MANAGEMENT INFORMATION SYSTEMS ERRORS. SCIENTOMETRIC ANALYSIS

ERRORES EN LOS SISTEMAS DE INFORMACIÓN DE GESTIÓN. ANÁLISIS CIENTOMÉTRICO

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ABSTRACT

The purpose of this articles is to identify errors related to management information systems through a Scientometric analysis to divulge the dynamics of the research topic to the academic community. The study was carried out, between 1971 and January 30, 2021, using the Scopus database and VOSviewer software. As a result of the search string "management information system" and "error*" or "mistakes" were obtained 826 published scientific articles. The highest percentage of documents published are conference paper (53.3%), and Article (39.7%). The most productive countries are the United States and Austria (60% articles) and citations are focused on United States (65%). The chronological analysis revealed that the scientific production in the area showed a particular increase from 2006 to 2009. The Lecture Notes in Computer Science. Lecture notes in Artificial Intelligence and Lecture Notes in Bioinformatics was the most productive journal. The 32.7% of the literature was published in the Computer Science field. 6 clusters were identified, and 19 keywords related with errors or mistakes were recognized. The Scientometric analysis accomplished allowed a descriptive analysis and identification of the countries, journals, keywords, sponsors, most cited articles, clustering the results facilitating the visual representation of the study.

Keywords: Scientometric; management information systems; mistake; error; fault.

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RESUMEN

El propósito de este artículo es identificar errores relacionados con los sistemas de información de gestión a través de un análisis cienciométrico para divulgar la dinámica del tema de investigación a la comunidad académica. El estudio se realizó, entre 1971 y el 30 de enero de 2021, utilizando la base de datos Scopus y el software VOSviewer. Como resultado de la cadena de búsqueda "sistema de información de gestión" y "error*" o "errores" se obtuvieron 826 artículos científicos publicados. El mayor porcentaje de documentos publicados son artículos de congresos (53,3%) y artículos (39,7%). Los países más productivos son Estados Unidos y Austria (60% artículos) y las citas se centran en Estados Unidos (65%). El análisis cronológico reveló que la producción científica en el área mostró un aumento particular de 2006 a 2009. Las Notas de Lectura en Ciencias de la Computación. Lecture Notes in Artificial Intelligence y Lecture Notes in Bioinformatics fue la revista más productiva. El 32,7% de la literatura se publicó en el campo de las Ciencias de la Computación. Se identificaron 6 clústeres y se reconocieron 19 palabras clave relacionadas con errores o desaciertos. El análisis cienciométrico realizado permitió un análisis descriptivo e identificación de los países, revistas, palabras clave, patrocinadores, artículos más citados, agrupando los resultados facilitando la representación visual del estudio.

Palabras clave: Cienciometría; sistemas de información; equivocación; error; falla.

INTRODUCTION

To estimate the state-of-the-art of a given topic, researchers can turn to Scientometric a quantitative study of the disciplines of science based on published literature and communication indicators, and one of the most important measures for the assessment of scientific productions (Schubert, 2015). This could include identifying emerging areas of scientific research, examining the development of research over time, or geographic and organizational distributions of research (Schubert, 2015).

The framework of this research occurs in the context of information, which, with the help of new technologies, has been managed, providing solutions to any organization through management information systems. Information systems have evolved, in such a way that they provide timely and reliable information generated through their use; its quality, and veracity, will result in support in decision-making at the managerial level in organizations (Patricio et al., 2017). As stated by Prifti et al. (2020) a management information system (MIS) is a computerized database organized and programmed in such a way that it produces regular reports on operations for each level of management in an enterprise, also it can generate special reports easily from the system. Besides it is an applied field concentrating on strategic, managerial, and operational usage of various types of information technologies at societal, organizational, and individual levels. Also, according to Mohnaty (2014), it draws upon several reference disciplines such as cognitive psychology, computer science, behavioral science, decision science, economics, operation management, organization theory and engineering. The information displayed by MIS shows the "real" data versus the "expected" results and the results from the previous year, it measures progress against goals. The main input to a MIS is data from enterprise units and functions (Prifti et al., 2020) and the limitations and deficiencies in the process of management information system performance are the main reason for diminishing the efficiency of decision-making process in the organization (Prifti et al., 2020). In this sense, for a MIS to add value

to organizations, it must address errors or inconsistencies that arise within the building phases of the information system cycle: planning, analysis, design, and implementation.

Moreover, the probable causes that generate errors and impact the processes in an organization must be identified. The errors in the information systems can occur in any phase, however, the errors that are identified in the production phase after the implementation of the IS, possibly are more complex to solve if they are due to an analysis and/or design. However, those generated by human factors, could determine its roots in the operation process (Salazar & Campos, 2009).

On the other hand, as stated by the author Nasa & Space (2004) the cost of solving an error increase significantly as the development of the software advances in its life cycle. It is important to consider that errors are frequently due to mistakes committed in early building phases, the lack of adequate standards in the development of software or bad programming practices. Leading in such a way to failures in the results of one or more processes, resulting in economic, technological, and even human loss.

In order to study and analyze the scientific trends that have been published in the area of management information systems and the related errors, a Scientometric analysis has been carried out.

METHODOLOGY

This Scientometric research is a general, retrospective, objective, reliable description, and not a partial review of a convenience sample, of the scientific production on errors related to MIS published from 1971 to 2021.

The following steps were necessary to perform the analysis:

Purpose

The present study has been undertaken with the following objective, to identify errors related to management information systems through a Scientometric analysis to divulge the dynamics of the research topic to the academic community.

Data source

The search was carried out through the Scopus electronic database, as it is one of the most relevant scientific information platforms that access the scientific databases and the most significant publications in the different areas of knowledge. Regarding management information systems issues. Additionally, this database allows searches in advanced structures by means of logical operators that conform to the specifications of the revision proposed in this investigation. As well as filtering tools that provide valuable information to the analysis by allowing to track, analyze and visualize the results of the research search and subsequent Scientometric analysis.

Search strategy

One of the relevant moments of a Scientometric analysis is the structured search strategy, since it must allow filtering the information available in the databases, so that the selected articles respond to

the questions posed in the research, and consequently the objective set.
Articles identified by electronic searches were selected based on title, abstract, and keywords.

The structured search used to search the articles was TITLE-ABS-KEY (“management information system*”) AND (TITLE-ABS-KEY (“mistake*”) OR TITLE-ABS-KEY (“error*”)

Data extraction and information analysis

This data collection process was developed in two stages:

Information Extraction: Once the search string described in section 2.2 has been executed, the database provided by Scopus is exported in CVS Excel format, including in this step all the fields: Citation information, Bibliographical information, Abstract & keywords, Funding details, other information. Next, the database extracted from Scopus was imported into VOSviewer to build and visualize the Scientometric networks by author, country, and keywords.

Data analysis: This step was carried out using the Scopus Scientometric analysis, as well as the analysis tools provided by VOSviewer.

DATA ANALYSIS AND DISCUSSION

The document search was carried out in Scopus, on January 30, 2021. The search string used was TITLE-ABS-KEY (“management information system *”) AND (TITLE-ABS-KEY (“mistake *”) OR TITLE-ABS-KEY (“error *”)), obtaining a total of 826 articles.

The results obtained and their analysis will be detailed below.

Number of articles per year since 1971 - current

Publications in the area have been viewed since 1971. In general, the number of documents published annually ranges from 1 to 25. However, a significant increase occurred in 2007, 2007 and 2008, so exceptionally, 125 articles were published.

Figure 1 shows the annual evolution of the publication of articles related to management information systems.

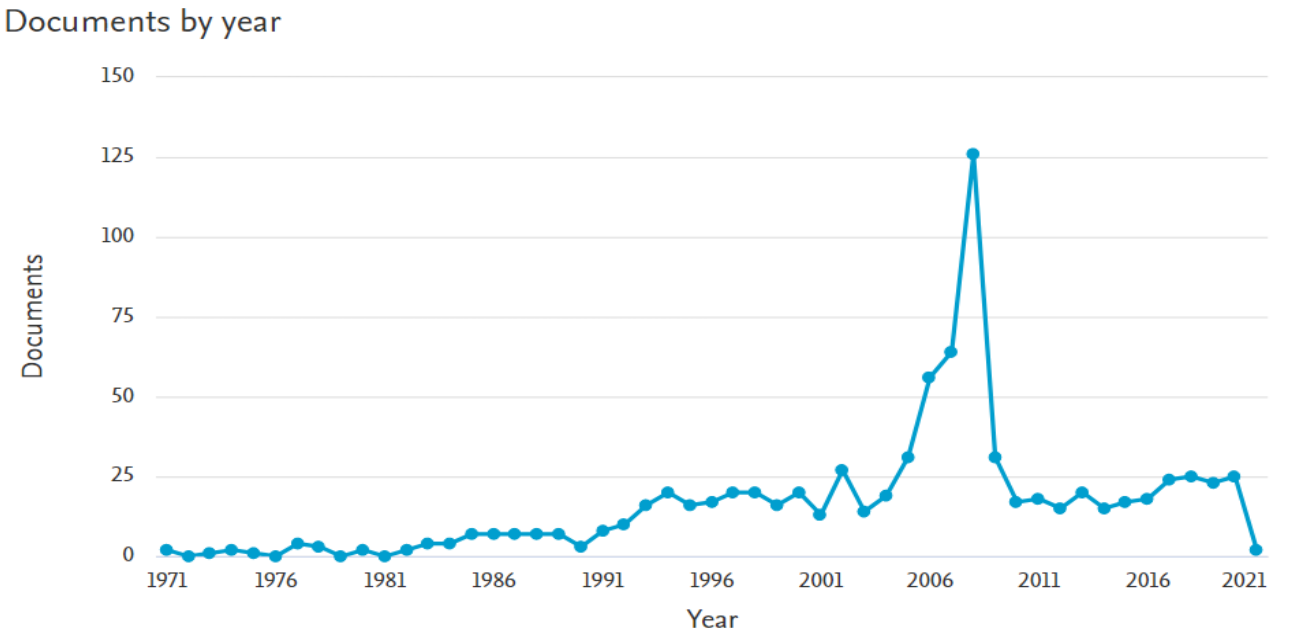

Figure 1. Number of articles per year since 1971- current

Articles published annually by source.

The main sources of publication in the area are ACM International conference Proceeding Series, MIS Quarterly Management Information Systems, Studies in Health Technology and Informatics, Transportation Research Record, Lecture Notes in Computer Science Including Subseries. Lecture notes in Artificial Intelligence and Lecture Notes in Bioinformatics. It should be noted that this last journal made a significant contribution to publication in 2008, and since 2011 it has not registered publications. Additionally, since 2017 the publications in the journal ACM stand out from the other journals. See figure 2.

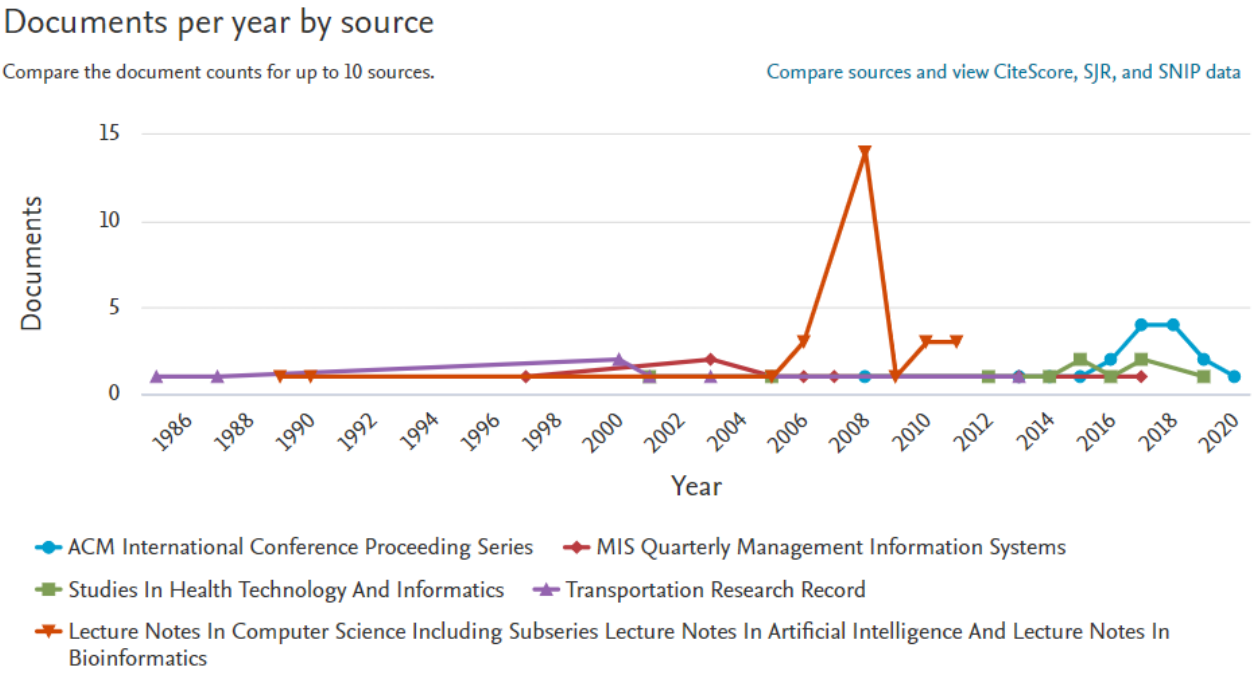

Figure 2. Articles published annually by source. Source Scopus

Percentage of documents published by type.

It is identified that the highest percentage of documents published are through Conference Paper with a participation of 53.3% (440 articles), with 39.7% being publications through Article (328 articles published), Review with 2.9% participation (24 articles), Conference Reviews with 1.8% shared participation (15 articles), Book Chapter, Short Survey, Book, Note, Erratum and Report with less than 1% participation each one (19 articles).

Figure 3 shows the percentage of participation of the different types of publication related to errors in management information systems.

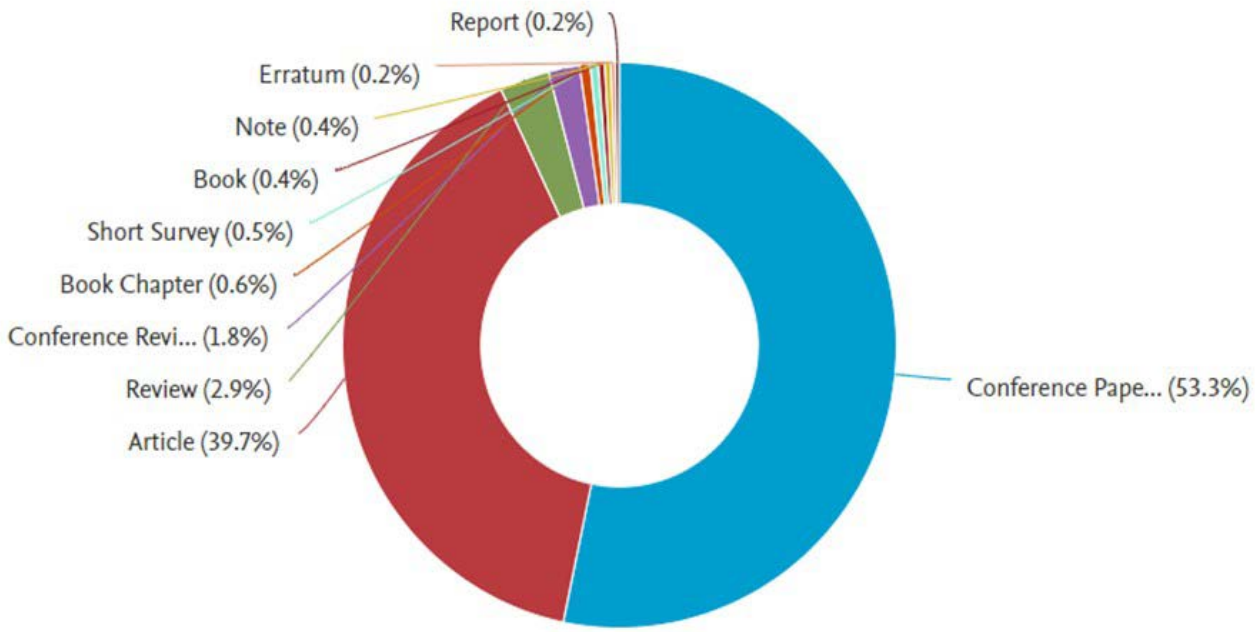

Figure 3. Percentage of documents published by type. Source Scopus

Percentage of publication of Documents in the Knowledge Areas.

It is identified that 32.7% of the publications belong to Computer Science areas, being the largest producer, followed by 23.9% to engineering area, 6.8% to Medicine, 5.7% to Business Management, 5.4% to Mathematics area, 4.8% to Decision Science, 4.8% to Social Sciences, 4.5% to Environmental Science, 2.1% to Earth and planet, 1.8% to Materials Science and finally 10.3% to other areas of knowledge.

The following figure 4 shows the percentage of participation in the publication of documents that refer to errors in the MIS mentioned by different areas of knowledge.

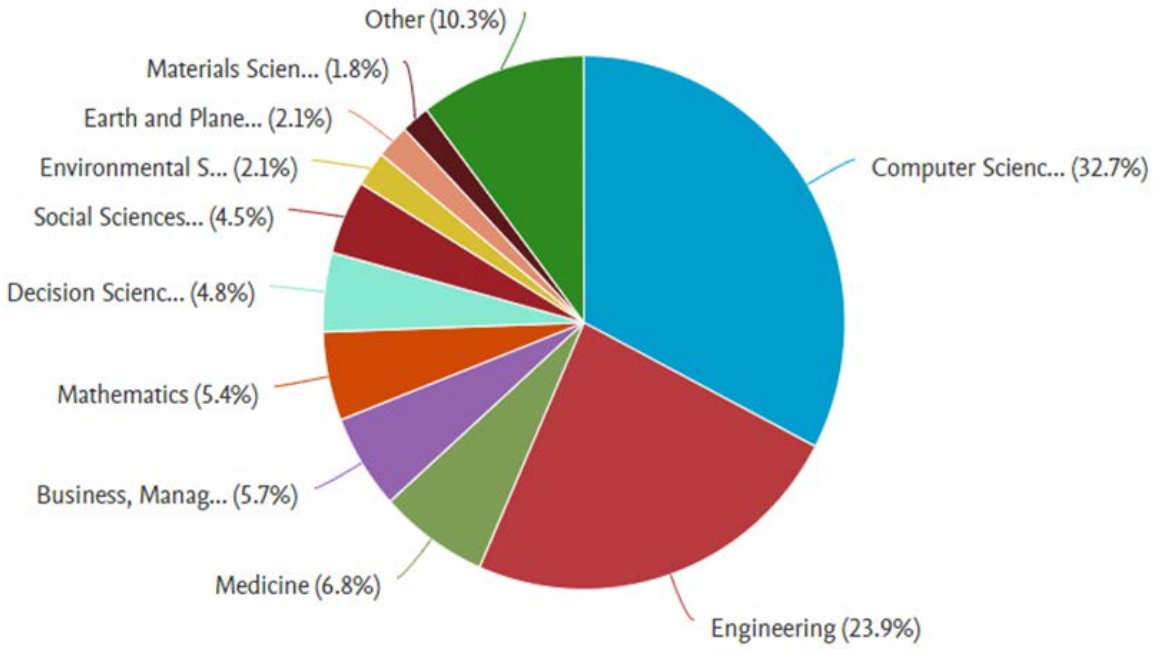

Figure 4. Percentage of publication of Documents in the Knowledge Areas. Source Scopus

Documents published by countries or territories.

The 15 countries with the highest number of publications related to errors in information systems is the United States with a total of 240 article, China with a contribution of 80 article, 40 articles to Germany, 35 articles to United Kingdome, 30 articles to South Korea, 25 articles to Canada and Taiwan, 20 articles to Japan, 18 articles to India and 15 articles to France approximately.

Figure 5 shows the 15 countries with the highest number of publications related to errors and MIS.

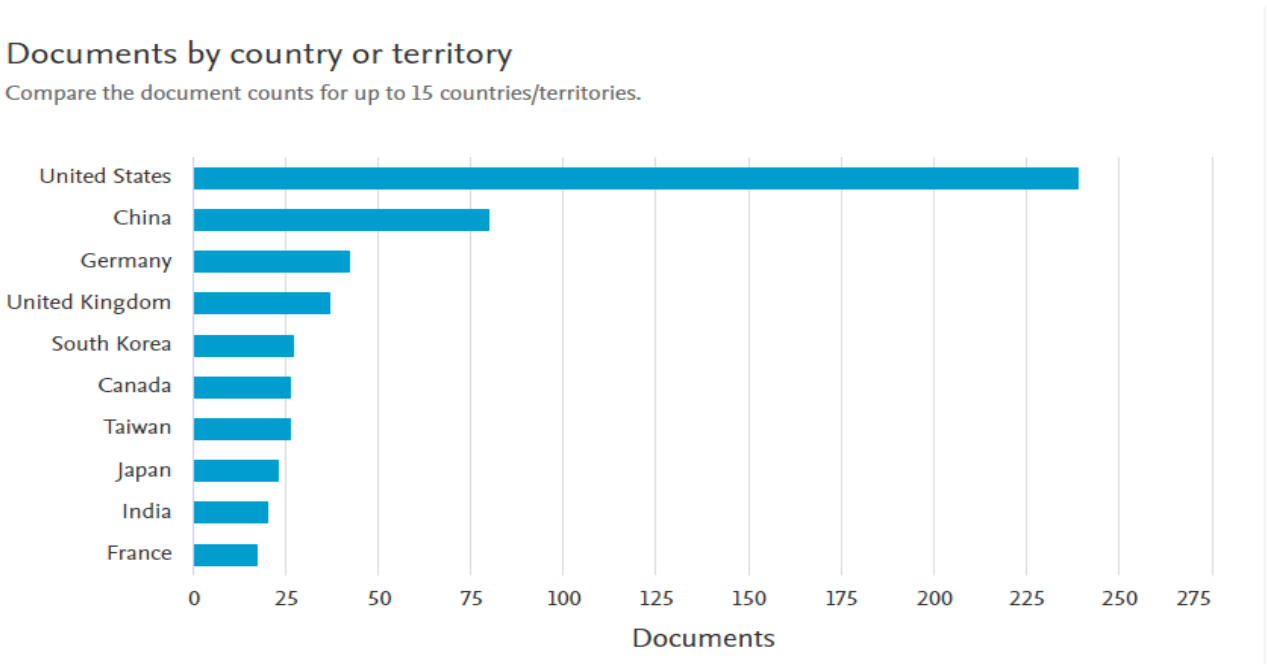

Figure 5. Documents published by countries. Source Scopus

Main sponsors of the publications

The main sponsor to the publication of these articles is the National Science Foundation, with almost 17 publications. Followed by the European Commission with around 4 articles. Then, Deutche Forschungsgemeinschaft, Fundacao para a Ciencia a Tecnologia, National Aeronautics and Space Administration, Office of Naval Research, sponsoring 3 articles. Finally, Conselho nacional de Desenvolvimento, Coordinates of Aperfeicoamento, Horizon 2020 Framework Program, Natural Sciences and Engineering Research, supporting 2 articles. See figure 6.

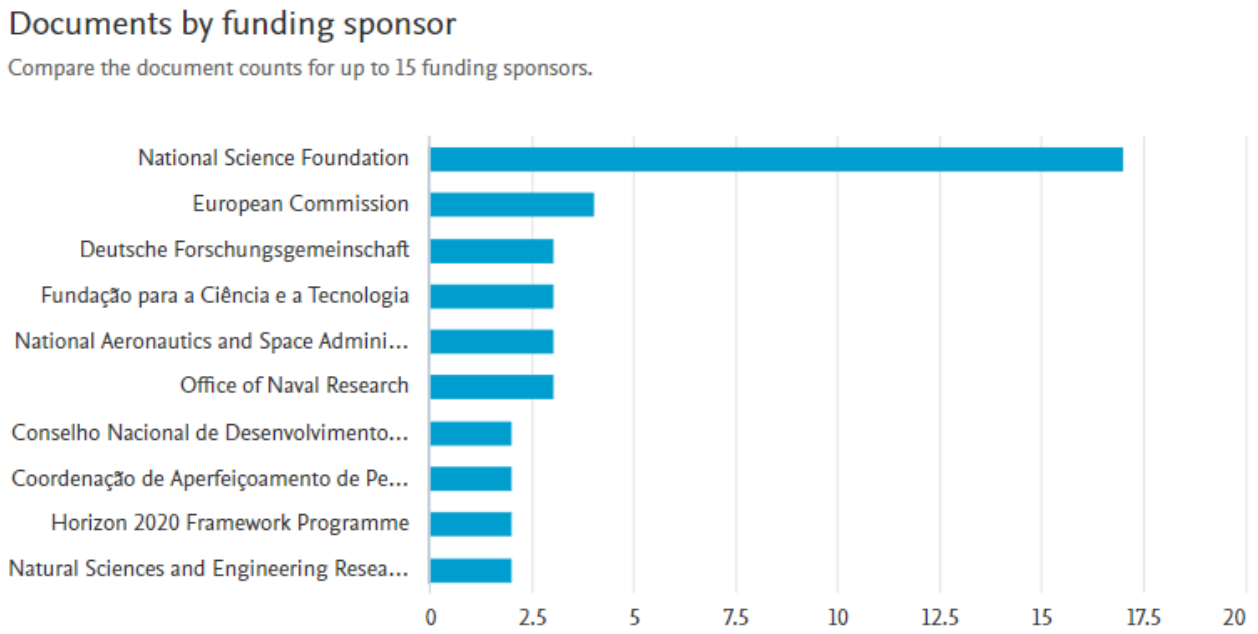

Figure 6. Main sponsors of the publications. Source Scopus

Keywords

From the Scopus database were extracted the main 15 list of keywords, evidencing the occurrences and the link strength they present. For which the keyword "management information systems" obtained a total of 653 occurrences and a link strength of 4682, followed by "information systems" with an occurrence of 170 and a link strength of 1287. For the case of "error analysis" presented a total of 65 occurrences and a link strength of 585 are evidenced. See Table I to review other keywords.

Table I. Keywords. Source VOSViewer

KEYWORD	OCCURRENCES	TOTAL LINK STRENGTH
MANAGEMENT INFORMATION SYSTEMS	653	4682
INFORMATION SYSTEMS	170	1287
INFORMATION MANAGEMENT	144	1181
ADMINISTRATIVE DATA PROCESSING	108	1030
HUMAN	62	777
ARTICLE	64	762
HUMANS	54	740
DECISION SUPPORT SYSTEMS	65	677
INFORMATION SYSTEMS	65	654

KEYWORD	OCCURRENCES	TOTAL LINK STRENGTH
DATABASE SYSTEMS	82	629
DECISION MAKING	62	628
ERROR ANALYSIS	65	585
SYSTEMS ANALYSIS	81	564
ARTIFICIAL INTELLIGENCE	53	552
INFORMATION SCIENCE	70	503
ERRORS	54	480
COMPUTER NETWORKS	51	472
INFORMATION USE	55	416
UNITED STATES	38	403
ORGANIZATION AND MANAGEMENT	33	381

The most frequently used terms are “management information systems”, “information systems”, “information management”, “administrative data processing”, “human”, “article”, “humans”, “decision support systems”, “information system”, “database systems”, “decision making”, “error analysis”. These topics are broadly part of the domain in information systems. See Figure 7.

Figure 7. Word cloud

Management Information systems, and mistakes or errors

The network features 410 keyword nodes (circles); 13418 links; 6 clusters represented by the strongest relationships between keywords (different colors). Among the clusters, those related to management information systems, the information systems applications mainly focused on the health area, administrative data processing, in decision-making, and industry 4.0-technology, stand out. The size of the circles and the font represents the weight of the keywords in the articles, the word “Management Information System” being of greater importance, see Figure 8 shows the clusters identified.

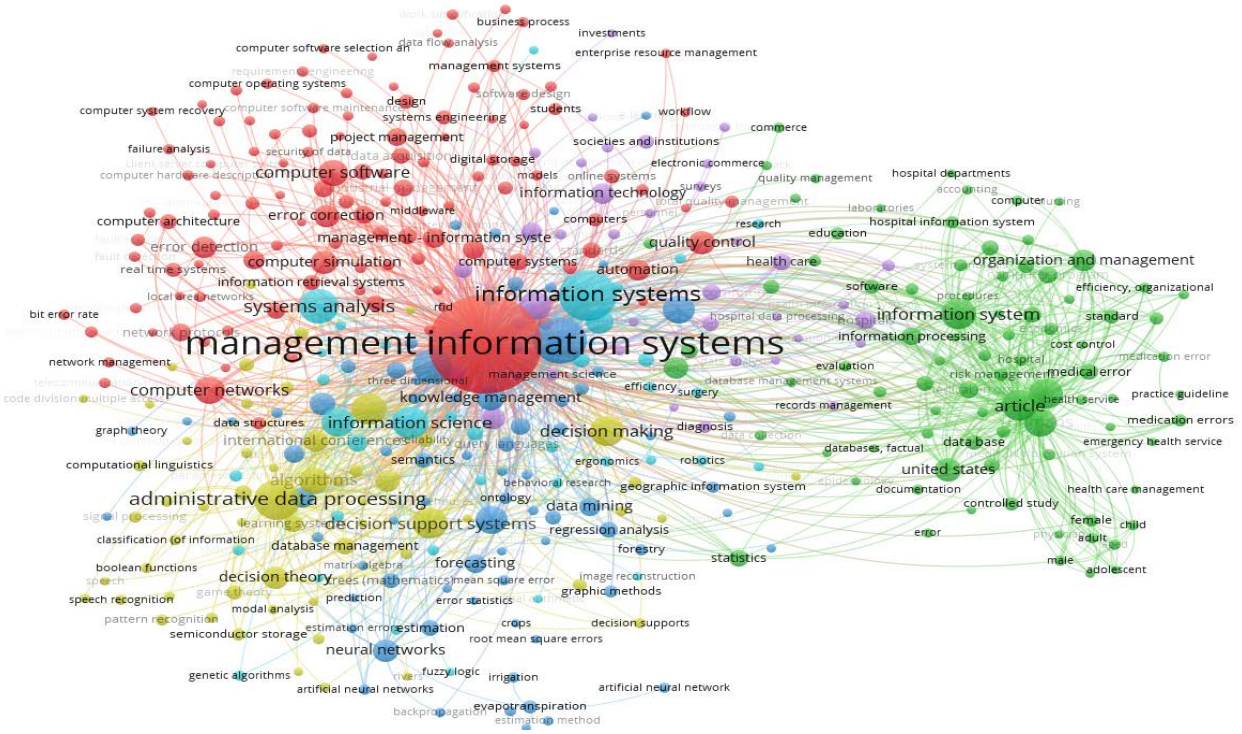

Figure 8. Keywords Network Visualization. VOSViewer

The overlay display in Figure 9 shows the same information as Figure 8, but the colors depend on the score based on the publication date of the article. Most of the keywords were included in articles between 2000 and 2015. The blue color of the keyword “Management information systems” corresponds to a year around 2005, while very few keywords correspond to recent years.

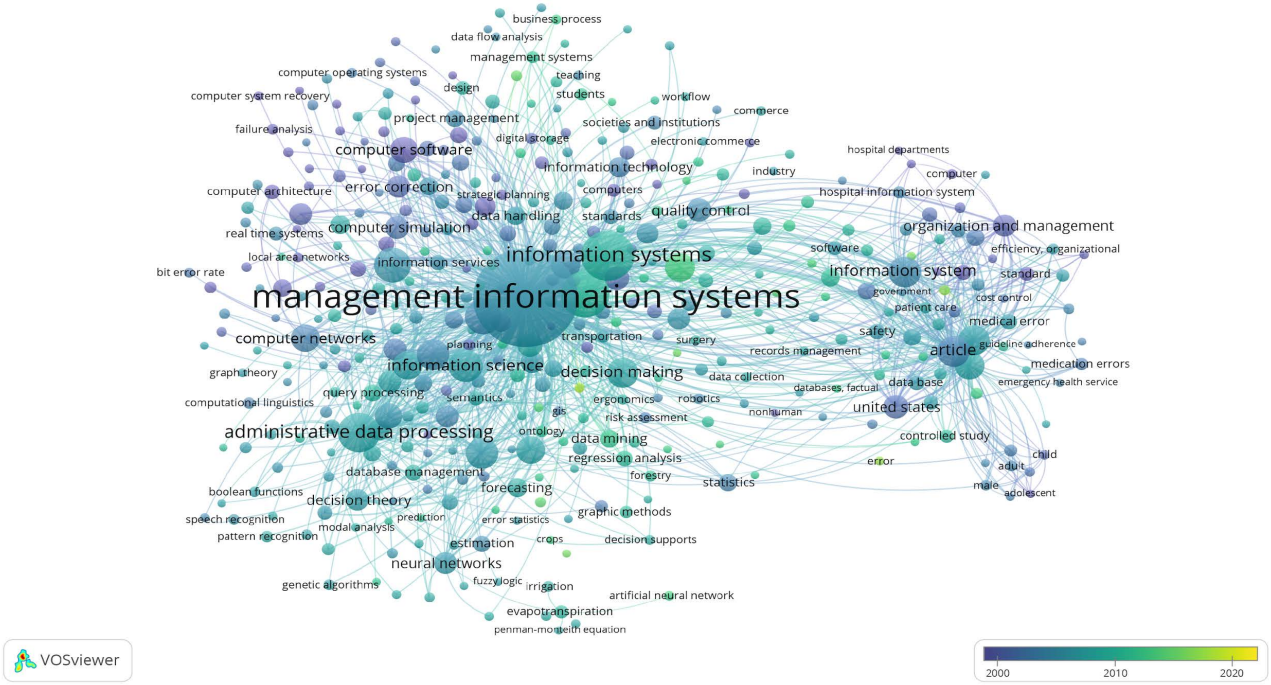

Figure 9. Keywords BD Web of science analysis Illustration. Source Vosviewer

This density map allows visualizing the terms that have been most related and addressed by the authors, standing out in the warm areas, in this case the yellow ones, the words "management information systems", "information systems" "information science", "administrative data processing", "error analysis", "human" among others. Additionally, the closeness of these terms shows the connection that has occurred between them in the different articles. The other areas represent terms that has less relationships in the articles and tend to lighter colors such as lemon green, in the case of words such as "information technology", "risk assessment", "computational complexity", "quality control", among others. Then, the blue tones indicate that there are very few articles that relate these keywords, for example, the case of "work simplification", "data flow", "medication errors", "artificial neural network", and "decision support". See Figure 10.

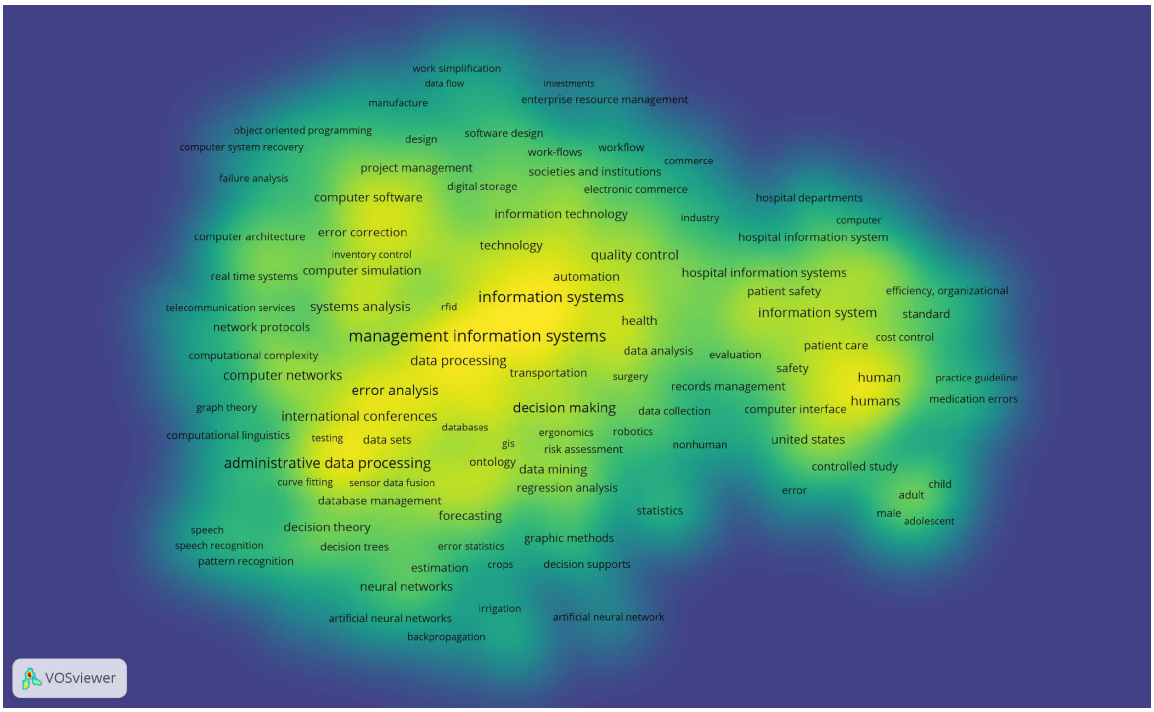

Figure 10. Density map. Source Vosviewer

Citation of articles

The Table II and Figure 11 list the main countries that have contributed the largest number of articles to the body of knowledge and citations in the area. Although the first three places in the publication of articles are reserved for the United States, Austria, and China, these differ, except for the United States, of the countries with the highest number of citations, which are the United States, Canada, and Germany.

Table II. Publication and citation of articles by country

PAÍSES	ARTÍCULOS	CITACIONES
UNITED STATES	238	9143
CANADA	26	1187
GERMANY	41	1108
NETHERLANDS	11	657

PAÍSES	ARTÍCULOS	CITACIONES
AUSTRALIA	16	559
TAIWAN	24	336
HONG KONG	10	249
UNITED KINGDOM	36	206
CHINA	79	195
GREECE	9	175
AUSTRIA	238	94
SWITZERLAND	9	86
FRANCE	17	66
BRAZIL	16	57
PORTUGAL	16	29

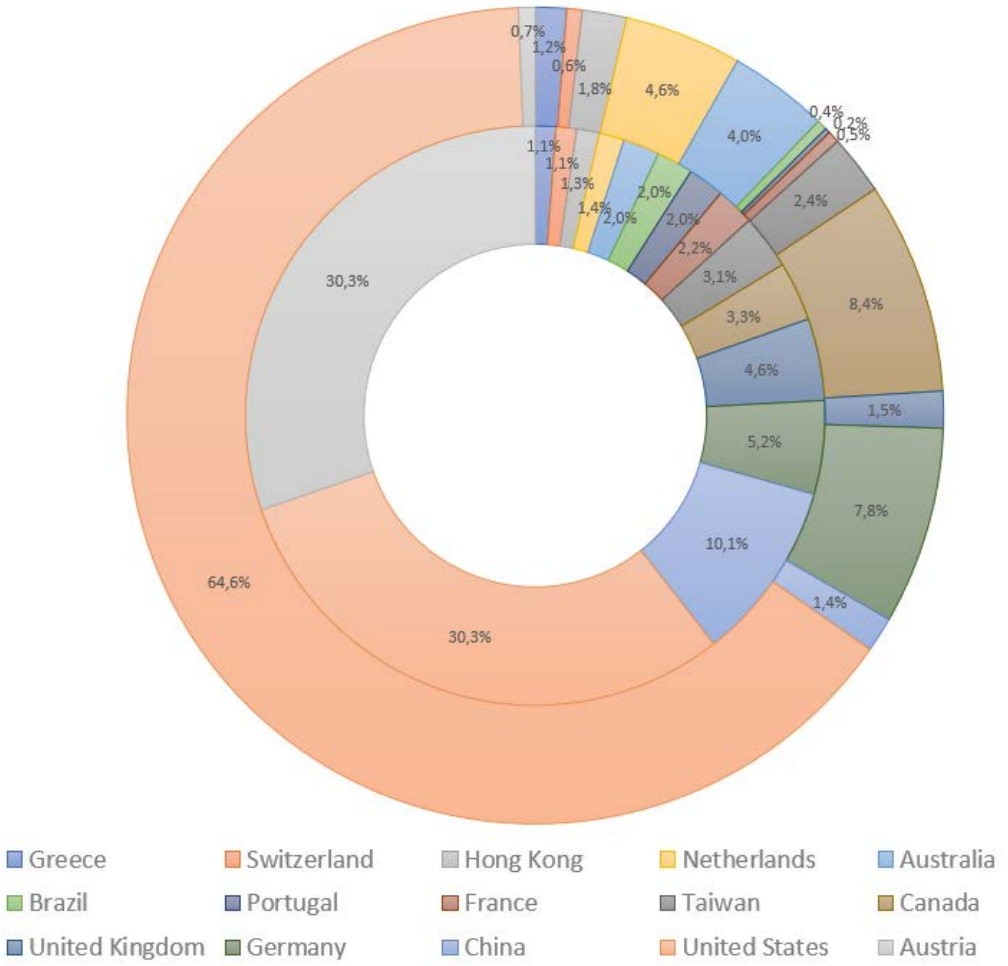

Figure 11. Article and citations percentage

Figure 12 displays the relationship that has occurred between countries thanks to the co-authorship presented in the different published articles. Co-authorship between the United States, Canada, Germany, and the Netherlands stands out.

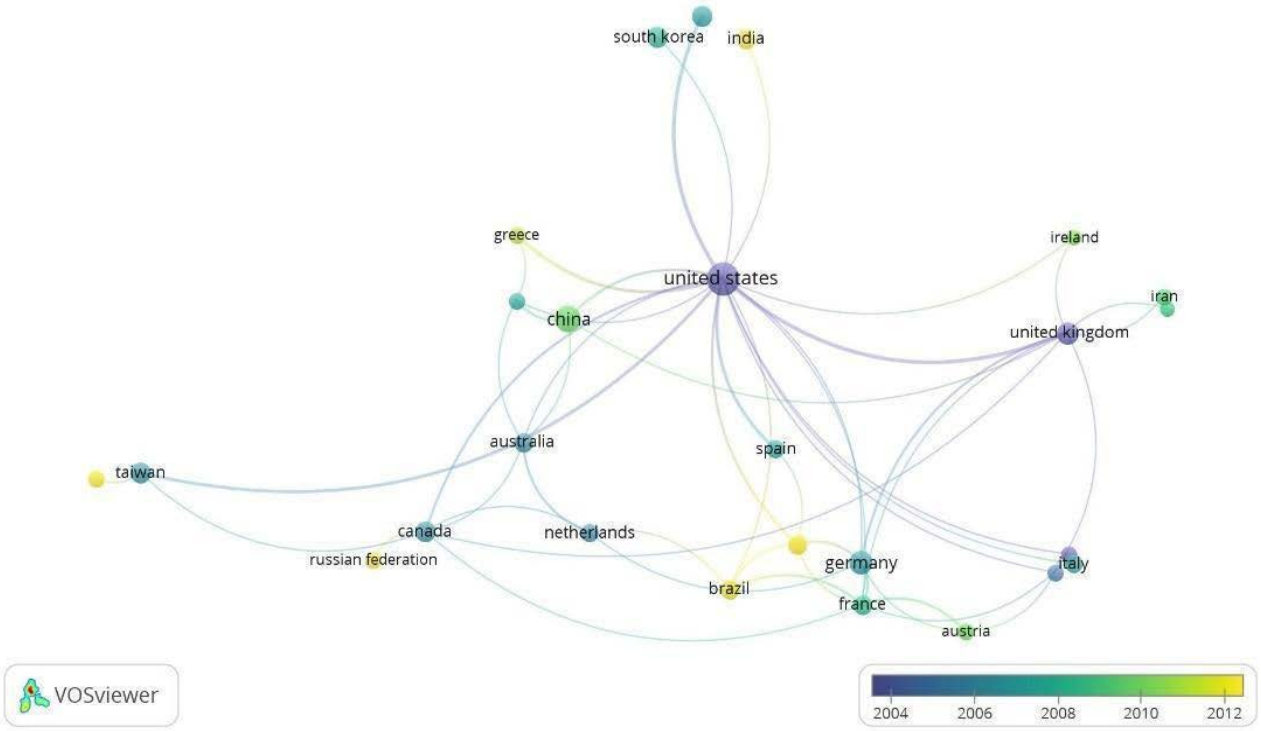

Figure 12. List of publications between countries

The most cited article is Specification of formative constructs in information systems research: MIS Quarterly: Management Information Systems. Volume 31, Issue 4, December 2007, Pages 623-656. Petter, S. Straub, D. Rai, A. Information Systems and Quantitative Analysis.
The following Table III consolidates the most cited articles.

Table III The most cited articles. Source Scopus

ARTICLE	YEAR OF PUBLICATION	TOTAL CITATIONS
SPECIFYING FORMATIVE CONSTRUCTS IN INFORMATION SYSTEMS RESEARCH	2007	1760
THE IDENTITY CRISIS WITHIN THE IS DISCIPLINE: DEFINING AND COMMUNICATING THE DISCIPLINE'S CORE PROPERTIES	2003	924
ADEPT SUPPORTING DYNAMIC CHANGES OF WORKFLOWS	1998	653
DISCOVERING MODELS OF SOFTWARE PROCESSES FROM EVENT-BASED DATA	1998	650
IN PURSUIT OF MODERATION: NINE COMMON ERRORS AND THEIR SOLUTIONS	2003	370
INHERITANCE OF WORKFLOWS: AN APPROACH TO TACKLING PROBLEMS RELATED TO CHANGE	2002	348
PLS: A SILVER BULLET?	2006	343
THE INFORMATION SYSTEMS IDENTITY CRISIS: FOCUSING ON HIGH-VISIBILITY AND HIGH-IMPACT RESEARCH	2005	282
IDENTIFYING REASONS FOR SOFTWARE CHANGES USING HISTORIC DATABASES	2000	278

ARTICLE	YEAR OF PUBLICATION	TOTAL CITATIONS
HIGH SPEED AND ROBUST EVENT CORRELATION	1996	274
A COMPARISON OF SPACING AND HEADWAY CONTROL LAWS FOR AUTOMATICALLY CONTROLLED VEHICLES	1994	244
TOTAL CITATIONS		14060

The most cited article is Specifying formative constructs in information systems research. MIS Quarterly: Management Information Systems. Volume 31, Issue 4, December 2007, Pages 623-656, by Petter, S. Straub, D. Rai, in the Journal A. Information Systems and Quantitative Analysis.

CONCLUSIONS

The keywords that present the highest frequency and weight are management information systems, information systems, information management, administrative data processing, unlike errors, which although they appear related in the keywords, it is evident that there is still a lack of studies that analyze the relationship between these two concepts.

The country that has made the largest contribution to the body of knowledge on information management systems is the United States, both in its number of publications and citations.

The most cited article is "Specifying formative constructs in information systems research" (Article) (Open Access). MIS Quarterly: Management Information Systems. Volume 31, Issue 4, December 2007, Pages 623-656. Petter, S. Straub, D. Rai, A. Information Systems and Quantitative Analysis. Report 1760 citations.

Six clusters represented by the strongest relationships between keywords were consolidated. The clusters considered are the first cluster management information systems-computer science (116 items), the cluster health field (85 items), information systems and computational environment applications (76 items), administrative data processing (57 items), decision-making (38 items), and technology industry 4.0 (38 items). The relevant keywords associated with errors or mistakes are error correction, error detection, failure analysis, fault detection, fault tolerance, fault tolerant computer, human errors, medical error, medical errors, medication error, medication errors, error statistics, estimation errors, error analysis, error rate, error rates, errors, missing data, and human error.

The main contributor to the publication of these articles is the National Science Foundation.

The highest percentage of documents published are through conference paper with a participation of 53.3% (440 documents), with 39.7% being publications through Article (328 articles published).

About 55% of the published articles have been studied in the areas of Computer Science and Engineering. The other documents have been published in areas such as Medicine, Business Management, Mathematics, and Decision Science, Social Sciences, and Environmental science, Earth and planet, Materials Science with participation and other areas of knowledge.

It is important to consolidate the Scientometric analysis exploring other scientific databases.

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