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MICHAŁ CIOCH
Lublin University of Technology, Poland
ORCID iD: 0000-0003-2674-6559

JOLANTA SŁONIEC
Lublin University of Technology, Poland
ORCID iD: 0000-0002-8869-5059

OUTSOURCING IN THE AGE OF ARTIFICIAL INTELLIGENCE: CURRENT TRENDS AND DEVELOPMENTS

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Abstract

Purpose: *The aim of the article is to identify trends in the application of modern technologies, with particular emphasis on artificial intelligence (AI), in the context of outsourcing practices from 2019 to 2024 and to determine future research directions in this area.*

Methods: *Using bibliometric analysis of keyword co-occurrence, four thematic clusters were identified, suggesting the main areas of research. Subsequently, by analysing the co-occurrence of keywords, the overall strength of keyword connections in the network, abstracts, and article contents, four dominant trends were identified.*

Results: *(1) The growing role of artificial intelligence in the automation and optimization of processes, (2) data security and privacy as a priority in outsourcing, (3) the integration of artificial intelligence with other technologies to support complex outsourcing processes, and (4) the use of advanced data analytics and personalization in outsourcing. Based on the analysis and identified research trends, potential research directions have been proposed.*

Overview: *The work highlights the interdisciplinarity of outsourcing practices in connection with the latest technologies. Moreover, the need for further exploration of the role of artificial intelligence in increasing efficiency, competitive advantage, and security of enterprises in their outsourcing strategies.*

Practical implications: *The research findings include practical guidance for, among others: (1) procurement departments and IT managers, in terms of prioritizing the implementation of AI and blockchain-based supplier selection systems; (2) HR departments, in terms of using AI to automate recruitment processes and manage employee performance; (3) outsourcing service providers, in terms of personalizing AI-based services for clients. Companies that adopt these practices can expect to improve operational efficiency, enhance data security, and gain a competitive advantage in increasingly technology-driven markets.*

Keywords: *business intelligence, outsourcing, blockchain security, digital transformation, artificial intelligence*

1. Introduction

Outsourcing is a practice that allows companies to conduct business activities more autonomously by delegating processes and tasks to external entities (Lair, 2019). The use of this practice is associated with many benefits, such as reducing operational costs and the possibility of developing the company's key competencies (Słoniec, 2021). Recent years in the field of research and business practices of enterprises show an increasing dependence of the outsourcing concept on artificial intelligence and other latest technologies (Beulen et al., 2022; Słoniec et al., 2018). They were characterized by the intensification of the development of artificial intelligence-based technologies, which are applied in various sectors and industries of the economy. These technologies play a significant role in optimizing business processes, which in turn gives companies the opportunity to use tools that allow for cost reduction and adaptation to the changing market environment.

Artificial intelligence (AI)-assisted outsourcing activities raise concerns about dehumanization and data security. However, the growing trend of using AI-based technologies to perform business tasks has led to the development of the concept of *smart* outsourcing. It integrates advanced technologies to increase the efficiency of business processes. Although its main aspect is the focus on humanization, meaning the use of technology not only to reduce costs in task delegation or other fundamental factors of outsourcing, but also to support employees and increase their productivity and job satisfaction (Heyder et al., 2023; Oshri et al., 2025). Therefore, the delegation of selected processes does not have to be associated with a reduction of employment in the company (Matytsin et al., 2023; Pizoń & Gola, 2023).

In the age of artificial intelligence, various business processes, including outsourcing, are being revolutionized. The integration of AI encompasses various sectors, such as marketing, customer service, and supply chain management, enabling businesses to enhance their competitiveness (Fischer-Preßler et al., 2024; Zyryanova et al., 2024). The significance of AI lies in harnessing its potential for task automation, solving complex problems, and driving innovation across various industries (Zahid Kamal Siddiqui et al., 2024). In human resource management, artificial intelligence streamlines recruitment, training, and performance management (Bojanowska & Kulisz, 2023; Stone et al., 2024).

However, in production and supply chains, AI transforms operations by reducing human intervention and finding more efficient solutions (Mandala & Dolu Surabhi, 2024).

Integrating the latest technologies into outsourcing brings both challenges and benefits. The benefits include cost effectiveness, innovation and flexibility (Simões & Santos, 2024). Challenges include a range of limitations such as infrastructure constraints, maintenance capacity, and inadequate training. (Cioch & Kulisz, 2023; W. G. Dolo. & S. Flomo, Jr., 2024). In addition, there is employee resistance to change, fear of job loss, and negative attitudes toward working with the latest AI-based tools (Cioch et al., 2024; Dr. Ranbir, 2024; Pizoń et al., 2022). Careful planning, clear goals, and regular evaluation are needed to maximize the benefits and minimize the problems associated with using the latest technologies in outsourcing (Hossain et al., 2024; Pizoń et al., 2023).

On the other hand, the use of AI tools can be helpful in making decisions based on data analysis and predicting possible scenarios. For example, when selecting a new business partner, artificial intelligence can be used for credibility analysis, assessing the financial situation or reputation of these enterprises based on data available in public sources. Moreover, AI can assist in the selection process during recruitment by automating CV checks, data analysis, and suggesting personalized interactions with candidates (Efrita Norman & Enah Pahlawati, 2024).

In summary, artificial intelligence is becoming increasingly important in various sectors of the economy, particularly in streamlining processes within companies. Its main applications include data analysis, process automation, and improving the efficiency and effectiveness of decision making. Although it can be difficult to implement new technologies because they are expensive and complicated, AI can help bring about major changes that make companies more innovative and competitive (Bruno, 2024; Klymenko & Polova, 2024; Sánchez-García et al., 2024; Walia, 2024). Particularly interesting is the use of AI in outsourcing practices, which are widely used in companies. The analysis of trends and research directions will allow to understand the current ways of shaping business strategies in enterprises and creating innovative solutions in process management.

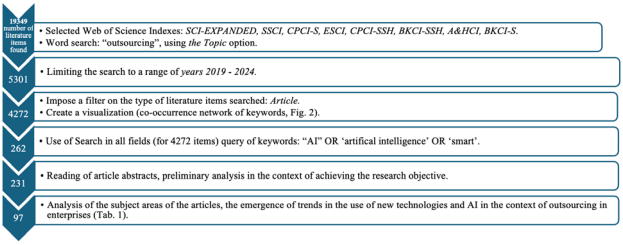
The purpose of this article is to look at how modern technologies, such as artificial intelligence (AI), will be used in outsourcing over the next five years, from 2019 to 2024, and to suggest some important new directions for research in this area.

2. Methodology

Bibliometric analysis of keyword co-occurrence is a way to find trends in how the latest technologies are being used, such as AI in the context of business outsourcing. This method allows you to find research trends or how ideas change over time in many different scientific fields. It then gives you ideas for current research topics and possible directions for future research (Taqi, 2019).

This analysis allowed for the identification of key trends and their evolution from 2019 to 2024, as well as an understanding of which technologies and outsourcing practices are gaining importance in companies. It also allowed us to identify changes in research priorities and business practices over the period. Figure 1 illustrates the research process.

Fig. 1. *Steps of the research methodology*



Source: Own elaboration.

The drawing (Fig. 1) illustrates the detailed process of selecting and analyzing scientific literature to identify trends in the application of new technologies, including artificial intelligence (AI), in outsourcing in enterprises from 2019 to 2024. This process is illustrated by a sequence of steps leading from the selection of specialized literature in the research area, through its filtering and selection, to the analysis and drawing conclusions about trends in the study period.

The selection of citation indices (SCI-EXPANDED, SSCI, CPCI-S, ESCI, CPCI-SSH, BKCI-SSH, A&HCI, BKCI-S) ensured a wide range of disciplines related to outsourcing and artificial intelligence, from management, business and social sciences to computer science, engineering and related technical fields. Only English-language items were searched for, and in the third point, in order to limit the number of items, the item type was restricted to articles only.

The result of 4272 articles was narrowed down by applying additional keyword searches using logical operators. The keywords *AI*, *artificial intelligence*, and *smart* were selected because they represent basic concepts related to artificial intelligence. This reduced the number of articles to 262.

Next, as part of the manual selection process, article abstracts were reviewed, excluding studies not related to business process outsourcing, resulting in 231 items. Finally, the texts were read and 97 articles were selected for analysis.

A threshold value of 15 keyword occurrences was selected to ensure a balance between map readability and depth of analysis in a relatively large data set. Similar or lower values are commonly used in keyword co-occurrence studies (including those using VOSviewer software). Authors often set minimum occurrence values between 5 and 10 for medium-sized data sets and higher values for larger samples to avoid illegible, difficult-to-interpret maps (Lim et al., 2024).

A key element was the gradual narrowing of the scope of the literature to focus on the most significant studies that allow drawing conclusions about changes and development trends in the application of new technologies in outsourcing.

VOSviewer parameters included association strength normalization of link weights, where link strength between keywords i and j is calculated as:

$$S = \frac{c_{ij}}{s_i s_j} \tag{1}$$

Where:

c_{ij} – co-occurrences,

s_i and s_j – total occurrences of each keyword (N. J. V. Eck & Waltman, 2009).

The VOS layout technique used default attraction=2 and repulsion=1 parameters, with clustering resolution=1.0 and minimum cluster size=10. Visualization settings displayed at most 1000 strongest links (min. strength=1) (N. J. Eck & Waltman, 2023).

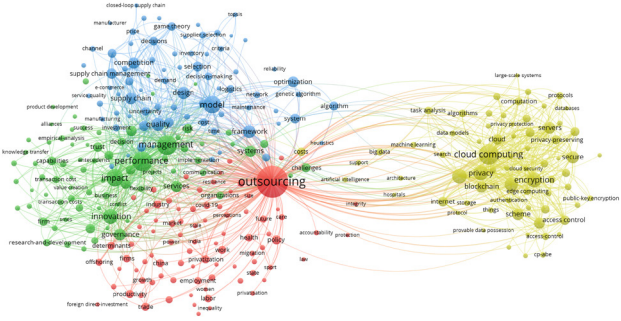
3. Results and discussion

By following the steps outlined in the previous chapter, it was possible to make a co-occurrence network of keywords, look at the connections between them, and find trends during the period that was studied, which was supported by previous research on the subject.

3.1. Analysis of keywords and their co-occurrence

We created a visualization after completing the initial, basic methodological tasks. The tasks included defining the indices of the Web of Science database, searching for the keyword, and limiting the search to the type of entry *Article* for the years 2019-2024. Thus, we limited the number of subject literature entries in the research area to 4272 articles. Figure 2 presents the co-occurrence network of keywords.

Fig. 2. *Co-occurrence of keywords*



Source: Own elaboration.

Fifteen occurrences in publications are the cutoff value for co-occurrence. The final number of keywords is 310. The node size represents the number of occurrences, while the distance between nodes represented by the lines between them indicates the co-occurrence link. The network was created with VOSviewer.

The above network was created using the above constraints (number of references and keywords), taking into account the relationship between readability and quality of the network visualization. The basic search for the keyword *outsourcing* led to its central placement. We identified four clusters,

which we can divide thematically and mark with colors in the figure. Table 1 shows the 10 keywords with the highest number of occurrences in the subject literature for each cluster.

Tab. 1. *Occurrence and total strength of keyword links for clusters*

Red cluster			**Yellow cluster**		
Keyword	**Occurrences**	**Total link strength**	**Keyword**	**Occurrences**	**Total link strength**
outsourcing	888	3641	cloud computing	354	1632
policy	77	296	encryption	200	1054
determinants	60	314	privacy	191	877
productivity	59	242	security	190	902
privatization	58	237	efficient	163	762
work	57	191	secure	132	588
industry	56	257	servers	125	860
health	54	184	blockchain	117	542
employment	54	185	cloud	97	490
globalization	44	150	internet	91	494
Green cluster			**Blue cluster**		
Keyword	**Occurrences**	**Total link strength**	**Keyword**	**Occurrences**	**Total link strength**
management	345	1795	model	271	1288
performance	338	1843	quality	153	755
impact	266	1360	framework	139	696
innovation	205	1072	supply chain	121	563
governance	121	591	competition	116	616
systems	115	535	optimization	107	387
information	96	487	supply chain management	100	545
technology	85	445	system	88	376
knowledge	83	457	strategies	84	453
strategy	81	455	selection	84	402

Source: Own elaboration.

The keywords in the table are sorted in descending order based on the Occurrences column. The higher the total link strength value, the higher the co-occurrence strength of the given keyword.

The red cluster focuses on the social and economic impacts of outsourcing. These impact areas include policy, labor, and productivity. The word *globalization* refers to one of the main characteristics of outsourcing, development through the global use of resources. This cluster also includes topics related to the analysis of the determinants that lead companies to delegate tasks and processes.

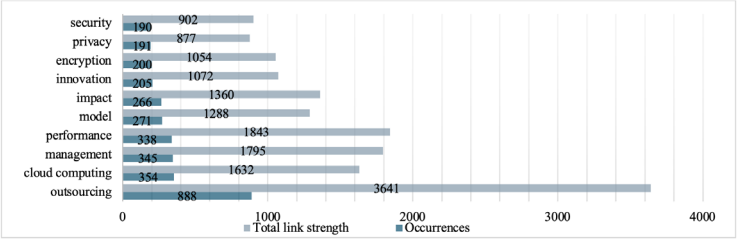
The yellow cluster concerns modern technologies, including *cloud computing*, which is the most commonly used term, as well as data security and privacy. Scientists in this cluster might also study how well security measures work, including security measures such as encryption and blockchain. The yellow cluster also has the keyword *artificial intelligence* in the visualization, near other keywords like *big data* and *machine learning,* as well as the red cluster. However, it may indicate a growing interest in using AI to automate, optimize, or analyze business and decision-making processes in organizations.

The green cluster focuses on management, innovation and the analysis of business performance and efficiency. Research in this area may cover topics such as the development and implementation of management strategies, the impact of innovation on economic development, the coverage of management strategies, the impact of innovation, and competitiveness.

The blue cluster represents areas related to process modeling, quality management, and supply chains. These studies may include development and testing focused on process modeling, quality management, and supply chain optimization.

Summarizing the characteristics of individual clusters can provide a compilation of the 10 most common keywords for the entire network. This is shown in Figure 3.

Fig. 3. *Occurrence and total strength of keyword links for network*



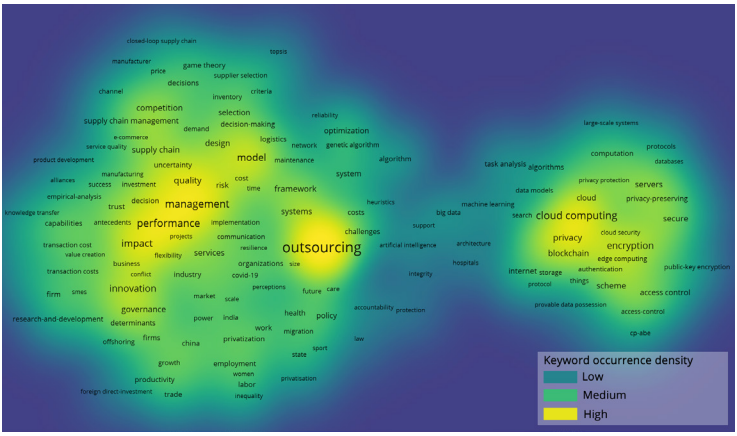
Source: Own elaboration.

In the literature reviewed, topics such as management, process modeling, and new digital technologies appear in the keyword list, along with the main area of outsourcing. The keyword co-occurrence analysis shows that the ideas of cloud computing and data security appear frequently. This shows the growing importance of digitalization and its impact on the growth of business and society. On the other hand, issues related to management and innovation highlight the need for effective use of new technologies and management methods in a dynamically changing business environment.

However, the values of total link strength and connections in the network visualization indirectly indicate the complexity of today's challenges, which require a multidisciplinary approach. For example, the development of cloud technologies is analyzed not only from a technological perspective, but also from management, outsourcing, security, and economic policy perspectives.

The analysis shows that technologies such as artificial intelligence, machine learning, blockchain technology, and cloud technologies play a key role in the transformation of outsourcing. Cloud computing, as one of the most frequently co-occurring terms, is associated with keywords related to efficiency. This may indicate that companies using this technology, such as outsourcing computing or data processing, can increase operational efficiency. On the other hand, blockchain appears as a technology related to security and transparency, with the presence of keywords such as *security, privacy, authentication,* or *smart contracts.* This can be important, especially in the management of outsourcing contracts. Blockchain technology can become a key tool to ensure the security and integrity of data in outsourcing. An alternative visualization of keyword density is a heat map (Figure 4).

Fig. 4. *Heat map of keyword occurrence*



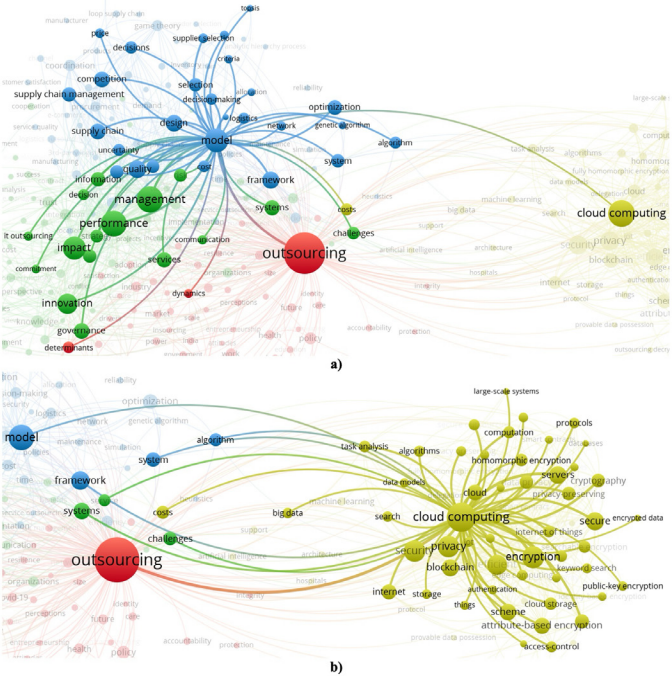
Source: Own elaboration.

The heatmap above uses occurrences as values to represent the density of keyword occurrences. A lighter color and larger font size indicates a higher density of occurrences – in this case, keywords – from 2019 to 2024. The density of keyword occurrences decreases as the colors change to darker ones, sequentially green and blue, and as the font size decreases.

In summary, the preliminary analysis of the co-occurrence network of keywords, along with the number of occurrences and total link strength for

clusters and the whole network, indicates the growing role of digitization and modern technologies, including AI, in the studied area. It also presents the network visualization (Fig. 5) for the keyword model and cloud computing. Highlighting the selected keywords allowed us to see specific connections between the clusters.

Fig. 5. *Co-occurrence of keywords for the keywords a) 'model' and b) 'cloud computing'*



Source: Own elaboration.

In today's world, where companies are delegating more and more tasks and processes to optimize core activities, an interdisciplinary approach to management and decision-making can play a crucial role in maintaining competitiveness and business development. For example, using artificial intelligence to help make decisions about outsourcing tasks to external partners can make these types of processes much more accurate and efficient. On the other hand, integrating the latest technologies into business management practices can enable a more dynamic response to market changes, which is essential for

the long-term success of the business. On the other hand, it requires certain investments in technologies or systems that support data protection.

3.2. Areas of occurrence of the outsourcing concept – overall results

We reduced the number of selected articles after completing the next research steps, which included narrowing the results with additional keywords and reading the abstracts. Based on these results, we identified the main research directions for the study period. Table 2 presents them by year and specifies certain elements of the relevant literature.

Tab. 2. *Trends in the use of the latest technologies and AI in the context of outsourcing in 2019-2024*

Year	Research directions	Literature
2019	Process optimization and subcontractor management	(Afanador et al., 2019; Ai et al., 2019; Graham et al., 2019; Tang et al., 2019)
	Secure storage and processing of outsourced data using blockchain technology	(Ahene et al., 2019; L. Chen et al., 2019; Eltayieb et al., 2019; El-Yahyaoui & Ech-Cherif El Kettani, 2019; Neto et al., 2019; Qiu et al., 2019; Santalova et al., 2019; S. Wang et al., 2019; Y. Wang et al., 2019; J. Xue et al., 2019; K. Xue et al., 2019; J. Zhang et al., 2019)
2020	Safe processing and sharing of data in cloud and IoT	(R. Chen et al., 2020; Elhabob et al., 2020; Samanthula et al., 2020; Sarfraz et al., 2020; X. Yang et al., 2020; Ye et al., 2020)
	Management and optimization of resources	(A. Khan et al., 2020; Kumar & Chand, 2020; F. Li et al., 2020; Lin et al., 2020; Liu et al., 2020)
	AI in operations and business processes	(Bogoyavlenska et al., 2020; Carter, 2020; Chasin et al., 2020; Dolman et al., 2020)
	AI and Blockchain in Ensuring the Security and Integrity of Outsourced Data	(Alex et al., 2020; Awan et al., 2020; Dorsala et al., 2020; F. Li et al., 2020; Niu et al., 2020; Sadati et al., 2020; Su et al., 2020; Tomic & Schneider, 2020)
2021	Blockchain technology and data security processed by a business partner	(Guo et al., 2021; H. Li et al., 2021; C. Wang et al., 2021; H. Wang et al., 2021; J. Wang et al., 2021; J. Yang et al., 2021)
	Outsourcing decisions supported by AI	(Barik & Rout, 2021; De Luca, 2021; He et al., 2021; Tian et al., 2021)
	Cloud computing and data processing optimization through AI	(Fan et al., 2021; G. Hu et al., 2021; J. Zhang, Cheng, et al., 2021; J. Zhang, Lu, et al., 2021; L. Zhang et al., 2021)
	Security and privacy in IoT systems	(Fan et al., 2021; G. Hu et al., 2021; J. Zhang, Cheng, et al., 2021)
2022	Application of AI in business analytics and decision optimization	(S. Khan et al., 2022; Pang et al., 2022; Sifah et al., 2022)
	Cloud computing as a tool for AI and big data	(Oravec, 2022; Owida et al., 2022; Zhao et al., 2022)
	Data security and privacy in IoT environments	(Nguyen et al., 2022; Qi et al., 2022; X. Wang et al., 2022)
	Blockchain and AI in ensuring data transparency and integrity	(Ge et al., 2022; Rahman et al., 2022; X. Yang et al., 2022)
	Process automation with AI support	(Al-Turjman & Deebak, 2022; H. Hu et al., 2022; Shi, 2022; Wongtada, 2022)
2023	Artificial Intelligence in Data Management and Business Analysis	(Dunleavy & Margetts, 2023; B. Li, Hou, et al., 2023; B. Li, Zhu, et al., 2023; H. Li et al., 2023; J. Li et al., 2023; Luo et al., 2023; Sun et al., 2023)
	Blockchain in ensuring security and transparency in outsourcing operations	(Jung et al., 2023; Swathika & Sekar, 2023; H. Wang et al., 2023)
	Cloud computing supports the flexibility and scalability of outsourced processes	(B. Li, Zhu, et al., 2023; J. Wang, He, et al., 2023; Zou et al., 2023)
	Automation of business processes using AI	(Abdelfattah et al., 2023; Ali et al., 2023; Gao et al., 2023)
	Cybersecurity and data privacy in the context of IoT and outsourcing	(Bankwitz et al., 2023; Muldoon et al., 2023; J. Wang, Lin, et al., 2023)
2024	The application of AI in the personalization of outsourcing services	(Marabelli & Lirio, 2024; Sadowski et al., 2024; Saidi et al., 2024)
	Integration of AI solutions with CRM and customer management systems	(Chakraborty et al., 2024; Exceline & Nagarajan, 2024; Maji et al., 2024)
	Advanced data analysis tools supported by AI	(Fassbender, 2024; R. Li et al., 2024; Zhou et al., 2024)
	Automation of business operations with an emphasis on cost reduction	(Huang et al., 2024; Veigt & Freitag, 2024; H. Wang et al., 2024)
	The application of blockchain in tracking and managing outsourcing data	(Hao et al., 2024; Humayun et al., 2024; Martínez, 2024)

Source: Own elaboration.

The analysis of selected literature on the topic shows that between 2019 and 2024, changes in the use of new technologies, including artificial intelligence in outsourcing, will be observed. They may reflect the growing adaptation of companies, but also the demand for these technologies.

In 2019, the main areas will be those related to improving operational efficiency and managing relationships with external service providers. In addition, the issue of security of data storage and processing with business partners is emerging. What can emerge from the growing awareness of the need to protect sensitive data? Among other things, a secure payment protocol based on blockchain technology has been proposed, which uses artificial intelligence to ensure fair and direct transactions without the involvement of third parties (Tang et al., 2019).

Conversely, in 2020, research directions emerge that point to the increasing integration of AI in the implementation of processes in companies. Once again, the issue of data security in cloud processing using blockchain technology arises. For example, AI models have been used in process outsourcing within smart energy grids to efficiently collect data on energy use and dynamically manage energy distribution (Liu et al., 2020).

In 2021, existing trends will continue to evolve, with a focus on blockchain technology in the context of data security and AI-enabled outsourcing decisions. The research also looked at the strategic outsourcing decisions made by companies. In addition, the role of cloud computing in optimizing data processing has increased. The growing popularity of cloud computing has increased the need to ensure data security. A blockchain-based distributed data integrity audit system has been proposed. This would allow users to store data without relying on a third-party auditor, protecting their privacy at a lower cost. (H. Wang et al., 2021). In addition, an AI-based system was developed to assist in the evaluation and selection of various reverse logistics service providers (C. Wang et al., 2021).

In 2022, research will continue to develop AI technology in business analytics and decision optimization. Researchers will continue to explore blockchain technology to ensure security and transparency in operations, including outsourcing. For example, AI can be used to automate delegated HR tasks, and blockchain technology and modern encryption methods can be used

to share patients' electronic health records that are stored and processed in external clouds (Shi, 2022; X. Yang & Zhang, 2022).

In 2023, research directions will revisit the topic of AI in supporting business data analysis and the security and integration of data in cloud computing using blockchain technology. Researchers have proposed an infrastructure for a crisis management system that can be integrated with the current infrastructure by outsourcing to cloud computing. This system, based on artificial intelligence, is capable of automatically allocating resources after an emergency situation occurs (Nanda et al., 2023). In addition, a scheme is presented that enables efficient management of the encryption of data outsourced for cloud processing (Shen et al., 2023).

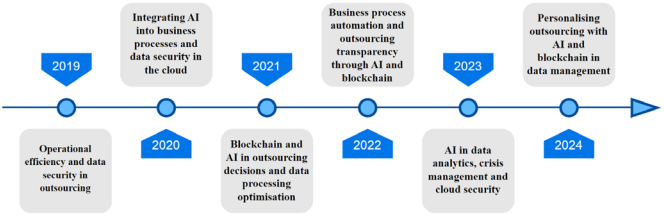
In 2024, researchers were most interested in how AI could be used to personalize outsourcing services, how AI could be integrated with CRM and customer management systems, and how AI could be used to create advanced data analytics tools. There were also discussions about automating business tasks to save money, and using blockchain technology to track and manage data sent to other parties. Thanks to blockchain technology, a system has been created that, among other things, allows encrypted images to be sent while all the work is being done on the servers of outsourcing partners. This frees up users, reduces the load on computers, and improves data security by eliminating the possibility of damage or manipulation during communication (Zhou et al., 2024). In addition, the yellow cluster (Figure 2), which is related to cloud computing, AI, or big data, is less associated with the keyword *outsourcing* than the clusters before it. Figure 6 shows a timeline of the general research areas from 2019 to 2024, with a focus on the topics studied.

The identified changes and current interests of researchers are consistent with recent bibliometric analyses on the implementation of artificial intelligence. Chiroma et al. (2024) and Egodawele et al. (2022) also found that security and technology integration are key areas of research. However, this study shows that technologies that were studied separately in 2019-2022 (i.e., cloud computing, blockchain technology, and artificial intelligence) were integrated into coherent ecosystems in 2023-2024, particularly in outsourcing relationships and platform-based service delivery. This indicates a shift toward systemic integration, and this evolution is consistent with the current

understanding of digital transformation. Schneider and Kokshagina (2021) emphasize that companies are increasingly recognizing the strategic importance of the implications of combining multiple digital technologies. The observed coordination of artificial intelligence, cloud computing, and blockchain technology in 2023-2024 is an example of this development. Namely, companies that managed to integrate technologies simultaneously rather than sequentially developed superior know-how in coordinating new technologies and increased their competitiveness.

On the other hand, when planning outsourcing strategies and selecting partners, managers should design contracts that focus on suppliers' capabilities. Their expertise in coordinating solutions based on artificial intelligence, cloud computing, and blockchain, rather than solely on cost benefits (Duan et al., 2023).

Fig. 6. *Timeline indicating general research directions by year*



Source: Own elaboration.

Based on the above characteristics, four main scientific trends of the period under study can be defined:

1. The growing role of artificial intelligence (AI) in automating and optimizing business processes.
2. Data security and privacy as a priority in outsourcing (blockchain).
3. Integration of AI with other technologies to support complex outsourcing processes.
4. Personalization and advanced data analytics in outsourcing.

There is growing interest in using advanced AI-based decision-making techniques to delegate tasks and processes or manage subcontractors.

In addition, companies are increasingly recognizing the potential of effective data management and processing. As a result, outsourcing data to cloud storage or processing systems is becoming more common. However, with this demand comes the need to ensure secure and fair payments for these services. Blockchain technology, which is increasingly being used not only to secure payments but also to protect and encrypt corporate data, offers a solution to this situation.

Considering the above areas and trends, future research directions may concern the development of current ones, i.e.:

1. The use of deep learning or natural language processing to automate complex outsourcing tasks. This technology supports decision making, process optimization and risk management in the outsourcing industry.
2. Developing specific security solutions using blockchain technology in outsourcing, including areas such as contract management, data authentication and secure payment systems.
3. Developing AI-based systems to support work ethics in task delegation, including optimizing human resource management.
4. Reviewing the environmental impact of outsourcing, the capabilities of artificial intelligence or other technologies in creating sustainable outsourcing practices.
5. Using AI to tailor outsourcing services to the specific needs of business partners, improve service quality, and increase customer satisfaction.

A study of the co-occurrence network of keywords and some relevant literature, along with trends in the use of new technologies and AI during the period under study, shows that there are strong links between technologies and important management issues such as supply chain management, efficiency, and innovation. These findings could mean that in the future, companies and academic research will focus on how to use outsourcing to combine the latest technologies, such as AI, with operations and process management.

Technologies such as AI, cloud computing and blockchain have influenced the way outsourcing is perceived by companies. Its transformation into a more complex and technologically advanced process, on the other hand, is a result of the growing need for process optimization, efficient data management, and security.

Companies that are able to effectively incorporate AI and new technologies into their outsourcing strategies will gain a competitive advantage by better leveraging global resources and responding to dynamic market changes. Since the inception of outsourcing, key factors for its successful implementation within an organization have been identified.

4. Conclusions

The objective of this study was to identify scientific areas and research trends related to the use of the latest technologies, including AI, in outsourcing from 2019 to 2024. It also aimed to identify potential future research directions in this area. The use of bibliometric analysis of keyword co-occurrence revealed significant trends.

The results of the analysis highlight the growing importance of artificial intelligence, cloud computing and blockchain technology in the delegation of processes within companies. Artificial intelligence is increasingly becoming an integral part of companies' outsourcing strategies for decision making, data analysis and processing, business process automation, and resource management optimization.

These findings confirm and extend the existing literature on outsourcing. The integration of artificial intelligence, cloud computing, and blockchain technology demonstrates a strategic approach to outsourcing and the coordination of partners' competencies in terms of cost minimization (Lahiri et al., 2022). The identified personalization trend (2023-2024) is consistent with the current definition of digital transformation, which focuses on outsourcing and customer relationship-oriented ecosystems (Schneider & Kokshagina, 2021). The results indicate an interdisciplinary evolution of outsourcing from tactical cost reduction to strategic and technological value creation.

Keyword co-occurrence analysis highlights the interconnectedness of areas such as AI, the use of cloud computing, and blockchain technology. For example, in addition to decision support and process optimization, data security and privacy are becoming essential to outsourcing practices. The trends identified in the study point to the growing importance of an interdisciplinary approach

to outsourcing research. Companies are striving to use global resources more efficiently, to adapt dynamically to technological developments in the marketplace, and to realize the potential of processing and analyzing large amounts of data. This underscores the need for future scientific research that integrates management areas with new technology areas.

4.1. Practical implications

The identified trends and directions for future research provide strategic guidance for companies considering or currently implementing AI-enabled outsourcing.

First, practitioners are becoming more aware of the need for secure task and process delegation. Enterprise procurement departments and IT managers should establish an AI-based framework for evaluating suppliers, assessing financial stability and compliance with security requirements, prioritizing data protection based on blockchain technology with distributed ledger capabilities, and implementing AI-based supplier performance monitoring systems (Zhou et al., 2024; Zou et al., 2023).

Second, innovations in artificial intelligence-based human resource management (Stone et al., 2024). HR departments should implement AI-based CV screening and candidate matching systems and adopt 'smart outsourcing' models that retain human oversight and consider ethical issues, rather than full automation, and develop change management protocols that address employee concerns (Cioch et al., 2024; Heyder et al., 2023).

Third, increasing personalization in AI-enabled outsourcing services. Service providers should integrate advanced analytics tools with CRM systems to tailor their offerings to customer needs through predictive measures, and develop a transparent contract management system based on blockchain technology (Chakraborty et al., 2024; Hao et al., 2024).

Fourth, in the face of rapid digital transformation, the widespread adoption of AI-based systems is no longer just a source of innovation. Business owners and managers should view artificial intelligence as a strategic asset, not just a cost-cutting tool. This is especially true when outsourcing processes to external partners (Lahiri et al., 2022). In addition, resources should be allocated for

infrastructure, security, and training, and management oversight of AI-based strategies should be ensured (Fischer-Preßler et al., 2024; Hossain et al., 2024).

4.2. Limitations

The study has several limitations. First, the Web of Science database was used to search for articles, which may have affected the number of results and resulted in the omission of some articles during the analysis. Second, the time frame (2019-2024) may not take into account long-term trends that could provide the basis and context during the analysis. Third, the study needs to be expanded with real-world research and examples of how the latest technologies and AI are being used in outsourcing, which makes this article less useful in this case. In conclusion, the study has enabled the identification of changes in outsourcing practices. It highlighted the role of modern technologies in shaping the future of delegating processes and tasks in companies. Thus, the study achieved its objective.

However, the results suggest that more research should be done on how modern technologies can be combined with outsourcing strategies to see if it is possible to make companies more efficient, secure, and competitive. In addition, the areas of research identified in this study require empirical verification.

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