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Robotic Process Automation in Scholarly Literature: A Bibliometric Review from 2001-2022

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Abstract. This bibliometric analysis examines scholarly research on robotic process automation (RPA) published from 2001 to 2022. Database searches in Scopus identified 310 relevant RPA articles using title, abstract, and keyword screening. Publication trends, prominent contributors, sources, citations, keywords, and research foci were visualized using VOSviewer and analyzed to reveal patterns in the rapidly evolving RPA literature. Results track dramatic growth since 2018 and the prominence of conference papers and computer science outlets. RPA applications for business process improvement and intelligent automation emerges as central themes. However, geographical imbalances skew toward European and North American sources despite global RPA adoption. India is prominently digging deep into robotic process automation research and securing the First position along with Germany. The published papers can primarily be classified into six overarching themes: 'RPA for digital transformation and social partnerships,' 'RPA for operational efficiency,' 'Robotic intelligence and automation,' 'RPA for business management,' 'RPA in business process automation,' and 'autonomous RPA.' This study contributes an empirical assessment of the current state and maturation of RPA research, identifying potential gaps and future directions, such as qualitative methods and non-Western contexts. More holistic bibliometric reviews can inform scholars seeking to advance RPA literature amidst its interdisciplinary nature and industry growth.

Keywords: Bibliometric Analysis, Robotic Process Automation, Digital technology, Business process management, VOSviewer

1. Introduction

In today's constantly evolving world, it is crucial for businesses to have highly adaptable processes that are efficient and cost-effective (Lohrmann & Reichert, 2016; Reichert & Weber, 2012). To remain competitive, companies are increasingly seeking process automation, and Robotic Process Automation (RPA), which involves software robots (bots) that simulate human interaction, is a promising solution (Cewe, Koch, & Mertens, 2017). Consequently, an increasing number of companies are relying on RPA to optimise and implement their internal business processes (Asatiani & Penttinen, 2016). RPA is a new technology that is one of the solutions that is being used to automate repetitive jobs that people do, freeing up staff to work on more complex tasks that provide more value to the firm. According to studies from consulting firms, robotic process automation is acknowledged as a new, disruptive technology that is already providing benefits (Deloitte, 2017; Forrester, 2022).

The term "Robotic Process Automation" refers to a group of methods and tools that use software and algorithms to automate repetitive operations that were previously carried out by people (Gejke et al., 2018). Utilising already-existing visual interfaces in different information systems, this automation is governed by straightforward rules and logic (Greyer-Klingeberg, 2018). Robotic process automation, commonly referred to as bots or non-intrusive software robots, automates repetitive and rule-based operations (Lacity, 2016; Leno and Rajesh, 2018). Robotic process automation (RPA) can now be utilised to carry out more difficult and valuable jobs, such as those involving process mining, AI, cognitive computing, and data analytics (Anagnoste et al., 2018; Greyer-Klingeberg et al., 2018).

Regardless of the view of several researchers and academicians who have reported different advantages of robotic process automation implementation inside an organization (Bourgouin, A., 2018, Cewe, 2018, C. Gejke,C., Leno, and Ratia, 2018), to the best of the authors' knowledge, Research is currently being done on robotic process automation less often than it is being used in practise. Thus, it is critical to comprehend how robotic process automation differs from related technologies and methodologies, including business process management, as well as how they complement one another. Harmon (2018) reported in his study that 30% of the practitioners want to add some kind of robotic process automation capabilities to their businesses. In order to fully comprehend robotic process automation, evaluate its applicability to the research community, and explore how it relates to business processes, the researcher has done a bibliometric analysis.

According to the IEEE Corporate Advisory Group (2017), Robotic Process Automation (RPA) is preconfigured software that uses predetermined business rules and choreographed activities to complete autonomous tasks and processes across one or more software systems. The goal is to deliver a service or result with human exception management while leaving the existing IT infrastructure of the enterprise untouched. Compared to other digital transformation technologies, RPA can be implemented quickly. RPA has three different models, namely attended, unattended, and hybrid, as defined by Axmann and Harmoko in 2020. The attended model of RPA operates as a personal assistant for the individual worker, taking commands from them. The unattended model of RPA automates processes for multiple workers without human intervention. The hybrid model falls in the middle of these models, automatically executing some processes while still accommodating user intervention for tasks that require cognitive decisions. (Axmann & Harmoko, 2020).

Forrester (2017) identified 12 vendors that offer enterprise-level solutions for robotic process automation that can be customized to meet the needs of specific industries. Although certain vendors offer solutions tailored to particular sectors, robotic process automation is generally considered to be sector-neutral (Schmitz et al., 2019). Collaboration between robotic process automation vendors and top artificial intelligence service providers has resulted in the incorporation of advanced technologies such as self-learning from process discovery, robot training, artificial intelligence screen recognition, natural language generation, and automated process documentation generation (Anagnoste, 2018).

Most of the companies surveyed by Deloitte (N = 400) are already on the RPA journey, and nearly

a quarter more intend to do so over the next two years. Additionally, they state that payback times often last a year and that their goals for cost savings, speed, accuracy, flexibility, and increased compliance have been met for robotic process automation. By 2021, there will likely be over 4 million robots executing repeated activities, according to Forrester (2017), but the emphasis will shift to robotic process automation, analytics advancements, and AI connections. Similar to this, another study notes that although most robotic process automation systems customers are delighted with them, they still need to be improved regarding analytics and cognitive capabilities (Everest Group, 2019).

The limited studies conducted on RPA usage and technology used conceptual frameworks such as UTAUT- Unified Theory of Acceptance and Use of Technology (Gupta et al., 2020; Mensah et al., 2020; Odoom & Kosiba, 2020; Singh, 2020; Zhou, 2013, 2014) and TTF- Task technology fit model (Kokina and Blanchette, 2019; Teo and Men, 2008; Junglas, Abraham and Watson, 2008; Dishaw and Strong, 1999; Goodhue and Thompson, 1995). Some other models used are TAM- Technology Acceptance Model (J. Wewerka, S. Dax and M. Reichert,2020), TOE framework (Gangwar et al.,2015; Alshamaila et al., 2013) and DOI-diffusion of innovation model (Dearing and cox.,2018; wangui.,2020), etc. Key obstacles to automating processes include a lack of management support, a lack of awareness of what robotic process automation is and where it can be used, and employee fear of losing their jobs (Suri, V. K. 2017). The gap between robotic process automation's status as a tool and its use on the business side may be closed with the aid of a change management strategy, a modification of organizational culture, and a change in perspective [Deloitte, 2017; Lacity, M. 2019; Suri,V. K. 2017]. On the other hand, Everest Group research (Everest Group, 2019) participants identified solid vendor ecosystems for complementing technologies, training and educational resources, robotic process automation maintenance services, and good customer support as particularly critical drivers of robotic process automation adoption. In addition, the development of new technologies raises issues about the governance, centralization, and administration of robots (Forrester, T. 2019). Despite the fact that, according to Taulli (2020), RPA is the second fastest-growing job field, it has gotten less academic attention than process automation, a more developed study area. However, there have been several case studies and uses of robotic process automation during the last ten years.

1.1. RPA in Business Process Management

As previously stated, it is critical to investigate similarities and differences, as well as complementarities, between RPA and similar technologies. Some publications connected the RPA concept with the BPM (Business Process Management) strategy, using this layered architecture as a means of enhancing the organization's efficiency and competitiveness (C. Flechsig, 2015). The integration of the life cycles of both techniques is often how these notions are related. BPM has been a well-known management technique for many years. In reality, it has been utilized in a variety of settings and by users with a variety of user profiles (J. Hill, 2007; C. Richardson, 2013), which has led several writers to suggest various lifecycle views for this management (J. Hill, 2007; Van-der Aalst, 2004).

Business process management has been significantly impacted by the rise of robotic process automation (RPA). Businesses now have a strong tool to automate repetitive and normal processes thanks to RPA, which boosts productivity and lowers costs. Businesses may accomplish jobs more quickly and correctly than humans with RPA software robots, which eliminates the need for manual labour and its costs. By guaranteeing that tasks are carried out in accordance with predetermined rules and guidelines, RPA has also increased accuracy and consistency in company operations. RPA has also made it simpler for companies to scale their operations and deal with huge amounts of data and tasks. By ensuring that tasks are carried out consistently and precisely, RPA has also helped firms comply with rules and standards. Before integrating RPA into their business operations, however, firms should carefully consider their unique requirements and objectives. This is because doing so may necessitate a sizable investment in infrastructure and software, as well as in employee training and support. Overall, RPA has had a considerable impact on business process management, and it is likely to continue to

influence how people will work in the future. Various researchers have analyzed that RPA is crucial for businesses, attributing its significance to its capacity for enhancing process efficiency, cost savings, and fostering improved employee relationships. By automating tasks that can be done faster and more accurately by technology, RPA allows employees to focus on more valuable and strategic work. This not only increases productivity but also reduces human error and saves costs. Additionally, RPA improves employee satisfaction by utilizing their advanced skills and knowledge, leading to better retention rates. Overall, RPA is a valuable tool that can save time, enhance processes, and optimize the work experience for businesses in any industry.

2. Research Gaps

The literature review indicates that most bibliometric research on RPA has been narrow, with few examining overall trends in recent years. A significant research gap exists in bibliometric studies on robotics' application and growth, presenting an opportunity for a comprehensive analysis of robotics' role. This study aims to address key knowledge gaps by exploring the application of bibliometrics in RPA research and understanding the current state of the field through publication patterns and collaboration trends. The analysis has identified influential authors, institutions, and research trends, aiding researchers, policymakers, and industry professionals. Additionally, the study also examines common challenges and benefits of RPA adoption, emphasizing the importance of considering various studies to gain a comprehensive understanding. Bibliometrics, a quantitative analysis of publications, offers valuable insights into scholarly communication patterns, aiding in the assessment of exploration quality and impact. While bibliometrics provides a systematic approach to studying scholarly communication, it should be complemented with qualitative and contextual information for a comprehensive understanding. Overall, this study aims to fill the gap in bibliometric research on RPA by providing a thorough review of the last decade's significant research.

3. Research Questions

Establishing research questions, the outcomes of the quick literature review showed the importance of robotic process automation for academics and business professionals, as well as the absence of a bibliometric analysis review in the robotic process automation field. The early results revealed gaps in study settings, a lack of theoretical frameworks, and differences between the concept and substance of robotic process automation. The research questions are established using earlier annotations on academic and professional works that concentrate on robotic process automation. The research questions of the current study are listed below:

a) What is the publication trend in Robotic Process Automation?
b) Which sectors and sorts of papers have published more Research on robotic process automation?
c) Which nations publish the most papers on robotic process automation?
d) What are the key research themes/ clusters emerging from bibliometric analysis of available literature in RPA?

4. Research Methodology

The methodology section outlines the approach used to conduct the study. This study aims to provide the current state of literature in the field of Robotic Process Automation (RPA). The articles for this study are sourced from the Scopus database, as it is the largest database of abstracts and citations of peer-reviewed literature, it includes research articles from top publishers and has global coverage and collaboration. The search string used in Scopus is “Title, Abstract, Keyword”. Initially, 328 articles are found using different keyword variations i.e., “Robotic Process” OR “Robotic Process Automation” AND “RPA*”. Subsequently, exclusions are made by applying filters such as document type, source type, language, etc. which resulted in an intermediate sample of 310 research articles as shown in *Table 1* and *Table 2*. For better understanding, selection at various stages is presented through a (PRISMA)

flow diagram (PRISMA, 2020) in Figure 1. Thus, 310 papers make up the final sample.

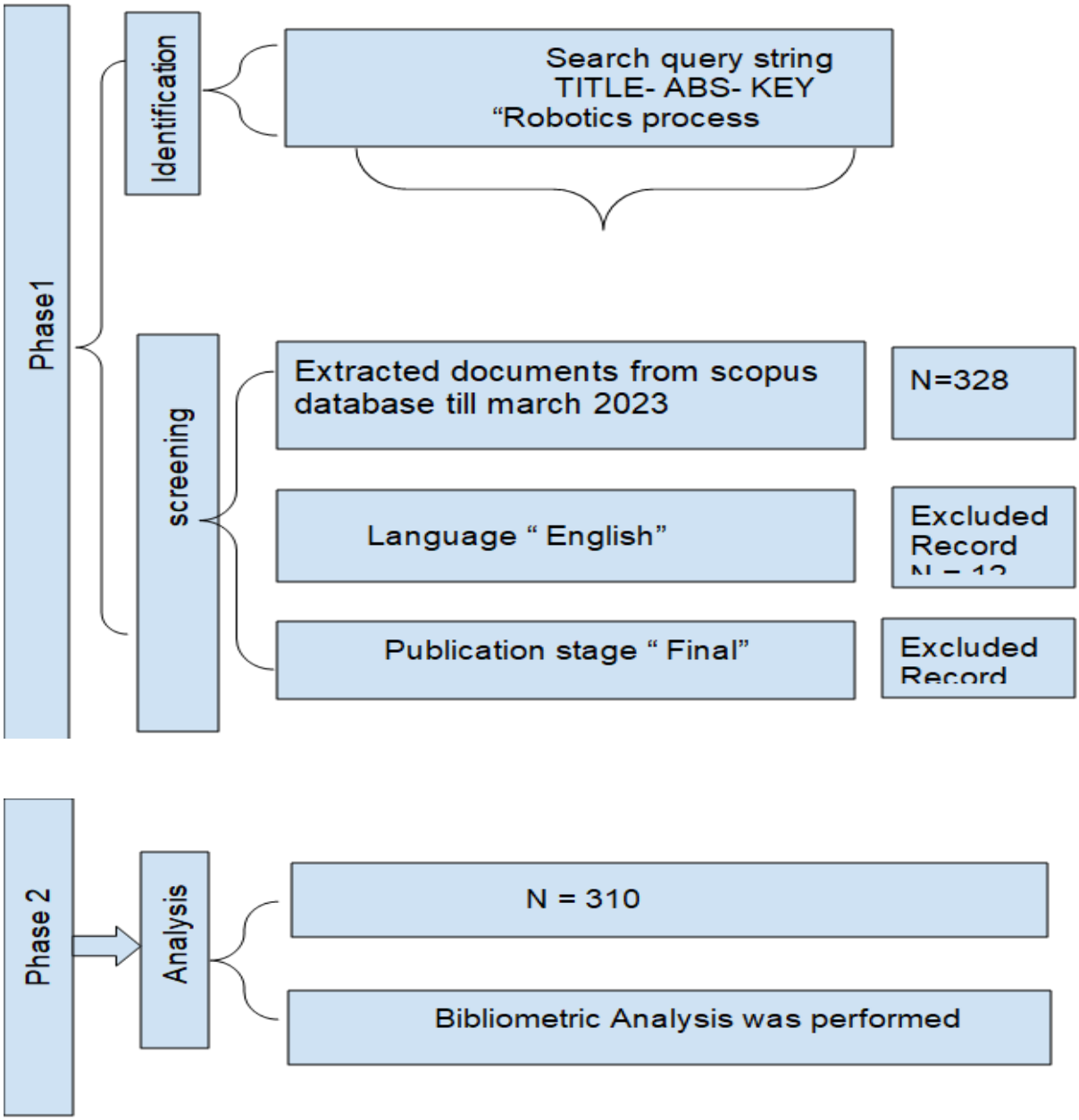

Fig.1 : Flow chart of study selection Using Prisma Diagram

4.1. Data Analysis Strategy

In this study, a bibliometric review is followed, which is similar to the procedure adopted by Caputo, Marzi, Pellegrini, and Rialto (2018). Bibliometrics is the most extensively practiced approach to tracing the knowledge anatomy of a research field (Li, Wu, & Wu, 2017) and is used to Analyze research topics (Blanco-Mesa, Merigo, & Gil-Lafuente, 2017). For the purpose of delving into the domain, bibliometric analysis is performed, followed by content analysis of the major themes (Baker, Pandey, Kumar, & Haldar, 2020). The most common bibliometric methods used to exhibit similarities among cited and uncited documents are citation and co-citation analysis (Small, 1973). Tools such as publication trends and citation network analysis are applied in the present study (Paul & Benito, 2018; Paul & Rosado-Serrano, 2019). Additionally, co-citation for clustering and keyword analysis are also used (Xu et al., 2018). The software used for analysis is VOS Viewer (1.6.18). VOSviewer is an effective software

solution with many key advantages for building and visualizing bibliometric networks. The user-friendly interface of VOSviewer is one of its main advantages. Researchers, analysts, and practitioners may all utilize the software with ease thanks to its user-friendly design. Additionally, VOSviewer has a broad range of analytical capabilities and can analyze co-citation, bibliographic coupling, and co-authorship networks, among other bibliometric data. VOSviewer is a useful tool for scholars and practitioners in a variety of domains because of its adaptability. In addition, VOSviewer provides a variety of visualizations, such as timelines, maps, clusters, and density plots, that help users interpret complex bibliometric data. Additionally, VOSviewer offers users a wide range of customization options, such as color schemes, font sizes, and node sizes, as well as a number of layout algorithms to help them create the best possible visualizations. Lastly, VOSviewer is made to facilitate communication between researchers and practitioners. Users have the option to export data, save their projects for later use, and share their bibliometric network visualizations with others. Overall, VOSviewer is a useful tool for analyzing and visualizing bibliometric networks due to its user-friendly interface, adaptability, visualizations, customization possibilities, and collaboration features.

4.2. Distribution of RPA publications by source type

Table 1. Type of source wise distribution of documents

SOURCE TYPE	NUMBER OF PAPERS	PERCENTAGE
CONFERENCE PROCEEDING	1132	42.58
JOURNAL	94	30.32
BOOK SERIES	71	22.90
BOOK / TRADE JOURNAL	13	04.19
Total	310	100

5. Database Selection, Data Extraction, and Analysis

For the present study, the Scopus data has been used to extract the data. Elsevier launched Scopus in 2004 and describes it as "the most comprehensive overview of the world's research outputs," which is selected, organized, and presented by the subject experts. Moreover, it is trouble-free to export the data from Scopus to any other application as it gives multiple options to export. Out of 328 papers, 310 documents were identified, arranged, evaluated, and analyzed for bibliometric analysis in this study which in mentioned here in *Table 2*.

Table 2. Summary of extracted documents

Particulars	Figures
Publication Years	2001-22
Citation years	22(2001-22)
Papers	310
Citation	3016

Cites/years	137.09
Cites/paper	9.72
Authors/paper (h- index / years)	1.22
H-Index	27

Bibliometric analysis of robotic process automation has been analyzed for 22 years, from 2001 to 2022, and during these years, more than 310 papers were written on the stated subject; total citations were 3016 in these years; therefore, it can be stated that every year, on average, 137.09 citations took place and each paper got an average citation of 9.72. From the author's point of view, each author has been credited with 1.22 papers to his credit, while the h index was 27 in these 22 years. Hence, this is the overall contribution by the various researchers and academicians regarding robotic process automation in these years.

6. Data Analysis & Discussion:

6.1. Year wise Distribution of Published Paper

Table and figure 2 show the trend of publication of papers during the last 22 years, from 2001 to 2022, and it is clearly observed that the publication of papers on robotic process automation has increased dramatically after 2018, particularly since 79 research articles were produced in 2021, whereas 96 research papers will be written next year. 94.19% of total papers on RPA were published between 2018 and 22 in the last five years.

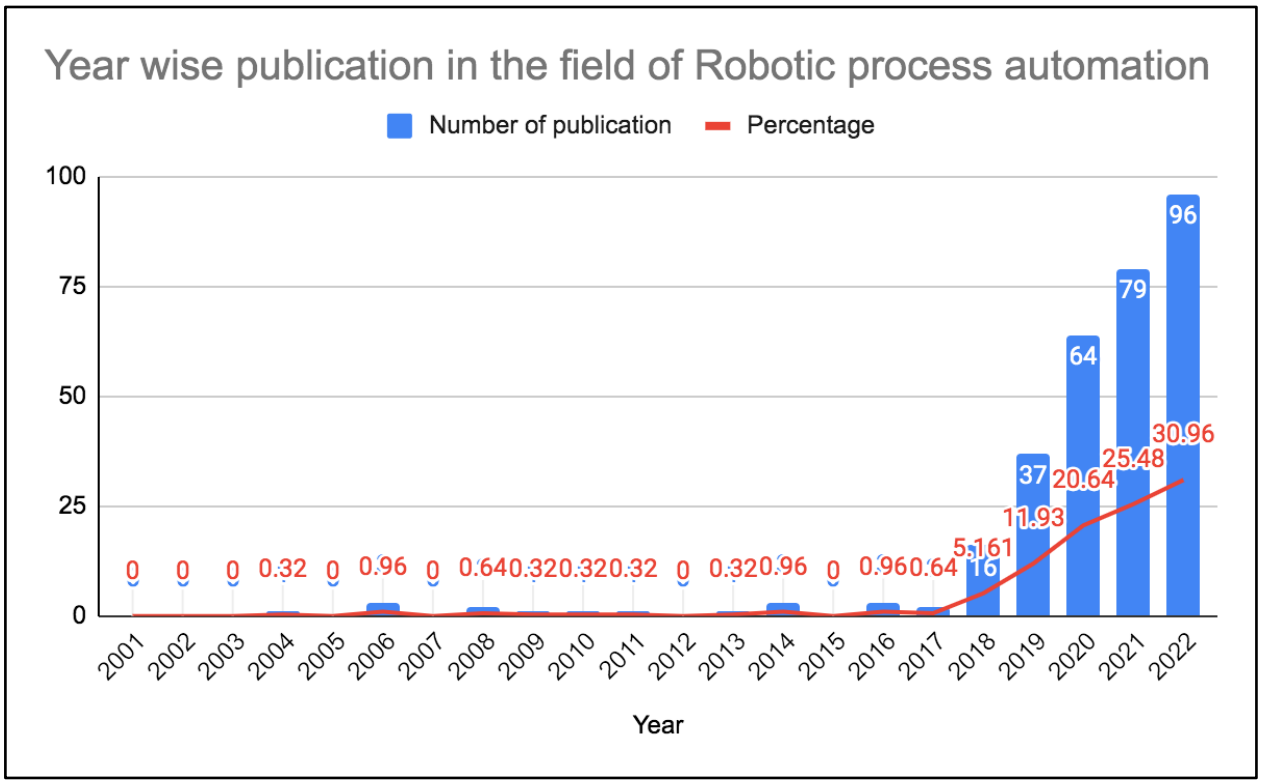

Fig.2: Year wise trend of publications in the field of Robotics Process Automation

Source: Author's Own

6.2. Country wise Distribution of Published Paper

Table 4 below shows Country wise paper publications on robotic process automation, and it shows that

Germany and India both were at first rank in this list with 52 publications among top 10 countries. followed by the US with 31, Australia 15 and the other countries have fewer than the average publication per country.

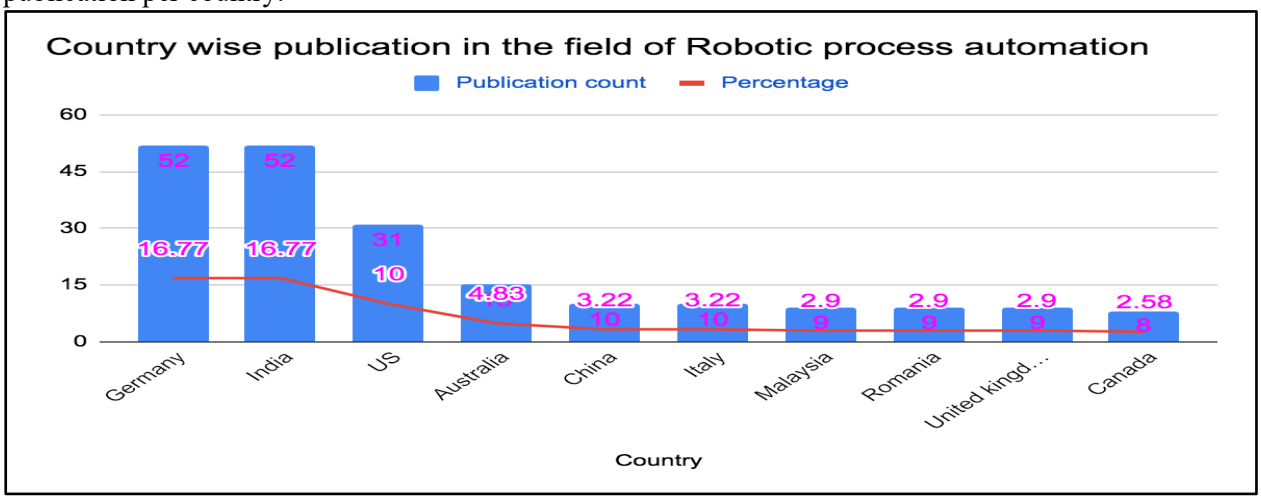

Fig .3: Top 10 leading countries in the field of robotic process automation

Source: Author's Own

6.3. Subject wise distribution of Publications

Table No. 5 represents the top 10 subject areas in the field of robotic process automation. and it shows that Computer Science has Top the list with 234 publications, where it has published the maximum number of papers. followed by engineering with 136, business management and accounting with 87, mathematics with 76, and decision sciences with 75. The other areas have fewer publications than the average.

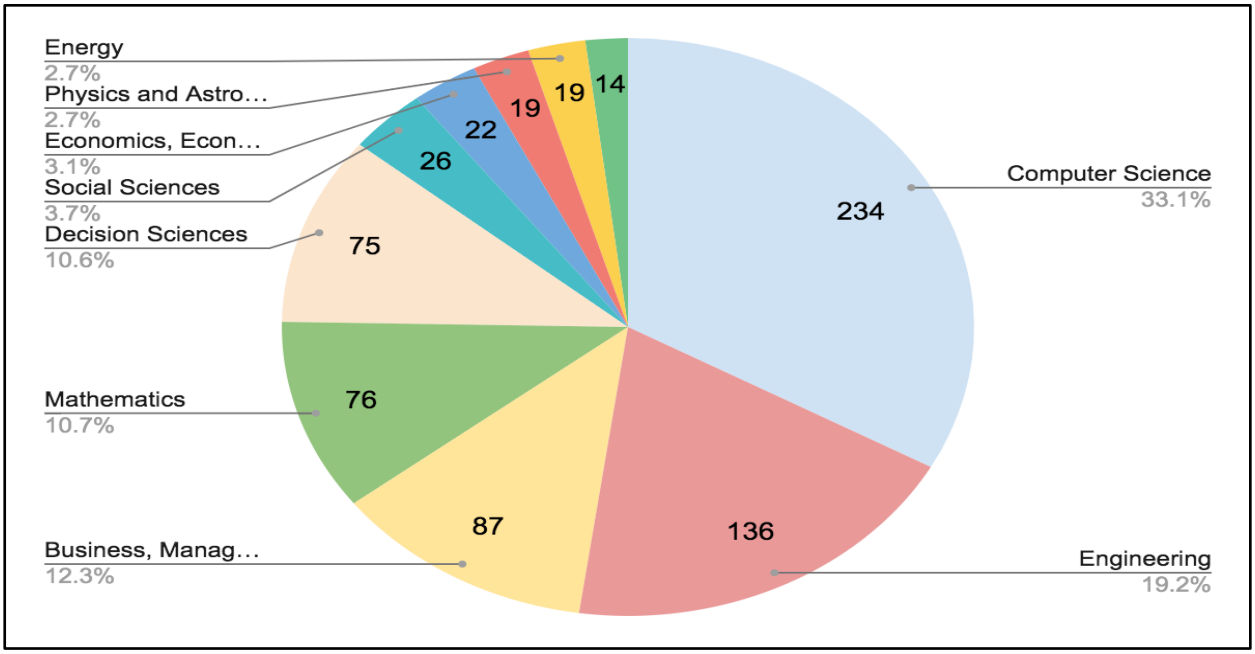

Fig.4: Top 10 Subject areas of Publications in the field of RPA

Source: Author's Own

6.4. Influential authors wise Distribution of publication

Table No. 3 represents the top 10 most influential authors, Authors citation score, total h-index paper and country with affiliation in the field of Robotic process automation. Here citation score showing overall citation score of authors. The h-index is the highest number of a scientist's publications that each received at least h citations, with the remaining publications having no more than h citations each. Citations and the h-index are valuable tools in bibliometrics for quantifying the impact and influence of a researcher's work. These metrics, by tracking how often a researcher's work is cited, indicate the significance and relevance of their contributions. Additionally, they offer a standardized measure to evaluate research quality and impact across disciplines and institutions. Analyzing citation patterns helps identify influential papers, track research trends, and understand the evolution of scientific knowledge.

So here as per table 3, Author, Volker,m. from Hasso Plattner Institute (University Potsdam), Weske,m. from Hasso Plattner Institute (University Potsdam) Has a score of six publications, which is the highest number of publications in the field of Robotic process automation. Agostinelli, S., from Sapienza University of Rome, and Plattfaut, R., from South Westphalia University of Applied Sciences, have contributed equally with five publications in this field. Most authors at the table are constantly working.

Table 3. Influential authors wise Distribution of publication from scopus database for 2001 to 2022

Authors	Citation Score of authors (overall)	Publication counts on RPA	Total h-index Paper	Country	Affiliation
Volker,m.	24	6	2	Germany	Hasso Plattner Institute, University potsdam
Weske,m.	9629	6	43	Germany	Hasso Plattner Institute, University potsdam
Agostinelli,s.	110	5	6	Italy	Sapienza University of Rome
Plattfaut,R.	2280	5	14	Germany	South Westphalia University of applied sciences
Reichert,m.	10316	5	46	Germany	University of Ulm
Wewerka,j.	33	5	4	Germany	University of Ulm
Reijers,h.A.	10454	5	51	Netherland	University of Utrecht
Marrella, A.	1286	4	18	Italy	Sapienza University of Rome
Maggi,F.M.	4994	4	39	Italy	Free University of Bozen-Bolzano
Leno,v.	139	4	7	Australia	University of melbourne

6.5. Affiliation Analysis

Figure 5 elucidates the details of the document published by the notable affiliation organization in the subject area of RPA. The data from the top 10 affiliate organizations from 2001–2022 was retrieved. A total of 55 documents were fetched from these top 10 affiliation organizations, with an average of 5.5 documents per organization. Out of all these 10 affiliation organizations, only 3 have more than average documents, and the rest of the 7 have less than average documents. Universitat Potsdam, Universidad de Sevilla, and Hasso-Plattner-Institut für Software system technique GmbH are the most prominent organizations in the subject field with 7 published documents each, and Universiteit Utrecht is the least consistent organization in the subject area with only 4 documents.

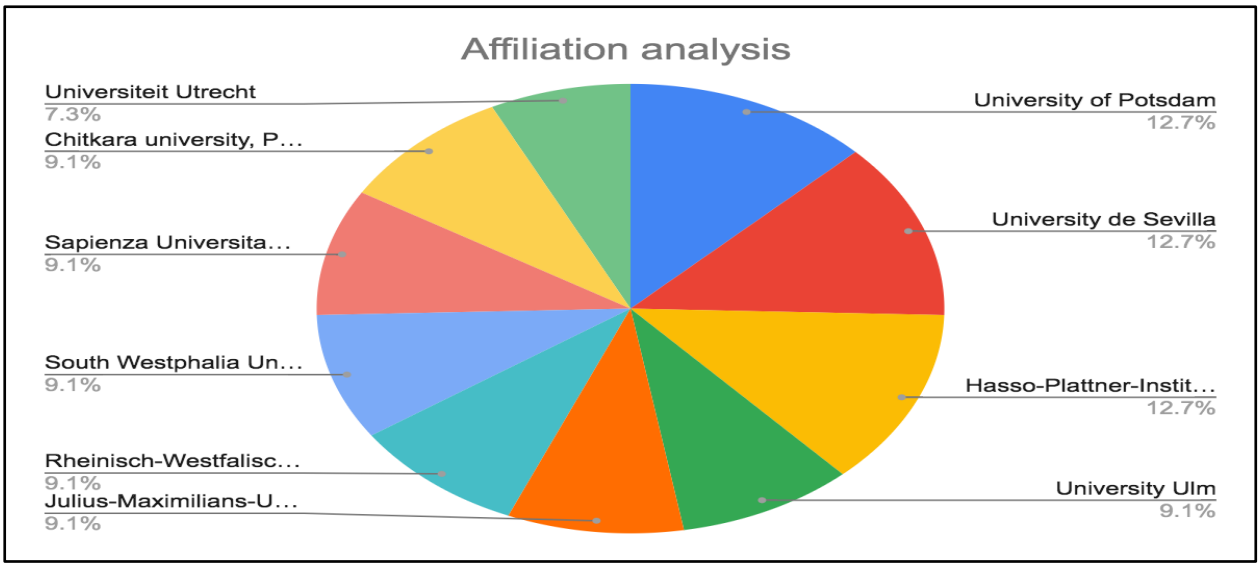

Fig.5: Affiliation Analysis

Source: Author's Own

6.6. Citation wise distribution of publications

Citation analysis is the analysis of the effect and presumed quality of a research paper, an author, or an organization depending on the number of times the article and/or writers have been cited by the organization. Table 4 represents the top 10 most cited articles out of 310 documents, including document title, publication year, first author, source, and citation score. With 209 citations, the most cited article from RPA was "Robotic Process Automation " by the author (VanderAalst, 2018), published in business and information systems engineering in 2018. This paper focused on the relevance of RPA. The goal of this paper is to reflect on these developments and discuss RPA research challenges for the BISE community.

Table 4. Citation wise distribution of Top 10 publications

Document title	**Year**	**First author**	**source/ journal name**	**Citation score**
Robotic Process Automation DOI: 10.1007/s12599-018-0542-4	2018	(Van der Aalst Wil M.P.,2018)	Business and Information Systems Engineering	**209**
Automation of a business process using robotic process automation (RPA): A case study Doi: 10.1007/978-3-319-66963-2_7	**2017**	(Aguirre,S.,2017)	Communications in Computer and Information Science	**139**
Robotic Process Automation: Contemporary themes and challenges **DOI:** 10.1016/j.compind.2019.103162	**2020**	(Syed.R.2020)	Computers in Industry	**131**
Turning robotic process automation into commercial success - Case OpusCapita Doi: 10.1057/jittc.2016.5	**2016**	(Asatiani,.,2016)	Journal of Information Technology Teaching Cases	**119**
Robotics process automation in Auditing Doi: 10.2308/jeta-10589	**2018**	(Moffitt,2018)	Journal of Emerging Technologies in Accounting	**104**

Robotic process automation at Telefonica O2	**2015**	(LacityM.C.,2016)	MIS Quarterly Executive	**112**
Applying robotics process automation in auditing : A framework **DOI:** 10.1016/j.accinf.2019.100433	**2019**	(Huang F., Vasarhelyi M.A.2019)	International Journal of Accounting Information Systems	**78**
Robotic process automation **DOI:** 10.1007/s12525-019-00365-8	**2020**	(Hofmann P., Samp C., Urbach N.2020)	Electronic Markets	**78**
Robotic process automation in public accounting **DOI:**10.2308/acch-52466	**2019**	(Cooper L.A.,2019)	Accounting Horizons	**76**
How do machine learning, robotic process automation, and blockchains affect the human factor in business process management? **DOI:** 10.17705/1CAIS.04319	**2018**	(Mendling J., 2018)	Communications of the Association for Information Systems	**76**

6.7. Keyword Network Visualization

Keyword network analysis measures the strength of the relationships between sample terms in relevant texts in order to get insight into the conceptual structure and trends of a certain topic.In total, there are 71 items, 6 clusters, and 1095 links, and the total link strength is 4812 in the network analysis of keyword search. Here, Total link strength represents the number of occurrences of a set of keywords in publications. If two keywords are connected, it means they appear frequently together. From Figure 6, it can be noticed that robotics has been searched a maximum of 189 times, while process automation was found 188 times each, and the rest of the keyword list has been mentioned in table 8 below.

6.8. Co-occurrence of keywords

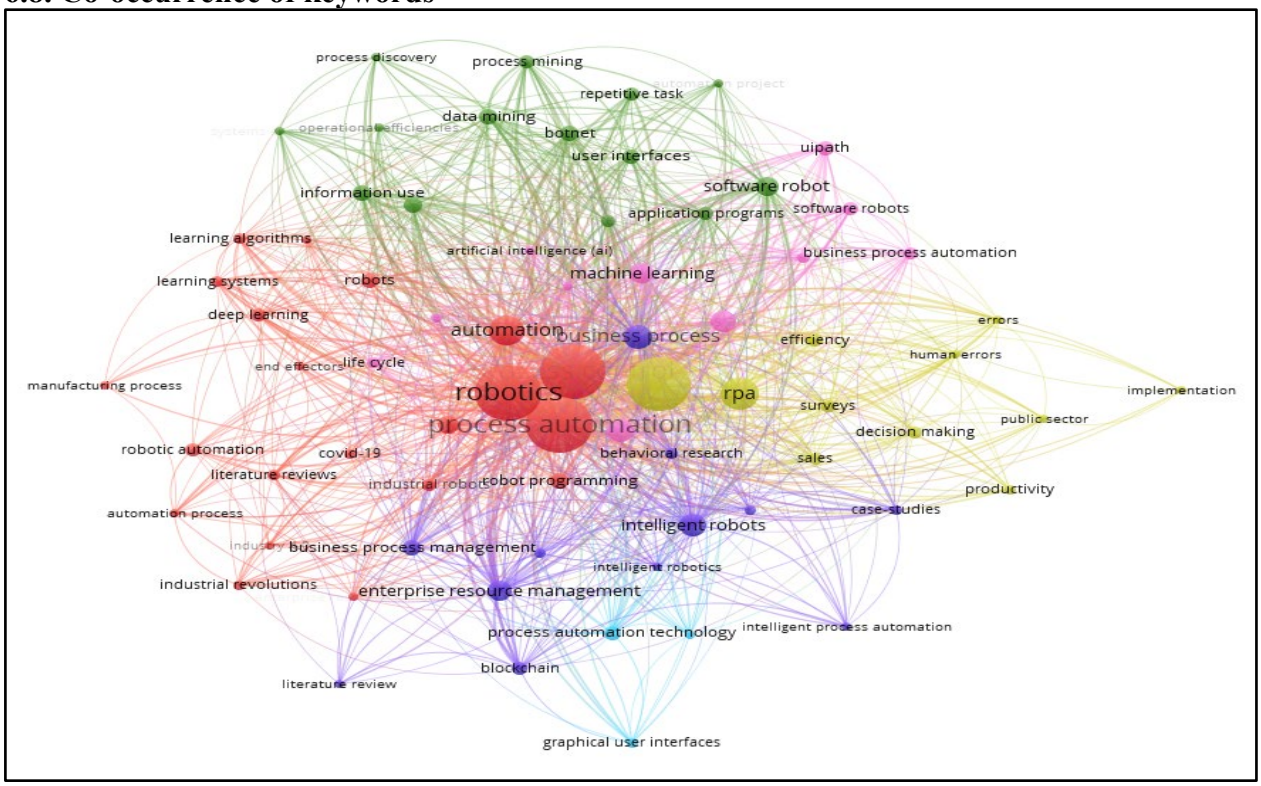

Fig.6: Network analysis of keywords using VOS viewer

Source: Prepared by Author

Figure 6 Represents different clusters and network analysis of the co-occurence keywords.

Cluster1 (Red) has 21 items and out of which the keyword Robotics has 189 Occurrences and has a connection with 1071 keywords. This cluster also suggests the theme of "RPA for digital transformation". This cluster appears to represent topics related to automation and robotics, particularly in the context of digital transformation and industrial applications. It includes terms such as RPA (robotic process automation), robotics, process automation, learning algorithms, industrial robots, social robots, end effectors, and robotic automation, among others. COVID-19 is also included, possibly due to its impact on automation and digital transformation efforts in various industries. Overall, this cluster seems to reflect a focus on the intersection of technology, automation, and digital transformation in industrial and business contexts.

Cluster2 (Green) has a total of 14 items, an Information use keyword with 17 Occurence and a connection with 134 keywords. This cluster appears to represent topics related to using "Robotic process automation (RPA) for operational effectiveness" in business and organizational contexts. The cluster includes terms such as information use, information systems, process mining, user interaction, systems engineering among others. The cluster also includes terms related to the technical aspects of RPA, such as software robots and user interfaces. Overall, this cluster seems to reflect a focus on using RPA and related technologies to improve operational effectiveness and efficiency in organizational contexts.

Cluster 3 (Blue) has a total of 12 items, An Enterprise resource management keyword with 25 Occurrence and a connection with 203 keywords. This cluster appears to represent topics related to the intersection of "Robotic intelligence and automation" with business and organizational processes. Many of these terms are related to the use of intelligent robotics and automation to streamline business processes and improve efficiency, particularly in the context of enterprise resource management and business process management. Overall, this cluster seems to reflect a focus on the integration of intelligent robotics and automation with business and organizational processes, and the potential benefits that these technologies can offer in terms of improved efficiency, productivity, and performance.

Cluster 4 (Yellow) has a total of 11 items, RPA keyword with 65 Occurrence and a connection with 345 keywords. This cluster appears to represent topics related to the use of "Robotic process automation (RPA) for business management". The cluster includes terms such as RPA, robotic process automation, implementation, sales, efficiency, decision making, surveys, errors, and productivity, among others. The cluster also includes terms related to the public sector, indicating that RPA may have applications in government and public administration as well. Overall, this cluster seems to reflect a focus on the use of RPA as a tool for improving business management and performance.

Cluster 5 (Pink) has a total of 10 items. Artificial intelligence keyword with 31 Occurrence and a connection with 188 keywords. This cluster appears to represent topics related to the use of "Robotic process automation (RPA) in business process automation", with a focus on artificial intelligence, machine learning, and software robots. Many of these terms are related to the technical aspects of RPA, such as software robots and machine learning, and how these technologies can be used to automate business processes. Overall, this cluster seems to reflect a focus on the intersection of RPA, artificial intelligence, and business process automation, and the potential benefits that these technologies can offer in terms of improving efficiency and reducing costs.

Cluster 6 (Sky Blue) has 3 items, Process automation technology keyword with 12 Occurrence and a connection with 81 keywords. This cluster appears to represent topics related to "Autonomous robotic process automation (RPA)" and the technology used to enable it. The cluster includes terms such as process automation technology, graphical user interface, and among others. These terms are related to the technical aspects of autonomous RPA, such as the technology used to automate processes and the user interfaces used to interact with the system. Overall, this cluster seems to reflect a focus on the

technical aspects of autonomous RPA and how these systems can be designed to optimize efficiency and user experience.

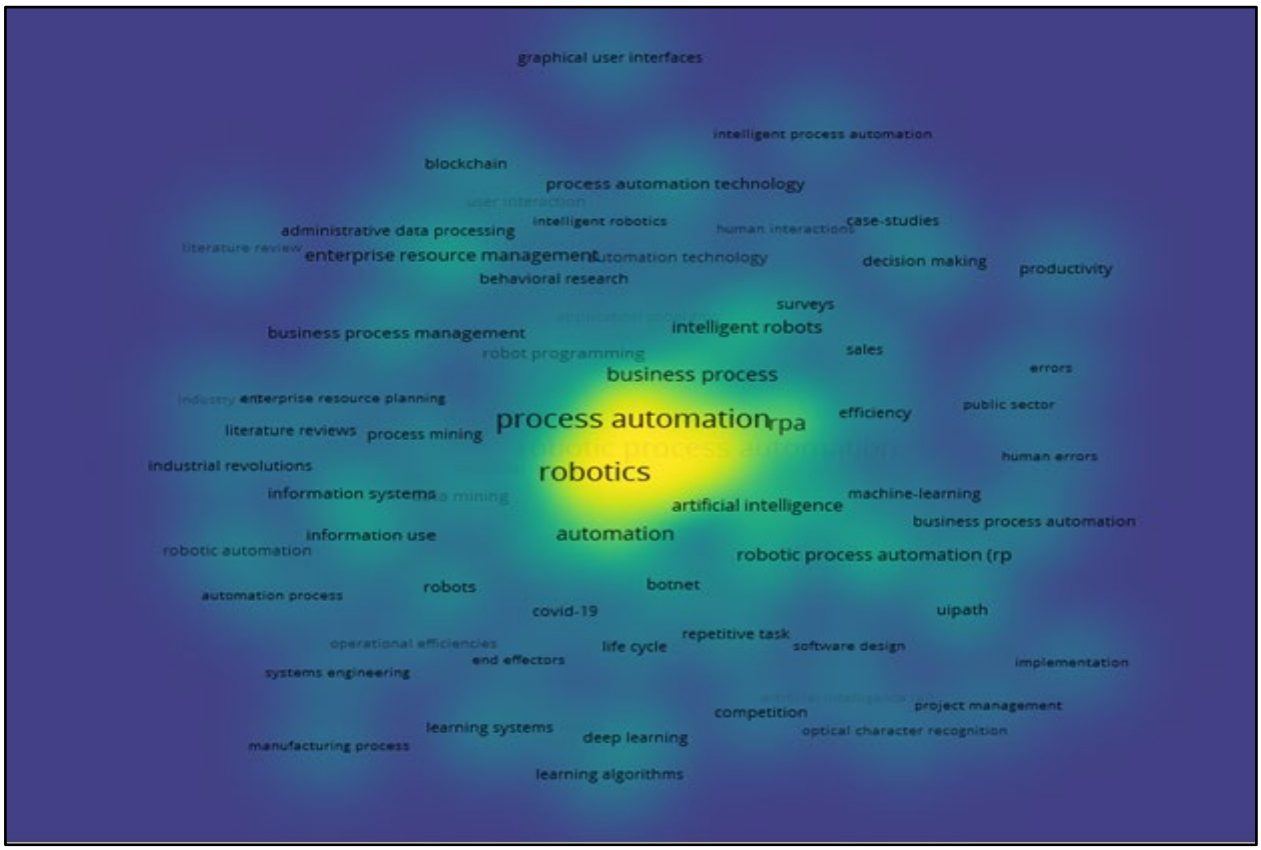

Fig.7: Density visualization using VOSviewer

Source: Author's Own

Figure 7 represents density visualization, which is retrieved from the VOS viewer. The keywords robotics, process automation, automation, RPA, business processes, and artificial intelligence show the highest density, while information systems, intelligent robots, business process management, software design, and life cycle robots show moderate density. The density is represented by the intensity of color around the keywords and the higher the ling strength with other keywords.

7. Results and Discussions

Research in Robotic process automation is crossing its boundaries throughout the world and it is spreading enormously. This study throws light on the importance of the contribution of RPA using research areas. The types of publications in the respective field of research are majorly conference papers followed by articles. To refine and state the research idea, these statistical and network analysis are effective channels. The English language is used by the majority of the researchers to publish the documents. It is observed that minimal contribution was made towards publishing the documents in the initial years of 2010 to 2012. The graph shows incremental changes after 2018. The year 2022 and 2023 shows the maximum number of document publications respectively in robotic process automation.

Countries like Germany, India and the United States are contributing more towards the research in this area. Keyword analysis diagrams show that the most significant keywords for robotic process automation are process automation, Information system, Natural Language Processing, Artificial Intelligence, robots, etc. The network analysis diagram on "Co Occurrence of keywords" inferred that the most significant keywords are present in the retrieved Scopus scientific publications for robotic

Process automation. The query string consisting of these co-related keywords will help researchers to get more accurate results in robotic process automation research. The analysis of the data reveals that around four clusters have emerged from the cluster analysis of the available literature in RPA. Each represents a different theme, such as Cluster 1 based on the theme of RPA as a social partner and for digital transformation; Cluster 2 based on the theme of RPA for operational effectiveness; Cluster 3 based on robotic intelligence and automation; Cluster 4 based on RPA for business management; Cluster 5 based on RPA in business process automation; and Cluster 6 based on autonomous RPA. The identified themes align with the research findings of Uklańska, A. (2023), Fernandez et al., (2023), Tang & Hwang, (2023). Many publications commonly feature a definition of RPA accompanied by a thorough review and analysis of cost–benefits. Despite the abundance of RPA vendors and products available, there exists a noticeable gap in the availability of implementation model guidelines.

The results of this study can offer important new perspectives for RPA scholars, practitioners, and policymakers. Future research should take into account the study's limitations, such as the exclusion of additional databases and languages. Researchers and practitioners may progress this technology and its potential effects on businesses and society by continuing to research and expand the field of RPA. In the end, the findings of this bibliometric analysis aid in understanding the current state of RPA research and the field's future developments.

The lack of a theoretical foundation that may support the conceptual framework of bibliometric analysis is the study's main flaw. Data from other databases, like Web of Science, Google Scholar, etc., have not been included because it was only taken from the Scopus database. Therefore, future research should use different datasets, such Wos. Using a specific database also makes it more difficult to find unpublished papers or papers that have already been published but in lower-quality journals, thus these scientific works are overlooked. The same issue occurs with language because there are less publications in other languages due to the higher percentage of English-language journals.

There are a number of potential directions for additional RPA study. One of these is looking into how RPA affects business performance and similarities and differences of RPA with BPM concept. Conducting empirical studies to evaluate the effects of RPA on productivity, efficiency, and cost reductions could be the main goal of future study. Finding the best RPA implementation practices is another topic of inquiry. It could be necessary to investigate what impact the application of RPA has on the company’s employees, and consequently on the organizations.

9. Findings and Conclusion

Overall, this study gives a bibliometric analysis of influential authors, countries, and emerging clusters in the field of RPA. The country analysis shows that Germany and India have the highest number of publications, while the US has the second highest number of publications, which indicates that India has embraced RPA technology. The findings indicated that (1) the scientific community is highly interested in this topic and (2) there is a trend towards more publications relating to RPA. This is demonstrated by the increasing number of scholarly publications published annually since 2018. However, there has been an almost twofold increase in scientific production in the past year. Most of these papers have a relative scientific interest since many of them only describe theoretical foundations of RPA, while others describe industrial results or experiences of having implemented RPA in specific scenarios.

The "Bibliometric Analysis of Robotic Process Automation" study offers several potential implications for various stakeholders, including industry professionals, policymakers, and researchers. For industry practitioners, the study could provide insights into the state of the art in RPA technology, including key areas for research and development, leading researchers and organizations, and potential benefits and challenges of RPA implementation. For society at large, the study could help policymakers understand the potential impacts of RPA on the workforce and the economy, while also identifying trends and developments in RPA research. Finally, for researchers, the study could provide a

comprehensive understanding of research challenge, and new directions in RPA research, as well as identifying opportunities for collaboration and networking. Overall, the study has the potential to provide valuable insights for those interested in RPA and related fields, helping stakeholders prepare for the future of work and maximize the benefits of RPA while minimizing potential challenges.

Hence this bibliometric analysis spanning 22 years of Robotic Process Automation (RPA) research yields valuable insights into the current landscape of scholarly work, offering a data-driven evaluation of both the maturation and existing gaps in the field. The dramatic upward trend in publications since 2018 reflects rising RPA prominence. Computer science forums lead in RPA activity, though business, engineering, and social science disciplines engage actively as well. Geographical and methodological imbalances point to research opportunities. Qualitative, cultural, and organizational behavior lenses could complement the quantitative engineering focus. Exploring RPA dynamics across global regions beyond Europe and North America represents another gap. Ultimately, the rapid evolution of RPA scholarship needs ongoing transparent monitoring. This study establishes an empirical foundation to guide future research directions and encourages cross-disciplinary collaboration as RPA research continues to expand. The role of comprehensive bibliometric reviews emerges as crucial in mapping the growth of this emerging domain.

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