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The Evolution of Business Process Management: A Bibliometric Analysis

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ABSTRACT This paper will present the research results for the analysis of the presence and evolution of the term Business Process Management (BPM) in the period 2000-2020 using a literature review with bibliometric analysis. This research sought to evaluate the quantity and quality of empirical support for the use of this tool in organizations. This allowed the researchers to acknowledge and confirm this discipline as an important investigation domain with great potential for helping companies achieve strategic alignment between business and information and communication technologies in the future. The Science Mapping Workflow methodology was used with database and search criteria applied to a total of 1,706 articles related to the subject, which resulted in a total of 624 articles selected for further research. This study identifies the journals that have the most publications about BPM. It concludes that the most promising perspectives are the ones related to Management, Framework and Performance. Even though, from a conceptual viewpoint, performance is the most valued perspective. Lastly, this research is of great interest for academics and professionals who hope to strengthen their knowledge about the BPM concept and find the historical path and the main authors and issues that contribute to knowledge in this scientific field.

INDEX TERMS Business process management, science mapping workflow, bibliometrix, business process reengineering, enterprise resource planning, customer relationship management.

I. INTRODUCTION

Organizations are becoming increasingly conscious of the importance of their integral management processes. This is due to the intense competition in a global market where only the best leading companies in different industries can survive in the long term.

Acknowledging the importance of business processes has constantly, though slowly, become a fact in the most developed economies since the mid-eighties, as demonstrated when Porter defined the concept of value chain in 1980. Moreover, the whole contemporary organizational structure emphasizes the role of business processes [1]. Thus, process management is becoming an important part of operational business in organizations as well as in new projects to improve performance.

[2] divide the history of BPM into three periods or waves. The first wave began at the beginning of the 20th century, when [3] proposed a management theory, in which we find the origin of modern process management. The second wave peaked with the movement of reengineering business processes in the mid-1990s [4], while the third wave began in the early 21st century with the advances and synthesis of previous and technical methods in the area of business processes that were merged into a single discipline that became known as Business Process Management (BPM).

[5] defines BPM as achieving an organization's goals with the improvement, management and control of essential business processes. The definition given by [1] also matches the previous one, as it defines BPM as a management discipline that focuses on improving the efficiency of an organization by managing its component processes. BPM is one of the most effective methodologies. It is being used to improve the efficiency and performance of process-oriented organizations [6], [7] and [8].

Later and equally important [9] defines the concept of BPM as a management discipline that integrates the strategy and goals of an organization with customer expectations and requirements by focusing on comprehensive horizontal processes. The BPM definition itself indicates that it is a complex

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discipline that covers strategies, objectives, culture, roles, policies, methodologies and tools for comprehensive analysis, planning, implementation, control, constant improvement and process management [9].

Research into BPM has been extensive in recent times and, also, poorly organized as will be demonstrated below. Thus, there was a significant increase in scientific production on BPM in 2000, which became known as the third wave of BPM. This sufficiently justifies that the beginning of the chosen research period is precisely that year.

On the other hand, the last major review of the literature in the field of BPM was conducted in 2013 by [7]. Since that study and until 2020, there has been no specifically bibliometric study of BPM. Furthermore, no quantitative work has been identified to support the relevance of pure research in BPM, along with the establishment and structuring of data as important as determining what the main authors and topics that have contributed to the knowledge in this scientific field are. All this justifies the research explained in this document.

The main aim of this paper is to identify the presence and evolution of the term BPM in the period 2000-2020 using a literature review with bibliometric analysis. In order to do that, some questions have been defined: Is there a real interest in researching this scientific domain? If so, what are the major areas of future development in BPM? And, finally, is there a consistent body of researchers which collaborate effectively? An in-depth bibliometric study answers these questions and this will be the main contribution of this study.

The scientific methodology used in this research was a type of bibliometric analysis known as Scientific Mapping Workflow, which attempts to show the structural and dynamic aspects of scientific research. This methodology requires a statistical tool to help with the analysis of the data. This study used the Bibliometrix package to implement the scientometric methodology. The details of this methodology will be described in more detail in the corresponding section.

The following sections of this article are organized as follows: first, articles are filtered along the lines of the research by [10] using the bibliometric methodology known as Scientific Mapping Workflow [11]. The analysis is done using R statistical software and Bond's Bibliometrix package [12].

The research is augmented with studies carried out by [13], which used a Systematic Literature Review (SLR) for the term BPM. An extensive literature review was carried out on articles published before 2020, with the articles identified in a bibliometric study of the collection of bibliographic metadata in the Web of Science (WoS), Scopus, Google Scholar, AMC, IEEE Xplorer, and EBSCO databases. The author, origin and document type were the search terms used for the analysis, which was then complemented with conceptual, intellectual and social structure analyses using factorial analysis of the k-structures or structures of knowledge as proposed by [11], and used in other studies, such as [14].

The first part of this document is the Literature Review, which presents the most relevant features of BPM. The second section is the Methodology, which explains the methods and procedures which were used to carry out this investigation. After this, the results are presented which identify the relevant authors, documentary analysis and the structure of knowledge for BPM. Finally, there is a discussion of the results and a conclusions section. As this research used a bibliometric study, the main contributions of this paper are that it shows the size, growth and distribution of scientific documents and also the structure and dynamics of the groups that produce and use these documents and the information they contain. In addition, another fundamental contribution of the research is that it creates a reference framework that will help future researchers of BPM with an easy and organized way of finding the history and authors that have contributed scientific knowledge about BPM.

II. LITERATURE REVIEW

Business Process Management is considered a management discipline that combines knowledge about information technology and management sciences and applies it to operational organizational processes [15]. Therefore, it has received considerable attention from academics and professionals in recent years, due to its ability to significantly increase productivity and cost savings. In addition, there are numerous BPM systems available today, which are generic software that rely on explicit process designs to carry out and manage operational business processes [16].

The origins of BPM are not easy to identify and have been written about differently many times. However, it is agreed that the theory behind BPM can be seen in Smith's Division of Labor [17] and the profits that this brings. Later, the principles of Taylor's Scientific Management [3], which remained in vogue until the 1980s, gave considerable attention to Total Quality Management (TQM). Since the 1970s, however, data rather than processes were the important focus of attention because of the complexity of process management. [16].

On the other hand, the ideology of business processes is a wide-ranging, customer-oriented management culture. This idea can be expanded, and using the definition of [18] process orientation consists of elements of structure, focus, measurement, ownership and customers. [4] also emphasizes the commitment to improving customer-directed processes and information-oriented systems of business processes as an important component of this culture.

Later, interest in processes continued to increase in the 1990s, with the introduction of business process reengineering (BPR), promoted by authors such as [4], [19]. Evidence since then suggests that it has not generated the expected positive effect on the performance of organizations [20].

Then, from the mid-1990s until the end of that decade, Enterprise Resource Planning (ERP) was the focus for organizations, thus becoming the next step in this area of knowledge [21]. In principle, ERPs should have offered better ways for organizations to operate. In addition, they were presented as the solution to the problems identified with the implementation of BPs. However, ERP systems did not solve process

problems in organizations, nor did they manage to increase efficiency and effectiveness on their own [22].

Towards the end of the 1990s and early 2000s, CRM (Customer Relationship Management) or Customer Relationship Management Systems were introduced and had a broad customer-based approach, but while CRM focused on the front-office, or rather customers, they did not improve back-office processes, understand horizontal processes or non-customer-visible activities. For this reason, organizations also used the Six Sigma process improvement methodology proposed by Smith [23] to reduce process time, eliminate production defects and increase customer satisfaction [24]. In this sense, CRM helps to take decisions made by the managers and CEOs of companies when proposing strategic agreements at the organizational and human resources levels [25].

Three fundamental elements therefore converge in BPM, namely the scientific analysis of processes, information technology and people.

However, [23] has since demonstrated the dissociation between processes, people and technology and the correct management of them. Thus, this was the trigger for [2] to propose the discipline of Business Process Management (BPM) to integrate the best practices of the technology industry with the best managerial practices. Therefore, the progress of BPM is due to the successes and failures of other proposals for process-based organizational management.

BPM, on the other hand, can be seen as an extension of Workflow Management (WFM), since it primarily focuses on process automation, while BPM has a broader scope, which ranges from optimization, automation and process analysis to operations management and the organization of tasks. In addition, as with WFM, BPM combines with software to manage, control and support operational processes. Therefore, the main difference with traditional WFM technology is that it automates organizational processes operationally, while BPM includes human factors, administrative support and optimization [26].

Hence, [27] coined the term "reengineering" to describe the development of a customer-centric, process-oriented, organization based on strategic business practices and using information technology as a tool to help overcome problems in company-wide activities.

As a result, [28] stated that the success of BPM is due to the business architecture of an organization, company-wide communication, innovation, people, continuous improvement, project management, but above all the strategic management of the organization.

While it is true that BPM focuses on processes, data and systems, the trend for data has had more impact, due to the complexity of understanding processes [15]. This period, better known as the third industrial revolution (1969 – 2015) was marked by the availability of computers, communications networks, databases and other emerging technologies, which contributed to the importance given to data because it was immediately available [29].

Therefore, one of the objectives of BPM is to improve operational processes with the use of new technologies. For example, by modeling a process and analyzing it using simulation, management can gain insights on how to reduce costs and improve service levels [30].

Currently, the world is talking about Industry 4.0 [31] better known as the fourth industrial revolution since the German Federal Government coined the term in 2011 [32]. Systems are being combined to make embedded systems or the Internet of Things, better known as IoT, which uses sensors, networks, service orientation, big data and business intelligence [33].

Finally, Fig. 1 shows a chronological summary of the literature review and also identifies important milestones and relevant authors.

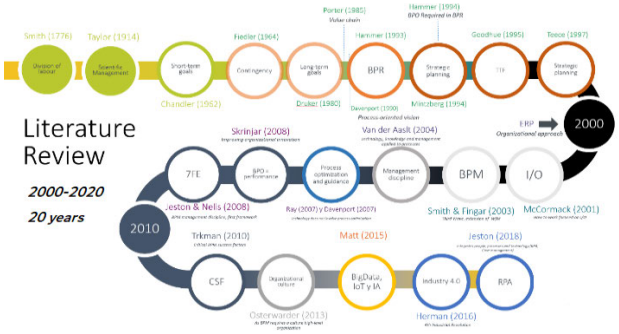

FIGURE 1. Chronological literature review.

III. METHODOLOGY

Developments in information and documentation science have led to the emergence of many easily accessible databases. However, the amount of information contained in these has been seen to be unmanageable [34] and additional tools must be used to manage all the data.

Therefore, a bibliometric analysis was carried out [10] using the methodology proposed by [35] known as The Scientific Mapping Workflow, hereinafter SMW, which is described in detail in Fig. 2 and the objective of which is to show the structural and dynamic aspects of scientific research. This analysis uses R as statistical software [36] in the Bibliometrix package developed by [11] that implements this scientometric methodology.

First, bibliographic data was collected from various databases. This was done by searching metadata for author, source and document. Once the metrics were defined, analyses of the k-structures or structures of knowledge at the conceptual, intellectual and partner level were done.

The bibliometric analysis was then performed using the Scientific Workflow procedure, shown in Fig. 2. Initially, in the data collection stage, filters were applied to the Web of Science, Scopus, IEEE Xplore, ScienceDirect, EBSCO, AMC and Google Scholar databases for the 19-year period between 2000 and 2020 in order to complement the

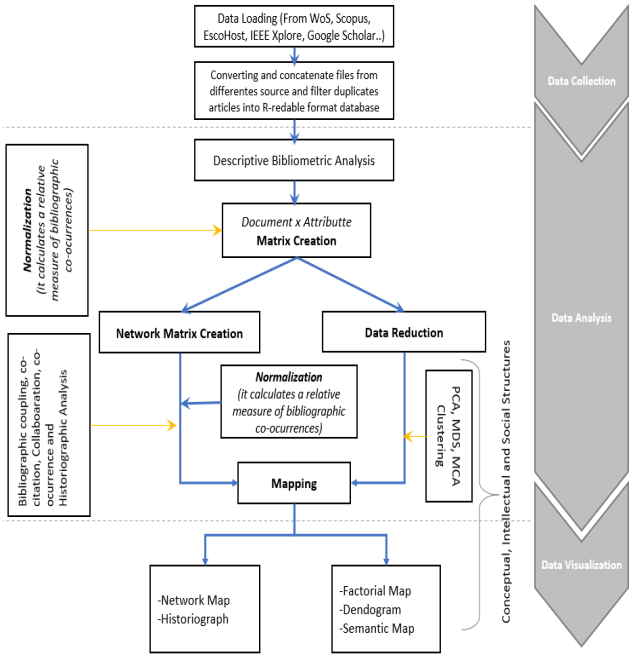

FIGURE 2. Science mapping workflow.

systematic literature review proposed by [37] in which a search strategy filters relevant criteria using the PRISMA methodology proposed by [38] and implemented by [11]. This methodology details the phases of database identification, selection of records and item filters with eligibility criteria.

The databases and search criteria applied, as indicated in Table 1 below, identified a total of 1706 BPM-related articles, of which, after applying Prisma methodology [38], the relevant documents for this research were found. 671 duplicate items were deleted from the database results, with a resulting total of 1035 items. Likewise, the search protocol for all databases were the same keywords, ''Business Process Management'' and ''BPM'' for the period between 2000 and 2020 (March) inclusive, in which the keywords must appear in the title of the article, abstract or in its meta data. In addition, other filtering parameters were included, namely English-only and published articles.

As can be seen in Table 1, four limitation rules were applied to the content of the papers and related documents: 1. Manuscripts that were not research or scientific review articles were excluded, 2. Articles that were not in the English language were excluded, 3. Selected articles should have a clear relationship with or contribution to the field of BMP study and 4. The main objectives and research questions in the selected articles should be clearly described and explained. The methodology should also propose appropriate ways to address the research problem and answer the research questions.

TABLE 1. Database search text.

Database	Search text	Total
Web of Science	Subject: (""Business Process Management"") OR Subject: (BPM) Refined by: WEB CATEGORIES OF SCIENCE: (COMPUTER SCIENCE INTERDISCIPLINARY APPLICATIONS OR ENGINEERING MULTIDISCIPLINARY OR COMPUTER SCIENCE INFORMATION SYSTEMS OR MANAGEMENT OR COMPUTER SCIENCE SOFTWARE ENGINEERING OR COMPUTER SCIENCE THEORY METHODS OR BUSINESS) AND DOCUMENT TYPE: (ARTICLE) AND LANGUAGES: (ENGLISH) AND RESEARCH AREAS: (COMPUTER SCIENCE OR SOCIAL SCIENCES OTHER TOPICS OR BUSINESS ECONOMICS OR ENGINEERING OR OPERATIONS RESEARCH MANAGEMENT SCIENCE OR INFORMATION SCIENCE LIBRARY SCIENCE OR PUBLIC ADMINISTRATION) AND CATEGORÍAS DE WEB OF SCIENCE: (COMPUTER SCIENCE INFORMATION SYSTEMS OR COMPUTER SCIENCE SOFTWARE ENGINEERING OR ECONOMICS OR MANAGEMENT OR BUSINESS OR INFORMATION SCIENCE LIBRARY SCIENCE OR ENGINEERING INDUSTRIAL) AND [excluding] CATEGORÍAS DE WEB OF SCIENCE: (TELECOMMUNICATIONS OR MEDICAL INFORMATICS OR AUTOMATION CONTROL SYSTEMS OR HEALTH CARE SCIENCES SERVICES OR PSYCHOLOGY APPLIED OR OPTICS) AND [excluding] WEB OF SCIENCE CATEGORIES: (COMPUTER SCIENCE ARTIFICIAL INTELLIGENCE) Index=SCI-EXPANDED, SSCI Time period=2000-2020"	616
Scopus	(TITLE-ABS-KEY ("Business Process Management") OR TITLE-ABS-KEY (bpm)) AND DOCTYPE (ar) AND PUBYEAR > 1999 AND (LIMIT-TO (SUBJAREA,"BUSI") OR LIMIT-TO (SUBJAREA,"SOCI") OR LIMIT-TO (SUBJAREA,"MULT") OR LIMIT-TO (SUBJAREA,"ECON")) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (EXACTKEYWORD, "Business Process Management") OR LIMIT-TO (EXACTKEYWORD , "Enterprise ResourceManagement") OR LIMIT-TO (EXACTKEYWORD,"Process Management"))	735
IEEE Xplore	(("All Metadata":"Business Process Management") OR "All Metadata": BPM); Publication Year: 2000–2020	33

TABLE 1. *(Continued.)* **Database search text.**

EBSCOhost	I "business process management" OR BPM - Academic Search Complete;Agricola;Art & Architecture Complete;Business Source Complete;Computers & Applied Sciences Complete;eBook Academic Collection (EBSCOhost);eBook Collection (EBSCOhost);Environment Complete;ERIC;Fuente Académica Premier;GreenFILE;Library, Information Science & Technology Abstracts;Regional Business; Publicaciones académicas (arbitradas); Fecha de publicación: 20000101-20201231; Language: English	50
SpringerLink	'"Business AND Process AND Management"' within 2000 - 2020	1
Google Scholar	allintitle: "Business Process Management" since 2000 site:.edu	133
ScienceDirect	pub-date >2000 and pub-date <2020 AND (BPM⁄ OR (process⁄ AND software⁄) OR (process⁄ AND business⁄) OR workflow⁄))) [All Sources (Business, Management and Accounting, Computer Science,Engineering)]	68
ACM	"query": {("Business Process Management")} "filter": {"publicationYear":{"gte":2000}}, {owners.owner=HOSTED}	70

Once the results of the different databases were obtained, the records were exported into plain text files in BibTeX format in order to maintain the consistency of the different data sources. These files were then combined into a single file [39].

The resulting data file was then processed using the R statistical software following the suggestions of [36], using the specialized package for bibliometric analysis called Bibliometrix developed by [11], supplemented by the Biblioshiny function developed by the same authors and available on the Wide Network of R Files, or Comprehensive R Archive Network, hereinafter CRAN.

Bibliometrix initially requires that the CRAN bibliometrix packages are installed and the R package must be subsequently loaded with the command library (''bibliometrix'') and finally the Biblioshiny plug-in must be run. This allows the filtering, normalization and final analysis of the results.

The WoS and Scopus databases allow data to be directly exported in the BibTeX standard bibliographic format, but each database includes different fields in a different order. For example, EscoHost and other databases use generic BibTex, thus the standardization proposed by [40] is performed with the BibTool standardization algorithm, in which bibliographic fields are consistently standardized, which is an indispensable requirement for treatment with Bibliometrix.

IV. RESULTS

After analyzing the consolidated and consistent databases, the scientific workflow mapping procedure was continued with the analysis and standardization phase. Table 2 shows the general descriptive data of the research. It is important to note that, in the 20-year period which was analyzed, it was found that the 1035 articles remaining after excluding duplicates came from 377 different sources, with an average annual publication of 6.7 articles per year and an average number of 27.6 citations.

TABLE 2. **Summary of processed bibliographic information.**

Description	Results
Time period	2000:2020
Origins	377
Articles	1035
Average publications per year	6.73
Average quotes per article	21.67
Average quotes per article per year	2.337
References	44588
Document Type	
Article	1035
Content of the Documents	
Keyword (ID)	2481
Author keywords (DE)	2754
Authors	
Authors	2289
Authors' appearances	3257
Single author	112
Multiple authors	2177
Collaboration	
Single author	118
Documents per author	0.452
Authors per document	2.21
Co-Authors per article	3.15
Collaboration Index	2.37

More than 44,500 articles, 2,500 keywords and 118 different authors have been referenced. This shows how strong the BPM field of study is and how it interacts with other topics.

As shown in Fig. 3, the number of scientific publications about BPM increased after 2000 and again markedly in 2003, as identified by [2]. This is known as the Third Wave of BPM, in which the authors of the documents were the triggers of the developments in BPM, according to [5]. Then, in the following years, BPM research had an average annual growth

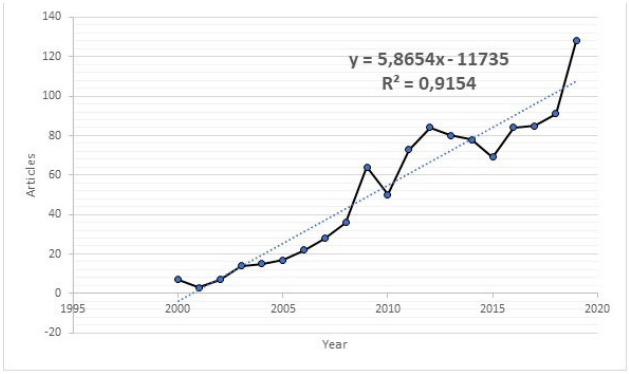

FIGURE 3. Annual scientific production of the subject under study.

rate of 16.53%, in addition to growth peaks in 2009 and 2012, 2016, 2018, 2019 and 2020, which coincide with the emergence of new technologies such as Cloud Computing, the Internet of Things or IoT, Industry 4.0 and Artificial Intelligence. Likewise, Fig. 3 shows the lineal regression of the variance with an explanatory effect coefficient of 91%, which is quite reliable as it is a value very close to 1, in line with the suggestion by [41], and checks the validity and correctness of the subject under investigation.

A. IDENTIFYING SOURCES OF BPM RESEARCH

The most relevant databases were identified in the bibliometric analysis. As can be seen in Table 1, the results were headed by Scopus (735), WoS (616) and Google Scholar (133). Other recognized databases, such as IEEE Xplore (33), ScienceDirect (68), EscoHost (50), ACM (70) or SpringerLink (1), only have a few papers.

Relevant scientific journals on the subject of BPM were also presented, with an average number of 32 published articles in the period being analyzed. The Business Process Management Journal was the journal that published the most articles with a total of 146. Table 3 shows the most relevant scientific journals for publications about BPM.

TABLE 3. Most relevant sources.

Journals	Articles
Business Process Management Journal	146
Expert Systems with Applications	27
Decision Support Systems	26
Information Systems	24
Enterprise Information Systems	19
Information and Software Technology	18
Information Systems and E-Business Management	18

Therefore, the in-depth description of the dataset in Fig. 4 shows the thematic development of keywords related to processes and business, and also the most relevant authors of BPM topics.

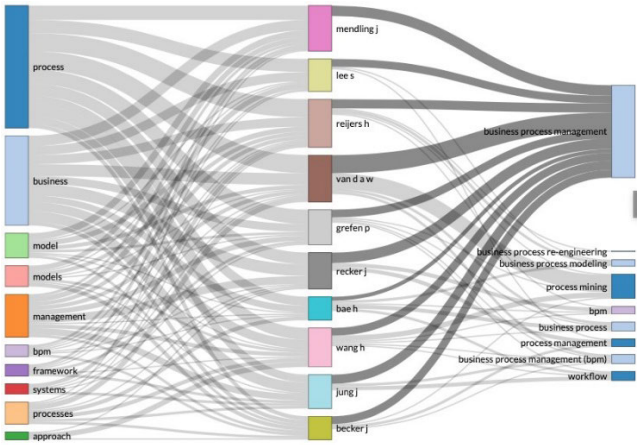

FIGURE 4. Thematic development.

TABLE 4. Most cited sources.

Journal	Articles
Lecture Notes in Computer Science	737
Business Process Manager Journal	227
Information System	156
Data Knowledge Engineering	153
Lecture Notes in Business Information Processing	151
Decision Support System	146
Business Process Management Journal	143
Harvard Business Review	109
Inform Software Tech	102

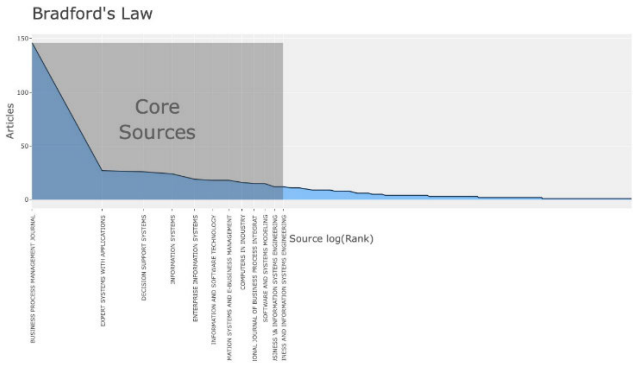

FIGURE 5. Bradford's Law.

Moreover, Table 4 identifies the 10 most cited journals for BPM, which is topped by the journal Lecture Notes in Computer Science with a total of 737 citations.

Fig. 5 shows how, by applying Bradford's Law [42] the most important journals on the subject of BPM can be identified, or as Bradford called them "core sources". These sources are where most of the relevant information about BPM is concentrated and according to [43], should be given special importance when preparing publications on

TABLE 5. Source impact.

Source	h_index	g_index	m_index	TC	PY_start
Business Process Management Journal	31	50	1,55	3104	2001
Expert Systems with Applications	14	21	1,00	485	2007
Decision Support Systems	12	25	0,57	669	2000
Information Systems	11	24	0,79	1485	2007
Enterprise Information Systems	10	19	0,77	370	2008
Information and Software Technology	12	18	0,67	505	2003
Information Systems and E-Business Management	10	16	0,71	284	2007
Computers in Industry	9	16	0,50	692	2003
International Journal of Business Process Integration and Management	5	9	0,33	90	2006
Software and Systems Modeling	7	9	0,78	98	2012

Note: TC: Total number of citations, PY_start: Publication start year

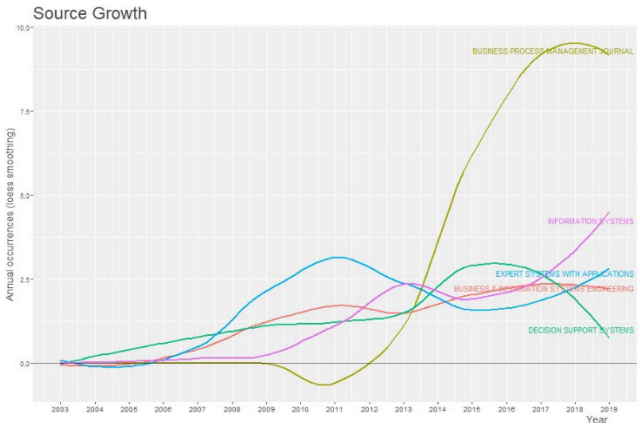

FIGURE 6. Journal publication growth.

the subject. This core is identified in zone 1, the shaded area, and includes the Business Process Management Journal and Expert Systems with Applications. These are the core of BPM, and therefore, these journals concentrate the most relevant research on the subject.

The calculation of the impact of the journal is consistent with Bradford's law and shows that the Business Process Management Journal has the highest impact factor, as shown in Table 5, with an h-index of 31, with more than 3100 citations. It is also the oldest journal and began publishing in 2001. In second place Expert Systems with Applications began publishing in 2007.

Fig. 6 also shows the consistent growth of the Business Process Management Journal. This growth has continued and has become exponential since 2003, being constant until 2020, with a slight drop of just half a point since 2018. At the same time, several journals which have also published articles on BPM show only a discrete growth in published research compared to the aforementioned journal. Journals such as Information Systems or Expert Systems and Applications have had an increase in BPM publications in recent years. Other journals such as Business & Information Systems Engineering have maintained the number of publications and Decision Support Systems shows an obvious drop in interest in publishing research on BPM or in receiving proposals on the same subject.

The g-index [44] is calculated based on the distribution of citations of a given researcher's publications, giving a set of articles ranked in decreasing order for the number of citations they have.

The h-index [45] uses the set of the author's most cited papers and the number of citations that they have received in other publications.

Table 5 shows both indices for authors and their publications in the main journals.

TABLE 6. Relevant authors of BPM.

Authors	Articles	Area
Wil van der Aalst	22	Computer Science
Hajo A. Reijers	15	Computer Science
Jan Mendling	14	Business and Economics
Harry Jiannan Wang	12	Management Information Systems
Jörg Becker	11	Information Systems
Paul Grefen	11	Information Systems
Jan Recker	11	Information Systems
BAE H	10	Management
Jisoo Jung	10	Computer Science
Stephen S.G.Lee	10	Management

B. IDENTIFYING RELEVANT AUTHORS

The most relevant authors of BPM articles were identified in the bibliometric analysis. As shown in Table 6, Dr. Wil Van Der Aalst, Professor of Data Sciences at the University of Aachen, Germany, is the author with publications on BPM which have had the greatest impact. In the analysis of published articles on BPM and PetriNets topics, Dr. Aalst can be seen to have published 22 articles related, the most noteworthy being the article entitled Case Handling: A New Paradigm for Business Process Support, with 509 citations and an average of 31 citations per year. Second is Dr. Hajo A Reijers, Professor of Computer Science at the University of Utrecht, Netherlands, with 15 publications. The article with the largest number of citations is entitled Business Process Mining: An Industrial Application, published in 2007 which has had 494 citations. Third, is Dr. Jan Mendling, Professor of Economics and Business at the University of Vienna, Austria, whose most cited article is Similarity of Business Process Models: Metrics and Evaluation, published in 2011 with more than 419 citations.

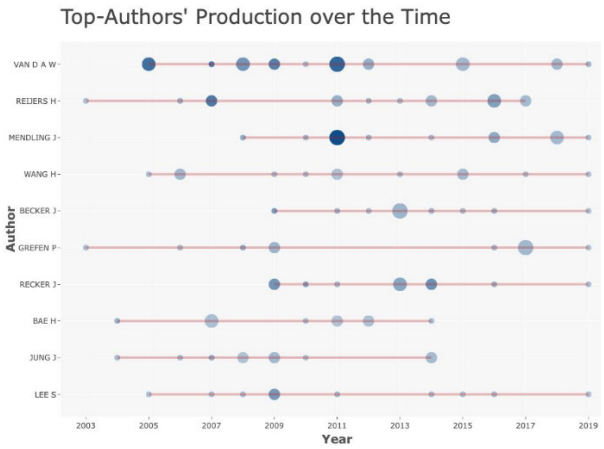

FIGURE 7. Scientific production of authors over time.

The two most popular areas of research by authors of BPM were Computer Science followed by Management and Economics.

Analyzing production over time in Fig. 7 confirms that Dr. Wil Van Der Aalst has consistently researched BPM in the period of time analyzed, with 2005, 2011, 2015, 2018 and 2019 being the most scientifically productive. Meanwhile, other authors, such as Halo Reijers, PhD. published in 2007, 2011 and 2015, and has drastically increased publishing since 2018. Third, Jan Mendling, PhD. began research in 2008, and published the greatest number of articles in 2011, followed by 2018 and then declined markedly in 2019. It should be noted that J. Mendling, PhD. together with Van Der Aalst, Wang, Becker, Grefen, Recker and Lee are the most active authors with publications about BPM.

Lotka's law describes the frequency of publications per author in any field of research [46].This law is expressed by Equation 1, in which the number of authors is inversely proportional to the square of the total number of publications n and directly proportional to A_1 the number of works published by a single author.

$$A_n = \frac{A_1}{n^2} \tag{1}$$

This study identified 2289 authors, as indicated in Table 2, of which 1822 authors, or 80% have contributed only one publication on the subject of BPM. In line with Pareto's theory 13% wrote two articles and only 3% contributed three articles. By contrast, only 63 authors of the total number have surpassed five publications and only 12 have exceeded 10 publications, as shown in Table 7 below.

Following the work by [47], Fig. 8 shows that 80% of authors wrote only one article about BPM and only 0.1% wrote more than 10 articles, so it appears that most authors only publish occasionally.

The impact rates of the authors in Table 8, affirm the predominance of the author Van Der Aaslt, who has an h-index of 15, which is higher than the average. The average is 9 and so Van de Aaslt has an outstanding overall impact in this field [48] taking into account that he is one of the authors who has worked in this field the longest, with his first publication in 2005. He is followed by Reijers and Mendling, who have h-indexes of 11 and 10 respectively, which is closer to the average number of publications for this group. These three authors have more than 4220 citations, which gives a clear idea of the impact of their publications.

Table 9 shows the University to which the authors are affiliated. The Eindhoven University of Technology, Netherlands has 79 publications, followed by the Queensland University of Technology, Australia and thirdly the University of Ljubljana, Slovenia. Finally, it is important to highlight the German

TABLE 7. Distribution of scientific production according to Lotka law.

Contributions	N. of Authors	Proportion	No. of Publications
1	1822	80%	1822
2	287	13%	574
3	73	3%	219
4	44	2%	176
5	21	1%	105
6	10	0%	60
7	9	0%	63
8	7	0%	56
9	4	0%	36
10	5	0%	50
11	3	0%	33
12	1	0%	12
14	1	0%	14
15	1	0%	15
22	1	0%	22
n	n	$1/n^2$	n
Total	n	100%	n

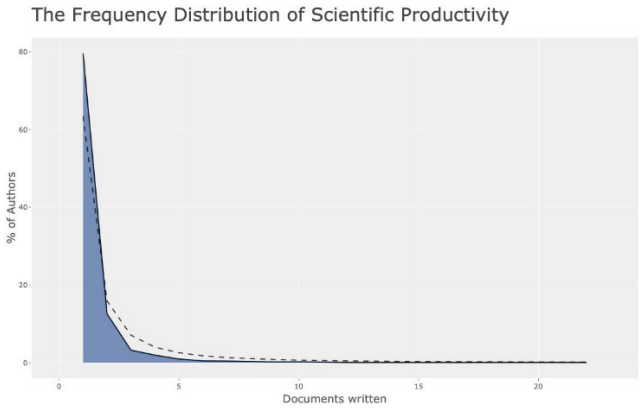

FIGURE 8. Scientific production of publications about BPM.

TABLE 8. Impact factor of authors.

Author	h_index	g_index	m_index	TC	NP	PY_start
Van Der Aalst W	15	22	0,938	2428	22	2005
Reijers H	11	15	0,611	907	15	2003
Mendling J	10	14	0,769	885	14	2008
Wang H	8	12	0,5	212	12	2005
Becker J	9	11	0,75	419	11	2009
Grefen P	7	11	0,389	324	11	2003
Recker J	10	11	0,833	805	11	2009
Bae H	6	10	0,353	202	10	2004
Jung J	6	10	0,353	280	10	2004
Lee S	6	10	0,375	341	10	2005

Note: TC: Times Cited, NP: Number of publications, PY_start: Publication year start

TABLE 9. Affiliations of Authors.

Affiliations	Articles
Eindhoven University of Technology	79
Queensland University of Technology	56
University of Ljubljana	34
University of Augsburg	14
University of Liechtenstein	14
University of Seville	14
University of Zagreb	14

TABLE 10. Scientific production by country.

Country	Articles	Freq N = 482	SCP	MCP	MCP_Ratio
Germany	107	0,14	99	8	0,07
USA	71	0,09	62	9	0,13
Korea	54	0,07	49	5	0,09
China	47	0,06	38	9	0,19
Netherlands	46	0,06	36	10*	0,22
Australia	40	0,05	32	8	0,20
United Kingdom	39	0,05	36	3	0,08
Spain	29	0,04	27	2	0,07
Italy	25	0,03	23	2	0,08
Austria	24	0,03	17	7	0,29

Note: N = Total cited; Freq: Frequency; SCP: single country publications; MCP: multiple country publications; MCP_Ratio: multiple country publication ratio.
* highest MCP.

Universities of Augsburg, and University of Liechtenstein, University of Seville (Spain) and University of Zagreb (Croatia) with 14 articles each.

Table 10 uses the simple production indicator by country or SCP, and shows that Germany, with 107 articles, is the country that leads production of articles about BPM, followed by the United States with 71 articles and Korea with 54 articles. However, the Netherlands is the country with the highest collaboration rate with a MCP of 10, which is outstanding for its 46 contributions.

TABLE 11. Average number of article citations by country.

Country	TC	AAC
Netherlands	3187	69.28
USA	2771	39.03
United Kingdom	2570	65.90
Germany	2263	21.15
Australia	1099	27.48
Slovenia	1040	57.78
China	877	18.66
Korea	684	12.67
Austria	503	20.96
Italy	448	17.92

Note: TC: Times cited; AAC: Average Article Citations

Nevertheless, the country with the highest number of citations of its publications is the Netherlands, with 3183 i.e., an average of 69% of citations, as seen in Table 11, followed by the USA with 2771, the United Kingdom with 2570 and Germany with 2263. Slovenia also stands out with 1040 citations, being the sixth country with the largest number of citations despite its small size and it surpasses other, bigger countries, such as South Korea, Italy, Australia or Spain.

TABLE 12. Most cited BPM articles.

Paper	DOI	TC	TCY
Wooldridge et al. (2000)	10.1023/A:1010071910869	1271	60,5
Cardoso et al. (2004)	10.1016/j.websem.2004.03.001	731	43,0
Van Der Aalst et al. (2005)	10.1016/j.datak.2004.07.003	509	31,8
Van der Aalst et al. (2007)	1016/j.is.2006.05.003	494	35,3
Trkman (2010)	10.1016/j.ijinfomgt.2009.07.003	444	40,4
Xu (2011)	10.1109/TII.2011.2167156	421	42,1
Dijkman et al. (2011)	10.1016/j.is.2010.09.006	419	41,9
Al-mashari (2003)	10.1016/S0377-2217(02)00554-4	389	21,6
Van Der Aalst et al. (2009)	10.1007/s00450-009-0057-9	351	29,3
Van Der Aalst et al. (2011)	10.1016/j.is.2010.09.001	260	26,0

C. DOCUMENTARY ANALYSIS

The documentary analysis included the identification of the most relevant articles and the citations of these. Table 12 shows that the article by [49] has been cited 1271 times, which is more than any other article, with an average annual citation rate of 60.5 times. The cited article explains the method of analysis and agent-oriented design, which are mainly associated with the concepts of roles,

responsibilities, permissions, activities and protocols and the interaction between these elements. This influential article discusses the paradigms of Behavioral-science and Design-science, arguing that both paradigms are relevant and effective in research about Information Systems (IS), and promotes the alignment of design with the real world, arguing that there is an insufficient theoretical base for the IS discipline, insufficient models, methods and tools for the IT/Business environment and that the lack of these impedes organizations and therefore staff. This is the basis of BPM and later process design using it.

The second article [50] has had 731 citations with an average annual citation rate of 43. The authors propose a Quality of Service, hereafter called Workflows QoS, measurement model that allows for monitoring, control and estimation of products and services for the customer. In addition, it suggests using SRL, and the need for the transverse integration of technology into the organization as a fundamental principle of BPM. The authors mention the process prediction requirement, which is the basis of what is now known in BPM as Case Handling (hereinafter CH) and process data mining technology, recognized as Business Activity Monitoring (BAM). It is interesting to note that both articles focus on workflows in processes as the basis of BPM.

Thirdly, the next most cited article is [51] and it lays the theoretical basis of CH, presenting the need to address the problem of dynamic processes led by process templates and governed by events. The fourth most cited article is [52] by the author we already mentioned as having the largest number of published works. This article explains process mining from the perspective of processes, organization and CH, which is the basis for Business Process Automation, hereinafter BPA.

The fifth article, [53] identifies critical success factors when adjusting the business environment and processes. It emphasizes the need for the theoretical basis of BPM by proposing a combination of theories and the advantages of the role of BPM role in combining IT and business processes. The advantage is in strategic alignment that can lead to competitive advantages, involving organizational changes and having the infrastructure to support these changes. If the organizational approach is not a clear success, BPM will probably fail, the author says.

The sixth article [54] talks about the impact of BPM, SOA, EAI, and computing on ERP business systems and how this blend is the most important one to improve organizational performance by adopting new technologies as long as they are properly integrated.

[55] in seventh place mentions the importance of the optimization of business processes using modeling. An experiment is used to investigate the similarities between node matching, structure and behavior similarity with comparable results.

Eighth [56] presents BPM as a critical factor for the success of ERP implementation and as a link between IT and the business as the key to effective implementation of BPM principles as a requirement for business success and the creation of a value chain.

Finally, two more works by Van Der Aalst close the list, namely [57] Process Oriented Information Systems, where BPM is the balance between flexibility and process support, and [58], which indicates that it can be used to predict the time needed for process completion. In turn, it also works when incorporating new processes. The interaction between cases and the available resources are important factors when predicting time losses. This interaction should be incorporated into the prediction.

Thus, these articles have been relevant in shaping what is now understood as BPM, from the theoretical foundations of the discipline, the need for behavioral analysis, modeling and process design, the integration of technology with ERP, SOA and web services and alignment with the business, identifying staff as a fundamental factor and the recognition of dynamic processes all led to the prediction of Industry 4.0.

1) DOCUMENTS CITED

The articles in Table 1 include 1035 records and 44588 references from 377 different sources, which according to [11] is important when identifying articles related to the research topic. In this case these articles on BPM are cited by other articles in the same database as shown in Fig. 9.

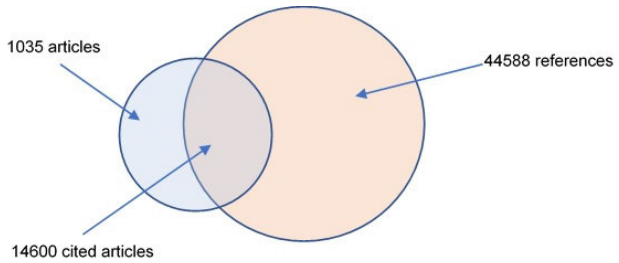

FIGURE 9. Diagram of articles, references and quotations.

TABLE 13. Most cited reference.

Cited References	DOI	Citations
Trkman (2010)	10.1016/j.ijinfomgt.2009.07.003	56
Hammer (2007)	NA	23
Van Der Aalst et al. (2003)	10.1007/3-540-44895-0_1	22
Hammer y Champy (1993)	10.1016/S0007-6813(05)80064-3	20
Van Der Aalst (1998)	10.1142/S0218126698000043	20
Davenport (1993)	NA	19
Kohlbacher (2010)	10.1108/14637151011017985	19
Tomas Davenport y Short (1990)	NA	18
Dumas et al. (2013)	10.1007/978-3-642-33143-5	18
Hevner et al. (2004)	10.2307/25148625	18

Note: DOI: Digital Object Identifier

Accordingly, in Table 13 the articles in the shaded area exist in the bibliometric database and have also been cited

in the references, with [53] being the most-cited article with 56 appearances. It has already been mentioned that this article proposes the theoretical critical factors for the success of BPM.

[27] with 23 appearances explains the framework, the Process and Enterprise Maturity Model (PEMM) for companies, which consists of 5 process enablers (Design, Executors, Process Owner, Infrastructure and Metrics) and 4 business skills (Leadership, Culture, Expert and Governance)

Thirdly [59] with 22 citations, makes a clear differentiation between WFM, BPM, BAM, BPA, Straight-Through Processing, hereinafter called STP, and CH, and was fully required at the time to present a definition of the scopes of each term.

Reference [60] published an important article with 20 citations and is considered a manifesto of Reengineering. It is not based on a division of the work of [17] and task orientation, but focuses on redesigning the processes used to complete a task or a job.

Reference [61], with 20 citations, is considered the origin of analysis and modeling tools in WFM.

Reference [4] has been referenced 19 times. This article indicates that change is process innovation, a revolutionary new approach that fused information technology and human resources management to improve business performance.

Reference [62], also with 19 citations, uses SLR to analyze the effects of process orientation, with positive results for improvements in times, customer satisfaction, quality, cost reduction and financial performance. In addition, it reports that existing SLRs do not have adequate empirical support. However, it emphasizes that the analyzed studies report improvements in speed, customer satisfaction, cost reduction and financial performance. Other benefits are improvements in delivery reliability, increased productivity, increased company value, efficiency and market response.

Article [18] with 18 references, is identified in the literature review of this article as a document that explores the relationship between IT and Business Process Redesign, hereinafter named BPR.

Reference [63] has 18 references and recommends BPM in order to ensure consistent processes in an organization, take advantage of opportunities, reduce costs, execution times and error rates. It then states that BPM is the orchestrator of a chain of events, activities and decisions that produce added value for an organization.

Finally, there is [64] with 18 references, which investigates the theories of design science and behavioral science in information systems, concluding that both are required.

It is important to note that this list contains highly recognized authors in the research areas of Management and Computer Science. The articles are consistent and show that the implementation of BPM brings benefits to organizations in terms of process optimization, organizational performance, time reduction, personnel management and technology integration, asserting that this implementation depends on critical success factors.

All of the articles which are cited have marked important research milestones, such as the foundation of process reengineering, the beginning of the relationship between IT and Business, the incorporation of WFMs, the base for BPM, the effects of PO and opportunities for improvement in organizations by appropriately incorporating the concepts.

2) ANNUAL SPECTROSCOPIC ANALYSIS OF PUBLICATIONS

After consulting the most relevant articles on BPM, an Annual Spectroscopic Analysis of Publications hereinafter called RPYS, (which is a method of identifying the historical origins of research areas) was applied.

The RPYS analysis creates a temporary profile of a set of articles, emphasizing the years with the most significant publications [65] in order to identify the temporal roots of a discipline. Fig. 10 clearly shows that, in the period of time analyzed there is an alignment of articles with scientific production, as can be seen in 2005, 2007, 2009 and 2012. This result is of great interest for future research into BPM.

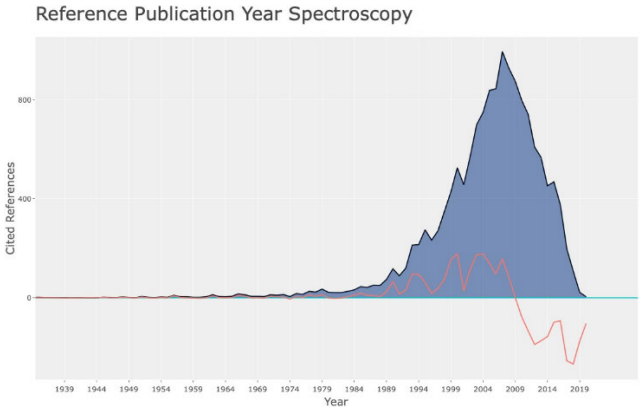

FIGURE 10. Annual spectroscopic analysis of publications.

It was found that the years 1955, 1962, 1966, 1979 and 1985 had important disruptions worthy of being mentioned, even if to a lesser extent than other periods of time, in which the value chain, process orientation, contingency theory, strategic planning and process vision [18] began to develop, [66]. Then another disruption occurred in the 1990s with the incorporation of reengineering of BRP processes [60], which was connected with the increase in the production of articles in the year 2000 and the boom in ERPs [67]. Later, another important milestone was identified in 2003, known as the third Wave of BPM, which gave an important impulse to the discipline [2]. Finally, in 2007, with the emergence of methodological frameworks such as that proposed by [68], which gives a practical guide for the implementation of BPM, which in turn are the basis of BPM maturity models. Previously, Fig. 1 presented the main innovative milestones identified in the literature review, which coincide with the RPYS analysis.

In addition, from the previous analysis of the metadata of the articles, an analysis of the common terminologies used

TABLE 14. Keywords.

Words	Occurrences
Enterprise Resource Management	303
Business Process Management	295
Administrative Data Processing	145
Business Process	90
Information Management	49
Information Systems	36
Business Process Model	32
Management	32
Process Mining	29

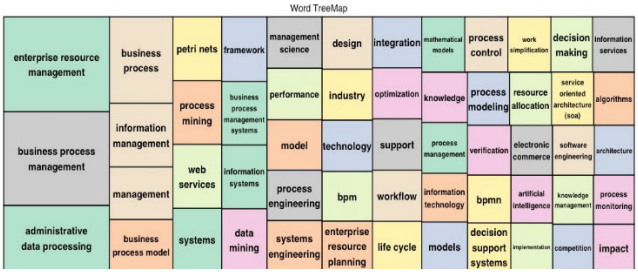

FIGURE 11. Word TreeMap.

in the articles found the results shown in Table 14. The terms found are also used in systems, management, methodological frameworks and data mining, which implies that these terms are related.

The identification of keywords is necessary for an in-depth identification of the content and the variety of topics covered in the articles [69]. Fig. 11 shows the distribution of topics using the main terms as a tree-like map of keywords.

It was possible to identify the relevance of keywords for BPM systems, such as ERP with 29% of the total occurrence, data processing with 14% and BPM with 28%. Then, followed by business processes with 9%, information management with 5% and Management and Business Process Model with 3% respectively, in line with [70]. But, in addition, a segregation of multidisciplinary keywords used in information and management technologies was also identified.

Keywords are effective terms for bibliometric analysis that investigate the knowledge structure of scientific fields, but are less exhaustive in representing the content of an article [71]. Therefore, the behavior of these terms with time needs to be analyzed. Thus, in Fig.12, it is evident, as in the literature consulted, that the term BPM continues having exponential growth, but that there are a number of adjacent topics with similar behavior, such as the need for a methodological framework of BPM or Framework [72], as well as Performance, and Management [73]. On the other hand, topics such as Information Technologies, Information Systems, Design and Technology have had less aggressive growth [74], even their use in articles about BPM has decreased.

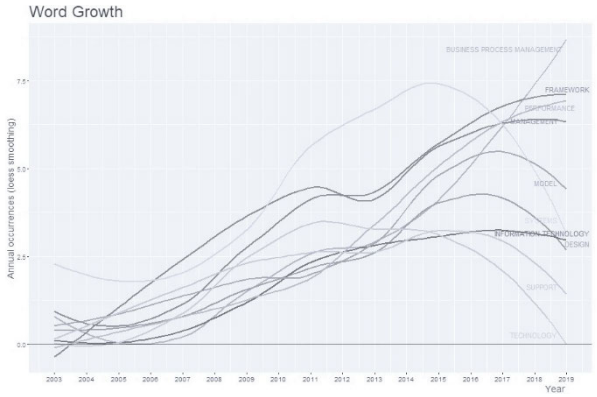

FIGURE 12. Term behavior over time.

D. STRUCTURES OF KNOWLEDGE ANALYSIS

Having a panoramic view of scientific knowledge is always desirable for several reasons, some of these are that scientific mapping tries to find the representation of intellectual connections in the dynamically changing system of scientific knowledge [75].

In other words, scientific mapping aims to show the structure and dynamic aspects of scientific research [35].

TABLE 15. Knowledge structures.

Knowledge Structure	Meaning
Conceptual	What Science talks about on a certain topic and its tendencies.
Intellectual	Shows how the work of an author influences the scientific community.
Social	Indicates how authors, institutions and countries interact with each other.

According to [11], the structure of knowledge used is divided into three types of mapping: conceptual, intellectual and social. As shown in Table 15, they are defined as follows:

1) CONCEPTUAL STRUCTURE

The conceptual structure is analyzed with a co-occurrence network approach, as shown in Fig. 13, where a number of BPM-related topics are identified, which precisely coincide with the keyword documentary analysis, such as performance, reengineering, workflows and data mining. Other terms such as knowledge, models and technology also appear as related nodes. Louvain's 61-node clustering algorithm, standardized for keyword association, was applied to identify communities in large networks [76].

Similarly, the network approach is consistent with the thematic map in Fig. 14, which shows the different topics of a given domain. Centrality is the importance of a particular field of research and Density is a measure of the development of the topic.

FIGURE 13. Co-occurrence network.

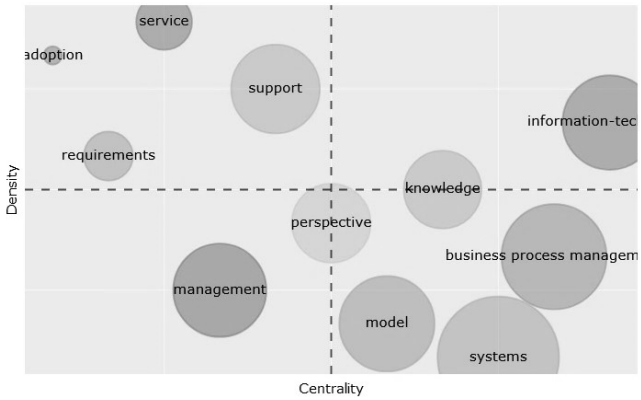

FIGURE 14. Thematic map.

The topics in the upper left quadrant have isolated use, for instance Adoption or Service, among others. The top left quadrant includes the main terms, such as Knowledge and Information Technologies or IT. The lower left quadrant represents emerging topics, in this case management is identified. Finally, the lower right quadrant represents transverse topics, such as BPM, systems, models and knowledge.

In addition to the co-occurrence network, Fig. 15, shows the thematic evolution of the topics in the period studied. In the early 2000s, the terms used in BPM were Processes, Technology and Systems, while today, these are not the only terms used, but others like BPR, ERP, BPMS, data models, management and web services have been incorporated, which shows that the term is more relevant.

To determine the dimensions of the study, the Confirmatory Factor Analysis approach (CFA) was used, using the Multiple Correspondence Analysis algorithm, hereinafter called MCA, following the work of [77]. Multiple Correspondence Analysis (MCA) is an extension of correspondence analysis (CA) that allows the analysis of the relationship pattern of several categorically dependent variables.

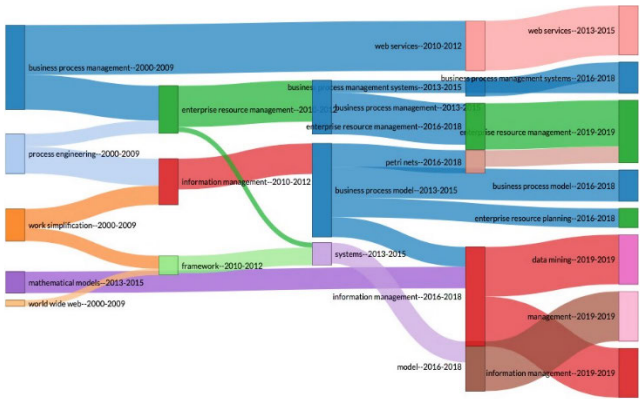

FIGURE 15. Thematic evolution.

As such, it can also be a general analysis of main components when the variables to be analyzed are categorical rather than quantitative.

Thus, MCA is obtained by using a Standard Correspondence Analysis (SCA) with an identity matrix (that is, a binary matrix, with the values 0 or 1). Consequently, the percentages of the explained variance must be corrected and the interpretation of the corresponding analysis of the distances between points must be adapted to find the importance of their use in large networks, as mentioned by [78].

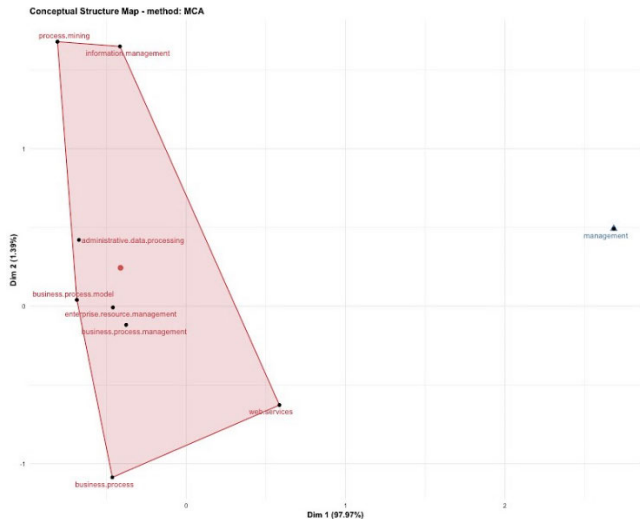

FIGURE 16. Factor Analysis (MCA).

Hence, in our analysis we identify two clear dimensions, as shown in Fig. 16. The first dimension is identified according to the terms encompassed, the management of the technology and its relationship with the processes. This term represents 97.97% of cases, and a second dimension is Management that represents only 1.39%. It is important to indicate how BPM is naturally central in both dimensions.

According to [79] the factorial analysis can be confirmed with a thematic dendrogram, depending on the height of the branches of the tree. When the branches are of similar height,

it can be said that, regardless of the subject, the same concept is being discussed. Likewise, the distance between words identifies the different dimensions.

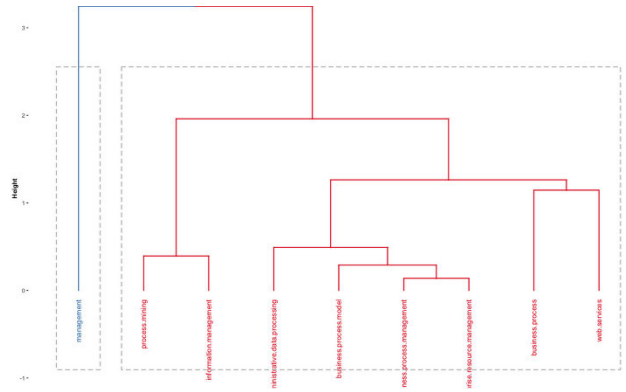

FIGURE 17. Thematic Dendrogram.

In this way, sizing is confirmed with the thematic dendrogram presented in Fig. 17, which is consistent in the dimensional separation between management and technology. The term Management has a height of 3.5, while themes with a height of about 2 are about technology. The groupings with the same height are about the same topic as indicated by [80].

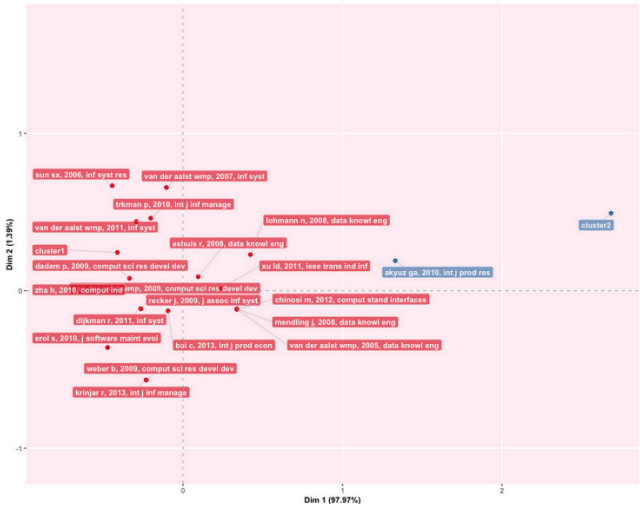

FIGURE 18. Most cited papers.

Consequently, a Factorial Analysis identifies the most cited and most collaborative articles in each cluster. Fig. 18 shows the number of links between articles for each topic. Clusters are differentiated by color intensity, and point to the second cluster with a single article. The influence of Trkman and Van Der Aalst on technology management issues is important, but the influence of the work by [81] in the Management cluster is striking.

2) INTELLECTUAL STRUCTURE

The intellectual structure was analyzed in two ways. Firstly, a co-citation analysis, in which the citations of two documents are identified when they are quoted by a third document. These are represented by an array of occurrences of the citations, showing the center of gravity [82].

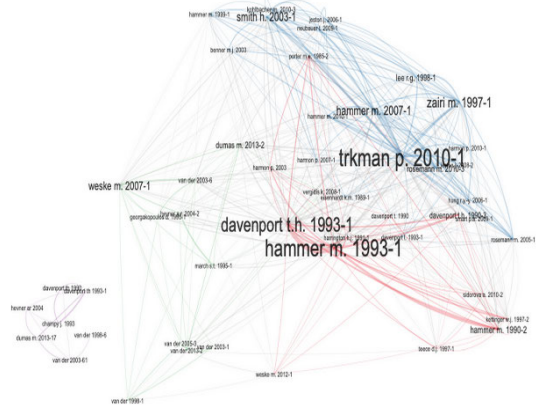

FIGURE 19. Co-citation network.

These are shown in Fig. 19. [4], [19] and [53] are identified in the management cluster, and Van Der Aalst in the technology cluster as the most influential and co-cited authors in the time period analyzed.

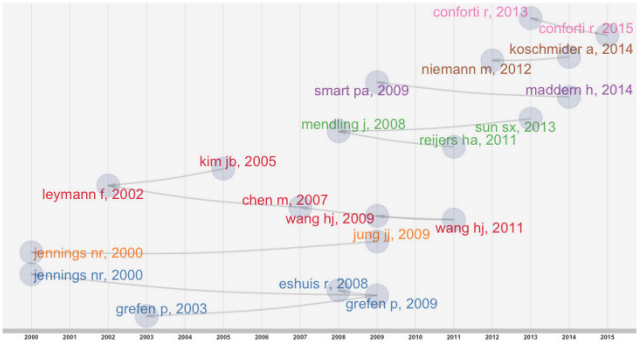

FIGURE 20. Historiographic mapping.

The second analysis is Historiographic Mapping, shown in Fig. 20, in which each route identifies a research topic and its main authors at different times [83]. In this case, it is clear that the technology topic began in 2003 and has grown since then, while, on the contrary, the management topic was very intense in 2005 but has decreased since 2010, with a significant reduction in recent years. However, it is important to note that most co-citation relationships are around 5 years.

3) SOCIAL STRUCTURE

The social structure shows how authors or institutions are related in a field of scientific research. The most commonly used social structure is the co-authoring network [84].

The co-authoring network is found with a collaborative network analysis. The network is shown in Fig. 21. It can be clearly seen that Jan Mendling, Hajo Reijers and Van Der Aalst are the authors who collaborate most with others, unlike

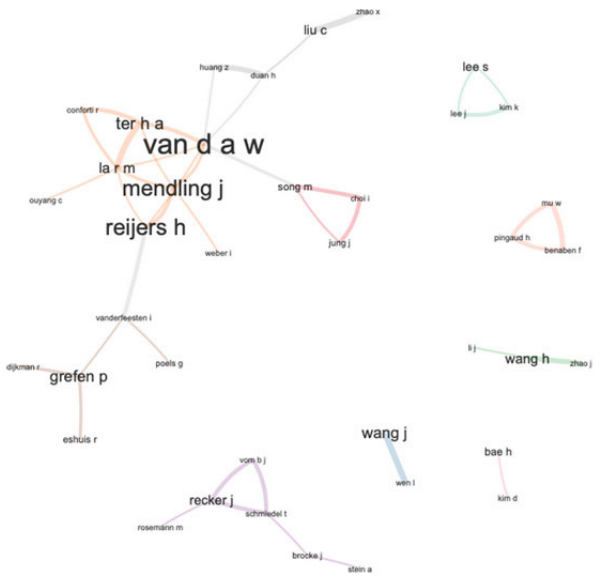

FIGURE 21. Collaboration Network.

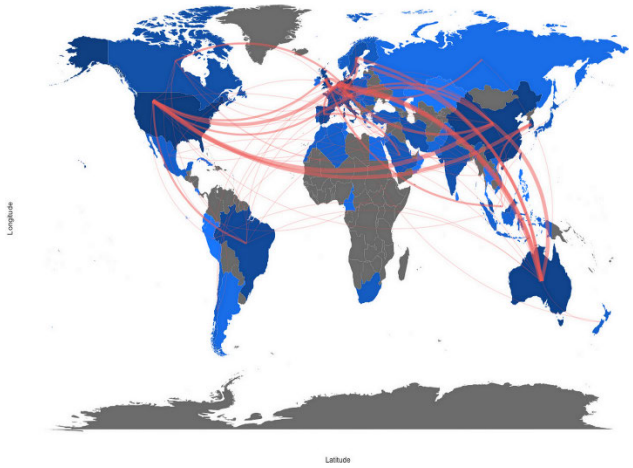

FIGURE 22. Global collaboration map.

Trkman, who has a very small number of collaborations compared to the number of citations.

Finally, the collaborative global map analysis identifies the relationships of collaboration between countries. Fig. 22 shows interesting relationships between Australia and European countries, as well as South America and North America. The latter has the highest concentration of collaboration for the BPM topic.

V. DISCUSSION

Using the existing literature, BPM research is still at a developing stage and future research should be further expanded to include the following aspects:

In the period of time analyzed only 3 SRL about BPM were found before 2011, as reported by [13]. Then, in our research only two more articles, by [85], were found before 2020. One of these explains the state of BPM in research published in conferences, and [86] presents a BPM SRL about Process Owners. In the analyzed period, no articles about Scientology were found. These articles investigate the relationship between BPM and other topics such as Software Product Line or Process Owners, so no quantitative work is available to support the relevance of pure research in BPM.

TABLE 16. Summary of the findings.

Number of SRL jobs in BPM up to 2011	3
Number of works related to state of the art in BPM after the end of the year 2011	2
Number of specifically bibliometric SRL works on BPM	0
Number of papers selected on BPM	671
Number of authors	2889
Number of quotations	1927
% authors with more than 1 article on BPM	3%
% of authors who publish repeatedly on BPM	0.1%
Number of journals publishing on BPM	7
Main journal	Business Process Management Journal
University with the highest number of publications	University of Technology of Eindhoven, Netherlands
Country with most publications	Germany
BPM accessory topics	technology issues, methodological frameworks, data mining, industry 4.0

BPM is a research domain with high potential, since of the 671 articles selected after the filtering indicated in the results section, around 2889 authors are collaborative, increasing scientific production over the period of time analyzed and having an excellent citation rate.

Nevertheless, only 3% of authors of BPM publications write more than one article about BPM and only 0.1% write consistently on the subject. The collaborative network is sparse, with very few authors collaborating with others. It is for this reason that research should be extended in order to identify the factors that make the BPM topic attractive for investigation but fail to maintain researchers' interest after a first publication. [5] emphasizes the demystification of BPM and the problem that tends to define it as a business information system, a WFM system or an improved management practice- These are all misconceptions, since, as shown above, BPM is a discipline that involves best practices of business management, technology and people. This statement is supported by the AFC, in which two clusters for Management and IT were identified.

Another important factor to consider is the concentration of publications in 7 journals, with Business Process Management Journal by Emerald Publishing having the largest number. In addition, the universities with most publications include Eindhoven University of Technology in The Netherlands, which also has the highest level of citation, together with Germany, which indicates European predominance in the subject. This has led countries, such as China, to collaborate more with Europe in research on BPM.

In the same way, as mentioned above, BPM is a current research domain that was can be described with the analyses presented. There are changes in the trend of the citation curve, where deviations, recessions and different historical factors can be seen to be the cause, which suggests that BPM research is highly susceptible to global economic conditions.

Nonetheless, with the previous premise, a number of accessory topics were identified that appear to be extremely relevant for BPM research. This are how technological issues, methodological frameworks and data mining are recurrent and have virtually the same relevance after 2012. This suggests the importance of the fourth industrial revolution in online management disciplines, as explained by [31], which means that BPM may have influenced Industry 4.0, or vice versa.

VI. CONCLUSION

This bibliometric analysis has shown that there a significant amount of research work has been carried out in the field of BPM. As can be seen in the section identifying the main publications, there has been exponential growth of interest in researching this scientific domain. The high number of publications found attests to this and suggests that in the coming years it will continue to grow.

The areas of BPM for future research should be about management, framework and performance. From a conceptual point of view, performance is the most valued area. This means that research will be in these areas and application and use of BPM will grow. Performance can be measured with respect to helping achieve greater decision-making capacity, improving planning, and creating a single operational framework for measuring results. A conclusion of the current research is that these will be the keys to growth in the future.

Many organizations that have implemented BPM report great benefits, with large cost savings and significant reductions in service time. It has been shown that BPM together with technology are essential to turn challenges into reality. In this respect, the emergence of technology such as cloud computing highlights aspects such as complexity that BPM can help [87].

Among the practical implications of this research are some factors to improve performance. To be successful when implementing BPM, organizations should not make the mistake of only focusing on technologies, but also on the knowledge, mastery and continuous improvement of their business processes, data, and resources.

Many authors suggest detecting a need for improvement in organizations as the first step to introducing BPM. This means that an analysis of the current process is made, the process is optimized, and key indicators are set to show the milestones achieved. Incorrect implementation of BPM will mean that is a need for more research and publications about BPM.

Although BPM is research domain that has been well researched in the period of time analyzed and has had an excellent citation rate, researchers do not maintain their interest in this line of research. This means that it is not a field where there is a body of consistent researchers and that lines of collaboration, especially international ones, do not prosper. However, despite this, growth is exponential and will likely continue to be exponential as the application and use of BPM extends further to medium- and small-sized enterprises.

In the future, more research on BPM will be demanded and will be in the areas of growth, especially the influence of BPM on performance. Academics and editors should investigate different applications of BPM in areas of research with the highest growth forecast.

The limitations of this bibliometric study are the collection of bibliographic metadata in Web of Science (WoS), Scopus, Google Scholar, AMC, IEEE Xplorer and EBSCO databases. This study is limited to these databases.

Finally, this work is of great interest to academics and professionals interested in deepening knowledge about the BPM concept. This article gives a historical review and identifies the main authors who contribute knowledge to this scientific area.

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