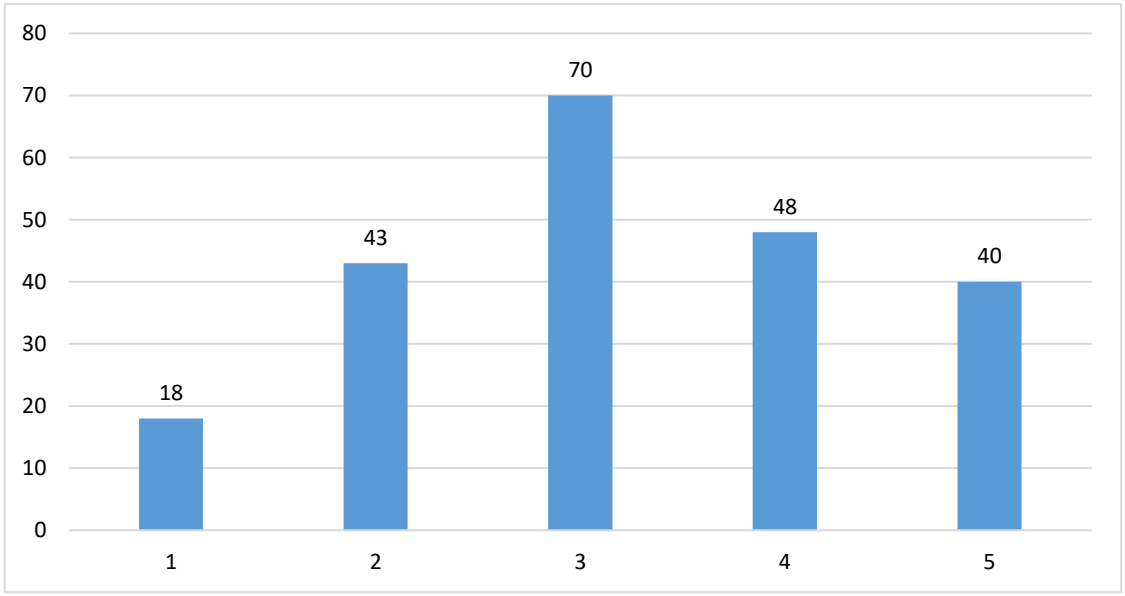
Regarding the amount publications regarding the number of authors for articles, as Graphic 2, it is observed that most publications, 70 articles were written by three authors, equivalent to 32% of all articles published in the period. Only 8.2% of the articles are written individually, while others, 91.8%, are collective compositions, ranging from two to five authors.

In research that deals with the ethical aspects of co-authorship in scientific publications, Hilario, Grácio, and Guimarães (2018) assert that the "scientific collaboration is a working strategy adopted by researchers to enable, facilitate and enhance the conduct of scientific research, especially those empirical and experimental nature. "Overall, this collaboration consists of guidance and suggestions for the improvement of research activities.

However, often related to "scientific collaboration" and "co-authoring" as synonyms; however, co-authorship is only part of the scientific collaboration, since you do not measure cooperation in its entirety and complexity (Vanz, 2009). The joint work of researchers characterizes scientific collaboration with the common goal of producing scientific knowledge. It has a broader connotation. In co-authoring, authors are intensely involved in the construction of research and take center stage of its contents, jointly signed the work, so that they can present, defend and be responsible for the original idea of the work (Hilario et al., 2018). In this case, it is assumed that there is an intense interaction within the scientific activities.

**Graphic 2.** Number of publications regarding the number of authors for articles

*Note*. Source: Survey data (2019)



One of the advantages of writing collaboratively is the issue of increasing the visibility of the results. It is understood that co-authoring improves the visibility of products, enhances both the professional growth and the development of knowledge, in addition to increasing the quotation thereof, this is due more exposed to a more significant number of researchers, thanks to the higher number of personal contacts (Batista, González & García, 2018; Chrisóstomo, Serrano & Fernández, 2018; Grácio, 2018), at this juncture, the research points (Graphic 2) to a reliable collaboration indicator of scientific works.

This is a relevant fact, as emphasizes the importance of writing so that each author can collaboratively contribute to the literature, to the research itself, with the construction and dissemination of knowledge. There is however severe criticism of hyper authorship in scientific production, for assigning many researchers authorship of research, one can cast doubt on the credibility of the study, questioning the useful intellectual contribution of all the authors in the development and construction of the text (Hilário et al., 2018).

Concerning the number of authors for articles, research shows (Graphic 2), in which 91.8% are collective compositions, and there is variability from two to five authors. However, the focus of research aimed to identify the hyper authorship ratio.

The data collected from the survey show that 706 authors published 219 articles. Table 3 shows the number of articles published by authors. The majority of writers, 502 authors, have only one publication in the period studied, this represents 71.1% of the total. Two editions were 45 authors, which is equivalent to 12.7% of total authors of publications in the period studied. This study is proven the principle of Lotka Law, as the proportion of those who make a unique contribution is about 60% (Ribeiro, 2017).

Table 3: Number of articles published by authors

| Qty. Authors | Qty. Publications |
|---|---|
| **1** | 11 |
| **1** | 8 |
| **2** | 7 |
| **6** | 5 |
| **6** | 4 |
| **9** | 3 |
| **45** | 2 |
| **502** | 1 |

*Note*. Survey data (2019)

Table 4 shows Among the authors who had three or more publications in the period, stands out Fabiano Maury Raupp, with eleven published articles, so the most productive in the studied period of time.

Table 4: **Authors who have published in the period**

| authors | Qty. Art. Pub. |
|---|---|
| **Fabiano Maury Raupp** | 11 |
| **Abraham Scott Junior Freires** | 8 |
| **Antonio Artur de Souza** | 7 |
| **Maxweel Veras Rodrigues** | 7 |
| **Adail Marcos Lima da Silva** | 5 |
| **Altair Borgert** | 5 |
| **Joanir Luis Kalnin** | 5 |
| **Reinaldo Pacheco da Costa** | 5 |
| **Rodney Wernke** | 5 |
| **Sandro Rogério dos Santos** | 5 |
| **Antonio Cezar Bornia** | 4 |
| **Antonio Zanin** | 4 |
| **Aparecida Claudia Mattos** | 4 |
| **Cristiane Mosque Tabosa** | 4 |
| **Josenildo Brito de Oliveira** | 4 |
| **Roberto Ribeiro Portes** | 4 |
| **Aldo Shimoya** | 3 |
| **Andreas Dittmar Weise** | 3 |
| **Fabio Walter** | 3 |
| **Getulio da Silva Abreu** | 3 |
| **Joisse Antonio Lorandi** | 3 |
| **Jose Luiz dos Santos** | 3 |
| **Livia Carolina Matos Lima** | 3 |
| **Paulo Roberto Pinheiro** | 3 |
| **Paul Schmidt** | 3 |
| **SUBTOTAL** | **114** |

*Note*. Survey data (2019)

The Law of the Inverse Quadrant holds that a small number of researchers produce much in a particular area of knowledge, while a large volume of researchers critical little (Machado et al., 2016). This is another point of proof of Lotka's Law on scientific productivity.

It also proves Price's Elitism Law, which states that every population of size **N** has a productive elite of size $\sqrt{N}$ and that the number of members of that elite corresponds to the square root of the total number of authors, and half of (Cintra, Amâncio-Vieira & Munck, 2017 and Santos & Cavalcante, 2018).

The number of members of this elite, totalling 27 writers, which is the square root of 706 authors and half

of the total studied scientific output corresponds to 110 articles. Analyzing the research data, it appears that the authors published 25 114 articles (Table 4), so that the elite research, according to this concept, is productive and confirms Elitism Act Price.

Regarding the institutional link, the research identified 639 writers related to national educational institutions and an author linked to the Chemnitz University of Technology, which is a public university in Chemnitz, Germany, authored by Charles Albino Schult.

Of the 80 authors who published in 2018, it was possible to identify the institutional link only 20%, i.e., 16 authors. Until then, along with the author's name came to define the institution to which he belonged, it was observed that this year, in the article body, did not reveal the binding Institution of Higher Education (IHE). The appointment of these 16 authors was measured when identified by institutional email.

Among the educational institutions, ten more had their authors with publications, depicted in Table 5, and five are in the Northeast, four in the South and the Southeast.

Table 5: **Institutional linkage of the author**

| name IHE | locale | Region | Qty. Authors |
|---|---|---|---|
| **Federal University of Ceara** | Fortaleza / CE | Northeast | 39 |
| **Federal University of Santa Catarina** | Florianópolis / SC | South | 38 |
| **The University of Caxias do Sul** | Caxias do Sul / RS | South | 33 |
| **Federal University of Minas Gerais** | Belo Horizonte / MG | Southeast | 32 |
| **Federal Rural University of Semi-Arid** | Mossoro / RN | Northeast | 28 |
| **Federal University of Paraiba** | João Pessoa / PB | Northeast | 27 |
| **Federal University of Santa Maria** | Santa Maria / RS | South | 26 |
| **Federal University of Campina Grande** | Campina Grande / PB | Northeast | 25 |
| **Federal University of Rio Grande do Norte** | Natal, RN | Northeast | 25 |
| **State University of Santa Catarina** | Florianópolis / SC | South | 18 |

*Note*. Survey data (2019)

The amount of authors by state, Table 6 shows that the Midwest is fewer authors have published 18 authors (2.5%), followed by North, with 38 authors (5.4% ); the Northeast, with 161 authors (22.8%); then the Southeast, authors 177 (25.1%); and South, the most representative, has 245 authors (34.7%). Authors who have not been identified as an institutional affiliation or not belonging to national institutions, representing 9.5%.

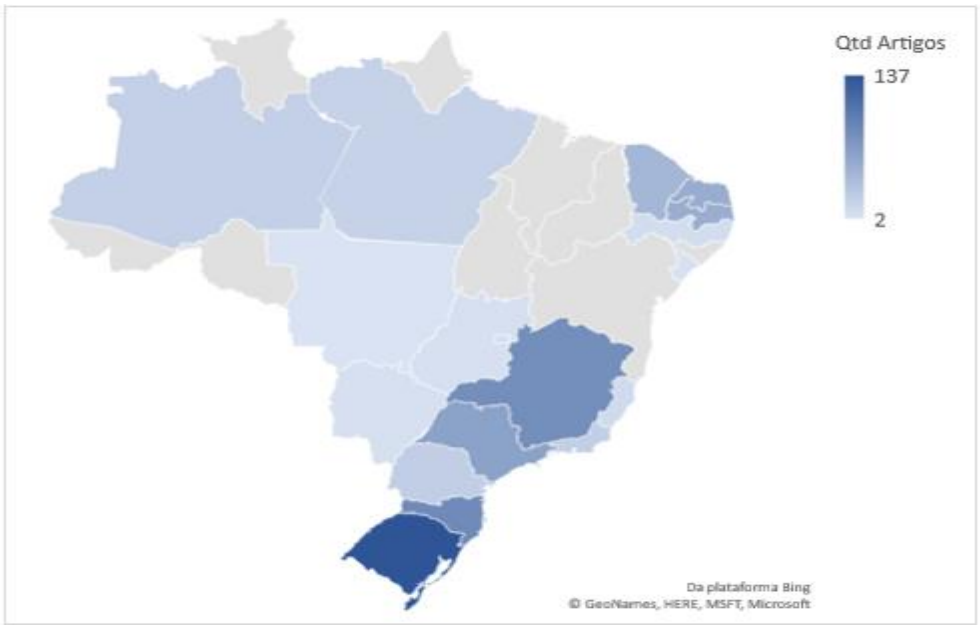
Table 6: **Number of authors by Federation Unit**

| Region | UF | Federation unity | Qty. Authors |
|---|---|---|---|
| **North** | AM | Amazonas | 20 |
| | PA | Pará | 18 |
| **Midwest** | DF | Brasília | 6 |
| | GO | Goiás | 5 |
| | MS | Mato Grosso do Sul | 5 |
| | MT | Mato Grosso | 2 |
| **Northeast** | EC | Ceará | 44 |
| | PB | Paraíba | 52 |
| | PE | Pernambuco | 8 |
| | RN | Rio Grande do Norte | 53 |
| | SE | Sergipe | 4 |
| **Southeast** | ES | Espírito Santo | 10 |
| | RJ | Rio de Janeiro | 21 |
| | MG | Minas Gerais | 82 |
| | SP | São Paulo | 64 |
| **South** | PR | Paraná | 22 |
| | RS | Rio Grande do Sul | 137 |
| | SC | Santa Catarina | 86 |

*Note*. Survey data (2019)

Graphic 3 shows the distribution of authors by institutional affiliation in the country. Of the seven states of the North, only two (Amazonas and Pará) present authors with a publication. There are no publications of authors linked to the institutios of the countries of Alagoas, Bahia, Maranhão, and Piauí. The Midwest Region is the one that has the smallest representation in terms of publications, and the southern region is where you will find the largest concentration of higher education institutions with publications.

**Graphic 3.** Distribution of authors by Federation Unit




*Note.* Source: Survey data (2019)

The key words presented in the study were at least three and no more than five per article. 760 were identified keywords, among them 485 different. That total was elaborated on a keyword cloud by applying the Word Pro Cloud® to highlight the words that were more often in Figure 1. A word cloud is an illustration is intended to show the degree of frequency of words in a given text. Thus, the more the word is used, the more striking is the representation of that word on the chart.


**Figure 1.** keyword cloud to the degree of frequency of keywords

Source: Survey data (2019)

Figure 1 shows the 760 keywords and notes that had the highest incidence of these, the five most frequently were: "Cost Management", with 38 repetitions, representing 5% of the total; "Cost", with 33 repetitions,

representing 4.3% of the total; tied third words "ABC Costing" and "Costing Method", with 10 repetitions, representing 1.32% of the total; in fourth place the words "Cost Accounting" and "absorption costing", with 9 repetitions, representing 1.18% of the whole; and fifth words "contribution margin" and "Decision Making", with 8 replicates, corresponding to 1.05% of the total.

Another law of great importance to the science of bibliometrics is the Zipf's Law, which describes the frequency in the use of words in a given text, ie, it highlights the occurrences of terms used in published studies (Santos & Cavalcante, 2018 ). George Kingsley Zipf observed that the frequency of occurrence of words is not uniformly or regularly distributed, but inversely related to the frequency rating. In other words means that the most common word appears twice as often as the second most frequent word, three times more than the third, and so on (Lestrade, 2017; Corominas-Murtra, Seoane & Solé, 2018).

Note that the second term "costs" with 33 repetitions, was discordant concerning Zipf's Law, but the other terms present significant proximity to the analysis of that research, demonstrating the empirical observation Zipf in respect of the frequent occurrence of a word and its frequency rating

## 6. Discussion and Final Remarks

The purpose of this research was to analyze the academic contributions published in the Annals ENEGEP from 2008 to 2018, intending to also identify issues and research trends in the area of Economic Management, Cost Management subarea. To do so, they were analyzed quantitatively and qualitatively, 219 articles published in the Proceedings of the Association of Industrial Engineering (ABEPRO).

Bibliometric analysis techniques and research findings were used state the applicability of this strategy to dissect a particular subject of study, in the specific case of "costs" because it was possible to deepen the knowledge addressing on several angles: authorship, both in appearance quantitative, as the relational aspect, researched themes, spatial distribution, institutional linkages, among others. That said, ratifies, macro way, that the use of this search feature contributes significantly to understand the object of study better, analyzing the correlational factors and dissemination of scientific knowledge.

Still, in the field of bibliometric, research has revealed necessary evidence of scientifically accepted studies. Confirmed the Lokta Act or Inverse Square Law, which describes the productivity of the authors, indicating that a small number of researchers produces very particular area of knowledge, while a large volume of researchers produces little. With this result, it was observed that, of all publications ENEGEP, less than 2% are related to management costs, representing a small percentage of research in the area. What can be inferred is that there is a gap in the agendas of scientific research in the context of cost management, revealing potential opportunities for studies on the topics unexplored.

Even with a limited amount of productions on the subject, this study raises in academia, continuing the search for scientific discoveries related to organizational cost systems. Validated the Zipf's Law, which

portrays the regularity in the use of words in a given text highlighting the occurrences of terms used in published works. That said, research has shown the empirical observation Zipf regarding the frequency of occurrence of a word and its frequency rating.

The Price of Elitism Law states that the number of members of an elite corresponds to the square root of the total number of authors and whether this elite or not productive, it must be considered half of total production. In the present study, survey data point to a productive elite. It has also shown that collaborative writing emerges as a strong presence in the construction of new knowledge. For the most part, the publications were held in a collective form of writing. The hyper authorship is a healthy sign because it allows the more experienced researcher to stay productive while approaching and encourages young scientists to produce science.

The study may contribute to the area costs from the time that broadly favors understanding better how are the academic standards of production of articles on the main topics and trends related to cost management area and presented an overview of the publications of the National Production Engineering Meeting (ENEGEP), the last eleven years. However, this study can cooperate not only for academia, as it produces a mapping of content and research aspects in the cost area, but also brings the practical application of the material for the organizational environment and dissemination of knowledge.

It should be noted the importance of the matter for the operational management of the organizations, since the data point to the fact that the keyword "Cost management" being the most frequent. This interrelation, cost management, and operational control are inherent in the production process because the costs are part of the production targets.

As a limiting factor, the research only focused on the ENEGEP publications, however it is worth noting that this is a specialized event in the field of production engineering and among the various topics transiting the meeting, cost management is one that has a significant interaction, this station, for future research, it is suggested further study with qualitative research in order to identify the main issues related to cost management; We can also explore other areas of ENEGEP publications, as are 59 sub-areas, distributed in 11 regions; and it suggests, finally, that are mapped to relational links between the authors, since the study showed that approximately 92% of the publications were written collectively.

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