

The Integration of ERP Systems and Technologies for Process Automation: A Bibliometric Analysis

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Abstract. *In the context of Industry 4.0, economic entities that want to be successful on the market have to take into consideration the use of various technologies for digitalization and automation of operational processes. To make work easier and increase performance, ERP (Enterprise Resource Planning) systems can be integrated with other innovative solutions for automation, such as RPA (Robotic Process Automation). This paper aims to identify the main topics of interest in the field and the correlations between them, using a bibliometric analysis of the literature. The database included 284 publications extracted from Scopus. The search was carried out using keywords such as “ERP”, “RPA” and “automation”. Using the VOSviewer software, the answers to the research questions were obtained by analyzing keyword co-occurrence network, the evolution of the number of papers published in the period 2015-2024, the papers with the highest number of citations, and the countries that contributed the most to the field. The results illustrate that interest is growing in integrating ERP systems with digitalization and automation technologies. In the analyzed papers, automation-based solutions, such as software robots, are mainly chosen. The current research contributes to the literature by exploring the integrated use of ERP solutions with RPA, an aspect that is not much addressed in existing work. An overview of trends takes shape as this study can represent the basis for future research in this particular field, which is constantly evolving.*

Keywords: ERP – Enterprise Resource Planning, RPA – Robotic Process Automation, automation, process automation technologies, bibliometric analysis.

Introduction

Today, digitalization is an essential factor for economic entities in different industries that want to grow and remain relevant in the public eye. They use various digitalization and automation solutions to optimize processes and increase profitability (Yang & Yee, 2022). In the recent years, there has been great interest in technologies based on artificial intelligence, with new skills to manage large volumes of data efficiently (Ritter & Pedersen, 2020). However, it is important to note that if a new solution for process management is to be implemented, a reorganization of existing resources must be considered (Yang & Yee, 2022). In this way, enterprises will be able to face the challenges in the market.

A well-known solution used by economic entities over the years to improve processes and resource management is ERP (Enterprise Resource Planning) systems. They can be integrated with other technologies used for digitalizing activities, such as RPA (Robotic Process Automation). By combining ERP and RPA, costs are substantially reduced, processes are managed efficiently, the risk of errors is minimized and staff can focus on tasks that require human expertise (Yendluri et al., 2023).

In this study, a bibliometric analysis of the existing literature on the integration of ERP systems with other automation technologies, in particular RPA solutions, was performed using the methodology proposed by Donthu et al. (2021). To better outline the results obtained, tables, figures, and graphs have been created using VOSviewer software. A total of 284 relevant publications in the field, extracted from the Scopus academic database, were analyzed, presenting

the most studied topics, the evolution of the number of papers published in the analyzed period, the types of papers present in the database, the countries where the most papers were published and the most cited studies. It will highlight aspects related to the usefulness of technologies now and future directions, with a focus on the benefits generated within economic entities.

This study is relevant for researchers as it addresses interesting and relatively new topics such as the integration of ERP with solutions for process automation, representing a good start for future in-depth research. Compared to the already existing literature review studies, in the current paper the focus is on the integration of ERP with RPA, a topic that has not been addressed by many authors so far. The other studies cover subjects such as the use of ERP with blockchain (Sunmola & Lawrence, 2024; Isbaih et al., 2024), cloud ERP solutions (Tongsuksai & Mathrani, 2020), the integration of BPA within entities (Moreira et al., 2024) and the use of RPA in audit processes (Almayyahi et al., 2024).

The paper is organized into several sections as follows: the next section is the literature review, followed by the research methodology, in which the study steps are described. The following section presents the results of the research. The paper ends with conclusions.

Literature review

In the recent years researchers increasingly published papers on the importance of automating and digitalizing operational processes. ERP systems, RPA tools, AI-based solutions, blockchain, and many others are considered revolutionary technologies used to improve processes (Moreira et al., 2024). This study will focus in particular on the integrated use of ERP and RPA, a relatively new and little addressed topic in the literature.

In ERPs, information from multiple departments is integrated into a single platform, facilitating quick access to data (Ali & Miller, 2017). The use of ERP systems can lead to optimal resource management and increase the performance of the economic entity (Ali & Miller, 2017; Ratchatawetchakul et al., 2024). The successful implementation of an ERP system requires that the project teams are well trained as possible, that there is effective communication between the staff, that the objectives and operational needs are properly established, and that the management pays particular attention to the project that will be implemented (Ali & Miller, 2017).

As early as the 1960s, various variants of ERP systems started to be developed, leading to the final version in the 1990s, called ERP (Costa et al., 2016). ERP systems provide users with specific modules for managing human resources, production, and sales processes, administering financial aspects, and much more, depending on the specifics of each entity (Nazemi et al., 2012; Ratchatawetchakul et al., 2024; Yendluri et al., 2023). ERP systems support communication and cooperation between employees. The most well-known ERP systems suppliers are SAP SE and Oracle Corporation (Costa et al., 2016).

With the help of process automation technologies, it is possible to generate robots that can be programmed to perform repetitive and rule-based tasks automatically (Costa et al., 2022). The robot can imitate the actions performed by an employee of an entity, but its role is not to remove the workforce, it is to support it (Costa et al., 2022). Software robots generated using RPA technologies automate repetitive tasks and can interact with various platforms, reducing execution time of the process (Yendluri et al., 2023). The amount of staff workload is significantly reduced, allowing employees to allocate their time to strategic activities or to interpret the results obtained (Yendluri et al., 2023). A survey has shown that employee job satisfaction is improved when the tasks they have to perform are valuable to the enterprise (Özkan & Esgin, 2023).

Economic entities that integrate RPA technologies into their operational processes benefit from the facilities they generate. Important benefits to mention are increased efficiency, reduced the number of errors, and improved customer satisfaction (Hartley & Sawaya, 2019). A significant advantage may be the low implementation costs compared to the cost of other solutions based on automation (Hofmann et al., 2020).

At the same time, many tasks are suitable to be performed automatically by software robots, such as filling in data forms, managing e-mails, generating offers, and processing payments (Hartley & Sawaya, 2019). Most economic entities that choose to use RPA tools implement one of the solutions offered by Automation Anywhere or UiPath (Hartley & Sawaya, 2019).

According to Yendluri et al. (2023), economic entities that have integrated both ERP systems and RPA solutions into their processes benefit from lower costs and fewer errors, optimized workflows, and an efficient allocation of resources. Once the choice is made to use both ERP and RPA technologies, the enterprise is organized as a chain of interrelated processes that facilitate transparency and operational efficiency (Stoykova et al., 2022).

Software robots can be used to automate processes within an ERP system. Some of the activities they can execute are: data entry, extraction and transfer, document generation, and system navigation based on predefined conditions (Stoykova et al., 2022). In addition to the above, Ratchatawetchakul et al. (2024) demonstrate how a robot created using the RPA solutions provided by the UiPath platform leads to the completion of purchasing and production related processes in much shorter time than if they are executed manually by the entity's employees.

Therefore, the literature review shows the utility of integrating several automation and digitalization technologies, such as ERP and RPA in economic entities. Each study highlights the benefits of using innovative technologies and their contribution to the automation of the processes. Even so, as this is a relatively new approach, there is no in-depth research in this area. However, the existing ones represent a significant starting point for future studies. In the results section, a broader picture will be outlined by analyzing the academic papers on ERP, RPA and automation in order to better understand their impact within an entity.

The extracted database, which includes papers on the integration of ERP systems with automation solutions, does not contain any literature review studies addressing ERP and RPA integration. Thus, the current study fills a gap in the literature in this area, focuses on the investigation of recent technologies and can be useful for researchers and practitioners. The literature review papers in the database focus on the use of ERP in conjunction with other technologies such as blockchain and the integration of automation solutions such as RPA or BPA within economic entities.

Methodology

This research aims to conduct a bibliometric study in order to review the literature on the integration of ERP systems with RPA or other solutions for automation, applying the methodology proposed by Donthu et al. (2021). In order to better understand the selection process of the existing papers in the analyzed database, Figure 1 shows the steps followed according to the PRISMA guidelines (Page et al., 2021).

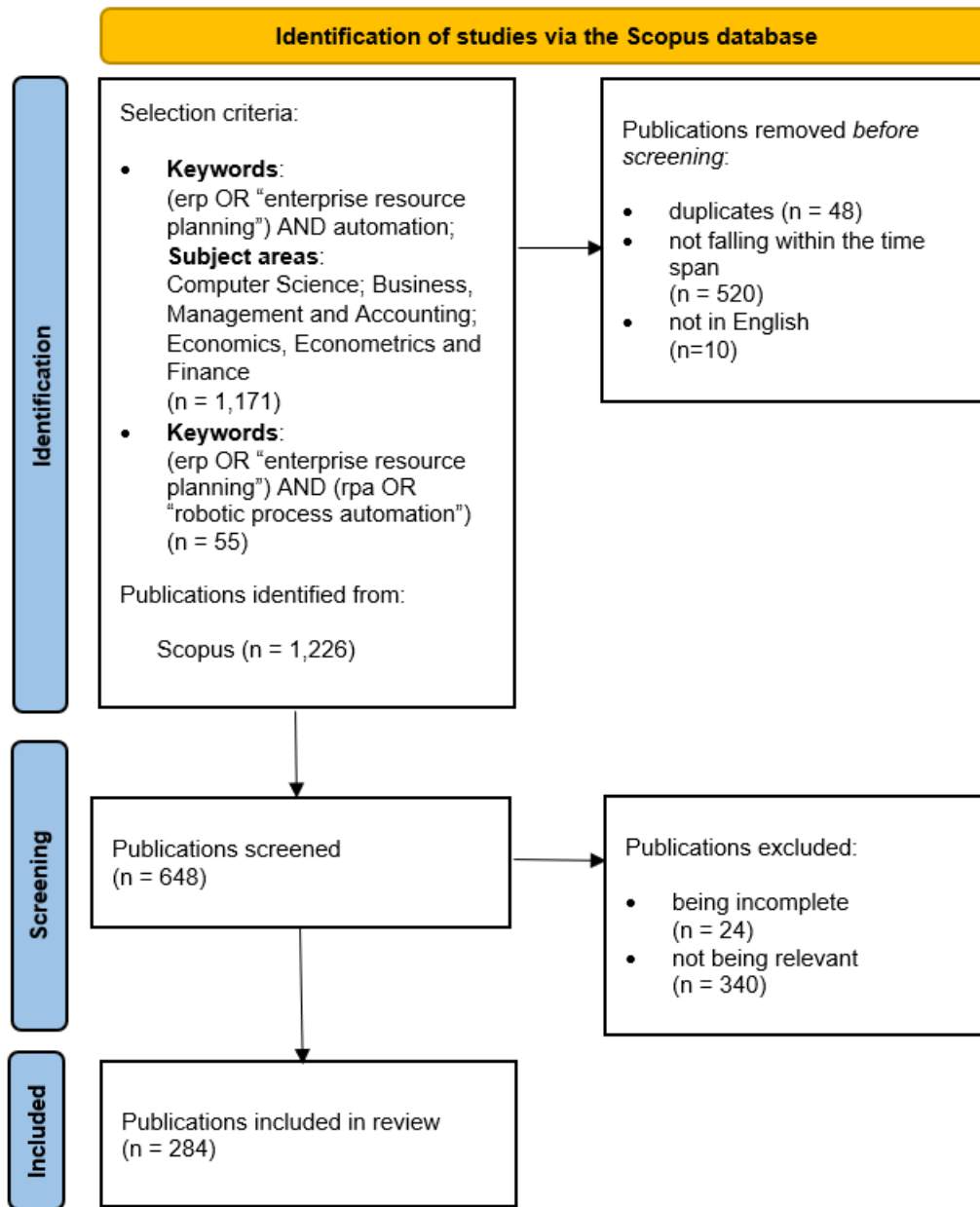


Figure 1. PRISMA flow diagram for bibliometric analysis

Source: Authors' own research based on PRISMA guidelines.

To begin with, 1226 academic papers were extracted on 19.12.2024, from the Scopus scientific database, which indexes journals from different fields. After analyzing existing papers indexed in the commonly used databases, I decided that Scopus is the most suitable for the current study, as it contains a wide range of publications on the selected topic.

Publications have been searched using keywords such as "ERP" or "Enterprise Resource Planning" and "Automation". In order to keep only papers that are of real interest for the research, several filters have been applied on the obtained database. A selection criteria was applied on the subject area, choosing "Computer Science", "Business, Management and Accounting" and "Economics, Econometrics and Finance." Another search was carried out using the following

terms: “ERP” or “Enterprise Resource Planning” and “RPA” or “Robotic Process Automation”, but it was noticed that most of the publications were already included in the database obtained in the first search. Therefore, the two resulting databases were merged and duplicates were removed.

The papers selected for analysis were published between 2015 and 2024. This time period was chosen due to the fact that the concepts under investigation are relatively new, with most of the relevant papers on the integration of ERP systems with automation technologies being published in this time range. The results have been restricted according to the language in which they were written, in this case selecting English. In addition, papers whose content was not fully available were removed. The papers that remained after filtering have been manually analyzed based on title and abstract content to ensure that they can all make a meaningful contribution to the analysis.

In the end, a total number of 284 publications was obtained and will be analyzed using the software VOSviewer. This study aims to answer the following questions:

1. What are the most frequently used terms in publications on integrating ERP systems with RPA or other solutions for automation and what are the correlations between them?
2. What is the evolution of the number of publications between 2015 and 2024 related to the integration of ERP systems with RPA or other automation solutions?
3. What is the distribution of types of publications related to the integration of ERP systems with RPA or other automation solutions?
4. What are the most cited publications on integrating ERP systems with RPA or other automation solutions?
5. In which countries have most publications been published on the integration of ERP systems with RPA or other solutions for automation and what are the collaboration trends between them?

Therefore, the methodology presented above was used to identify the most significant academic papers that were included in the research. In the results section, the conducted analysis will be described in order to discover the answers to the five research questions.

Results and discussions

In order to answer the research questions, the results of the analysis conducted on the basis of the publications extracted from Scopus, will be presented in the form of figures, graphs and tables, as well as their interpretation. It will include the analysis on the most used keywords, the number of publications by year, the distribution of types of papers, studies with the highest number of citations, and also analysis of the countries that have contributed most to the development of the field regarding the integration of ERP systems with RPA solutions or with other technologies for digitalizing and automation.

Analysis of the author keyword co-occurrence

Through this analysis, the most used keywords from the selected papers will be determined in order to identify topics of interest in the field and the correlations between them. Using the VOSviewer software, the co-occurrence network of keywords with at least three occurrence was generated. In this way, 64 words were grouped into eight clusters. Each cluster has a different color, and the terms included in the clusters are divided by topics of interest (Donthu et al., 2021).

In Figure 2 it is possible to identify some of the main keywords, the top 10 with the highest number of occurrences being: “erp”, “industry 4.0”, “enterprise resource planning”, “automation”,

“erp systems”, “artificial intelligence”, “robotic process automation”, “enterprise resource planning (erp)”, “process mining” and “rpa.”

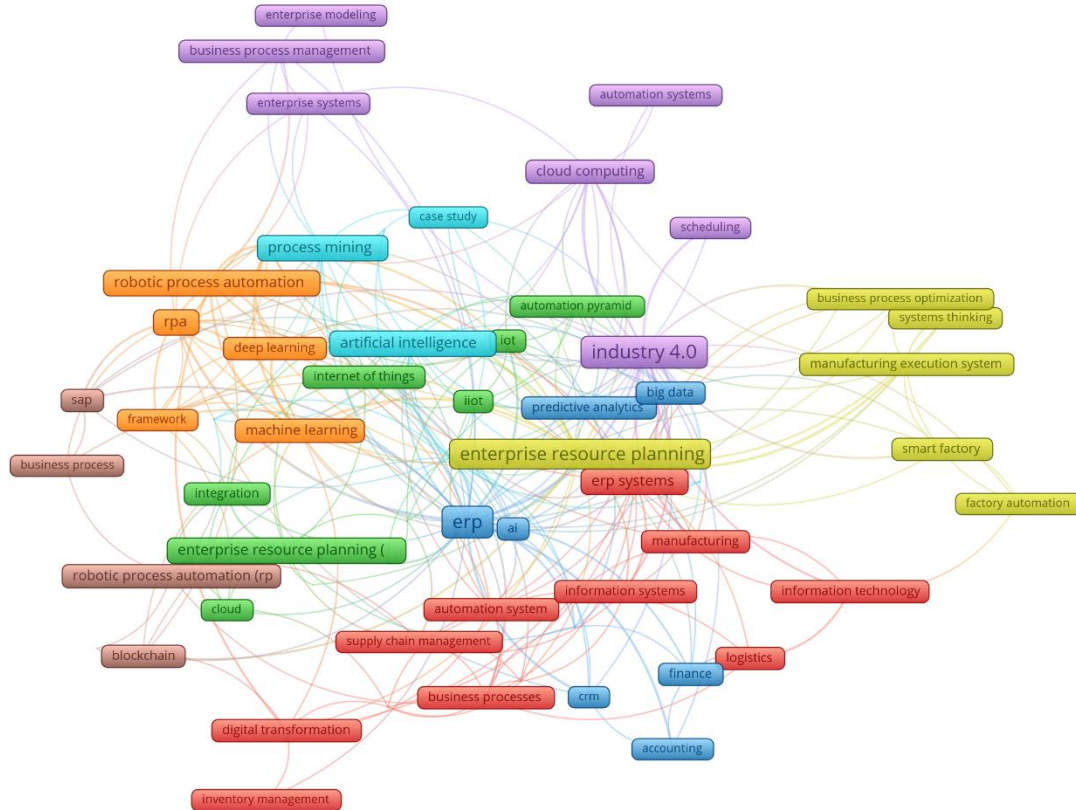


Figure 2. Keywords co-occurrence network visualization

Source: Authors' own research processed with VOSviewer.

In the generated figure, the nodes are represented by the keywords, and the size of the node is given by the number of occurrences of the word in the database papers (Donthu et al., 2021). When analyzing all the terms appearing in the previous figure, it can be observed that “erp” has the highest number of occurrences, but also the highest total link strength (TLS). Thus, this is a topic of interest for the analyzed studies.

In addition, the nodes are interconnected in order to create an overview of the links between the relevant topics discussed in that area (Donthu et al., 2021). The keywords “robotic process automation” and “rpa” are strongly connected to terms such as “erp”, “business process”, “sap”, “artificial intelligence”, “blockchain” and “machine learning,” an aspect that can only represent the growing interest in the literature on the integration of innovative solutions for process improvement within economic entities.

Additionally, it can be noted that the strongest connection is between “erp” and “rpa” compared to the one between “erp” and other automation solutions. This shows that in the publications included in the analyzed database, in most cases, software robots are used to optimize processes and simplify the tasks of employees, to the detriment of other types of innovative technologies.

Analysis of the number of publications per year

By analyzing the evolution of the number of papers published in a particular period, it is possible to determine when a topic was most debated by researchers, as well as some important aspects concerning the development of the field. As can be seen in Figure 3, with the passage of time and the emergence of new technologies, the number of academic studies presenting topics related to the integration of innovative tools for digitalizing and automation in economic entities is increasing. Between 2018 and 2024, although there have been fluctuations in the number of publications, there has been an increase in academic interest in this field, compared to the first three years analyzed.

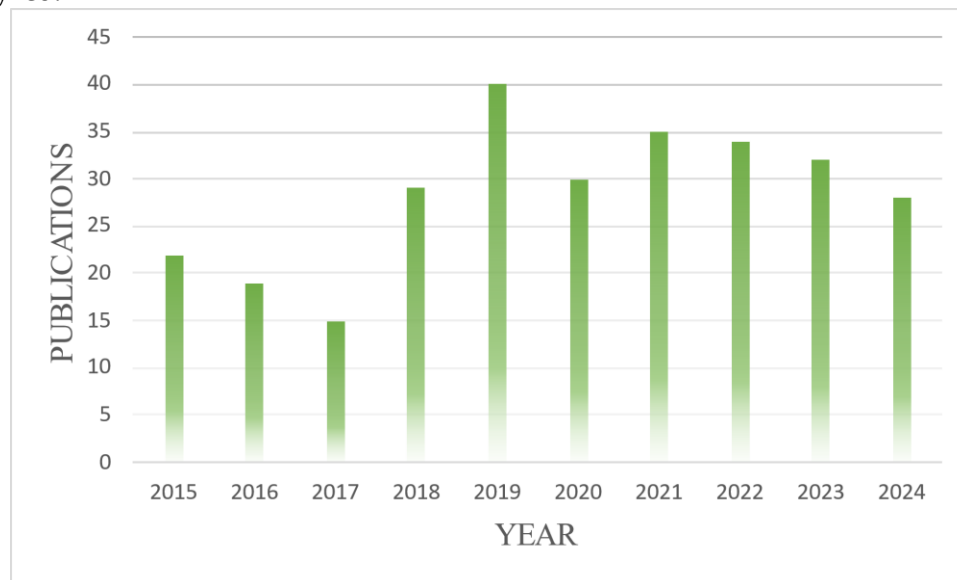


Figure 3. Evolution of the number of publications per year

Source: Authors' own research.

It can be highlighted that since 2018, several papers related to the integration of ERP systems and RPA solutions or other automation technologies have been published in the scientific literature. The highest number of publications was reached in 2019, with 40, approximately 14% of the total number of papers in the analyzed database. Further, also analyzing the content of the publications, it can be seen that all the studies with main topics related to the integration of RPA solutions were published after 2019. Tongsuksai and Mathrani (2020) obtained the same results following an analysis of a database including papers related to the integration of cloud ERP with Industry 4.0 technologies, 2019 being the year in which most studies were published also on this topic.

Also, many studies on the integration of ERP with RPA or other automation solutions were published in 2021 and 2022, a number of 35 and, respectively, 34 papers. Therefore, 2019, 2021 and 2022 can be considered representative years for the field.

Analysis of the number of publication types

The distribution of the types of publications in the Scopus-extracted database can be visualized below, highlighting the variety of types of studies in this field. After filtering the database, 173 conference papers remained. This is the most common type of publication in the analyzed case, covering approximately 61% of the total. Articles represent 27.46% of the total volume of papers, more precisely a number of 78, followed by book chapters.

Thus, according to the information shown in Table 1, researchers writing papers on topics such as the integration of ERP and RPA or other tools for process automation are predominantly choosing to present their results at conferences and to disseminate their work in indexed academic journals. It was noted that the focus of the papers was on practical examples, with a small number of theoretical and literature review papers. Furthermore, no trend could be observed between the type of publications and specific research topics or years of publication.

Table 1. Distribution of publication types in Scopus

Publication Type	Number	Percentage
Conference paper	173	60.92%
Article	78	27.46%
Book chapter	27	9.51%
Book	3	1.06%
Review	2	0.7%
Editorial	1	0.35%
Total	284	100%

Source: Authors' own research.

Analysis of the number of citations of publications

By analyzing the number of citations of publications in the database, it is possible to identify the most widely used studies that have contributed to the development of the field. The papers mentioned in Table 2 are the most cited in the academic literature on the analyzed topic. In the first four papers, ideas are outlined from a more general perspective with a focus on digital transformation and how emerging technologies are influencing the way operational processes are carried out, without focusing on specific technologies. It can also be noted that, although the first three papers are recently published, they have a high number of citations both in total and per year. Therefore, researchers have been recently paying particular attention to these topics.

Table 2. Top 20 most cited publications

No.	Publications	Number of citations	Number of citations per year
1	Ivanov et al. (2021)	317	79.25
2	Balsmeier & Woerter (2019)	223	37.17
3	Hartley & Sawaya (2019)	141	23.5
4	Weichhart et al. (2016)	121	13.45
5	Zdravković et al. (2022)	52	17.33
6	Karimanzira & Rauschenbach (2019)	45	7.5
7	Marmolejo-Saucedo et al. (2020)	45	9
8	Werner et al. (2021)	44	11
9	Wang et al. (2016)	44	4.89
10	Badewi et al. (2018)	33	4.71
11	Xu et al. (2021)	27	6.75
12	Hadidi et al. (2017)	27	3.38
13	Majstorovic et al. (2020)	22	4.4
14	Antonino et al. (2019)	21	3.5
15	Salcic et al. (2019)	21	3.5

No.	Publications	Number of citations	Number of citations per year
16	Wachnik (2022)	20	6.67
17	Shree et al. (2020)	20	4
18	Eros et al. (2019)	18	3
19	Liu et al. (2019)	18	3
20	Kannoth et al. (2021)	17	4.25

Source: Authors' own research.

Furthermore, in the other positions in the table there are researches focusing on topics related to Industry 4.0 such as: the integration of ERP and innovative tools for making work easier (Shree et al., 2020; Kannoth et al., 2021; Wachnik B., 2022), robots and automation (Xu et al., 2021; Salcic et al., 2019; Eros et al., 2019), the use of ERP systems (Badewi et al., 2018; Hadidi et al., 2017; Majstorovic et al., 2020), cloud computing used in small and medium enterprises (Wang et al., 2016; Liu et al., 2019) and other topics that add value to the literature.

It is also relevant to mention that the majority of the most cited publications are academic articles. They illustrate new concepts that are of interest to researchers or useful solutions for economic entities.

Analysis of countries with the largest number of publications

Using this type of analysis, it will be possible to identify the countries with the most publications on the use of ERP, RPA or other technologies for automation and also the collaborations between authors from different countries. As can be seen in the Figure 4, the countries of origin of the authors who wrote the most papers on the analyzed topic between 2015 and 2024 are: India, Germany, United States, Russia, and China.

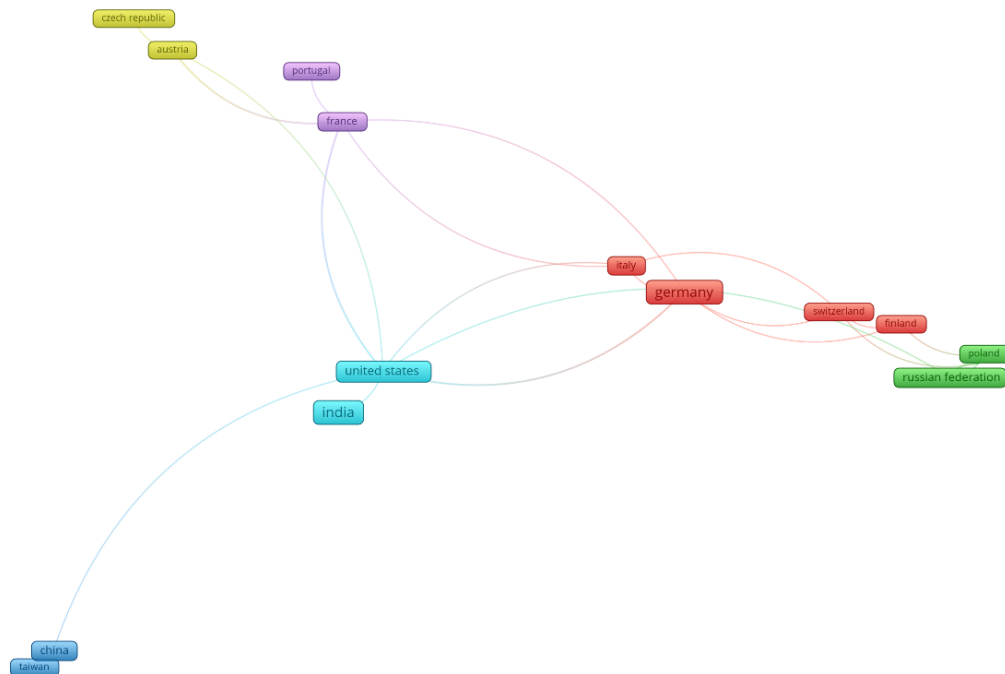


Figure 4. Visualization of the co-authorship network by country

Source: Authors' own research processed with VOSviewer.

In both India and Germany, 33 papers were published, and in the United States a number of 24, together representing approximately 32% of the total publications in the database. Some of the reasons why they are the countries with the most published studies would be the high number of researchers, the existence of well-known institutions, and the research funds.

Collaboration networks between countries can also be identified, the United States having a total link strength (TLS) of 9 and France 7. Thus, authors from the United States have two collaborations each with authors from France and Germany and one each with authors from India, China, Russia, Austria and Italy. The French researchers have also collaborated, in addition to their two collaborations with the American authors, they have worked on two other studies with researchers from Austria.

Therefore, according to the geographical distribution of the publications in the database, it can be emphasized that the greatest interest in ERP systems, RPA solutions or other technologies used integrated within economic entities, is presented by developed or developing countries, which also rely on collaborations to increase the quality of the resulting academic work. There is a lack of collaboration between authors from developed countries and those from less developed countries with limited access to resources.

In addition to the above, it is also important to note that from universities in Germany, Vietnam, India, and others, there are two publications each that have been relevant to the topic discussed, with strong academic impact. At the same time, these have a high number of citations, with German universities having authors with research ranked in the top 20 publications with the most citations noted in Table 2.

Conclusions

In today's digitalization era, economic entities are turning their attention to the use of the latest technologies that can generate numerous benefits, such as improving processes, reducing the risk of errors, maximizing performance, and increasing employees' job satisfaction. Some of the technologies that can be easily integrated within an enterprise are ERP systems and RPA solutions, which have been presented in detail in the first part of the current study. However, these are not the only efficient options. As studies show, there are several types of Industry 4.0 specific technologies that can bring competitive advantages on the market.

With the help of a bibliometric analysis, it was possible to identify the main keywords used by the authors in studies on the integration of ERP systems with RPA or other automation solutions, these being in particular: "erp", "industry 4.0", "automation", "artificial intelligence", "robotic process automation". The bibliometric analysis was performed on a database that included 284 academic publications extracted from Scopus, the selected period being 2015 – 2024. The years in which the most research has been published are 2019 and 2021 and the predominant types of papers are conference proceedings and articles. The most frequently cited studies in the database are those that present an overview of innovative Industry 4.0 technologies, those that focus on the usefulness of ERP systems and their integration with other solutions, or papers that discuss the importance of using automation technologies based on robots. At the same time, it the collaborations between authors from countries such as United States, Germany, France can be noticed, but the country with the highest number of published studies is India.

All these aspects are also illustrated by using figures or tables to facilitate understanding of the analysis and the results obtained. Therefore, this study presents the importance of the integrated use of new technologies, such as ERP systems with RPA or other solutions based on automation and digitalization, as well as emerging trends in the literature. The information described here can be useful for economic entities that want to turn their attention to digitalization in order to face the challenges that constantly arise on the market. At the same time, based on the current study, researchers can carry out more complex analysis, which is just a starting point for future work. Some aspects that could be mentioned regarding the limitation of the research would be the use of a single database for the extraction of publications and the limited number of studies strictly related to ERP and RPA integration. Furthermore, given that only a few literature review studies addressing these topics were identified in the database, future research could conduct literature reviews focusing strictly on the integration of ERP and RPA to explore the field in more detail and gain a clearer picture of trends and gaps.

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