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# Big Data as An Emerging Paradigm in Organisations' Management: A Bibliometric Analysis

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**Abstract**

*The Big Data Age defines the present era, and the globalisation of business makes it pressing to derive valuable insights from data so that organisations can make sustained decisions. There is no consensus in the literature on how organisations should guide the vast volume of data in value creation or galvanise performance gains. The study aims to address these gaps by reviewing the literature searching WoS using R. Bibliometrix. 4,019 documents were identified between 2008 and early February 2022 through a current mapping of Big Data in management. The results indicate a strong collaboration network among authors and a notable trend in Big Data, Big Data Analytics, Machine Learning, and Artificial Intelligence. These keywords reveal a concern for the predictive analysis of data and the emergence of new research trends, namely management, performance, decision-making, business and value creation, supporting the thesis that Big Data is an emerging paradigm in organisational management.*

**Keywords:** *Big Data; Bibliometrics; R. Softwar; Management; Organizations.*

## Introduction

Big Data is a topic of unavoidable relevance in the management panorama. At the same time, it is challenging and demanding because it requires a solid and sustained infrastructure in terms of the creation of mechanisms in the information and computing systems of organisations that allow them to successfully process and analyse a large amount of data (Hashem, Yaqoob, Anuar, Mokhtar, Gani, & Khan, 2015; Wolfert, Ge, Verdouw, & Bogaardt, 2017). It is an emerging topic that has attracted attention not only from Academia but also from public and private organisations for its ability to support decision-making with unprecedented value in the digital age (Wamba, Gunasekaran, Akter, Ren, Dubey, & Childe, 2017). Big Data is considered the "fourth paradigm of science" (Strawn, 2012, p. 34). It is also characterised as the engine of the following "management revolution" (McAfee & Brynjolfsson, 2012), enabling value addition and new organisational capabilities (Davenport, Barth, and Bean, 2012), new ways to support businesses in the key challenges they face successfully (Gehrke, 2012) and to have the ability to transform the decision-making process by attributing greater visibility into the company's operations and better performance measurement mechanisms (Popovič, Hackney, Tassabehji, & Castelli, 2018). Yang, Huang, Li, Liu and Hu (2017) also consider it a new paradigm that gives organisations enormous amounts of data and new opportunities to improve and support decision-making at the business, science, and engineering levels.

This study considered the period between 2008 and the beginning of February 2022, identifying the temporal dimension of Big Data's production, the authors' affiliations, the most-cited authors and articles, the network of co-citations between authors/articles that are useful in identifying trends and lines of investigation for future research. This study aims to provide a better understanding of Big Data and contribute to identifying new lines of research. The article is structured as follows: it begins with an introduction, followed by the theoretical framework that presents the concept, evolution and emergence of

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Big Data in the organisations' management, the methodology adopted, the bibliometric analysis and the results, discussion and conclusions.

## Theoretical framework

*Big Data: concept and evolution*

Big Data is a recent term that has evolved rapidly since 2011; currently, there is no closed and objective definition of what Big Data is, despite the rampant growth of definitions that have emerged in the literature (De Mauro, Greco, & Grimaldi, 2016). Despite the lack of consensus around the origin of the term Big Data (Gandomi and Haider, 2015), the concept has become a topic of great relevance and interest in Academia; it is considered a potential source of competitive advantage in many sectors (Morabito, 2015). There is no unanimity around the concept of Big Data (Mishra et al., 2017).

For Numan and Didomenico (2017), Big Data translates into large amounts of data available to be analysed; it is a large volume of structured and unstructured data (Jeble, Kumari, and Patil, 2018); it consists of large volumes of data generated and made available on the internet through current digital media ecosystems and has implications for the growth, results and survival of organisations (Constantiou and Kallinikos, 2015). It is not the amount of data that is crucial; what organisations do with the data is also crucial (Jeble et al., 2018). The challenge is getting the desired information from a large amount of data (Witkowski, 2017).

According to Mikalef, Pappas, Krogstie, and Giannakos (2018), Big Data is a new generation of technologies and architectures designed to extract economic value from massive volumes of a wide variety of data, enabling high-speed capture, discovery and/or analysis. Wamba, Akter, Edwards, Chopin and Gnanzou (2015) define Big Data as the holistic approach to manage, process and analyse the 5 V's (Volume, Velocity, Variety, Veracity and Value) to perceive ways to create value, measure performance and create competitive advantages and improve the decision-making process. The most recent literature on Big Data adds new characteristics, and there can be mentioned 8 V's. Variability, volatility, and validity are added to the five previous characteristics. Volume refers to massive data sets currently measured in Exabytes, Zettabytes and Yottabytes, which, according to Davenport (2014), doubled every 40 months.

Big Data is widespread in areas as multifaceted and distinct as economics, medicine and management (Vasarhelyi, Kogan, & Tuttle, 2015). For some scholars, Big Data has enabled greater transparency in information (Davenport, et al., 2012), detected needs and improved performance (Beath, Becerra-Fernandez, Ross, and Short, 2012), supported decision-making through algorithms (Allen, Bresnahan, Childers, Foster, Kandaswamy, Kettimuthu, and Tuecke, 2012) and innovate in business models, products and services (Brown, Chul, and Manyika, 2011).

Big Data has seen remarkable evolution over the last decade, and according to Dhankhad's (2019) study, between 2017 and 2018, about 90% of the data today was generated. Reinsel, Gantz and Rydning (2018) predict that the amount of data generated, captured or replicated will grow from 33 zettabytes in 2018 to 175 zettabytes in 2025. Structured data, between 5% to 10%, is joined by a fairly significant slice, between 90% and 95%, of unstructured data (Tanwar, Evangelatos, & Venne, 2020). According to Balios, Kotsilaras, Eriotis and Vasiliou (2020), more than 98% of information stored worldwide is electronic/digital, and companies recognise that this information can bring significant advantages and benefits.

To understand the current development of Big Data research, the first research question (RQ) aims to know:

RQ1: What are the main evolutionary milestones of Big Data in management?

*The emergence of Big Data in the organisation's management*

The potential of Big Data is unquestionable, and data analysis using the best technologies will allow the automation of some management practices (Wimmes, Hess, & Gschmack, 2015). Davenport (2014) argues

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that Big Data transforms technology and business management processes and changes organisational orientations and cultures, leading them to discoveries. It allows to gauge trends, anticipate behaviours metrics and present strategic business solutions in real-time and continuously (Leskovec, Rajaraman, and Ullman, 2014) using the interpretation of vast data volumes (Williams, 2016). To effectively harness the potential that Big Data can provide, organisations must analyse all types of data (Davenport, 2014), structured (data that can be integrated into traditional databases) and unstructured (data that is not as well organised as structured and growing exponentially, such as videos, images, audio and text, blogs, sensor data) regardless of their origin (Richins, Stapleton, Stratopoulos, and Wong, 2017) to define and align their strategy. Most important is the quality of this data (Chae, Koh, and Prybutok, 2014), which must be complete, accurate, valid, relevant, consistent, and timely (Redman, 2013), and only high-quality data can provide a strong impact on an organisation's performance (Gorla, Somers, & Wong, 2010). The technological capabilities and resources available in data processing generated by Big Data can define the strategy organisations may adopt in the market and redefine innovation, productivity, and competitiveness (Mazzei, 2017).

It is urgent to recognise Big Data as an emerging paradigm in organisations, so the second research question is to identify:

RQ2: What are the new research trends in big data that are applied to organisations' management?

## Methodology

This study follows a methodology based on a systematic literature review, whose purpose is to explain and discuss a subject, theme or problem from references published in journals, magazines, books and other documents (Martins & Theóphilo, 2009). This research follows a bibliometric analysis, a research method that uses quantitative and statistical analyses to describe patterns of publications about a particular field of study and analyses cooperation between different research profiles (Shanmugan, 2010).

The applied method follows a bibliometric analysis using R. Bibliometrix software, which is based on co-citation networks and content analysis of scientific articles (Aria & Cuccurullo, 2017).

R. Bibliometrix is a statistical package written in the open-source R language, encompassing statistical algorithms, mathematical functionality, and visualisation features. It runs in a Windows and Linux operating system environment, with R Studio's graphical interface (Dervis, 2019). It can be updated and integrated quickly, providing several routines to import bibliographic data from SCOPUS, Web of Science, ClarMate Analytics, PubMed, and Cochrane databases, preparing the bibliometric analyses and data matrices for co-citation, coupling, scientific collaboration analysis, and co-word analysis (Aria & Cuccurullo, 2017).

The methodology focused on three steps. In step one, the Web of Science (WoS) database was selected due to being recognised worldwide as one of the most complete and reliable (Pacheco et al., 2020), in addition to indexing highly prestigious journals in such diverse areas, identifying the citations of documents, references used and analysis of scientific production with the calculation of bibliometric indices (Ceretta, Reis, & Rocha, 2016). The term "Big Data" was searched. Throughout the data collection process, the definitive database was identified whose analysis was elaborated from the exportation to BIBText of the bibliographic data, identifying the types of documents, number of citations, distribution by year of publication, the authors, research areas and titles of sources.

Subsequently, through the software R. Bibliometrix, the data of the various series of publications under analysis was processed (Ekundayo and Okoh, 2018), culminating in obtaining 4,019 documents between 2008 and February 2022. Records obtained in duplicate were excluded from the study. In step two, the authors are interrelated, affiliations, countries, and documents that have most addressed the topic. In step three, bibliometric analyses are performed of co-occurrence, co-citation and bibliographic, document and author coupling, which are the most commonly used to map the topic and introduce a more objective component to the study, increasing the precision and rigour that this type of study requires (Zupic & Cater,

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2015). The VOSviewer software was also applied to the network, and the RStudio analysis was performed in the graphical interface.

## Bibliometric Analysis and Results

The search focused on the Web of Science database conducted in February 2022, covering the period between 2008 and February 2022, on Big Data oriented to the management of organisations. A total of 878 sources were identified, namely books, journals and periodicals corresponding to 8,274 authors, of which 7,719 are co-authored documents and only 555 refer to individually authored documents. This bibliometric study identified 4,019 documents, alluding to 166,246 bibliographic references. About 73.18% of the documents are articles (472 articles), 16.05% are chapters in books (472 chapters), and the rest are spread over other types of documents, namely scientific production in conferences, reviews, etc.

Table 1 presents the summarised results obtained

**Table 1.** Results of the Bibliometric Study

| Timespan | 2008 to 2022 |
|---|---|
| SOURCES (JOURNALS, BOOKS, ETC) | 878 |
| DOCUMENTS | 4,019 |
| AVERAGE YEARS FROM PUBLICATION | 3.25 |
| AVERAGE CITATIONS PER DOCUMENT | 16.12 |
| AVERAGE CITATIONS PER YEAR PER DOC | 3.535 |
| REFERENCES | 166,246 |
| DOCUMENT TYPES: | |
| article | 2,941 |
| article; book chapter | 472 |
| article; early access | 327 |
| article; proceedings paper | 53 |
| review | 184 |
| review; book chapter | 5 |
| review; early access | 37 |
| DOCUMENT CONTENTS: | |
| Keywords Plus (ID) | 4,959 |
| Author's Keywords (DE) | 10,266 |
| AUTHORS: | |
| Authors | 8,274 |
| Author Appearances | 11,524 |
| Authors of single-authored documents | 555 |
| Authors of multi-authored documents | 7,719 |
| AUTHORS COLLABORATION: | |
| Single-authored documents | 676 |
| Documents by Author | 0.486 |
| Authors per Document | 2.06 |
| Co-authors per Documents | 2.87 |
| Collaboration Index | 2.31 |

Throughout this section, the results obtained and the respective interpretations based on the bibliometric analysis are presented.

*Annual scientific production*

There was a remarkable increase in knowledge production on Big Data starting in 2011/2012. There was a substantial growth from 2012 (1 article) to 2021 (828 articles) (Table 2).

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The years 2019, 2020 and 2021 represent the highest scientific production in the period under review, 623, 703 and 828 articles, respectively, revealing the growing interest of researchers in this area of knowledge. This year, 75 articles have already been published in the first month of 2022 alone. Between 2016 and 2017, there was an increase of 93%, as in the period between 2017 and 2021. The same percentage increase was also recorded, revealing a strong interest in field research on Big Data throughout the period under review.

**Table 2.** Scientific production evolution between 2008 and February 6, 2022

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Articles | 1 | - | - | 1 | 1 | 38 | 122 | 149 | 221 | 428 | 458 | 623 | 703 | 828 | 75 |

The keywords found in the documents are Big Data with 1,165 occurrences (28%), Big Data Analytics with 194 (5%), Machine Learning with 161 (4%), Artificial Intelligence with 143 (3%), Analytics with 131 (3%), social media with 129 (3%), and Data with 101 (2%) (Figure 1).

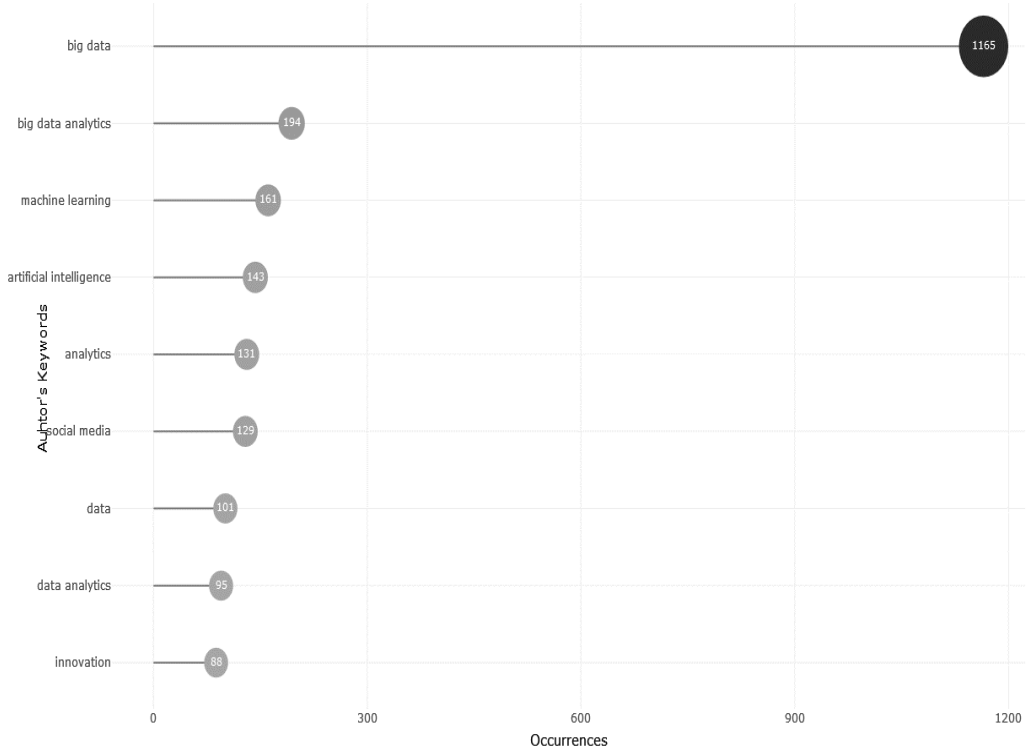


**Figure 1.** Most relevant keywords

Figure 2 shows the trends of these topics over the years, and it can be seen that in 2015, the research trend was towards the *Geographic Information System* theme. In 2016, the most worked-on themes were related to the organisational theme, *Outsourcing* and *Sensemaking* (new developments and experiences with Big Data). In 2017, research was oriented towards *Co-creation*, *Crowdsourcing, Education*, *Visualization* and *Data Protection.*; In 2018, research focused on *Supplementary Chain Management*, *Business Intelligence*, *Business Analytics, Online Reviews,* and *Decision-Making*. In 2019, research followed new directions towards *Big Data, Data Analytics*, and *social media*. In 2020, studies focused on *Big Data Analytics*, *Machine Learning, Artificial Intelligence, Digitalization*, and *Technology*. Finally, in 2021, *Covid*, *Industry 4.0*, *Digital Transformation* and *Literature Review* became a research target associated with Big Data.

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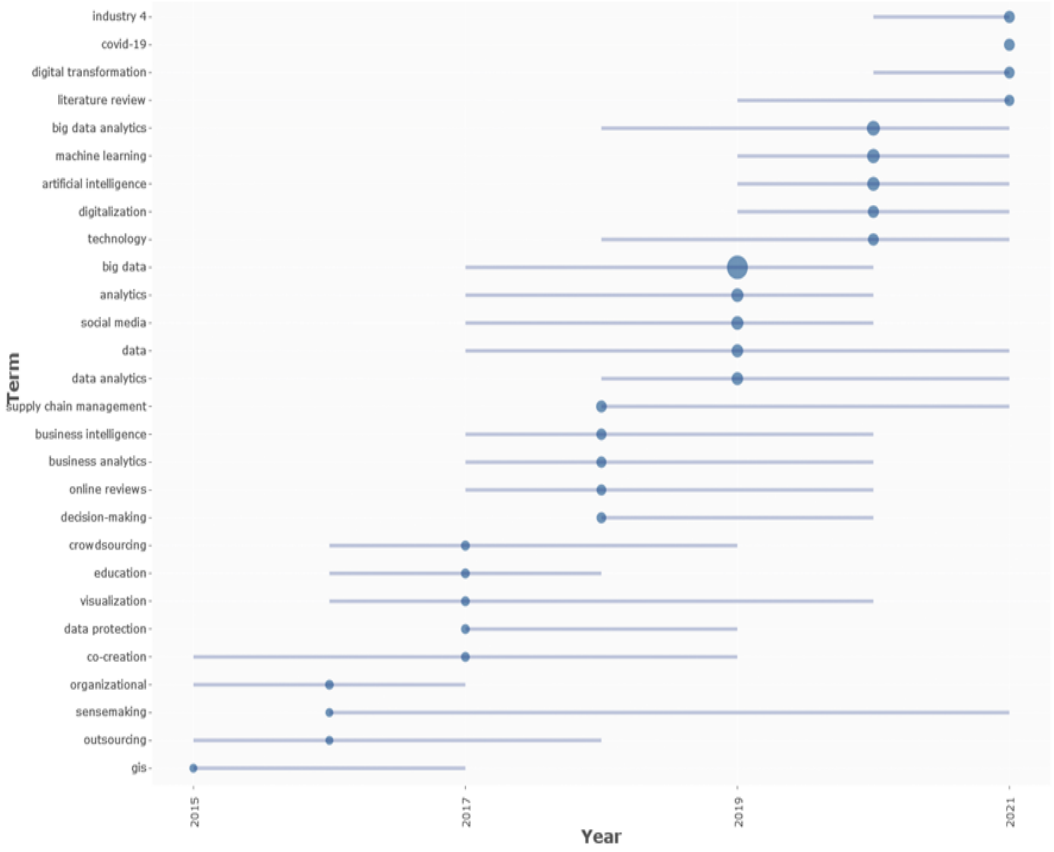


**Figure 2.** Trends in terms used in the survey

Co-word analysis reveals the density and centrality of the words considered as themes; it allows us to classify and map the themes into four dimensions or quadrants according to research trends through a two-dimensional diagram (Cobo et al., 2011).

In the thematic map, it is possible to analyse the themes inserted in four quadrants: (1) in the upper right are the driving themes, namely Big Data, Machine Learning, and Artificial intelligence; (2) in the lower right are the primary themes; (3) in the lower-left are the emerging or disappearing themes; and in the (4) upper left are framed the very specialised or niche themes such as Big Data Privacy (Figure 3). The words COVID and Supply Chain Logistics border niche and emerging themes, while Big Data Analytics, management and supply chain management fall on the border between basic and emerging themes. The term Big Data Analytics, as seen, has taken on an increasingly prominent role in recent research on Big Data.

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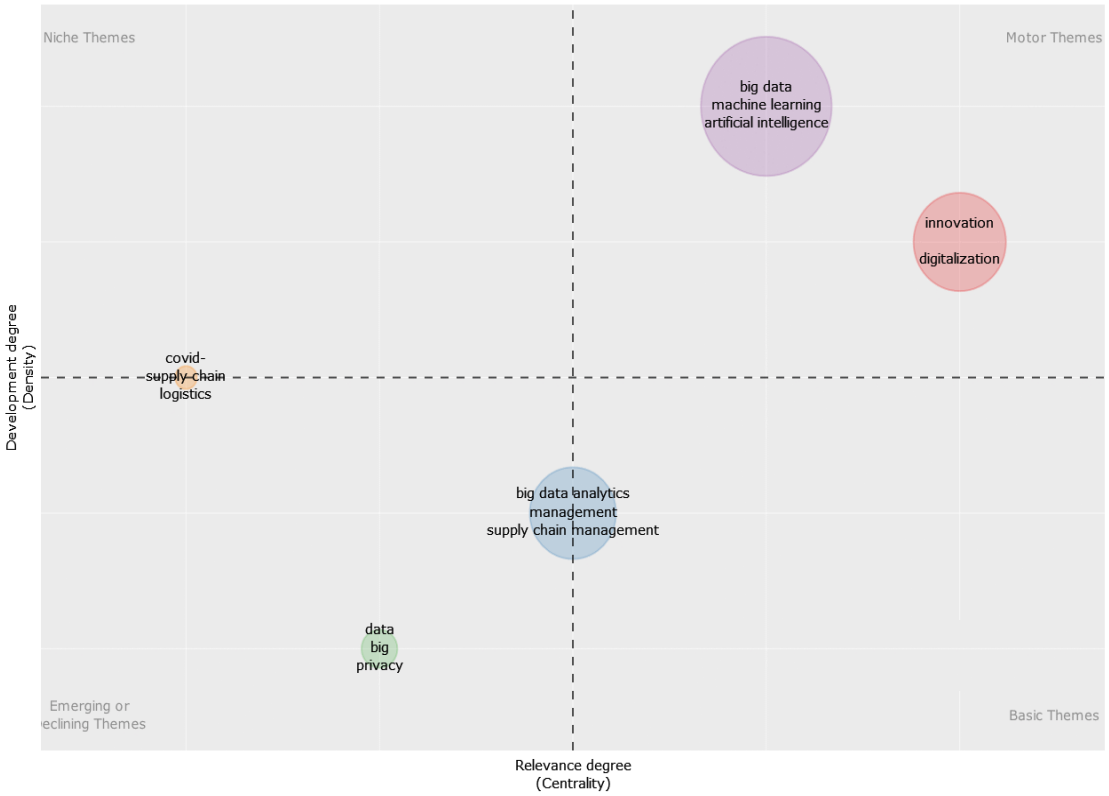


**Figure 3.** Thematic map of the most relevant words

*Journals with the most published and cited articles*

For Ardito, Scuotto, Giudice and Petruzzeli (2019), a journal analysis is vital in identifying the various research streams on the topic and encouraging cross-production between different streams.

The journals that published the most papers over this period are Technological Forecasting and Social Change, with 177 articles; the Journal of Business Research, with 102; Tourism Management, with 51; the Journal of Enterprise Information Management, with 48; the Journal of Transport Geography with 47 and the European Journal of Operational Research with 44 (see Figure 4).

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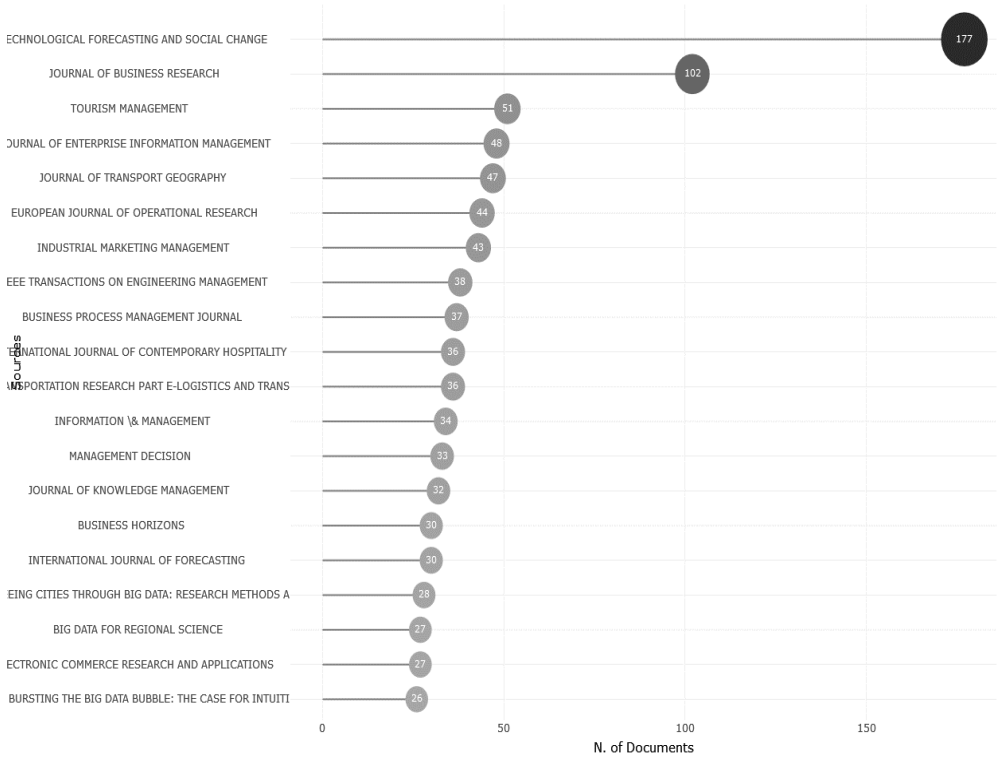


**Figure 4.** Journals with the most relevant sources

As for the most-cited journals in the Web of Science, the Journal of Business Research with 2,762 citations, the Management Information Systems Quarterly with 2,686 citations, followed by the International Journal of Production Economics with 2,155 citations and the Technological Forecasting and Social Change with 2,132 citations (Figure 5), were, firstly, identified. The latter represents the journal with the most published papers; this analysis represents the fourth with the most citations in the survey. These journals manage information systems and technologies to analyse the collected data, with data science and data mining techniques applied to business. Figure 5 completes the information with the remaining most cited journals.

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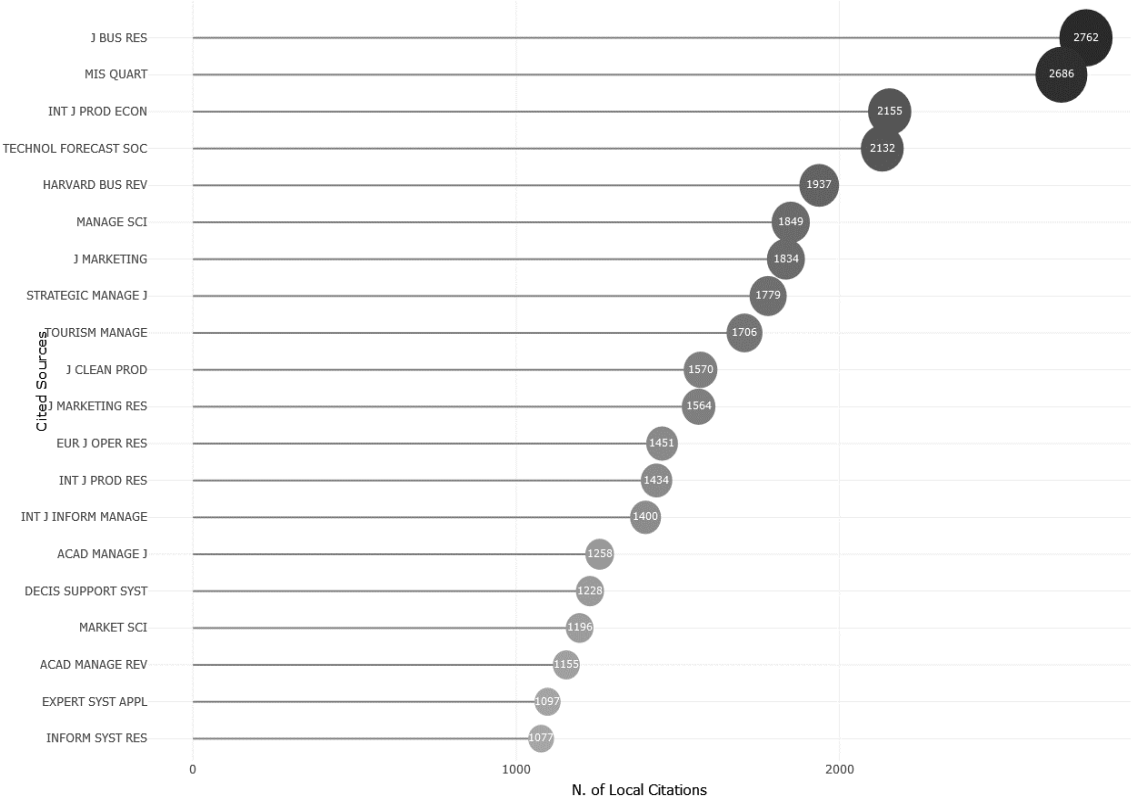


**Figure 5.** Most local cited sources

*Countries with the highest scientific production*

Regarding scientific production, the United States, China, and the United Kingdom occupy the top three places, with 3,364 documents, 2,755 documents, and 1,264 documents, respectively, as can be confirmed in the following table (Table 3).

**Table 3.** Number of publications by country

| Country | No. of publications |
|---|---|
| USA | 3.364 |
| CHINA | 2.755 |
| UK | 1.264 |
| ITALY | 647 |
| INDIA | 543 |
| GERMANY | 472 |
| AUSTRALIA | 461 |
| FRANCE | 371 |
| CANADA | 369 |
| SOUTH KOREA | 358 |
| SPAIN | 314 |
| BRAZIL | 267 |
| NETHERLANDS | 209 |
| RUSSIA | 189 |
| FINLAND | 175 |
| DENMARK | 153 |

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| | |
|---|---|
| SWITZERLAND | 151 |
| NORWAY | 143 |
| SWEDEN | 143 |
| TURKEY | 135 |

The countries whose scientific output is the most cited are the United States with 23,992 citations, the United Kingdom with 8,253 citations, China with 7,094 citations, Italy with 2,692, and Germany with 2,404 Australia with 2,375 citations and below 2,000 citations, France with 1,903 citations (Figure 6).

In addition to being the country with the most publications, the United States is also the country with the most citations; China, which ranks second with the most significant number of publications, is relegated to third place in terms of citations, being overtaken by the United Kingdom.

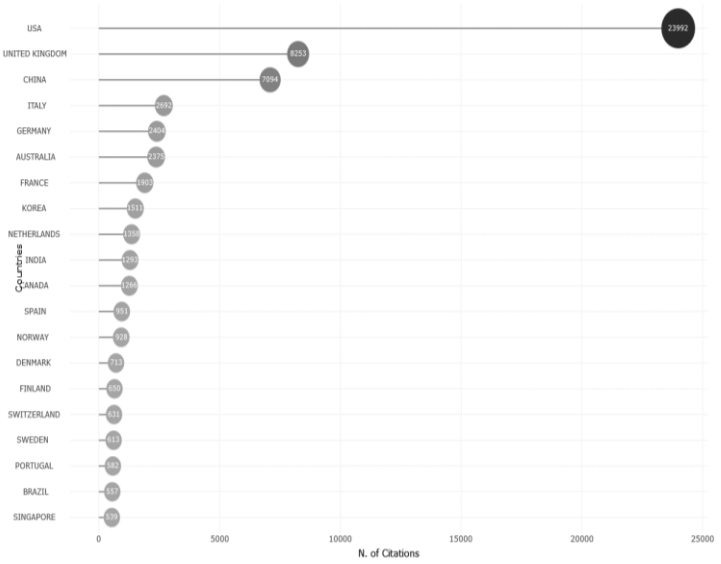


**Figure 6.** Most cited countries

*Documents*

The document with the highest number of unique citations within the Web of Science (Local Citations) is Wamba et al.'s (2017) article published in the Journal of Business Research, with 210 citations, whose study proposed the creation of an analysis model of Big Data capabilities and evaluated the direct and indirect impact of this model on the company's performance. The second paper, with 192 citations, is LaValle et al.'s (2011) article from the MIT Sloan Management Review, whose study, promoted by a partnership between MIT and IBM, involved more than 3,000 executives and 30 organisations of various sizes spread over 108 countries. To learn how the analysis of data generated by Big Data could create insights that would allow a greater understanding of the relevance of data and how the analysis of it could be leveraged in the issues and problems, not only tactical but also strategic, that arise in organisations. Considering all databases, this paper has the highest number of citations (713).

The third document, with 162 citations, is Waller and Fawcett's (2013) article published in 2013 by the Journal of Business Logistics and articulates the predictive analysis of Big Data with the supply chain to identify insights from the analytical analysis of Big Data, which can be applied to improve the effectiveness of the supply chain. Of the three most cited documents, a common point reinforces organisations' need to take advantage of the enormous amount of data to obtain gains and improve performance. Table 4 presents the most cited documents within the WoS (Local Citations) and the number of citations in all databases (Academic Search Complete, ScienceDirect, Web of Science and Scopus, for example), the Global Citations.

**Table 4.** Most cited documents

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| Document | Year | Local Citations | Global Citations |
|---|---|---|---|
| WAMBA SF, 2017, J BUS RES | 2017 | 210 | 513 |
| LAVALLE S, 2011, MIT SLOAN MANAGE REV | 2011 | 192 | 713 |
| WALLER MA, 2013, J BUS LOGIST | 2013 | 162 | 553 |
| EREVELLES S, 2016, J BUS RES | 2016 | 143 | 388 |
| SIVARAJAH U, 2017, J BUS RES | 2017 | 134 | 568 |
| GUNASEKARAN A, 2017, J BUS RES | 2017 | 104 | 319 |
| DAVENPORT TH, 2012, MIT SLOAN MANAGE REV | 2012 | 99 | 260 |
| CHEN DQ, 2015, J MANAGE INFORM SYST | 2015 | 82 | 217 |
| VARIAN HR, 2014, J ECON PERSPECT | 2014 | 80 | 429 |
| CORTE-REAL N, 2017, J BUS RES | 2017 | 72 | 147 |
| SCHOENHERR T, 2015, J BUS LOGIST | 2015 | 70 | 179 |
| JANSSEN M, 2017, J BUS RES | 2017 | 60 | 187 |
| VASARHELYI MA, 2015, ACCOUNT HORIZ | 2015 | 59 | 138 |
| GROVER V, 2018, J MANAGE INFORM SYST | 2018 | 57 | 169 |
| MIKALEF P, 2018, INF SYST E-BUS MANAG | 2018 | 57 | 188 |
| VIDGEN R, 2017, EUR J OPER RES | 2017 | 56 | 146 |
| BRAGANZA A, 2017, J BUS RES | 2017 | 52 | 117 |
| DUBEY R, 2019, BRIT J MANAGE | 2019 | 51 | 138 |
| AKTER S, 2016, ELECTRON MARK | 2016 | 44 | 200 |
| MIKALEF P, 2019, BRIT J MANAGE | 2019 | 44 | 106 |

As for the most cited documents in all databases it was found, in the first place, Chen et al.'s (2012) article published in *Management Information Systems Quarterly*, with 2,137 citations in the period; it is followed by McAfee and Brynjolfsson's (2012) article from the *Harvard Business Review* with 1,792 and Zuboff's (2015) article published in the *Journal of Information Technology*, with 735.

Table 5 presents the most cited articles between 2008/2022 and the total annual citations in all databases.

**Table 5.** Most cited articles in all databases

| Article | Total Citations | Total Citations per year |
|---|---|---|
| CHEN H, 2012, MIS Q | 2,137 | 194,273 |
| MCAFEE A, 2012, HARV BUS REV | 1,792 | 162,909 |
| ZUBOFF S, 2015, J INF TECHNOL | 735 | 91,875 |
| LAVALLE S, 2011, MIT SLOAN MANAGE REV | 713 | 59,417 |
| OSTROM AL, 2015, J SERV RES | 702 | 87,75 |
| SIVARAJAH U, 2017, J BUS RES | 568 | 94,667 |
| WALLER MA, 2013, J BUS LOGIST | 553 | 55,3 |
| WAMBA SF, 2017, J BUS RES | 513 | 85,5 |
| GRETZEL U, 2015, ELECTRON MARK | 479 | 59,875 |
| VARIAN HR, 2014, J ECON PERSPECT | 429 | 47,667 |

*Authors*

Between 2008 and 2022, it was found that 8,274 authors published papers on Big Data from a management perspective, of which 555 articles were single-authored (6.7%), while 7,719 were co-authored papers.

The authors with the most scientific production on Big Data are Y. Zhang with 31 documents, Y. Li with 30, Y. Wang with 29, Y. Liu with 28, X. Li with 26, X. Wang with 23 and J. Li with 20. Figure 7 shows the

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main authors with the most scientific production in this period, with the last three authors having half of the publications of the first three previously mentioned.

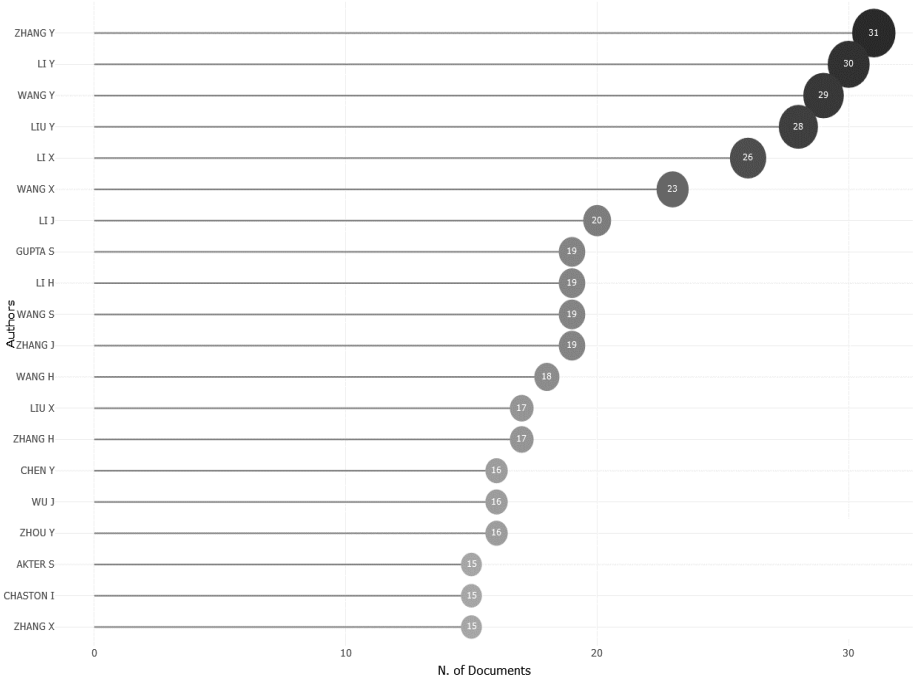


**Figure 7.** Most relevant authors

Figure 8 presents a time dimension of scientific production on Big Data. Y. Zhang, Y. Li, Y. Wang and X. Li were the most regular authors regarding the scientific output. Between 2015 and 2021, almost all authors in the graph published papers, and by 2021, six of the authors had published more than one paper (e.g., Y. Zhang, Y. Li, Y. Wang, X. Li, X. Wang, H. Li). This fact confirms what is seen in Figure 2; since 2021, there have been 828 publications, the highest number of the whole period under analysis, revealing the growing interest in the subject. In evolutionary terms, the scientific production of Y. Zhang translates into the publication of two papers in 2016, two in 2017, four in 2018, three in 2019, two in 2020, four in 2021 and two in January 2022.

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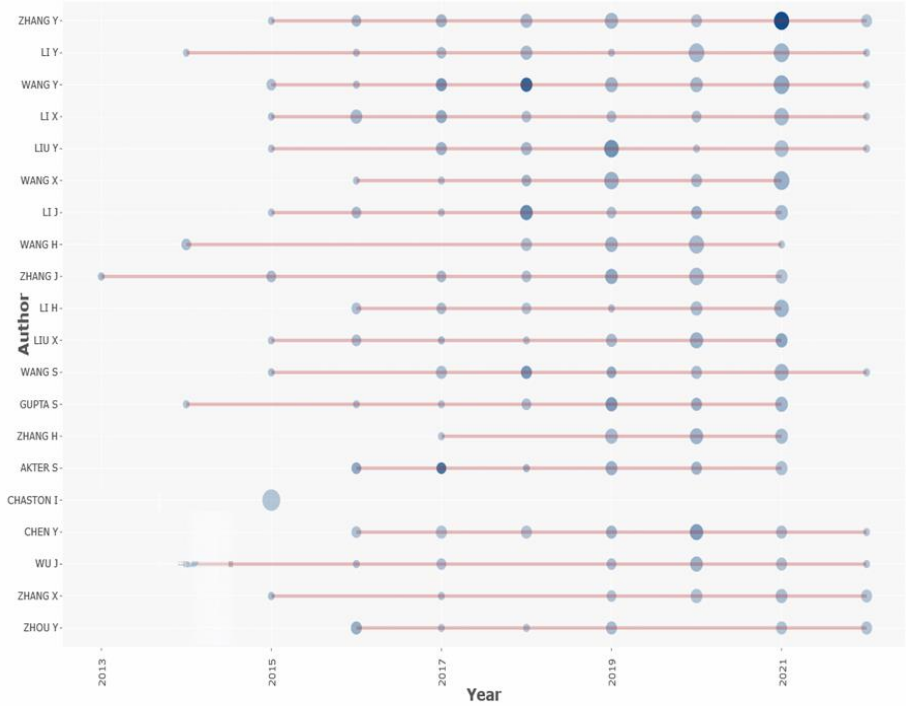


**Figure 8.** Scientific production by author in the period

The first ten authors had the most publications throughout the period, but they were not the most cited within the WoS citations. Except for S. J. Akter, who has been showing a consistent production between 2016 and 2021, despite corresponding to half of the papers published by Y. Zhang, he is one of the most-cited authors. The article "Big Data Analytics in E-Commerce: A Systematic Review and Agenda for Future Research", published in the Electronic Marketing Journal, has 210 citations in WoS and is therefore one of the authors with the most research impact, alongside S. Gupta with production published from 2014 to 2021 (Table 6).

**Table 6.** Scientific production of authors with more citations (Global Citations)

| Author | Year | Nº of jobs | Total Citations (TC) | TC per year |
|---|---|---|---|---|
| AKTER S | 2016 | 2 | 213 | 30,429 |
| AKTER S | 2017 | 2 | 530 | 88,333 |
| AKTER S | 2018 | 1 | 73 | 14,6 |
| AKTER S | 2019 | 4 | 79 | 19,75 |
| AKTER S | 2020 | 3 | 48 | 16 |
| AKTER S | 2021 | 4 | 9 | 4,5 |
| CHASTON I | 2015 | 15 | 0 | 0 |
| CHEN Y | 2016 | 2 | 22 | 3,143 |
| CHEN Y | 2017 | 3 | 7 | 1,167 |
| CHEN Y | 2018 | 3 | 2 | 0,4 |
| CHEN Y | 2019 | 3 | 65 | 16,25 |
| CHEN Y | 2020 | 6 | 124 | 41,333 |
| CHEN Y | 2021 | 3 | 11 | 5,5 |
| CHEN Y | 2022 | 1 | 0 | 0 |

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| | | | | |
|---|---|---|---|---|
| GUPTA S | 2014 | 1 | 4 | 0,444 |
| GUPTA S | 2016 | 1 | 41 | 5,857 |
| GUPTA S | 2017 | 1 | 0 | 0 |
| GUPTA S | 2018 | 2 | 29 | 5,8 |
| GUPTA S | 2019 | 4 | 177 | 44,25 |
| GUPTA S | 2020 | 3 | 63 | 21 |

The most local cited authors were A. Gunasekaran with 382 citations, S. J. Childe with 314, R. Dubey with 304, S. F. Wamba with 288, and S. J. Akter with 210. None of them is among the authors with the most scientific output (Figure 9).

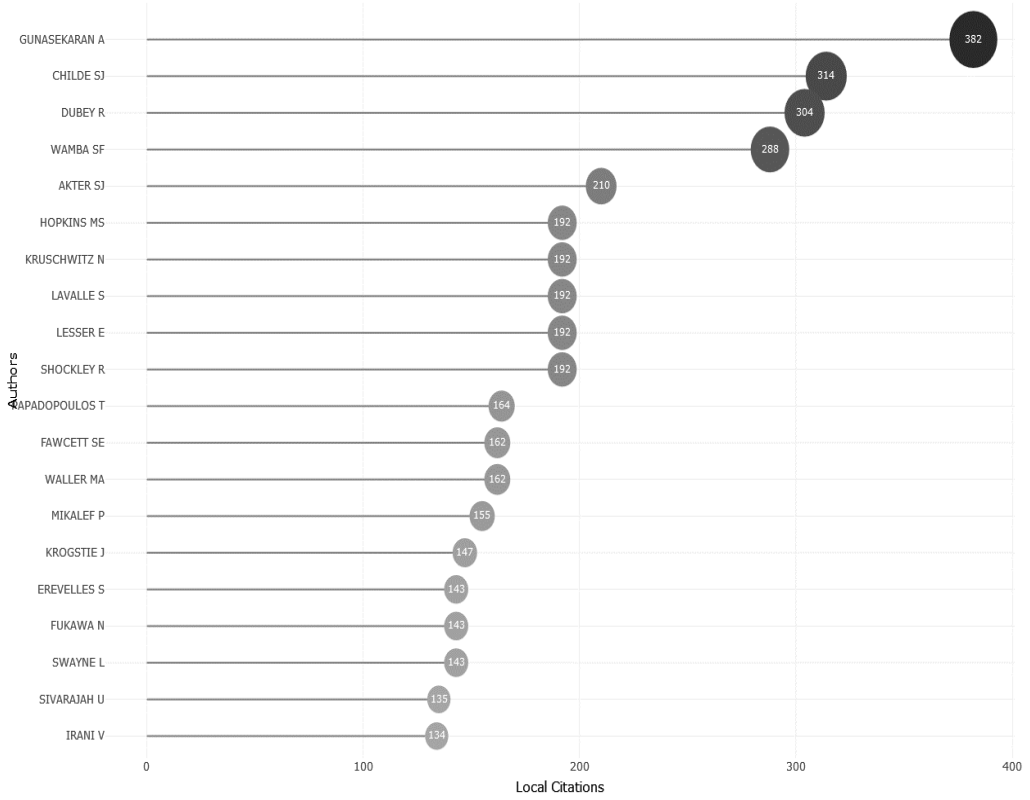


**Figure 9.** Most local cited authors

As for the most cited references within WoS, some similarities were found with the most cited documents in all databases (Table 5); the first two authors, Chen et al. (2012) and McAfee and Brynjolfsson (2012) have the highest number of references (434 each). On the other hand, Gandomi and Haider (2015) present 216 references in the analysed documents (Figure 10). It can be noted that the interest in the quality and interpretation of data is vital for organisations. The research corroborates the trend of the most prominent themes, such as Big Data Analytics, Machine Learning and Artificial Intelligence.

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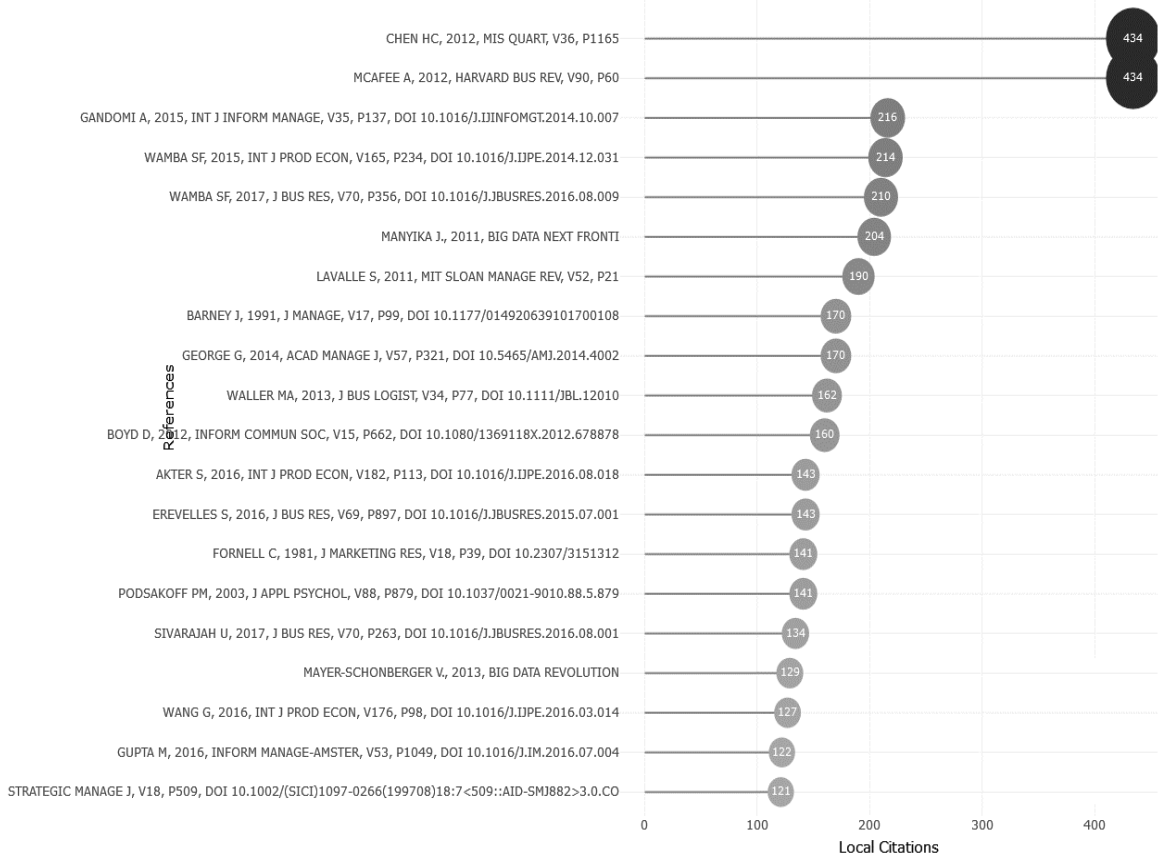


**Figure 10.** Most local cited articles

Regarding affiliations, Yuan Ze University in Taiwan has the most publications (102 articles), followed by three Chinese universities, Beihang University with 86 publications, Beijing Jiaotong University with 62 publications, and Hong Kong Polytech University with 62 publications. The first European institution is Carlos III University of Madrid, with 56 publications. The University of Illinois represents the United States of America with 52 publications (see Table 7).

**Table 7.** Affiliations

| Institutions | Articles |
|---|---|
| YUAN ZE UNIV | 102 |
| BEIHANG UNIV | 86 |
| BEIJING JIAOTONG UNIV | 62 |
| HONG KONG POLYTECH UNIV | 62 |
| UNIV CARLOS III MADRID | 56 |
| ZHEJIANG UNIV | 55 |
| ASIA UNIV | 54 |
| UNIV ILLINOIS | 52 |
| CHINESE ACAD SCI | 49 |
| SOUTHWEST JIAOTONG UNIV | 49 |
| SUN YAT SEN UNIV | 49 |
| TSINGHUA UNIV | 49 |
| UNIV MARYLAND | 49 |
| NORWEGIAN UNIV SCI AND TECHNOL | 48 |
| UNIV SALENTO | 48 |
| KENT UNIV | 46 |

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| | |
|---|---|
| SHENZHEN UNIV | 45 |
| CHINESE UNIV ACAD SCI | 45 |
| UNIV READING | 45 |

The Sankey Diagram was used to analyse authors, words, and themes of more outstanding research and the most cited references (Figure 11). This diagram streamlines and clarifies the interactions between the three elements. The larger the size of the coloured rectangles, the greater the importance of keywords, references and authors. The lines, or links, connecting publications to authors and keywords are thicker or thinner depending on the number of links.

It was found that all authors mentioned the most relevant words, Big Data and Big Data Analytics. S. Akter and S. Gupta are the most cited in all databases. Y. Wang, X. Wang, Y. Liu and Y. Zhang are some of the most cited in WoS. These authors incorporated these words and referenced the most cited publications analysed earlier.

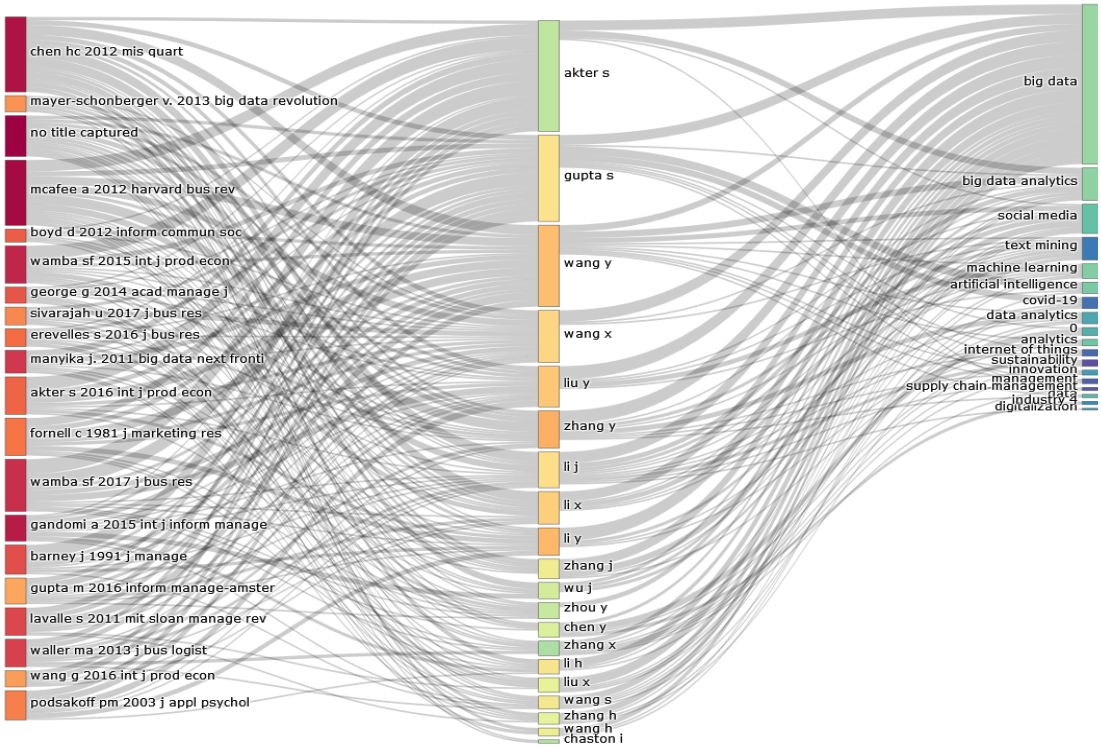


**Figure 11.** Sankey's diagram: relation between authors, words and documents

*Network Analysis*

Collaboration networks

Scientific collaboration between authors strengthens knowledge production and is vital for disseminating science. The interaction between authors and countries is fundamental to understanding how they transmit information and knowledge and how they relate. A collaboration network was found between authors that amounted to 676 documents, an average of 2.87 co-authors per document and 2.06 authors per document found.

Figure 12 shows the collaboration between countries: in blue, the articles published only in a single country and in pink, the articles published with the collaboration in several countries, published by authors from more than one country. This type of collaboration is essential as it allows us to understand the themes that

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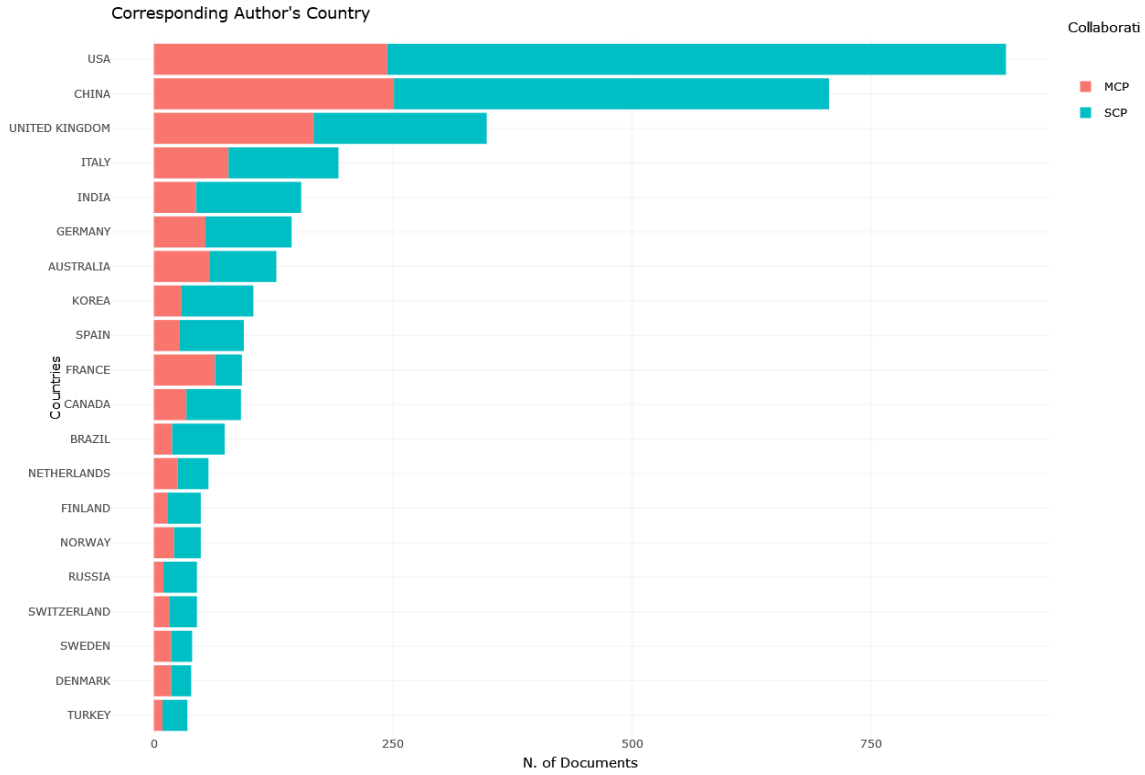
brought the authors and their respective institutions together and the research networks. Again, the United States of America and China stand out in the collaboration between authors.




Key: MCP = Multiple Country Publications; SCP = Single Country Publications.

**Figure 12.** Collaboration between countries

## Author networks

Figure 13 shows seven author clusters whose names are identified by circles. The variation in size of the circles corresponding to each author is proportional to the number of articles each author has in the selected sample.

The authors with the most prominent letter are those with the highest number of co-authorships and are positioned in the centre of the graph, namely Y. Zhang, X. Li and S. Wang in the red cluster, Y. Li and Y. Wang in the blue cluster, and X. Wang and H. Zhang in the purple cluster. The authors positioned in the red, blue and purple clusters are Asian authors leading research in Big Data in institutions with the largest collaboration networks with universities and departments in other countries. On the one hand, Y. Zhang, X. Li and S. Wang, and on the other hand, Y. Li and Y. Wang form a strong cooperation network between them visualised by the degree of closeness between them and the central position occupied in the graph. In the yellow cluster are grouped authors Gupta and Kumar A. and Kumar V., affiliated to universities in the United States and India respectively; in the pink cluster are grouped authors A. Gunasekaran, S. Akter and S. F. Wamba, from Universities in the United States, Australia and France; in the brown cluster, authors from Norway, P. Mikalef and J. Krogstie and finally in the green cluster, authors with affiliations to institutions in the United States of America and the United Kingdom. Although some authors' names are unclear or may lead to confusion, particularly about Asian authors with the same last name, the Vosviewer software allows for their correct identification.

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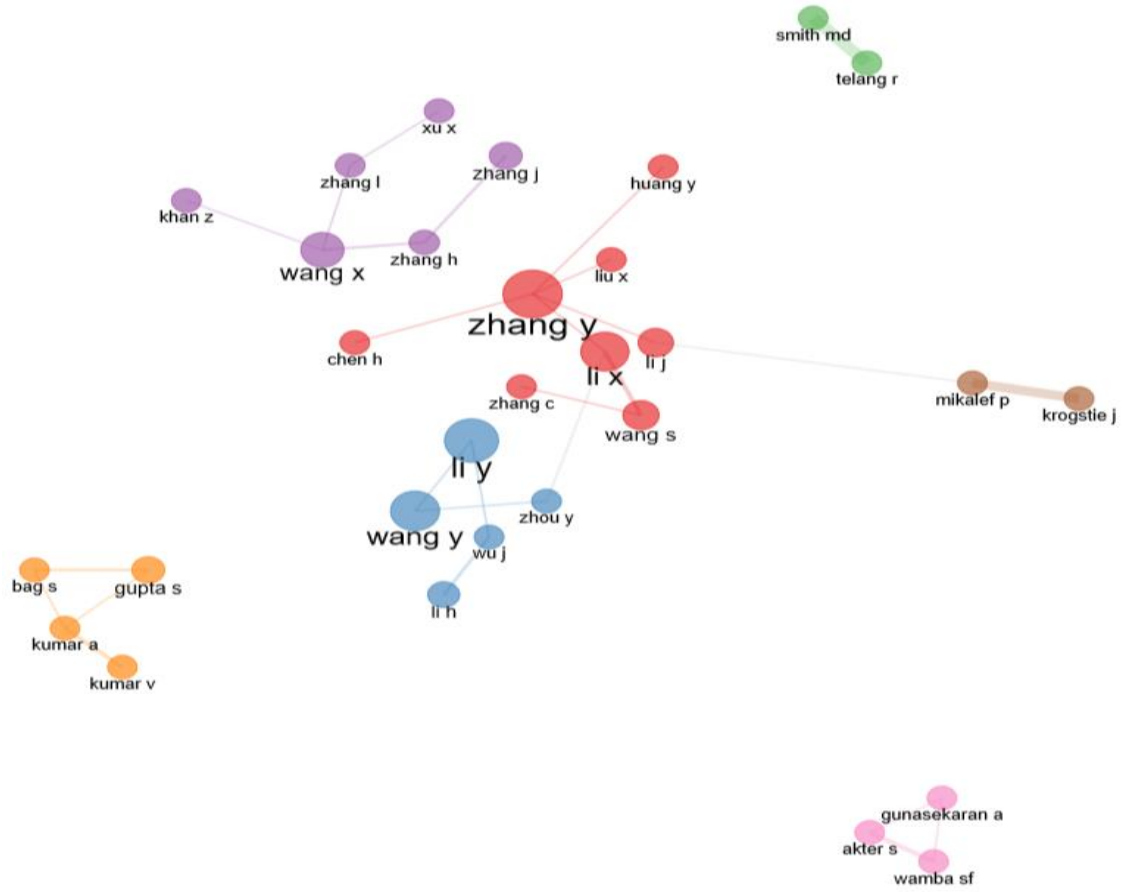


**Figure 13.** Authors' network

## Co-citation analysis

Figure 14 presents the mapping of documents based on bibliographic coupling. Three clusters were identified relating to distinct clusters of publications. Each cluster has a different colour and is marked as a set of articles co-cited together. Each circle corresponds to an article, and the lines establish their connection through co-citations. The size of the circles is determined by the number of times it was co-cited in the publications.

The network graph based on the bibliographic coupling of the documents highlights the most significant ones in the set, many of which are from recent years, expressing the proximity between publications according to the references used. The greater the proximity between publications, the greater the number of documents they share, whether or not they belong to the same country and institution. The green cluster represents the cluster with the largest number of papers, followed by the red and purple clusters. The blue cluster is composed of a single article (Elia G., 2020) but establishes relationships with the other two clusters.

For articles to be categorised in the same cluster, they must have a high degree of similarity. The number of lines that are established between them and their distances denote the level of their relationships. In the green cluster, the articles by Van Rijmenanm M. (2019), Sheng I. (2019), Vitale G. (2020), Cappa F. (2021), Sarti D. (2019), Akter (2016), Guenther W. (2017), and Nozari H. (2021) were found. The red cluster consists of Ghasamaghaer M. (2019), Zhang (2020), Jeble (2018), Liedong Ta (2020), Dubey (2019), Mikalef (2018, 2020), Batistic (2019) and Mendel (2018). The purple cluster consists of the following authors: Surbakti (2020), Sundarakani (2021), Gupta (2019), Rossman B. (2018), Ardito I. (2019), and Gravit (2018).

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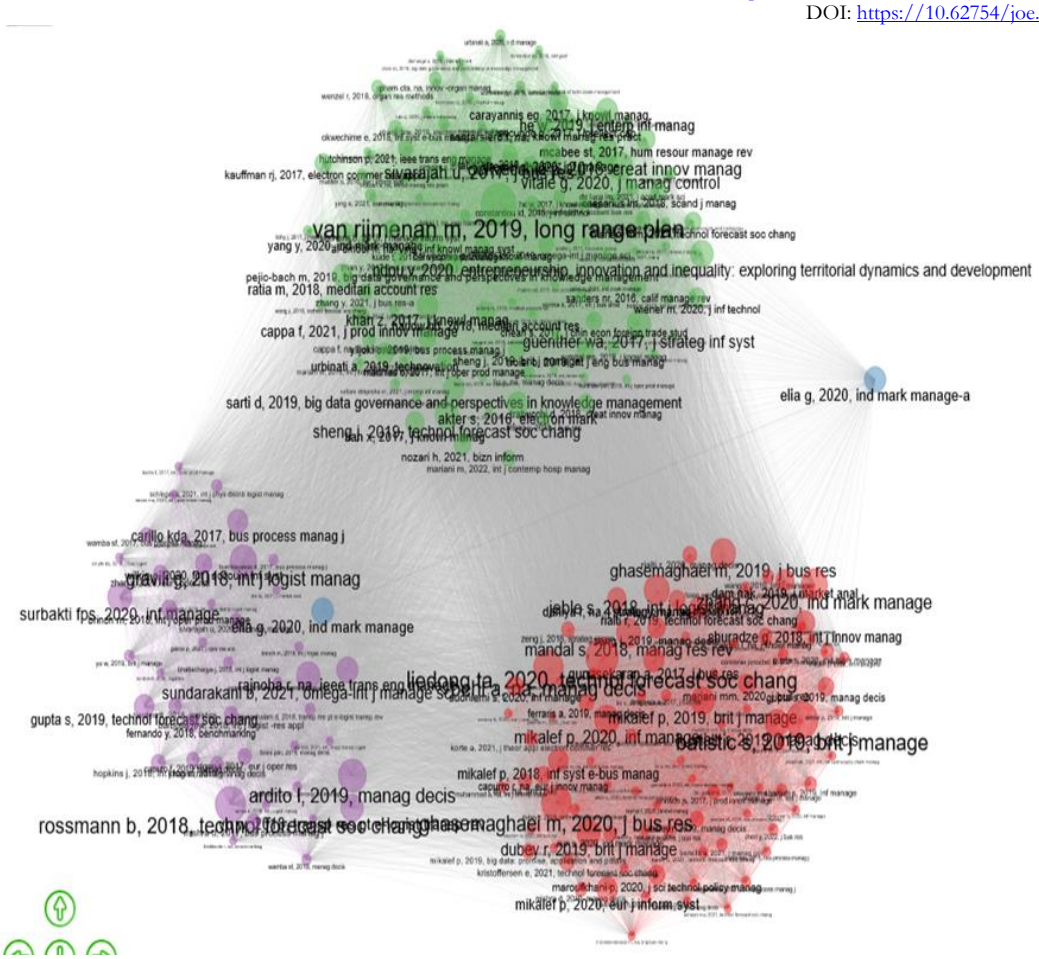


**Figure 14.** Document map based on bibliographic coupling

## Discussion

This study uses bibliometric analysis to understand the emergence of big data for organisations' management. The evolution of this relationship reveals a growing interest in the theme, which is evident in the trend analysis of the most researched themes, the journals that published most articles, and the co-occurrence keywords analysis that shows the temporal evolution of contributing to more assertive future research.

The innovative nature of Big Data in organisation management is unavoidable. The oldest document dates back to 2008, and after a two-year interruption in 2011, an article was found again. From 2013 onwards, there has been an upward movement until today.

The following sections present this research's theoretical and practical contributions, answering the research questions identified in the theoretical framework.

*Theoretical contributions*

This research contributes to Big Data publications' quantitative and statistical analysis in the management of organisations. The first research question intends to show the main evolutionary milestones of Big Data scientific production in organisation management between 2008 and 2022. The results allow us to conclude an exponential production growth from a sample that culminated in 4019 documents present in 878 journals. Between 2008 and 2012, only three articles were published; between 2015 and 2021, 2154 articles were published out of 4019, corresponding to 54% of the total scientific production. This remarkable increase between 2015 and 2021 corroborates the growing trend of scientific production of Big Data in organisations' management. As for the keywords, it was found that Big Data, Big Data Analytics, Machine

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Learning and Artificial Intelligence are the ones that registered the most occurrences, revealing the interest of researchers in techniques and tools that support organisations in the extraction and analysis of data. These terms reflect a stable evolution trend, as they continue to be potential drivers of future research due to the value and importance they bring to organisations. At the beginning of the analysis, the terms Geographic Information System, Outsourcing, Co-creation and Crowdsourcing were the most commonly found trends in the literature.

In 2021, the trends in scientific production point out the terms Industry 4.0 and Digital Transformation, both appearing in the research for the first time in 2020. Also, in 2021, the term Covid-19 became part of the scientific production. Literature Review, Machine Learning, Artificial Intelligence and Digitalization also marked the production in the area in 2021, but they appeared for the first time in 2019, marking the scientific production also in 2020. Big Data Analytics, Technology, Data Analytics and Supply Chain Management appeared in 2018 and have been dominating the literature until 2021. Data appeared in 2017 and continues to be the target of interest in 2021. Finally, from 2016 until 2021, Sensemaking has a marked presence in scientific production. A multidisciplinary of terms around the theme, spread across several areas of knowledge was identified.

Regarding the most cited articles, Chen et al.'s (2012) article published in the Management Information Systems Quarterly and the McAfee and Brynjolfsson's (2012) article published in the Harvard Business Review are highlighted. Among the journals with the most publications, Technological Forecasting and Social Change stand out, which deals with the evaluation and forecasting of the evolution of technologies, followed by the Journal of Business Research, which is the most cited in WoS and analyses business decisions, processes, and activities in the real business environment, and Tourism Management is a leading academic journal that focuses on travel and tourism management, planning, and policy. These journals are also the ones with the highest h-index impact factor, and according to this study, a similar behaviour in 2022 was predicted.

As for the authors, the most productive ones, namely Y. Zhang, Y. Li and Y. Wang, continued to publish in the last 4/5 years and more than two papers per year. Indeed, Asian authors publish the most, followed by authors from the US and the UK. A. Gunasekaran, S. J. Childe, R. Dubey, S. Gupta, S. Akter and Y. Chen are some of the most cited authors. Currently, Asian institutions are the most prominent in terms of the highest number of publications, namely Yuan Ze University, Beihang University, Beijing Jiaotong University, and Hong Kong Polytech University, all Chinese institutions.

Concerning the analysis of collaboration networks between institutions and countries, the United States and China are the countries that contribute most to the literature on Big Data in management. However, an analysis of the scientific production of the countries indicates that the United States has the most significant number of publications and the largest number of cited publications, closely followed by the United Kingdom and then China. This preponderance of the US over China is noteworthy, as it may denote a new evolutionary trend in the coming years.

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As for the second research question, it was foreseen that after this phase of the search for data extraction and analysis techniques by organisations, the research panorama will understand how Big Data can be optimised to increase value and improve performance. In fact, in 2018, some topics emerged as new research trends, namely Management, Performance, Decision-Making, Business, Value Creation and Supply Chain Management. This finding may open new avenues to more refined and robust research in an area with much to grow. The thematic maps obtained in this analysis also point to innovation as a driving theme. This concept may be the target of future research, as it is crucial in increasing competitiveness and enhancing organisational performance gains. Here, a research niche was identified that needs more research, internationally and nationally, and fully responds to the need to identify the data with value and quality that will lead to better profitability ratios, better sales, and higher productivity rates. The emergence of articles on the application of Big Data to supply chain management and logistics indicates the importance of this topic, which has been gaining in recent literature. Big Data is undoubtedly an emerging paradigm in organisations' management, both the urgency to find effective techniques for extracting and analysing data and the need to understand how these techniques can be allocated more efficiently to obtain practical performance gains.

*Practical contributions*

This study allows academics to identify research trends in this area and disseminate to professionals the essential tools to apply Big Data in organisational management in diverse areas such as tourism, marketing, and supply chain management. It also contributes to updating knowledge about Big Data in management. These inputs are vital in the current competitive environment in which organisations are inserted. It was also provided information on the evolution of research with the authors who publish the most, the most cited articles, the most relevant terms, the existing collaboration networks and the most cited journals with the most publications, enabling the identification of areas in which research in this theme is still non-existent or weak.

## Conclusions

This research was guided by an articulation between a systematic literature review and innovative software, the R. Bibliometrix, contributing significantly to a better knowledge of the theme. It is understood that bibliometric analysis is the most appropriate technique to identify the evolutionary milestones of scientific production and future research trends of an emerging paradigm such as Big Data in organisation management.

The belief is that the terms Big Data, Big Data Analytics, Machine Learning, and Artificial Intelligence correlate with performing predictive data analysis through data mining and business intelligence tools to better understand organisations' business environments. The primary documents reflect precisely this concern, pointing the study to the need to manage and analyse data efficiently because Big Data can provide advantages in making smarter decisions and solving problems oriented not only to the operational but also the organisation's strategic component. Therefore, future research must explore Big Data areas that still need in-depth investigation. In this domain, the analysis of how performance indicators can be obtained based on Big Data to increase value and support the decision-making process in organisations is highlighted. This study is only the starting point for it.

*Limitations and future research directions*

The fact that the bibliometric analysis is focused only on one database (WoS) can be considered a limitation. Future studies should gather other databases so that the paradigm of Big Data in management can be more widely understood in its different dimensions, contributing to the literature review in an emerging area. It is suggested that VOSviewer be used to conduct more refined analyses of the publication's evolution in other journals over the years, focusing on national scientific production and comparing it with the results obtained internationally.

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