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Adoption of Cloud Computing in the organizations: a bibliometric analysis of this technology within a digital transformation context

Adoção de *Cloud Computing* nas organizações: uma análise bibliométrica desta tecnologia no contexto da transformação digital

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ABSTRACT

Purpose: The purpose of this study is identify and analyze articles on the adoption of Cloud Computing services in the business field. The study intends to demonstrate the increasing relevance and impact of Cloud Computing technology on business processes.
Design/methodology/approach: The study adopted a Bibliometric Review methodology to collect and analyze data. A total of 1,330 articles were collected from the Scopus (Elsevier) database, and various aspects such as authors, journals, and countries were considered. The analysis includes the use of maps to visualize the co-occurrence of terms, co-citation of references, and bibliographic coupling.
Findings: The investigation reveals that the adoption of Cloud Computing services in the business environment is a rapidly growing area of research. The study provides an overview of the theme and highlights the significance of Cloud Computing technology in enhancing business processes' efficiency.
Research limitations/implications: The study's limitations include relying solely on articles available in the Scopus (Elsevier) database and focusing on the period between 2008 and 2020. Future research can expand the analysis by including a broader range of databases and considering a more recent timeframe.
Practical implications: The findings of this study have practical implications for businesses, as they highlight the benefits of adopting Cloud Computing services. The technology offers low cost and flexible use, contributing to increased efficiency in business processes.
Social implications: The adoption of Cloud Computing services can have significant social impacts by enabling businesses to provide enhanced value to their clients. The technology's efficiency and flexibility contribute to improved service delivery and customer satisfaction.
Originality/value: This study contributes to the advancement of knowledge in the field of Cloud Computing adoption in the business field. The bibliometric analysis provides a comprehensive overview of the research landscape and highlights the key contributions and trends in this area.

Keywords: Cloud Computing; Adoption; Business field; Bibliometric review; Digital transformation

RESUMO

Finalidade: O objetivo deste estudo é identificar e analisar artigos sobre a adoção de serviços de computação em nuvem na área empresarial. O estudo pretende demonstrar a crescente relevância e impacto da tecnologia *Cloud Computing* nos processos de negócio.
Desenho/metodologia/abordagem: O estudo adotou uma metodologia de Revisão Bibliométrica para coleta e análise de dados. Um total de 1.330 artigos foram coletados da base de dados Scopus (Elsevier), e vários aspectos como autores, periódicos e países foram considerados. A análise inclui o uso de mapas para visualizar a coocorrência de termos, cocitação de referências e acoplamento bibliográfico.
Constatações: A investigação revela que a adoção de serviços de computação em nuvem no ambiente de negócios é uma área de pesquisa em rápido crescimento. O estudo oferece uma visão geral sobre o tema e destaca a importância da tecnologia *Cloud Computing* na melhoria da eficiência dos processos de negócios.
Limitações/implicações de pesquisa: As limitações do estudo se apresentam na utilização de somente artigos disponíveis na base de dados Scopus (Elsevier) e em focar no período entre 2008 e 2020. Pesquisas futuras podem expandir a análise incluindo uma gama mais ampla de bases de dados e considerar um período de tempo mais recente.
Implicações práticas: Os achados deste estudo têm implicações práticas para as empresas, pois destacam os benefícios da adoção de serviços de computação em nuvem. A tecnologia oferece baixo custo e flexibilidade de uso, contribuindo para o aumento da eficiência nos processos de negócios.
Implicações sociais: A adoção de serviços de computação em nuvem pode ter impactos sociais significativos, permitindo que as empresas forneçam maior valor aos seus clientes. A eficiência e a flexibilidade da tecnologia contribuem para melhorar a prestação de serviços e a satisfação do cliente.
Originalidade/valor: Este estudo contribui para o avanço do conhecimento na área de adoção de computação em nuvem na área empresarial. A análise bibliométrica fornece uma visão abrangente do cenário de pesquisa e destaca as principais contribuições e tendências nesta área.

Palavras-chave: Computação em nuvem; Adoção; Área empresarial; Revisão bibliométrica; Transformação digital

1 INTRODUCTION

Technology is changing the way the companies are managed, enabling the creation of new products and services (Yoo, Boland, Lyytinen, & Majchrzak, 2010). More recently, digital transformation has represented a change in the way the companies offer value to their customers. Such measures reinforce the strategy of adoption and use of digital resources to boost competitiveness in a considerable number of sectors in the economy (Iansiti & Lakhani, 2014).

One of the elements responsible for the digital transformation in the companies is the set of disruptive technology, namely SMAC (Social, Mobile, Analytics and Cloud)

(Chen et al., 2020). The SMAC set of technologies is so relevant to the industrial scenario that the results of its impact may translate into significant changes in the years to come (Srivastva & Kiran, 2016). However, amongst all technologies present in this transformation, Cloud Computing is the most relevant, as it enables the companies to use computer tools that can promote greater agility in the business without the need for large investment (Iansiti & Lakhani, 2014; Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011). Therefore, the use of Cloud Computing is growing in the companies, promoting an improvement in the ways to do business and boosting the companies' competitiveness (Raut, Jha, Priyadarshinee, & Gardas, 2018).

Amongst the various acceptances of Cloud Computing, (J. Lee, 2013) points out that this service consists in a form of online storing in which data can be shared by different users, however distant they might be. These data may be public domain or private, access to the public in general occurs when the data storage service is made available to the general public. On the other hand, private access to Cloud Computing may be used internally by companies or organisations, however, limiting the data sharing to its boundaries.

Additionally, (Dirican, 2015) proposes a similar concept, he argues that Cloud Computing is a space for net storage - the internet being more widely used - which enables data and information sharing in a more comprehensive way. Data may be accessed by one or more people in different locations by means of the internet with the use of electronic devices (Marston et al., 2011). Similarly, (Low, Chen, & Wu, 2011) state that Cloud Computing is a breakthrough in the form of offering computer services, data sharing and storage.

Moreover, given its flexibility, Cloud Computing is currently being adopted strategically by different types of companies (Raut et al., 2018). In this regard, some companies, such as IBM (International Business Machines Corporation) and Google offer Cloud Computing services, allowing other organizations to use the resources of these services (Demirkan & Delen, 2013). In addition, Oliveira, Thomas, e Espadanal (2014)

point out that Cloud Computing provides computational advantages the companies can no longer ignore such as agility and scalability, which are factors that can enhance the transformation in the way of doing business.

Therefore, the adoption of the Cloud Computing services provides a series of benefits such as reduction of costs related to the maintenance of data providers and can also boost the efficiency in the delivery of products and services (Raut et al., 2018). In this sense, the current study aims at presenting the evolution in the scientific publications on the theme of Cloud Computing services in the field of business. Therefore, a bibliometric review based on a set containing 1,330 articles indexed on the Scopus base between the years 2008 and 2020 was approached. A bibliometric review allows investigation into specific areas of knowledge, promoting in-depth exploitation of the publications and allowing relevant conclusions towards the proposition of an agenda for further research (Yu, Xu, & Wang, 2018). Still, under this perspective for review, graphs were plotted by VOSviewer – a software for visualization of similarities. The graphs generated allowed an analysis of the main keywords, reference co-citation and bibliographic couplings.

The article is organised as follows: Section 1 gives the introduction, section 2 presents the methodological route adopted, enhancing the bibliographic review. In its turn, Section 3 is the core of the article, for it shows the results of the analysis. In conclusion, section 4 presents the final considerations, which encompass the principles found, conclusions and an array of suggestions for further research.

2 DATA SOURCE AND METHODOLOGY

Taking into consideration the fact that the current investigation seeks to assess the evolution on the scientific publications concerning the theme of Cloud Computing systems in the business field, a methodological path based on the bibliometric review method was adopted. It allowed the identification and analysis of: the evolution of the publications throughout the years, the most prolific authors, the most relevant countries and journals publishing about the theme, and also the graphs for the

visualisation of the similarities between the keywords, co-citation of references and bibliographic coupling.

The bibliometric review is a method that permits the identification, in a quantitative form, of a panorama of scientific production of a considered phenomenon by means of analysis of the most relevant studies and authors on the theme (Zupic & Čater, 2015). In addition, (Soares, Carneiro, Calmon, & Castro, 2016) understand that this method contributes to the identification of new paths for future investigation of certain subjects and the most relevant sources regarding the theme to be researched.

The data used in the current study was extracted from the Scopus (Elsevier) database. The choice for this database is justified by the fact that it presents a more widespread coverage of scientific articles in the social sciences field, when compared to the Web of Science base (Mongeon & Paul-Hus, 2016). Initially, the term "Cloud Computing" was researched through the Scopus (Elsevier) database and disclosed 22,709 articles published up to the year 2020. As follows, in order to identify the studies regarding the business environment in a more concise way, the filter "Business, Management and Accounting" was added, resulting in a sample containing 1,330 articles published between the years 2008 and 2020, as depicted in Table 1.

Table 1– Research by Scopus (Elsevier) database

Scopus	Research / no filter	Research / filtered
Date of search:	19/ June /2020	19/June/2020
Terms of research:	"cloud computing"	"cloud computing"
Period:	From 1945 to 2020	From 1945 to 2020
Fields:	All	Business, Management and Accounting
Type of Publication:	Articles	Articles
Search Key:	TITLE-ABS-KEY ("cloud computing") AND (LIMIT-TO (DOCTYPE, "ar")) AND (EXCLUDE (PUBYEAR, 2020))	TITLE-ABS-KEY ("cloud computing") AND (LIMIT-TO (DOCTYPE, "ar")) AND (EXCLUDE (PUBYEAR, 2020)) AND (LIMIT-TO (SUBJAREA, "BUSI"))
Results	22,709 articles	1,330 articles

Source: Elaborated by the authors with the use of Scopus (Elsevier)
Note. Access to database: 19/June/2020

By means of the tool Analyse search results, available at Scopus (Elsevier), it was possible to devise graphs and tables revealing the main articles, authors countries and journals addressing Cloud Computing in the business field.

Subsequently, the programme VOSviewer was used in the processing of the data collected. This programme allows the generation of graphs by producing networks based on the similarities of the data concerned (Ren et al., 2020; Van Eck & Waltman, 2017). The maps drawn relying on the programme VOSviewer are: keywords, co-citation of reference and bibliographic coupling.

3. RESULTS

The results of the current study present a bibliometric review of the 1,330 articles extracted from the Scopus (Elsevier). It comprises two parts, the first exhibits the panorama of the publications and the second approaches the visualisation of the similarities in the articles.

3.1 Panorama of the publications

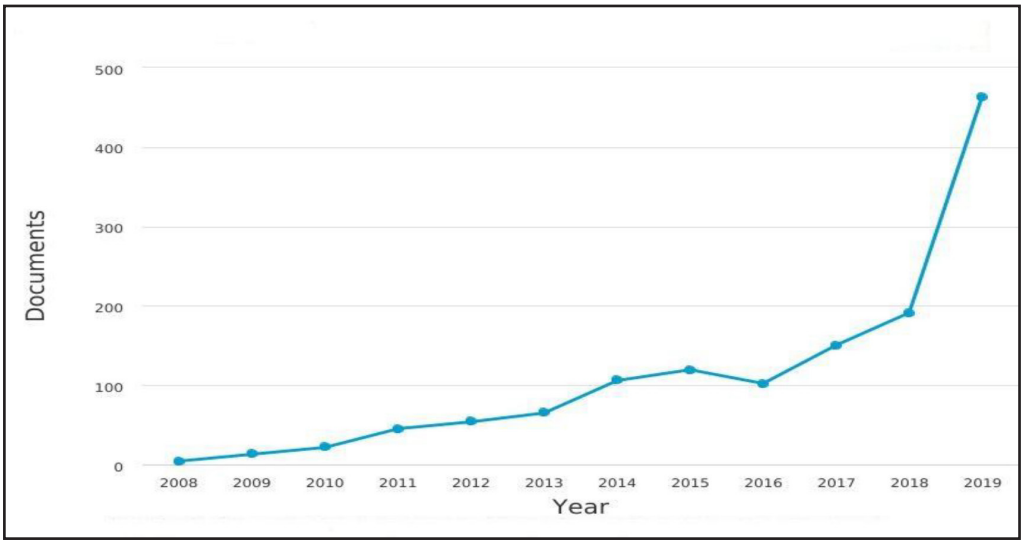
3.1.1 Temporal evolution of the publications

The theme Cloud Computing has been earning evidence within the field of Business in the last few years. The number of articles published between 2008 and 2019 in the Scopus (Elsevier) database, as represented in Fig 1, allows the verification of the chronological evolution of the scientific studies concerning this theme.

Figure 1 also reveals that before 2008 no studies into Cloud Computing existed in the field of business. The year 2008 saw the first four publications, in the following years a tendency of continuous publications was perceived, up to the year 2016. Thus, in the interval between 2008 and 2016, 527 articles were published on Cloud Computing in the business field. Since then, a growing interest was observed and between 2017 and 2019, 803 articles were published, being 464 works in the year

2019 alone. This quantitative evolution with an exponential growth tendency reveals a relevant scientific interest in the theme, as far as the business field is concerned.

Figure 1– Rise in the number of articles published between 2008 and 2019 on Cloud Computing



Source: Scopus (Elsevier) – Analyze search results

Note. Data of access: 16/June/2020

In the face of this relevant aspect, the main studies encompassed in the database were assessed. In order to do that, the main articles having a greater volume of citations about Cloud Computing were enhanced and analysed, according to figures presented in Table 2. The central objective of this analysis is to disclose possible relations and disputes amongst the articles.

Table 2– Articles about Cloud Computing enjoying the highest number of citations in an organisation

Continue...

#	Article	Year	Citations
1	Cloud computing - The business perspective	2011	1,254
2	The Internet of Things (IoT): Applications, investments, and challenges for enterprises	2015	694
3	Understanding the determinants of cloud computing adoption	2011	510

Table 2– Articles about Cloud Computing enjoying the highest number of citations in an organisation

Conclusion

#	Article	Year	Citations
4	Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors	2014	374
5	Industry 4.0: State of the art and future trends Open Access	2018	338
6	Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud	2013	324
7	Significance and Challenges of Big Data Research	2015	296
8	Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework	2013	283
9	Opportunities and risks of software-as-a-service: Findings from a survey of IT executives	2011	256
10	Resource Management in Clouds: Survey and Research Challenges	2015	254

Source: Elaborated by the authors with the use of the Scopus (Elsevier) database

Note. Date of access: 01/July/2020

The studies analysis presented in Table 2 revealed that the adoption of Cloud Computing in the organisations is a recurrent subject appearing in the articles cited more frequently. Cloud Computing services may be applied in different organisations, including hi-tech companies, manufacturers, and even in medium and small-sized enterprises (Alshamaila, Papagiannidis, & Li, 2013; Low et al., 2011; Oliveira et al., 2014; L. Xu, E. Xu, & Li, 2018). Moreover, the studies address the need for assessment of the Cloud Computing services in a way that adoption can become more easily available to the companies (Low et al., 2011; Marston et al., 2011). Apart from that, relying on interviews with IT executives, present a risk analysis (trust, information security, dependence on the process) and opportunities (higher flexibility in the Information Systems department, increase in the IT department productivity) in the Cloud Computing systems, whether the companies adopt or not this type of service (Benlian & Hess, 2011).

In addition, some authors relate other themes to Cloud Computing in their studies; amongst them the Internet of things (IoT) and Big Data deserve highlighting; such technologies make use of Cloud Computing in their solutions (Srivastva & Kiran, 2016).

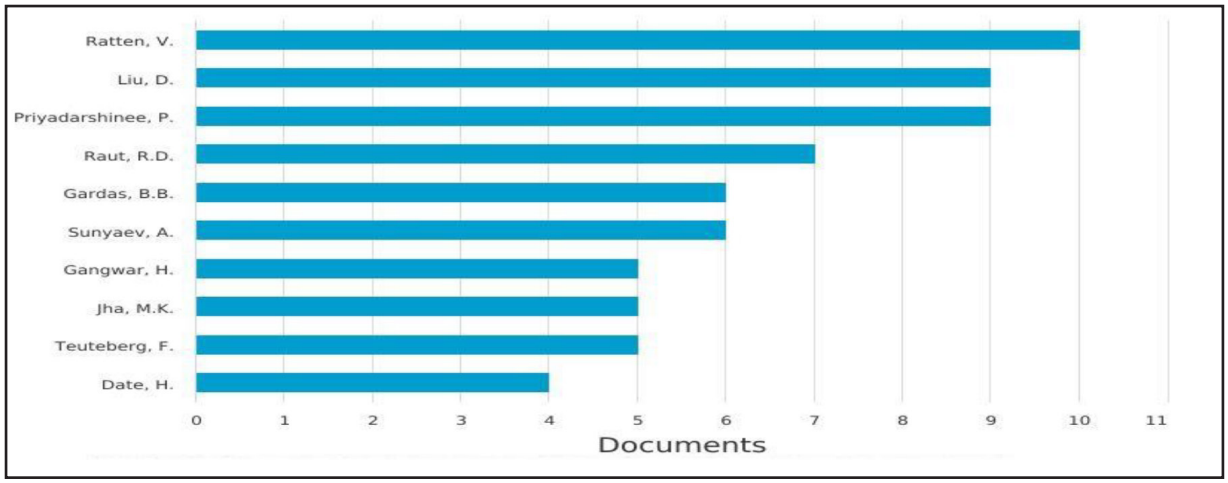
With regard to IoT, (I. Lee & K. Lee, 2015) enhance the impact of its adoption by various sectors of the industry, also described are challenges faced up by the companies when using this technology. A practical example of the application of this technology is the logistics companies that make use of IoT to monitor the temperature of the products, incurring then fewer risks related to the deterioration of the goods they hold (I. Lee & K. Lee, 2015). On the other hand, owing to the use of a significant array of data, IoT meets a few challenges such as: security, consumer's privacy, data management, servers and data centres (I. Lee & K. Lee, 2015). As far as Big Data is concerned, the articles address the adoption of this technology as a means of boosting agility within the organizations (Demirkan & Delen, 2013; Jin, Wah, Cheng, & Wang, 2015).

Amongst all the studies analysed, the article denominated "Cloud computing - The business perspective", is the work that presents the highest number of citations (Marston et al., 2011). This study seeks an understanding of the pros and cons of the utilisation of the Cloud Computing system in the business sectors. In this direction, a SWOT (strengths, weaknesses, opportunities and threats) analysis was made. This analysis revealed a number of advantages, amongst them a significant reduction in costs of corporate computing for small companies, possibility of use of the service by companies in countries with a low IT structure, a flexible structure that can be used according to the companies' necessities; also, reduction in technological barriers affecting innovation. Besides the aforementioned aspects, the current article also shows that there are disadvantages that may affect the parties involved with this service: loss of physical control of the data, difficulties related to the physical location of the data stored, and perception of uncertainty about the quality of the service are just a few to mention (Marston et al., 2011).

3.1.2 Most prolific authors

The analysis of the database also allowed an assessment of the authors who produced most studies into the theme Cloud Computing in the business field. Figure 2 presents the 10 authors having the highest number of studies published amongst the 1,330 authors considered.

Figure 2– Authors who published most about the theme



Source: Scopus (Elsevier) – Analyze search results
Note. Date of access: 25/June/2020

When analysing the works published by these ten authors, it was possible to verify that 8 of them, in at least one of their studies, investigated the adoption of Cloud Computing services in the companies. Therefore, it is well worth mentioning that a fair number of these authors have worked together in various publications as co-writers.

Overall, these studies investigated the critical factors involving the adoption of Cloud Computing in the small and medium–sized enterprises, as well as innovation and creativity in the continuous use of Cloud Computing services as a means of ameliorating their activities as well making them more competitive (Date, Gangwar, & Ramaswamy, 2014; Gardas, Raut, Priyadarshinee, Jha, & Kamble, 2018; Priyadarshinee, Raut, Gardas, & Jha, 2017; Ratten, 2016; Raut et al., 2018; Sunyaev & Lansing, 2016)

On the other hand, (Liu & Yang, 2015) discusses the quality of the provision and distribution of the Cloud Computing services in his studies; his main article approaches

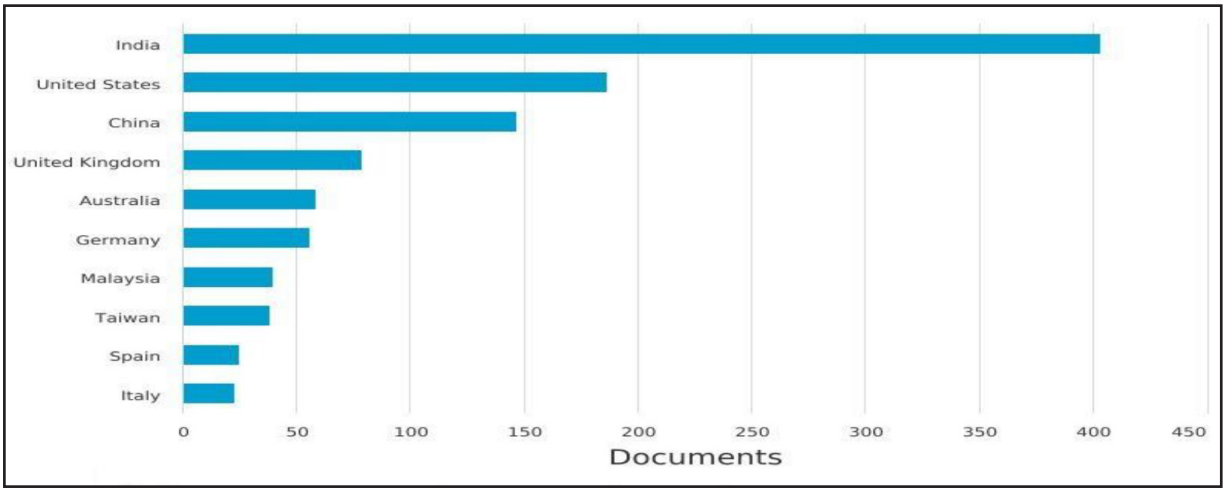
ways of improving the quality of the Cloud Computing services by using a virtual machine coined “relax reservation” (Liu & Yang, 2015).

Last but not least, it is also well worth mentioning the studies of Teuteberg addressing the analysis of the Cloud Computing services relying on the costs these services incur (Walterbusch, Martens, & Teuteberg, 2013).

3.1.3 Countries that published the most

When the geographical perspective of the 1,330 articles is considered, it was possible to spot the countries that produced the greatest number of studies into the theme investigated (Figure 3) and also the connections amongst the studies produced.

Figure 3– Countries that most produced studies into the theme (2008 – 2020)



Source: Scopus (Elsevier) – Analyze search results
Note. Date of access: 25/june/2020

Within the period analysed, India tops the list in terms of production of knowledge about the theme in the business field, amounting to 436 studies published. Amongst all these works is the article having the greatest number of citations (225). It approaches the adoption of Cloud Computing in the light of the integration between TAM-Technology Acceptance Model and the structure TOE-Technology Organizational Environmental (Date et al., 2014).

Subsequently, the United States and china appear with practically half the number of works produced if compared with China, amounting to approximately 200 and 150 articles respectively. The article written by (Marston et al., 2011) is the most frequently cited work in the USA, with 1,281 citations. This study sought to analyse the strengths and weaknesses encompassing the Cloud Computing services. In order to identify these features, SWOT (strengths, weaknesses, opportunities and threats) analysis was applied (Marston et al., 2011). The results revealed the pros and cons of the system. The pros were namely the expressive reduction in costs, flexibility regarding the service and accessibility to small and medium-sized enterprises (Marston et al., 2011). On the other hand, insuficient physical control of the data, difficulties in locating the physical site of the suppliers of the data stored and also uncertainties regarding the quality of the services were pointed out as cons (Marston et al., 2011).

China, however, has the chief study (Jin et al., 2015), totalling 310 citations. The manuscript approaches the Big Data under a Cloud Computing perspective, by presenting the concept applicability and importance in the use, besides providing information about the challenges concerning the complexity of the data, computational complexity as well as the overall complexity of the system related to this technology (Jin et al., 2015).

3.1.4 Leading Journals

The theme Cloud Computing has been attracting the interest of various journals, especially those tending to the field of technology management. In order to assess this interest, regarding the 1,330 studies selected for the current study, the periodicals that published most articles on the theme were appointed. In this regard, the journals boasting the highest number of publications on the subject were analysed. The readings of the titles and abstracts of the most cited articles amongst the articles contained in the database were included in the analysis.

This analysis allowed the verification that these periodicals approached the theme Cloud Computing, to a considerable extent, in a multidisciplinary form, which

included computer engineering, information systems, Cloud Computing management, Cloud Computing security and data management and optimization (Jennings & Stadler, 2015; Subashini & Kavitha, 2011).

Table 3– Periodicals that most published from 2008 to 2019

#	Journal	ISSN	H Index	Publications
1	International Journal Of Recent Technology And Engineering	2277-3878	17	225
2	International Journal Of Scientific And Technology Research	2277-8616	15	61
3	International Journal Of Grid And Utility Computing	1741-8488	16	54
4	Computer Law And Security Review	0267-3649	32	37
5	Journal of Network and Systems Management	1573-7705	32	35
6	International Journal Of Business Information Systems	1746-0980	24	31
7	International Journal Of Networking And Virtual Organisations	1741-5225	19	27
8	Knowledge Based Systems	0950-7051	107	21
9	Service Oriented Computing And Applications	1863-2394	24	19
10	Advances In Science Technology And Engineering Systems	2415-6698	7	18

Source: Elaborated by the authors by using Scopus (Elsevier)
Note. Date of access: 18/June/2020

The journal “Computer Law And Security Review” presents 37 studies into the subject. It holds publications addressing Cloud Computing regulation and legislation issues such as client/supplier`s data protection and security. The main articles published by the journal approach issues as: cloud-related consumer`s privacy and risks (Svantesson & Clarke, 2010); digital evidence in Cloud Computing (Taylor, Haggerty, Gresty, & Hegarty, 2010) and cyber threats (Hooper, Martini, & Choo, 2013).

Another leading journal is the “International Journal Of Business Information Systems”. It presented 31 publications on the theme Cloud Computing. A fair number of these articles approaches the applicability of Cloud Computing in a small and

medium-sized enterprise environment, in an attempt to boost the companies` competitiveness (Vidhyalakshmi et al., 2016), by improving the business management (Avenue et al., 2015 as cited in F. Safari, N. Safari, Hasanzadeh, & Ghatari, 2015) and at the same time it provides the clients with value (Jaya, 2015 as cited in Soon et al., 2015). Table 3 presents the list of the main journals and the number of publications related to each one of them.

Based on data extracted, 308 journals publishing at least one article on Cloud Computing were identified. The sum of all publications amounted to 1,330 articles. Aiming at identifying the most relevant publishers on this theme, 10 of them were sorted out, representing 3.25% per cent of the total amount, with a combined number of 528 publications, representing 39.70% of the studies considered in the current research. Moreover, it is well worth putting a premium on the journal "International Journal Of Recent Technology And Engineering", as it appears as the most prolific publisher – 225 articles, topping the list with 16.92% of all the articles published. Also identified is its difference, if compared to its counterparts, it published well over the sum of all articles published by the 5 subsequent institutions listed in table 3, which was (218).

SCImago is a public platform that compiles journals and scientific indicators from the various countries appearing in the database Scopus (Elsevier). Amongst the various indicators, H-Index was also utilised, this index measures the productivity of the scientists and journals and the impact of the citations published (SCImago, 2020).

Table 4– Journals topping H-Index (SCImago)

Continue...

#	Journal	ISSN	H-Index	Publications
1	Management Science	0025 1909	237	2
2	MIS Quarterly: Management Information Systems	0276-7783	216	3
3	Journal of Business Research	148-2963	179	1
4	Journal of Cleaner Production	0959-6526	173	8
5	International Journal of Production Economics	925-5273	172	3

Table 4– Journals topping H-Index (SCImago)

Continue...

#	Journal	ISSN	H-Index	Publications
6	Journal of Management Studies	0022-2380	172	1
7	Information and Management	378-7206	153	6
8	Information Systems Research	1526-5536	151	6
9	Decision Support Systems	167-9236	138	6
10	Journal of Management Information Systems	0742-1222	137	5

Source: Elaborated by the authors relying on Scopus (Elsevier)
Note. Date of access: 18/06/2020

The articles published in the journals detached in Table 5 present an array of approaches regarding Cloud Computing. Generally speaking, the works display discussions about (i) forms of allocation and optimisation of resources in Cloud Computing (Cohen, Keller, Mirrokni, & Zadimoghaddam, 2019), (ii) the possibility of greater flexibility in the way the companies meet the client`s needs (Fazli, Sayedi, & Shulman, 2018); (iii) the availability of technical support to companies adopting Cloud computing systems (Retana, Forman, Narasimhan, Niculescu, & Wu, 2018); (iv) the promotion of continuous use of Cloud Computing services from a creativity and innovation perspective (Ratten, 2016) and (v) security on the Cloud Computing structures (August, Niculescu, & Shin, 2014).

In addition, an improvement on the hospital supply chain information flux (Gonul Kochan, Nowicki, Sauser, & Randall, 2018); stakeholders integration in the beef supply chain in search of enough resources to enable the agents to control carbon emissions, and also an improvement on client-supplier collaboration (Schniederjans & Hales, 2016) are examples of the benefits that the adoption of Cloud Computing can offer to the parties involved in the supply chain.

The studies addressing sustainable activities were published in its majority by “Journal of Cleaner Production” which appears as the journal that most published (8) amongst all listed in the table 4. A considerable number of the studies published in the aforementioned journal addresses the development of technologies integrated by

Cloud Computing structures that can lead to a reduction in carbon emission (Dandres et al., 2017; Singh, Kumari, Malekpoor, & Mishra, 2018; Xing, Qian, & Zaman, 2016).

3.2 Visualization of similarities

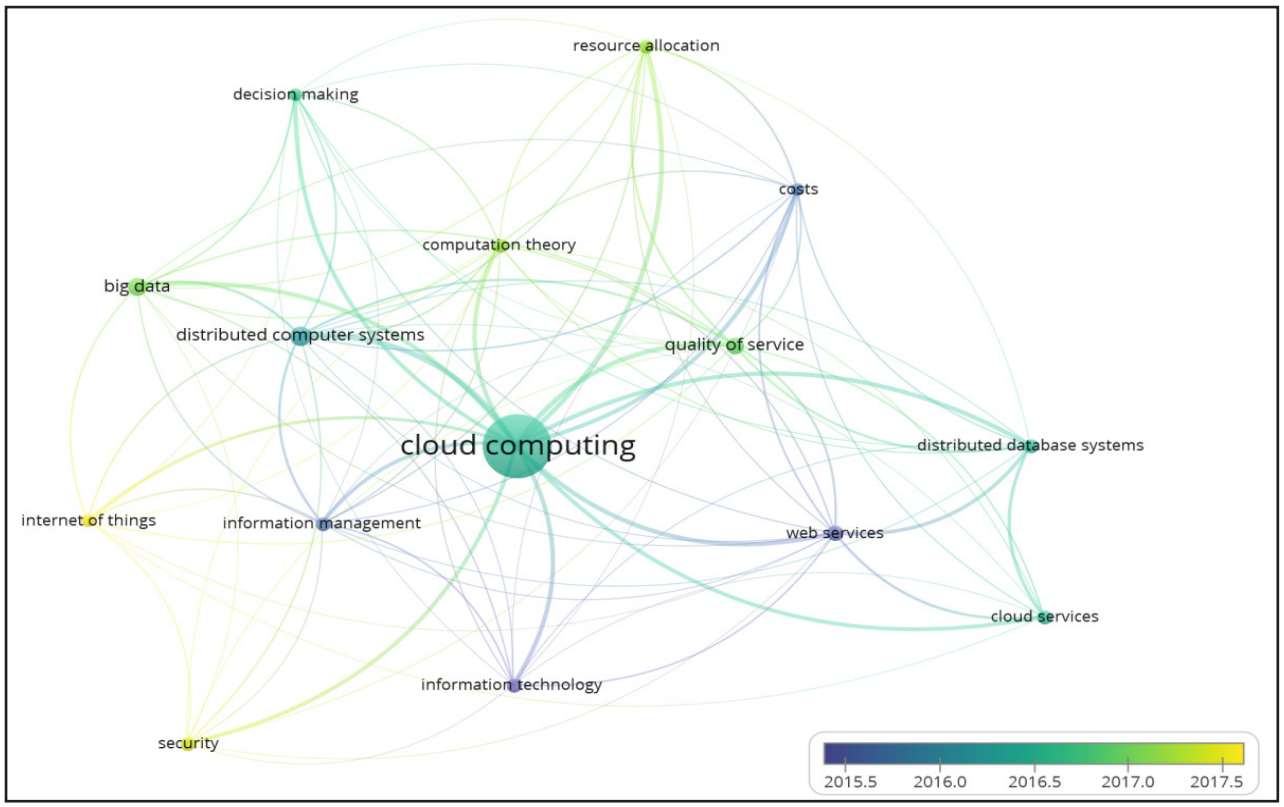
One of the ways of delving deep into the bibliometric analysis of a given subject is by means of VOS – Visualization of Similarities. The VOS technology is a tool which enables the sorting of fragmented knowledge according to their similarities (Ren et al., 2020). In order to exhibit this visualisation, the programme VOSviewer was used, which is what allowed the formation of networks and groups established to identify relationships by means of co-occurrence of terms, namely (co-word), reference co-citation and bibliographic coupling containing in the database encompassing the 1,300 works (Van Eck & Waltman, 2017).

3.2.1 Co-word

Keywords are fundamental elements in a scientific paper (Yu et al., 2018). Still, as stated by the aforementioned authors, the analysis of keywords allow not only the identification of subjects and themes but also the possibility of following up the evolutions and changes in a certain field of knowledge.

Figure 4 shows the map of co-wordings of keyterms present in articles considered in the current study. To enable the identification of such terms, the data referring to the 1,300 articles were processed in the VOSviewer tool and resulted in 6.509 terms. The full counting method was applied in the counting, which consists in counting the total number of occurrences of a term in all the documents investigated (Van Eck & Waltman, 2017). Still, the terms appearing only a few times are usually general terms and do not encompass specificity (Van Eck & Waltman, 2017). Therefore, only the terms appearing at least 39 times were selected. This selection was defined by considering only the most frequently cited terms. Hence, the restriction was applied to boost the specificity of the words and to enable the relevant ones to be distinguished from the ones deemed unimportant, with regard to the current investigation.

Figure 4– Graph of co-occurrences of the main terms related to Cloud Computing



Source: devised by the authors with the use of VOSviewer and Scopus data.

The colours in Figure 4 allows the identification of the temporal evolution of the most important terms related to the theme of the research between the years 2015 and 2017. The period analysed was considered by VOSviewer as being the time interval having the occurrence of the main terms. These terms came to prominence after the publications made in 2015, with the studies addressing information technology (Järveläinen, 2012), information management (Choudhary & Zhang, 2015), costs (Ross & Blumenstein, 2015) and web services (Nakai, Madeira, & Buzato, 2015). In 2016, the studies became more specific, turning towards the Cloud Computing area (Khan, Flanagan, & Lu, 2016), distributed computer systems (Fang et al., 2016), distributed data base systems (Sunyaev & Lansing, 2016), cloud services (Henneberger, 2016) and decision making (Schneider & Sunyaev, 2016). It is when the term Cloud Computing gains and establishes itself in the business field, it is expressed by the size and colour of the circle representing this term in the graph of Figure 4. Therefore, the terms

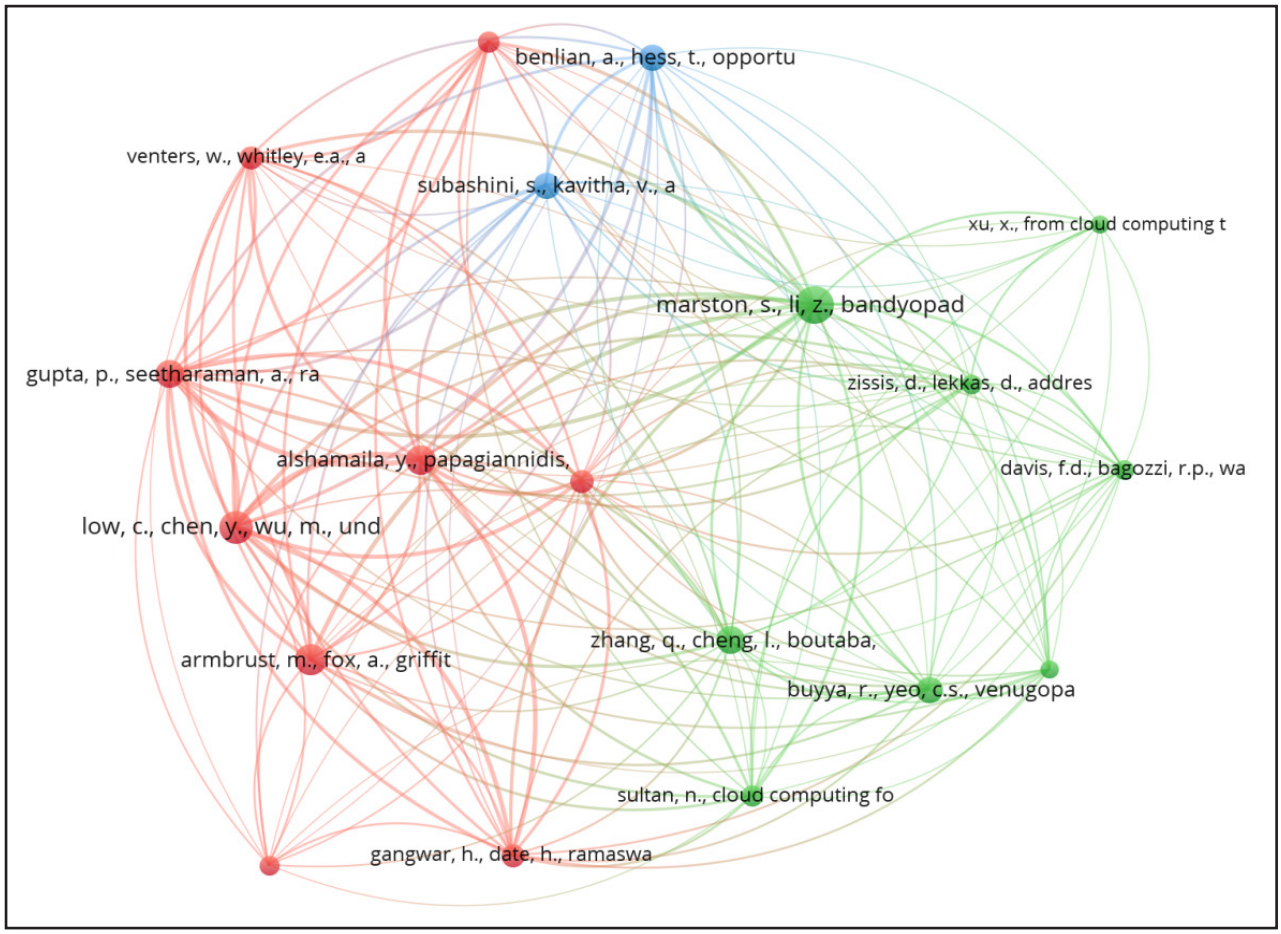
detached in the following years bear characteristics related to Cloud Computing, such as: Big Data (Gill, Buyya, & Chana, 2017), quality of service (Banerjee, Adhikari, & Biswas, 2017), computation theory (Dalmazo, Vilela, & Curado, 2017) and resource allocation (Computing, 2016 as cited in Feng & Buyya, 2016). Hence. The terms used subsequently are more closely related to security (Kalloniatis, 2017) and IoT (Agrifoglio, Cannavale, Laurenza, & Metallo, 2017).

3.2.2 Co-citation of references

The objective of co-citation of references is to identify the main studies used as reference by the articles considered in the database concerning the theme investigated, also the relations amongst them. Co-citation is made up of the strength of the connection between studies, by observing the proximity of the ideas between two or more papers (Galvagno & Dalli, 2014; Vogel & Güttel, 2013). Therefore, this analysis calculates the number of times two works were cited together in the references of the articles containing the database considered (Zupic & Čater, 2015). The result of this calculation allows the identification of patterns of academic influence, having a more widespread literature as its base (Udomsap & Hallinger, 2020).

The 1,330 articles considered in the current study present 47.511 references. These references were analysed by means of co-citation (Figure 5). With regard to the 47.511 references, 21 of them reach the minimum number of 12 co-citations, however, 2 studies were not cited together amongst the 21, and as a result, they were disregarded in the graph. The objective of selecting a minimum number of citations (21 in such case) is to obtain the main references about the theme in a more specific way (Van Eck & Waltman, 2017). Therefore, the resulting graph presents the co-citation relation amongst the 19 references.

Figure 5– Graph of references co-citation



Source: VOSviewer, based on search data on Scopus (Elsevier)

As can be noticed, taking into consideration the colour of the elements in the graph of Figure 5, the graphs are sorted in 3 clusters, which are represented by the colours red, green and blue. Clusters are groups of items in a map, formed according to the strength of the links amongst them (Van Eck & Waltman, 2017). Given the temporal characteristics, the green cluster will be tackled first, then the red and the blue subsequently. The green cluster encompasses two studies with primary characteristics concerning Cloud Computing services, presenting studies regarding perspectives relating to the use of the services offered. On the other hand, the red and blue clusters involve more direct and objective studies, which do not demonstrate uncertainties about the theme, indeed, they present a more consolidated view of the Cloud Computing services.

The green cluster is composed by primary studies into the adoption of new technologies- more precisely regarding Cloud Computing. It was possible to identify the fact that the first study into adoption aimed at the analysis of people's acceptance of computers (Davis, Bagozzi, & Warshaw, 1989). In the following years, in the face of the spreading of the Cloud Computing services, new research emerged, such as the one carried out by (Marston et al., 2011), which examines the negative and positive aspects of Cloud Computing; this investigation was done by SWOT analysis (strengths, weaknesses, opportunities and threats).

In turn, (Zhang, Cheng, & Boutaba, 2010) presented, in the early days of Cloud Computing services, a panoramic view on the subject, they address the concepts, implementation and architectural principles concerning Cloud Computing. Moreover, also tackled are the difficulties inherent in the use of the services such as: energy management and data security.

Concerned about management in times of economic instability, (Sultan, 2010) ponders how the Cloud Computing services could become a viable way out for educational institutions in times of crisis. Apart from that, what is discussed is the existing uncertainties concerning security, where the authors present perspectives considering possible problems and solutions (Sultan, 2010; Zissis & Lekkas, 2012).

The red cluster, however, is the one which presents articles carrying citations in common- totalling 9 studies. After analysing the articles, the approach to adoption of Cloud Computing services in the companies was identified as similarity. The study carried out by (Low et al., 2011) explicates the 8 factors that may affect the adoption of Cloud Computing by the high technology companies, they are aspects such as: relative advantage, complexity, compatibility, high management support, size of the company, technology readiness levels, competitive pressure and commercial partner`s expression.

On the other hand, (Armbrust et al., 2010) observed how the Cloud Computing services can contribute to the company's activities. The study considers the scale

potential provided to the companies owing to the low cost of the service. However, with a low cost, the institutions may improve their services continuously and still be competitive in the marketplace.

In the environment of the Small and Medium-sized Enterprises – SMEs, (Alshamaila et al., 2013) discuss how the use of Cloud Computing companies enable the small and medium-sized enterprises to prosper, by offering products and services that so far were only possible to big companies (Alshamaila et al., 2013). Still, in the SMEs perspective, (Gupta, Seetharaman, & Raj, 2013) present factors regarding the Cloud Computing services that can lead to a betterment business performance such as ease of use and convenience, security and privacy and cost reduction.

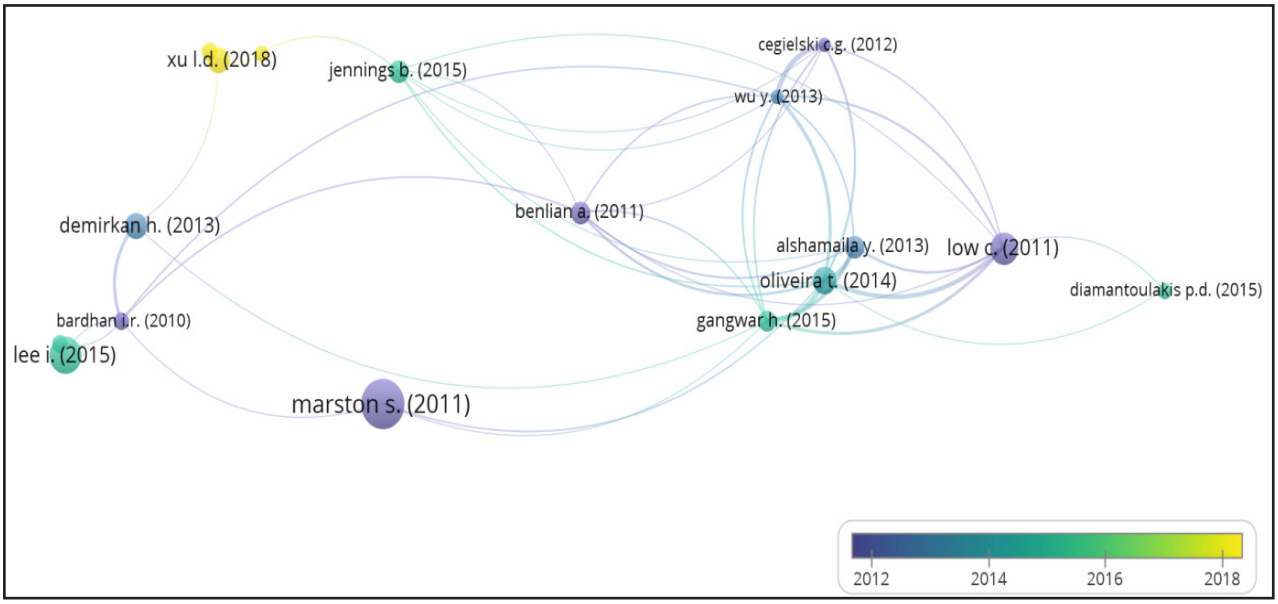
Therefore, the cluster in blue compiles studies addressing the risks involving the use of Cloud Computing by the companies. Although these services offer advantages, there are also drawbacks related to their use (Subashini & Kavitha, 2011). The security risk connected to Cloud Computing services is one of the main aspects that justify the resistance to adopt these services, as presented by some of IT executives (Benlian & Hess, 2011).

3.2.3 Bibliographic coupling

Last but not least, the bibliometric analysis in the current work identifies bibliographic coupling amongst the main articles included in the database used. It was performed in two steps, the first consisted in the elaboration of a quantity ranking concerning the number of times each one of the 1.330 articles in the base were cited by other studies. Then, the 20 most cited articles in the ranking were selected for the analysis. These studies had been cited by at least 120 other works. In turn, the second step verified the bibliographic coupling existing amongst the same 20 articles aforementioned. This coupling verifies the number of bibliographic references each one of the articles share with the remaining, then the measurement of the proximity amongst the articles can be taken (Grácio, 2016; Zupic & Čater, 2015).

Figure 6 presents the graph of the bibliographic coupling amongst the 20 main articles amongst the 1.330 studies extracted from the Scopus. It is important to clarify that, when plotting the graph, it was noticed that only 17 articles presented bibliographic couplings. In this graph, the articles are represented by circles whose ray sizes are related to the number of times the articles were cited. Moreover, the link between the circumferences represents the degree of similarity among the bibliographic references of the studies.

Figure 6– Bibliographic coupling graph



Source: Created by the authors by using VOSviewer and Scopus data

The coupled studies present an overview of the discussion about the adoption of Cloud Computing services in the organizations. Amongst the most relevant studies (Marston et al., 2011) deserve highlighting, it discusses the perspective of adoption of Cloud Computing services in the companies. Other important studies addressing the subject were also carried out, who address the adoption of Cloud Computing in companies inserted in the high technology industry in their article (Low et al., 2011). Following the same approach, (Benlian & Hess, 2011) address the opportunities and risks involved in the adoption of Cloud Computing in the view of IT executives.

However, (Alshamaila et al., 2013) discusses the adoption of Cloud Computing by small and medium-sized enterprises.

Although all the documents coupled have the adoption of Cloud Computing services in the companies as a bedrock, different approaches to the theme were identified between the years 2010 and 2018. The oldest study presented in the graph dates back to 2010, it discusses issues involving service sciences as an essential theme within the information systems area (Bardhan, Demirkan, Kannan, Kauffman, & Sougstad, 2010). Subsequently, between 2011 and 2014 it was possible to identify studies addressing the adoption of Cloud Computing services. The studies carried out approached aspects starting from the adoption of Cloud Computing by small and medium-sized enterprises (Alshamaila et al., 2013) up to companies in the manufacture sector (Oliveira et al., 2014) that manage the supply chain system through Cloud Computing services (Cegielski, Jones-Farmer, Wu, & Hazen, 2012; Wu, Cegielski, Hazen, & Hall, 2013). From 2015 onwards, the studies developed and started approaching subjects related to the adoption and use of novel technologies such as Big Data (Diamantoulakis, Kapinas, & Karagiannidis, 2015) and IoT (I. Lee & K. Lee, 2015) by the organizations.

In 2018, still following the same evolution, the studies discussed issues related to the 4.0 industry. The integration of new technologies such as cyber-physical systems, IoT, Cloud Computing and industrial integration are essential in the creation of the 4.0 industry (Xu et al., 2018). These technologies allow the connection of the assets in the industry, and as a result a more intelligent productive process (Kusiak, 2018; Xu et al., 2018). Moreover, they appear less costly and more flexible than traditional methods, which allow the small, as well as the medium-sized enterprises access to these technologies (Moeuf, Pallerin, Lamouri, Tamayo-Giraldo, & Barbaray, 2018).

4. CONCLUSIONS

The current bibliometric review seeks to analyse the studies published on Cloud Computing services in the administration field, by taking into consideration 1,330

articles extracted from Scopus (Elsevier) base. the results of the review were exhibited in two forms of analysis – panorama and visualisation of similarities.

The panorama revealed a series of characteristics of the set of articles analysed. The number of articles published in the interval between the years 2008 and 2020 grew significantly, chiefly from 2016, which suggests that the theme has gained relevance within the business field. In turn, the articles most frequently cited in this interval approach, to a good extent, the adoption of Cloud Computing services by companies seeking to improve their efficiencies (betterment in management) and competitiveness (cost reduction). The analysis of the panorama also revealed that India is the country that published the largest number of articles on the theme, followed by the USA and China. All in all, when analysing the works published on this theme, the study of (Marston et al., 2011) appears as the article most frequently cited by the academic world acting in the business field. The interest in the aforementioned article can be justified by the fact that it is one of the first studies addressing the adoption of the Cloud Computing technology in a company environment.

From another perspective, the visualisation of similarities permitted the analysis, initially, of co-occurrence of terms. In a sense, this analysis allowed the observation of the temporal evolution of the principal terms related to the theme of the research. A transition in the words describing the web terms in 2015 going from systems of distribution and services in clouds in the year 2016, up to Big Data and IoT in 2017 that was observed.

Moreover, the analysis of co-citation of references allowed the identification of 3 clusters that concentrate studies into (i) the characteristics of the Cloud Computing systems, (ii) the adoption of Cloud Computing systems by the companies and (iii) security- related risks involving the use of Cloud Computing, that to a certain extent result in the companies` resistance to adopt this type of services, as displayed by some IT executives. Hence, the visualisation by similarities was concluded in the current study by means of the bibliographic coupling analysis, which revealed an evolution

in the investigations into Cloud Computing throughout the last decade. These studies initiated in the information systems area and spread towards a company`s perspective observing the adoption of this technology by the small and medium-sized enterprises, and also in different sectors of the industry, so as to enable the companies to develop solutions in Big Data, IoT, as in the 4.0 industry, resulting in gain in efficiency in the company processes.

Therefore, a relevant part of the study analysed in the current research addresses the adoption of Cloud Computing services. This can be related to the fact that Cloud Computing is a recent technology, in a sense the work unveils an opportunity for further investigations into Cloud Computing, concerning the various sectors of the industry, the small and medium-sized enterprises, as well as the agribusiness. Moreover, now in the heydays of the studies into Digital Transformation, there is also room for novel bibliometric analysis of Social Media, Mobile and Analytics, elements that compose the SMAC structure, or even the consideration of the adoption of Cloud Computing in other areas; logistic, production and finances are just a few to mention.

Far beyond the aforementioned suggestion for new studies, the current work renders theoretical and managerial contributions. The theoretical contribution relies on the fact that the study presents a synthesis of the recent evolution and examines the Cloud Computing theme in the business field. Therefore, the managerial contribution rendered by the current study resides in the presentation of a consolidated source of considerable knowledge to companies` executives. In this direction, these professionals may strengthen the understanding that as a technology, Cloud Computing is fundamental to digital transformation, it incurs low costs, flexible use, besides providing the company`s processes with greater efficiency. To sum up, Cloud computing is of utmost importance as a digital technology, therefore it deserves high regard when devising and conducting business strategies.

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REFERENCES

Agrifoglio, R., Cannavale, C., Laurenza, E., & Metallo, C. (2017). How emerging digital technologies affect operations management through co-creation. Empirical evidence from the maritime industry. *Production Planning and Control*, *28*(16), 1298–1306. https://doi.org/10.1080/09537287.2017.1375150

Alshamaila, Y., Papagiannidis, S., & Li, F. (2013). Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework. *Journal of Enterprise Information Management*, *26*(3), 250–275. https://doi.org/10.1108/17410391311325225

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., & Zaharia, M. (2010). A view of cloud computing. *International Journal of Networked and Distributed Computing*, *1*(1), 2–8. https://doi.org/10.2991/ijndc.2013.1.1.2

August, T., Niculescu, M. F., & Shin, H. (2014). Cloud implications on software network structure and security risks. *Information Systems Research*, *25*(3), 489–510. https://doi.org/10.1287/isre.2014.0527

Banerjee, S., Adhikari, M., & Biswas, U. (2017). Design and analysis of an efficient QoS improvement policy in cloud computing. *Service Oriented Computing and Applications*, *11*(1), 65–73. https://doi.org/10.1007/s11761-016-0196-3

Bardhan, I. R., Demirkan, H., Kannan, P. K., Kauffman, R., & Sougstad, R. (2010). An interdisciplinary perspective on IT services management and service science. *Journal of Management Information Systems*, *26*(4), 13–64. https://doi.org/10.2753/MIS0742-1222260402

Benlian, A., & Hess, T. (2011). Opportunities and risks of software-as-a-service: Findings from a survey of IT executives. *Decision Support Systems*, *52*(1), 232–246. https://doi.org/10.1016/j.dss.2011.07.007

Cegielski, C. G., Jones-Farmer, A. L., Wu, Y., & Hazen, B. T. (2012). Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach. *The International Journal of Logistics Management*, *23*(2), 184–211. https://doi.org/10.1108/09574091211265350

Chen, S., Zhang, L., Tang, Y., Shen, C., Kumar, R., Yu, K., Tariq, U., & Bashir, A. K. (2020). Indoor temperature monitoring using wireless sensor networks: A SMAC application in smart cities. *Sustainable Cities and Society*, *61*(June), 102333, 1-9. https://doi.org/10.1016/j.scs.2020.102333

Choudhary, V., & Zhang, Z. J. (2015). Patching the cloud: The impact of saas on patching strategy and the timing of software release. *Information Systems Research*, *26*(4), 845–858. https://doi.org/10.1287/isre.2015.0601

Cohen, M. C., Keller, P. W., Mirrokni, V., & Zadimoghaddam, M. (2019). Overcommitment in cloud services: Bin packing with chance constraints. *Management Science*, *65*(7), 3255–3271. https://doi.org/10.1287/mnsc.2018.3091

Dalmazo, B. L., Vilela, J. P., & Curado, M. (2017). Performance Analysis of Network Traffic Predictors in the Cloud. *Journal of Network and Systems Management*, *25*(2), 290–320. https://doi.org/10.1007/s10922-016-9392-x

Dandres, T., Farrahi Moghaddam, R., Nguyen, K. K., Lemieux, Y., Samson, R., & Cheriet, M. (2017). Consideration of marginal electricity in real-time minimization of distributed data centre emissions. *Journal of Cleaner Production*, *143*, 116–124. https://doi.org/10.1016/j.jclepro.2016.12.143

Date, H., Gangwar, H., & Ramaswamy, R. (2014). Understanding determinants of cloud computing adoption using an integrated TAM-TOE model. *The Eletronic Library*, *34*(1), 1–5.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982

Demirkan, H., & Delen, D. (2013). Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud. *Decision Support Systems*, *55*(1), 412–421. https://doi.org/10.1016/j.dss.2012.05.048

Diamantoulakis, P. D., Kapinas, V. M., & Karagiannidis, G. K. (2015). Big Data Analytics for Dynamic Energy Management in Smart Grids. *Big Data Research*, *1*, 6–13. https://doi.org/10.1016/j.bdr.2015.03.003

Dirican, C. (2015). The Impacts of Robotics, Artificial Intelligence On Business and Economics. *Procedia - Social and Behavioral Sciences*, *195*, 564–573. https://doi.org/10.1016/j.sbspro.2015.06.134

Feng, G., Buyya, R. (2016). Maximum revenue-oriented resource allocation in cloud. International *Journal of Grid and Utility Computing*, *7*(1), 12–21.

Fazli, A., Sayedi, A., & Shulman, J. D. (2018). The effects of autoscaling in cloud computing. *Management Science*, *64*(11), 5149–5163. https://doi.org/10.1287/mnsc.2017.2891

Galvagno, M., & Dalli, D. (2014). Theory of value co-creation: A systematic literature review. *Managing Service Quality*, *24*(6), 643–683. https://doi.org/10.1108/MSQ-09-2013-0187

Gardas, B. B., Raut, R., Priyadarshinee, P., Jha, M., & Kamble, S. (2018). Modeling the implementation barriers of cloud computing adoption: An interpretive structural modeling. *Benchmarking*, *25*(8), 2760–2782. https://doi.org/10.1108/BIJ-12-2016-0189

Gill, S. S., Buyya, R., & Chana, I. (2017). IoT based agriculture as a cloud and big data service: The beginning of digital India. *Journal of Organizational and End User Computing*, *29*(4), 1–23. https://doi.org/10.4018/JOEUC.2017100101

Gonul Kochan, C., Nowicki, D. R., Sauser, B., & Randall, W. S. (2018). Impact of cloud-based information sharing on hospital supply chain performance: A system dynamics framework. *International Journal of Production Economics*, *195*, 168–185. https://doi.org/10.1016/j.ijpe.2017.10.008

Grácio, M. C. C. (2016). Bibliographic coupling and co-citation analysis: theoretical-conceptual review. *Bibli Meetings: Electronic Journal of Librarianship and Information Science*, *21*(47), 82-99. https://doi.org/10.5007/1518-2924.2016v21n47p82

Gupta, P., Seetharaman, A., & Raj, J. R. (2013). The usage and adoption of cloud computing by small and medium businesses. *International Journal of Information Management*, *33*(5), 861–874. https://doi.org/10.1016/j.ijinfomgt.2013.07.001

Henneberger, M. (2016). Covering peak demand by using cloud services – an economic analysis. *Journal of Decision Systems*, *25*(2), 118–135. https://doi.org/10.1080/12460125.2016.1141275

Hooper, C., Martini, B., & Choo, K. K. R. (2013). Cloud computing and its implications for cybercrime investigations in Australia. *Computer Law and Security Review*, *29*(2), 152–163. https://doi.org/10.1016/j.clsr.2013.01.006

Iansiti, M., & Lakhani, K. R. (2014). Digital ubiquity: How connections, sensors, and data are revolutionizing business. *Harvard Business Review*, *45*(2). https://doi.org/10.2469/dig.v45.n2.8

Järveläinen, J. (2012). Information security and business continuity management in interorganizational IT relationships. *Information Management & Computer Security*, *20*(5), 332–349. https://doi.org/10.1108/09685221211286511

Jennings, B., & Stadler, R. (2015). Resource Management in Clouds: Survey and Research Challenges. *Journal of Network and Systems Management*, *23*(3), 567–619. https://doi.org/10.1007/s10922-014-9307-7

Jin, X., Wah, B. W., Cheng, X., & Wang, Y. (2015). Significance and Challenges of Big Data Research. *Big Data Research*, *2*(2), 59–64. https://doi.org/10.1016/j.bdr.2015.01.006

Kalloniatis, C. (2017). Incorporating Privacy In The Design Of Cloud-Based Systems: A Conceptual Metamodel. *World Journal of Engineering*, 91–100. https://doi.org/10.1108/S1479-3512(2011)0000021018

Khan, K. I. A., Flanagan, R., & Lu, S. L. (2016). Managing information complexity using system dynamics on construction projects. *Construction Management and Economics*, *34*(3), 192–204. https://doi.org/10.1080/01446193.2016.1190026

Kusiak, A. (2018). Smart manufacturing. *International Journal of Production Research*, *56*(1–2), 508–517. https://doi.org/10.1080/00207543.2017.1351644

Lee, I., & Lee, K. (2015). The Internet of Things (IoT): Applications, investments, and challenges for enterprises. *Business Horizons*, *58*(4), 431–440. https://doi.org/10.1016/j.bushor.2015.03.008

Lee, J. (2013). A view of cloud computing. *International Journal of Networked and Distributed Computing*, *1*(1), 2–8. https://doi.org/10.2991/ijndc.2013.1.1.2

Liu, D., & Yang, G. (2015). Virtual resource provision with enhanced QoS in cloud platforms. *International Journal of Networking and Virtual Organisations*, *15*(4), 359–375. https://doi.org/10.1504/IJNVO.2015.073857

Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management and Data Systems*, *111*(7), 1006–1023. https://doi.org/10.1108/02635571111161262

Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J., & Ghalsasi, A. (2011). Cloud computing - The business perspective. *Decision Support Systems*, *51*(1), 176–189. https://doi.org/10.1016/j.dss.2010.12.006

Moeuf, A., Pellerin, R., Lamouri, S., Tamayo-Giraldo, S., & Barbaray, R. (2018). The industrial management of SMEs in the era of Industry 4.0. *International Journal of Production Research*, *56*(3), 1118–1136. https://doi.org/10.1080/00207543.2017.1372647

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, *106*(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

Nakai, A., Madeira, E., & Buzato, L. E. (2015). On the Use of Resource Reservation for Web Services Load Balancing. *Journal of Network and Systems Management*, *23*(3), 502–538. https://doi.org/10.1007/s10922-014-9303-y

Oliveira, T., Thomas, M., & Espadanal, M. (2014). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors. *Information and Management*, *51*(5), 497–510. https://doi.org/10.1016/j.im.2014.03.006

Priyadarshinee, P., Raut, R. D., Gardas, B. B., & Jha, M. K. (2017). Examining the critical success factors of cloud computing adoption in the MSMEs by using ISM model. *Journal of High Technology Management Research*, *28*(2), 125–141. https://doi.org/10.1016/j.hitech.2017.10.004

Ratten, V. (2016). Continuance use intention of cloud computing: Innovativeness and creativity perspectives. *Journal of Business Research*, *69*(5), 1737–1740. https://doi.org/10.1016/j.jbusres.2015.10.047

Raut, R. D., Jha, M. K., Priyadarshinee, P., & Gardas, B. B. (2018). Analyzing the factors influencing cloud computing adoption using three stage hybrid SEM-ANN-ISM (SEANIS) approach. *Technological Forecasting and Social Change*, *134*(May), 98–123. https://doi.org/10.1016/j.techfore.2018.05.020

Ren, R., Hu, W., Dong, J., Sun, B., Chen, Y., & Chen, Z. (2020). A systematic literature review of green and sustainable logistics: Bibliometric analysis, research trend and knowledge taxonomy. *International Journal of Environmental Research and Public Health*, *17*(1). https://doi.org/10.3390/ijerph17010261

Retana, G. F., Forman, C., Narasimhan, S., Niculescu, M. F., & Wu, D. J. (2018). Technology support and post-adoption IT service use: Evidence from the cloud. *MIS Quarterly: Management Information Systems*, *42*(3), 961–978. https://doi.org/10.25300/MISQ/2018/13064

Ross, P. K., & Blumenstein, M. (2015). Cloud computing as a facilitator of SME entrepreneurship. *Technology Analysis and Strategic Management*, *27*(1), 87–101. https://doi.org/10.1080/09537325.2014.951621

Safari, F., Safari, N., Hasanzadeh, A., & Ghatari, A. R. (2015). Factors affecting the adoption of cloud computing in small and medium enterprises. *International Journal of Business Information Systems*, *20*(1), 116–137.

Schneider, S., & Sunyaev, A. (2016). Determinant factors of cloud-sourcing decisions: Reflecting on the IT outsourcing literature in the era of cloud computing. *Journal of Information Technology*, *31*(1), 1–31. https://doi.org/10.1057/jit.2014.25

Schniederjans, D. G., & Hales, D. N. (2016). Cloud computing and its impact on economic and environmental performance: A transaction cost economics perspective. *Decision Support Systems*, *86*, 73–82. https://doi.org/10.1016/j.dss.2016.03.009

SCImago. (2020). *SJR — SCImago Journal & Country Rank [Portal]*. https://www.scimagojr.com/

Singh, A., Kumari, S., Malekpoor, H., & Mishra, N. (2018). Big data cloud computing framework for low carbon supplier selection in the beef supply chain. *Journal of Cleaner Production*, *202*, 139–149. https://doi.org/10.1016/j.jclepro.2018.07.236

Soares, P. B., Carneiro, T. C. J., Calmon, J. L., & Castro, L. O. C. O. (2016). Bibliometric analysis of the Brazilian scientific production on Building and Construction Technologies in the Web of Science database. *Built Environment*, *16*(1), 175–185. https://doi.org/10.1590/s1678-86212016000100067

Soon, J. N. P., Mahmood, A. K., Yin, C. P., Wan, W. S., Yuen, P. K., & Heng, L. E. (2015). Barebone cloud IaaS: revitalisation disruptive technology. *International Journal of Business Information Systems*, *18*(1), 107–126.

Srivastva, A., & Kiran, P. (2016). Transforming customer experience in e-commerce market place: A SMACT approach. *Indian Journal of Science and Technology*, *9*(32). https://doi.org/10.17485/ijst/2016/v9i32/98652

Subashini, S., & Kavitha, V. (2011). A survey on security issues in service delivery models of cloud computing. *Journal of Network and Computer Applications*, *34*(1), 1–11. https://doi.org/10.1016/j.jnca.2010.07.006

Sultan, N. (2010). Cloud computing for education: A new dawn? I*nternational Journal of Information Management*, *30*(2), 109–116. https://doi.org/10.1016/j.ijinfomgt.2009.09.004

Sunyaev, A., & Lansing, J. (2016). Trust in cloud computing: Conceptual typology and trust-building antecedents. *Data Base for Advances in Information Systems*, *47*(2), 58–96. https://doi.org/10.1145/2963175.2963179

Svantesson, D., & Clarke, R. (2010). Privacy and consumer risks in cloud computing. *Computer Law and Security Review*, *26*(4), 391–397. https://doi.org/10.1016/j.clsr.2010.05.005

Taylor, M., Haggerty, J., Gresty, D., & Hegarty, R. (2010). Digital evidence in cloud computing systems. *Computer Law and Security Review*, *26*(3), 304–308. https://doi.org/10.1016/j.clsr.2010.03.002

Udomsap, A., & Hallinger, P. (2020). A bibliometric review of research on sustainable construction, 1994–2018. *Journal of Cleaner Production*, *254*, 120073. https://doi.org/10.1016/j.jclepro.2020.120073

Van Eck, N. J., & Waltman, L. (2017). *Manual for VOSviewer versión 1.6.6. October*, 48.

Vidhyalakshmi, R., Kumar, V., & Kumar, V. (2016). Determinants of cloud computing adoption by SMEs. *Int. J. Business Information Systems*, *22*(3), 375–395. http://www.niesbud.nic.in

Vogel, R., & Güttel, W. H. (2013). The dynamic capability view in strategic management: A bibliometric review. *International Journal of Management Reviews*, *15*(4), 426–446. https://doi.org/10.1111/ijmr.12000

Walterbusch, M., Martens, B., & Teuteberg, F. (2013). Evaluating cloud computing services from a total cost of ownership perspective. *Management Research Review*, *36*(6), 613–638. https://doi.org/10.1108/01409171311325769

Wu, Y. U. N., Cegielski, C. G., Hazen, B. T., & Hall, D. J. (2013, July). Cloud computing in support of supply chain information system infrastructure : understanding when to go to the cloud. *Journal of Supply Chain Management*, *49*(3), 25–41.

Xing, K., Qian, W., & Zaman, A. U. (2016). Development of a cloud-based platform for footprint assessment in green supply chain management. *Journal of Cleaner Production*, *139*, 191–203. https://doi.org/10.1016/j.jclepro.2016.08.042

Xu, L., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research*, *56*(8), 2941–2962. https://doi.org/10.1080/00207543.2018.1444806

Yoo, Y., Jr, R. J. B., Lyytinen, K., & Majchrzak, A. (2010). *Organizing for Innovation in the Digitized World*. *23*(5), 1398–1408.

Yu, D., Xu, Z., & Wang, W. (2018). Bibliometric analysis of fuzzy theory research in China: A 30-year perspective. *Knowledge-Based Systems*, *141*, 188–199. https://doi.org/10.1016/j.knosys.2017.11.018

Zhang, Q., Cheng, L., & Boutaba, R. (2010). Cloud computing: State-of-the-art and research challenges. *Journal of Internet Services and Applications*, *1*(1), 7–18. https://doi.org/10.1007/s13174-010-0007-6

Zissis, D., & Lekkas, D. (2012). Addressing cloud computing security issues. Future Generation *Computer Systems*, *28*(3), 583–592. https://doi.org/10.1016/j.future.2010.12.006

Zupic, I., & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, *18*(3), 429–472. https://doi.org/10.1177/1094428114562629

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1. Definition of research problem	√	√	√	√
2. Development of hypotheses or research questions (empirical studies)	√	√	√	
3. Development of theoretical propositions (theoretical work)	√		√	
4. Theoretical foundation / Literature review	√	√		
5. Definition of methodological procedures		√	√	√
6. Data collection		√		
7. Statistical analysis	√	√	√	√
8. Analysis and interpretation of data	√	√	√	√
9. Critical revision of the manuscript	√	√	√	√
10. Manuscript writing	√	√	√	

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The authors have stated that there is no conflict of interest.

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