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Bibliometric Panorama of Accounting Information System Research Evolution

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Abstract

Accounting information systems (AIS) are closely connected with using automated accounting data processing technologies, which increase reliability and prompt information delivery to stakeholders for management decision-making. The purpose of the article is to provide the AIS research domain with an additional impetus for further development based on a comprehensive characterization of quantitative parameters and systematic rethinking of trends in the evolution of the scientific themes. The article contains the methods of bibliometric analysis and chronological literature review based on clustering of keywords from a sample of AIS research indexed in Scopus in 1973–2023. The key findings indicate the nicheness of the AIS research problems, due to which the evaluation of the scientific output requires a multifaceted approach. It is found out which countries, journals, articles and authors play a decisive role in the formation of trends in the AIS research domain. Author keywords are used to assess the content orientation of the AIS research themes and to identify patterns of its evolution. We conclude that there is a content exhaustion in AIS scientific problems and the need to find new objects of research that correspond to the trends of Industry 4.0.

Keywords

Accounting; AIS; Bibliometric analysis; Chronological literature review; Cluster analysis; Information systems; Information technology; Thematic map.

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1 Introduction

Due to its broad and interdisciplinary nature, scientific studies of the phenomenon of Accounting Information Systems (AIS) have always been characterized by diversity acquired under the influence of numerous disciplines that relate to completely different fields of knowledge (Guragai et al., 2017). Baldwin et al. (2000) asserted that AIS researchers publish in journals specialising in accounting, auditing and taxation, as well as AIS, information systems (IS), artificial intelligence, education, behaviour, engineering, computer science and a variety of other areas. This, of course, contributes to the expansion of the spectrum of research topic in this field and deeper understanding of the relationship between accounting and IS, but it inhibits the systematization of research areas that cover completely different aspects of the application of AIS. As a result, a situation arose where due to the absence of a generally accepted definition of AIS research, it is almost impossible to establish its formal boundaries (Poston & Grabski, 2000). The totality of these circumstances significantly complicates the use of the tools of bibliometric analysis, content analysis and/or systematic literature review to study the trends in the field of AIS research, encouraging authors who undertake to write such articles to use a combination of different methods for forming a publications sample and analysing it.

The choice of the scientometric base for drawing the sample of articles was determined by the fact that Scopus has larger journal coverage than Web of Science core collection in relation to social sciences and humanities (Mongeon & Paul-Hus, 2016).

The combination of methods such as bibliometric analysis and chronological literature review used in this article ensures not only systematization of the quantitative parameters of the totality of publications on AIS, but also provides identification of trends in the evolution of themes of research conducted in this field at each stage of its development. Based on the results of the comprehensive assessment and systematic rethinking of the existing achievements, the AIS research domain can receive an additional impetus for further development. Taking into account the above-mentioned, the research questions (RQ) of this article are as follows:

- RQ 1. How many articles devoted to AIS are indexed in the Scopus database? How has this field developed in dynamics? Authors from which countries have made the greatest contribution to the total scientific production?
- RQ 2. Which countries, journals, articles and authors from the publication sample are the most cited?
- RQ 3. What is the content orientation of the AIS research themes based on the frequency of use of author keywords?
- RQ 4. What patterns of evolution do the AIS research themes show in dynamics in terms of time slices of the thematic map?

The paper adds and contributes to the extent of literature, because it is the first to provide a comprehensive evaluation of AIS scholarly research based on a combination of bibliometric analysis and chronological literature review, offering a complementary approach going beyond traditional research.

The study is based on a sample of 167 Scopus peer-reviewed articles related to AIS published between 1973 and 2023 and written by 420 authors representing 43 countries. Unlike prior research focusing on AIS (Ezenwoke et al., 2019; Monteiro & Cepêda, 2021), specific parameters of the sample help map the scientific production and identify topics of interest, related exactly to accounting practice, whereby this study identifies more comprehensive thematic categories and topics of interest in AIS research.

The article is structured as follows: In Section 1, the specifics of the AIS research domain are revealed and the RQs are defined. Section 2 summarizes the relevant literature. Section 3 describes the research methods of this study. Section 4 provides the results of bibliometric analysis on the sample of articles and findings

of content analysis on the AIS research area. Section 5 presents the main discussion aspects. Finally, Section 6 offers conclusions and future research opportunities.

2 Literature Review

Although the authors of articles devoted to the identification, analysis and systematization of scientific research trends in the field of AIS have used various approaches and methodological tools during their research, three main groups of such articles can be distinguished with the following specific features each:

1) no limitation on the sample of researched publications;
2) the sample is limited to some editions and a publication period;
3) thematic limitations (to discover a connection between AIS and phenomena related to other scientific and applied fields).

The authors of articles in Group 1 have generally tried to characterize as many bibliometric and/or content aspects of the selected publications in the field of AIS as possible. Thus, having used triangulation of five methods consecutively applied to sources from the Business Source Complete database to form a sample of publications, Rom and Rohde (2007) singled out two main research streams in the field of AIS – with a focus on the accounting side and with a focus on the IS side. The authors saw the most promising areas of future research in the expanded implementation of analysis-oriented IS in accounting practice; determining the optimal level of IS integration with company accounting systems; using actor-network theory and functionalist theory for deeper understanding of the relationship between IS and accounting; and assessing the impact of IS and accounting on firm performance.

Ezenwoke et al. (2019) noted that at the beginning of the development of AIS research, the most predominant stream of research was led by representatives of computer science. However, recently, the streams related to psychology and economics have become more active. The authors made these conclusions by conducting a bibliometric analysis of 727 articles in the AIS research domain indexed in Scopus during 1975-2017 and a content analysis of only the top 20 most cited publications, which together with the use of non-specialized software (Google Sheets and MS Excel) could affect both the obtained results and their interpretation.

Monteiro and Cepêda (2021), based on the results of a study of 144 articles published in journals indexed in the Web of Science database, found out that the most addressed AIS research themes were related to behaviour, experience, system requirements, organizational culture, management accounting and internal control. However, the researchers saw the greatest prospects for development in the AIS research topics where theoretical foundations are correlated with agency and contingency theory. According to Monteiro and Cepêda (2021), these are the following topics: AIS impact in the organization, AIS construction, implementation of AIS in SMEs and the public sector, and factors that contribute to AIS efficiency/quality.

As for the studies included in Group 2, it is worth mentioning Poston and Grabski (2000), who analysed articles published in 17 leading accounting, management information systems and computer science journals in the period from 1982 to 1998. Although the selected publications on AIS showed a changing mixture of trends, the authors ventured to predict future shifting of focus in the AIS themes from computer science theory to organizational theory, as well as expansion of model building and analytical work to cover a wider variety of theoretical foundations (Poston & Grabski, 2000). In turn, Ferguson and Seow (2011) used these results as a benchmark base in their study, which included 395 articles from 18 leading journals dated 1999–2009. According to their estimates, the decline in the use of information theory in AIS-related research predicted by Poston and Grabski (2000) goes on, but it is associated with a decline in analytical and model building research.

Moffitt et al. (2016) identified the top research themes across the three leading AIS journals using text mining techniques on AIS article abstracts for the period 1986-2014. Their research is distinguished by the

fact that the authors divided all AIS research streams (both revealed by their analysis of the publication sample and predicted ones) into issues of timeless concern and emerging themes. Among the former, it is worth noting the impact of technology on accounting decision-making, acceptance of technology by users, and information privacy. Among the numerous AIS-related emerging themes, the study of accounting processes in terms of need for human participation deserves a special attention; determining the level of replacement of human accountants by computerization and social consequences of its increase, and the formation of the skill sets necessary to serve as an effective monitor over a computer system (Moffitt et al., 2016).

Chiu et al. (2019) analysed the content of six journals for the period 2004–2016, which, judging by their titles, specialize in the topic of AIS, and came to the conclusion that, in general, these journals do not have a singular focus but range in the breadth of the articles they publish. As a result, the most commonly researched accounting areas of the studied totality of 681 articles were in the auditing and financial field, while AIS ranked third. At the same time, 45% of the selected articles were devoted to various aspects of the application of the latest technologies in accounting. According to the researchers, in the future, the AIS research area would develop in the field of taxation, where the introduction of the latest technologies would be intensified, but there is no proper scientific basis for this (Chiu et al., 2019).

A special place in Group 2 is occupied by publications that aim to determine the role of a specific edition in disseminating quality AIS research, namely, the International Journal of Accounting Information Systems and its predecessor Advances in Accounting Information Systems (Hutchison et al., 2004; Kumar et al., 2020). Hutchison et al. (2004) limited their scientific research review to an analysis of materials published exclusively in these editions during 1992-2003. Therefore, eight research topics were singled out with a stable domination of information system organization and management during the research period; judgment and decision-making research were obviously formed under the influence of the editorial direction of these publications in AIS topic coverage. Kumar et al. (2020) chose publications in the International Journal of Accounting Information Systems from the period 2000-2019 as a source of data for their analysis. Using Kleinberg's burst-detection algorithm, the authors characterized the dynamics of "bursting" topics in the journal as "promoting articles that find applications of the most modern technologies of the time in the field of accounting" (p. 12), among which the internet, world wide web, databases and e-commerce stood out in the first years, while XBRL and cloud computing became more popular from the second half of the studied period. Kumar et al. (2020) also noticed the influence of the journal editorial board policy, which, among other things, is embodied in the preparation of thematic special issues.

Group 3 includes reviews of interdisciplinary publications, which are characterized by a narrow thematic focus, as they are devoted to how AIS correlate with specific phenomena of a diverse nature. Thus, Wilkin and Chenhall (2010) tried to identify how IT governance informs AIS by analysing relevant IS literature. Having detected a lack of integration between the focus areas, the authors came to a conclusion about the perspective of joint research with AIS, IT governance and management IS in the field of IS control and auditing, while Grabski et al. (2011) saw the potential for a future agenda for AIS in ERP research, such as risk management and auditing of ERP systems, regulatory issues, internal and external economic impacts of ERP systems, extensions needed in ERP systems for XBRL, for interorganizational support and for the design of management control systems (Grabski et al., 2011).

Research into the use of social network analysis as an alternative research method for conducting AIS-related research, carried out by Worrell et al. (2013b), showed that traditionally, actors in a network have been viewed as human entities. Therefore, the key research questions in this segment are largely related to the study of connections/relations between human actors, as well as determining the effectiveness of social control, coordination and collaboration within the implementation of a new form of organizational governance. At the same time, a number of studies were found out in which software, hardware, IS and

infrastructure standards are regarded as nonhuman actors of stable social structures. Due to this approach, the problems of this research domain are complemented by the impact of the position of IS in the network on company competitiveness, risk management and strategic advantages, as well as adjustment of business processes and/or practices as a result of the usage of transaction processing systems and related internal controls (Worrell et al., 2013b).

Guragai et al. (2017) systematized the existing research related to AIS and ethics, leading them to the conclusion that the role of AIS in unethical behaviour of accountants is increasing due to the deepening integration of AIS with ERP systems. Further research in the field of AIS, according to Guragai et al. (2017), should include study on how various environmental, technological and human factors enable or limit unethical practices when using AIS.

Similar conclusions were made by Kauffman et al. (2011), who analysed the results of research into the growing influence of AIS on the security and ethical aspects of the information privacy of consumers. Considering the negative consequences of stealing personal information for social well-being, the identified research questions related mainly to preventive measures at the societal level and a regulatory framework aimed at increasing privacy when using IT, which can affect the information privacy of consumers. At the same time, Kauffman et al. (2011) saw prospects in further research into the factors that influence the choice of privacy practices in business, as well as the effectiveness of investments in information privacy.

Kocsis (2019) made similar conclusions about the most relevant themes in AIS literature, among which he singled out audit, ERP, monitoring and control, adoption and decision- making. As for obvious gaps in the AIS literature, Kocsis (2019) mentioned a lack of studies evaluating the consequences of expanding the use of automation, artificial intelligence and cloud platforms for existing AIS.

A study of scientific works devoted to the impact of AIS on companies' financial performance conducted by Ali and Oudat (2021) showed that previous research was limited to the cost implications of AIS. Instead, according to the authors, future research could explore the direct relationship between AIS and non-financial performance, as well as the influence of consumer satisfaction on the relationship between financial sustainability and non-financial variables that influence AIS implementation.

As mentioned above, AIS are an evolving and underexplored scientific area. We found out that there is a gap in the literature regarding the study of AIS research evolution, which would cover only articles published in journals indexed in the Scopus database using cluster analysis to identify chronological patterns in the development of topics related to the application of AIS, including the period of peak publication activity in this field, which was in 2019-2020, and conducting a bibliometric analysis using specialized software. In this part, the research significantly complements a bibliometric study of AIS research performed by Ezenwoke et al. (2019) on the Scopus database. Furthermore, this article compares the results of a previous WoS-based study (Monteiro & Cepêda, 2021), with which it is the most comparable in terms of sample formation parameters and technical tools, which allows us to analyse the scientific production on AIS on a large scale. Thus, this study contributes to the relevant understanding of the evolution of AIS research by means of a comprehensive analysis of articles indexed in Scopus over the 50 years that have passed since the appearance of the first publication in the aforementioned database.

3 Research Methods

The analysis was carried out using an integrated approach based on a bibliometric analysis as a set of quantitative methods for evaluating bibliographic objects (Donthu et al., 2021), which was performed using a Bibliometrix package for the R statistical programming language (Aria & Cuccurullo, 2017), and a chronological literature review, which involves reviewing the historical development of a scientific phenomenon with intellectual evaluation of the content of the studies conducted within its development

(Argyres et al., 2020) and interpreting their time sequence in order to determine further research areas (Burgelman et al., 2018). The combination of the methods mentioned above ensures a comprehensive overview of the field of scientific interest (Ahadi et al., 2022), eliminating drawbacks of a literature review such as the author's judgment bias (Bragge et al., 2019).

The search query for drawing a sample of scientific publications in Scopus consisted of a combination of terms that determine the content of the selected field of research ("accounting" AND "information system*" OR "information technolog*") and had to be indicated in the title of the article, since the title in most cases describes the content quite well (Rom & Rohde, 2007). The criteria favoured the inclusion of documents concerning the relationship between accounting and both dimensions of its informatization identified in the literature.

At the same time, an option was added to the search query to exclude publications where the title, abstract and keywords contained terms related to training, education and the environment (AND NOT "train*" AND NOT "educat*" AND NOT "environ*" AND NOT "student*"). Since the purpose of the study is to identify evolutionary trends exclusively in the application of AIS, then the specified search criteria allowed minimizing the risk of inclusion in the sample and further analysis of publications that consider the phenomenon from standpoints that are not directly related to the purpose.

The sample for the analysis is limited to the articles published (or being published) in scientific journals in English and classified by Scopus in terms of the specific accounting subject area.

The interdisciplinary nature of the topic of the researched publications, which, according to the Scopus classification, is the best fit to the "management information systems" sub-field of knowledge, significantly narrows the number of specialized journals for publishing the results of relevant scientific research. In particular, on the date of sample formation, only 154 periodicals were indexed in this sub-field. At the same time, according to the Scopus classification, IS is part of "Computer Science", while Information Systems and Management is part of "Decision Sciences", according to which 455 and 164 journals are indexed, respectively. The largest number of periodicals in which the results of AIS research can be published are indexed in Scopus by the subject area of "Business, Management and Accounting" – these journals account for 2,150.

The inclusion in the sample of articles from scientific journals only is due to the standard practice of double reviewing of such materials before publication that will ensure the homogeneity of the sample and contribute to increasing reliability of the results of the analysis of documents selected by this indicator and credibility of the conclusions drawn on its basis. For the purpose of the most complete assessment of the evolution in the field, the time interval of the sample was not limited (Pizzi et al., 2021).

The final sample comprised 167 articles from Scopus as of 11 July 2023. Figure 1 presents the sample selection process (PRISMA). The key parameters of the sample and assessment of the completeness of bibliographic metadata are shown in Figure 2. In order to construct a word cloud, a co-occurrence network, thematic evolution and a thematic map (time slice), the list of author keywords was optimized by applying a list of synonyms, which included identical terms in plural form and/or their abbreviations; geographical names were removed. As a result, the number of author keywords decreased by 10% – to 459 from the initial 510 that were identified by Bibliometrix.

When constructing the co-occurrence network, thematic evolution and thematic map (time slice), data clustering was carried out using the Leiden algorithm, which forms a subset of optimal clusters as a result of not only their division, but also their merger, guaranteeing the presence of a connection between the clusters. The choice of the Leiden algorithm was determined by the opinion that "the Leiden (using modularity) and Louvain algorithms performed on par with parallel analysis whereas the Walktrap and Leading Eigenvalue algorithms were subpar" (Christensen, 2024, p. 14). At the same time "the Leiden

algorithm is faster than the Louvain algorithm and uncovers better partitions, in addition to providing explicit guarantees" (Traag et al., 2019, p. 1).

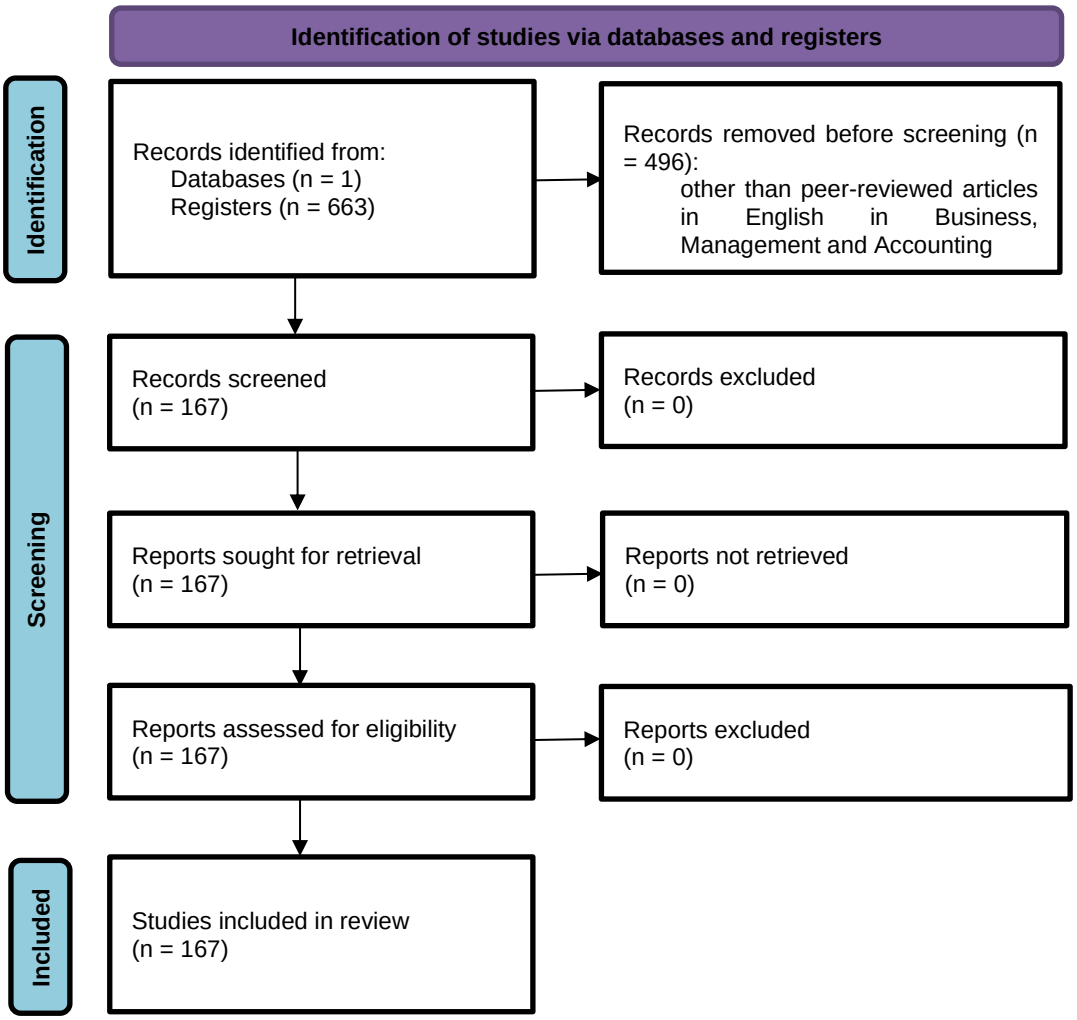


Figure 1. *Sample selection process (based on PRISMA).*

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1973:2023
Sources (Journals, Books, etc)	75
Documents	167
Annual Growth Rate %	5.1
Document Average Age	8.11
Average citations per doc	15.34
References	8349
DOCUMENT CONTENTS	
Keywords Plus (ID)	47
Author's Keywords (DE)	510
AUTHORS	
Authors	386
Authors of single-authored docs	40
AUTHORS COLLABORATION	
Single-authored docs	44
Co-Authors per Doc	2.51
International co-authorships %	11.38
DOCUMENT TYPES	
article	167

(a)

Completeness of bibliographic metadata

Metadata	Description	Missing Counts	Missing %	Status
AU	Author	0	0.00	Excellent
DT	Document Type	0	0.00	Excellent
SO	Journal	0	0.00	Excellent
LA	Language	0	0.00	Excellent
PY	Publication Year	0	0.00	Excellent
TI	Title	0	0.00	Excellent
TC	Total Citation	0	0.00	Excellent
C1	Affiliation	3	1.80	Good
CR	Cited References	3	1.80	Good
AB	Abstract	4	2.40	Good
DE	Keywords	17	10.18	Acceptable
RP	Corresponding Author	41	24.55	Poor
DI	DOI	52	31.14	Poor
ID	Keywords Plus	163	97.60	Critical
NR	Number of Cited References	167	100.00	Completely missing
WC	Science Categories	167	100.00	Completely missing

(b)

Figure 2. *Parameters (a) and assessment of completeness of bibliographic metadata (b) of sample of scientific articles on AIS indexed in Scopus in 1973-2023 (as of 11 July 2023).*

4 Results

4.1 Bibliometric analysis

RQ 1. How many articles devoted to AIS are indexed in the Scopus database? How has this field developed in dynamics? Authors from which countries have made the greatest contribution to the total scientific production?

The assessment of dynamics of the number of publications in the sample allows us to assert that although the first article on the studied topic was indexed in Scopus back in 1973, there was almost no interest among scientists during the next four decades in the development of issues related to using IS and IT in accounting and analytical practice (Figure 3).

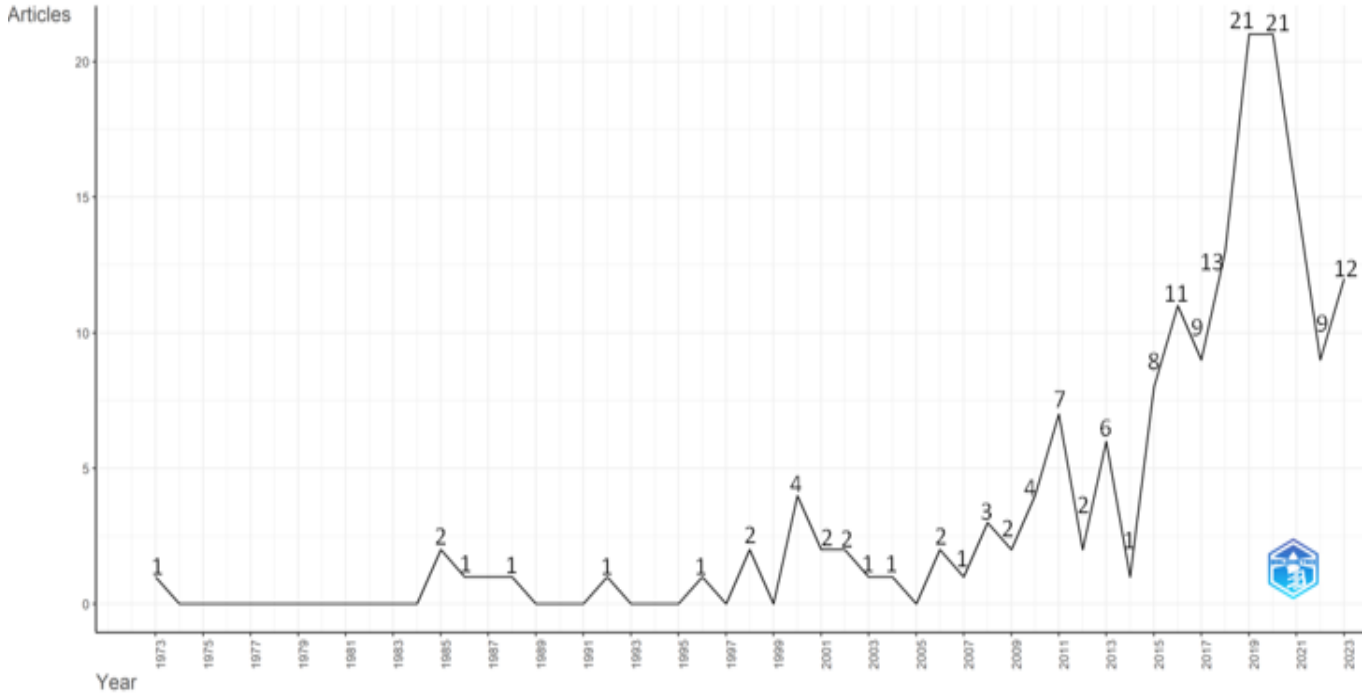
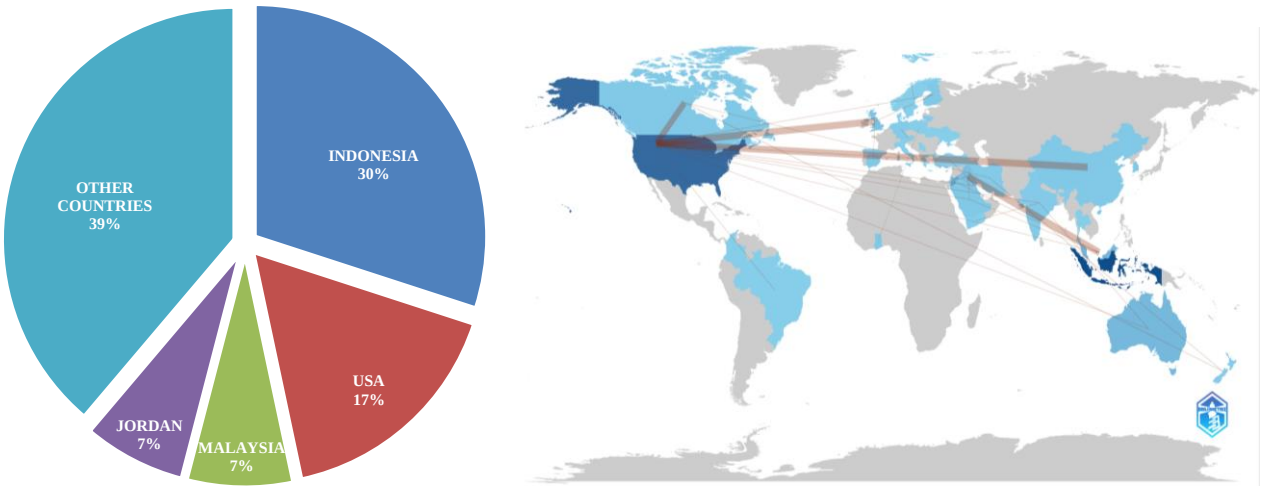


Figure 3. *Dynamics of number of scientific articles on AIS indexed in Scopus in 1973-2023 (as of 11 July 2023).*

In general, until 2011, the number of relevant publications in Scopus never exceeded five units annually. A significant increase in publications on the studied topic coincided with the beginning of Industry 4.0 (2011), but a stable positive trend in its development started only in 2015. The peak of academic interest was in 2019-2020, when 21 articles were indexed in Scopus every year, which totals a quarter of the publications in the entire sample.

During the research period, the sample included publications of scientists from 43 (according to Scopus data) countries with the total country scientific production amounting to 420 author appearances by country affiliation. Representatives of the USA, Indonesia, Malaysia and Jordan were the most active. They provided 61.19% (257 out of 420) of total author appearances by country affiliation (Figure 4a).

At the same time, the level of international co-authorship in the sample is low at 11.4%. Mostly, scientists from English-speaking countries (the USA, Canada, the UK), as well as researchers from the USA and China, Malaysia and Iraq collaborated with each other (Figure 4b).



(a) (b)

Figure 4. *Country scientific production (a)* and country collaboration map (b) of sample of scientific articles in 1973-2023 (as of 11 July 2023).*

*Note: * Identified by authors based on viewing all article profiles in Scopus and/or their full-text publications posted on Internet.*

RQ 2. Which countries, journals, articles and authors from the publication sample are the most cited?

The analysis of the average annual citation rate of the sample articles (Figure 5) indicates that scientists began to show their interest in publications on AIS issues only back in the early 1990s, which coincides with the peak of Industry 3.0.

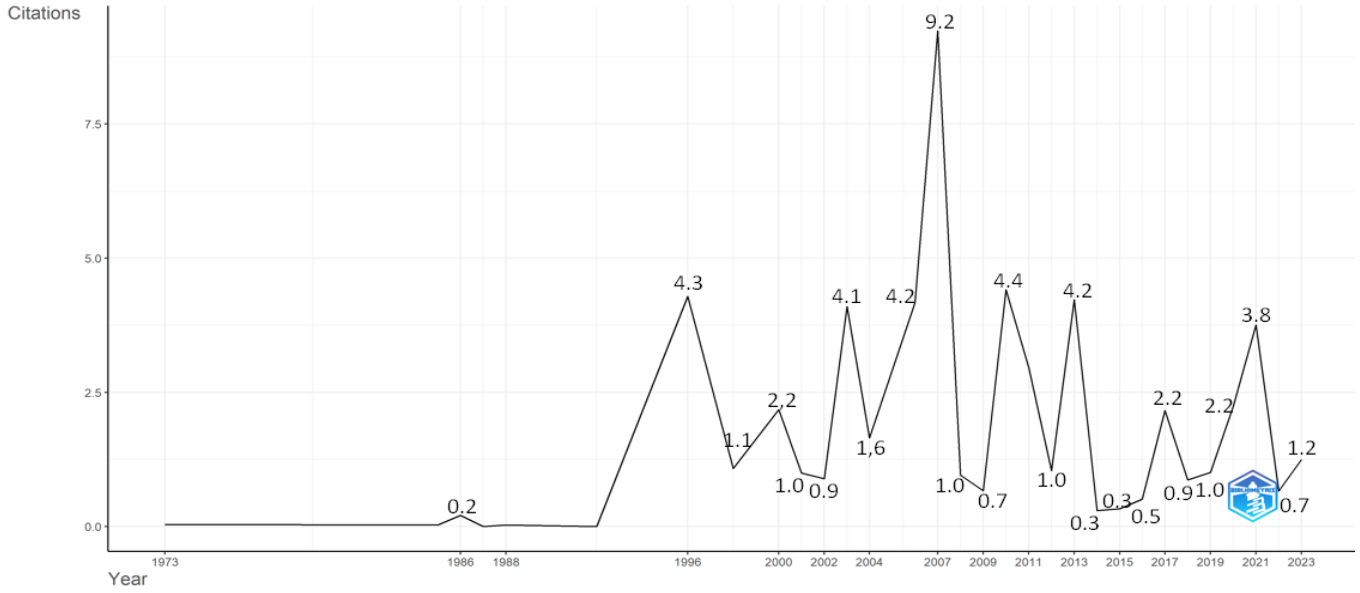


Figure 5. *Average annual citation rate of publications of sample in editions indexed in Scopus in 1973-2023 (as of 11 July 2023).*

The revealed trends in the change of this indicator can be characterized as moderate – the average annual citation rate actually does not exceed 5 – and constantly changing, when an increase in the indicator in one period is regularly replaced by a decrease in the next one. Moreover, the greater the growth, the faster the subsequent decline.

The highest productivity of authors from the USA and Indonesia in the sample is also manifested in the largest number of references (Table 1).

Table 1. *Top 10 most cited countries in sample of scientific articles in 1973-2023 (as of 11 July 2023).*

No.	Country	Total citations	Average article citations
1	USA	371	23.20
2	Indonesia	210	7.50
3	United Kingdom	177	44.20
4	Korea	174	58.00
5	Finland	159	79.50
6	Denmark	157	157.00
7	Greece	124	62.00
8	New Zealand	43	43.00
9	Netherlands	38	38.00
10	Australia	36	12.00
	TOTAL in top 10 countries	*1 489*	*24.41*
	…	…	…
	TOTAL in sample	*2 561*	*15.34*

The data presented in Table 1 show that, as of 11 July 2023, articles by authors from the two most productive countries (the USA and Indonesia) amount to 39.02% (581 out of 1,489) of all references to the publications of the top 10 most cited countries and 22.69% (581 out of 2,561) of all references to the publications in the sample. At the same time, studies by representatives of the top 10 most cited countries account for 58.14% (1,489 out of 2,561) of citations in the entire sample.

The International Journal of Accounting Information Systems is an undisputed leader in terms of the number of published articles included in the sample. Since 2000, when this specialized edition began to be indexed in Scopus, it has published 23 articles on AIS issues (Table 2).

Table 2. *Top 10 Scopus journals by publications on AIS in 1973-2023 (as of 11 July 2023).*

No.	Journal title	Number of articles	Publication start year
1.	International Journal of Accounting Information Systems	23	2000
2.	International Journal of Applied Business and Economic Research	10	2015
3.	Academy of Accounting and Financial Studies Journal	8	2019
4.	International Journal of Supply Chain Management	7	2019
5.	Journal of Information Systems	5	2010
6.	Journal of Asian Finance, Economics and Business	5	2020
7.	International Journal of Recent Technology and Engineering	5	2019
8.	Management Accounting Research	4	2001
9.	International Business Management	4	2015
10.	Cogent Business and Management	4	2020
	TOTAL in top 10 journals	*75*	*X*
75.	…	…	…
	TOTAL in sample journals	*167*	*X*

A total of 75 articles (44.91% of their total number) were published in only 10 journals out of 75 in which the sample articles were published. It accounts for 13.33% of the total number of editions. As a result, the top 10 journals of the studied sample provide an average of 7.5 publications, which is more than three times higher than the average for the entire sample (2.27 articles per journal).

The total number of citations in the sample articles as an indicator of their scientific significance is quite high and amounts to 2,561 citations, which is an average of 15.34 citations per article. At the same time, 2,024 citations referred to articles placed in the top 10 Scopus journals based on references to publications from the sample (Table 3).

Table 3. *Top 10 Scopus journals by references to publications from sample for 1973-2023 (as of 11 July 2023).*

No.	Journal title	Citations		Number of articles	Publication start year
		Total	Local		
1.	International Journal of Accounting Information Systems	925	20	23	2000
2.	Journal of Information Systems	354	5	5	2010
3.	Management Accounting Research	230	5	4	2001
4.	Journal of Management Information Systems	120	6	1	1996
5.	European Accounting Review	86	3	1	2003
6.	Journal of Asian Finance, Economics and Business	79	12	5	2020
7.	Information and Management	78	0	3	1998
8.	International Journal of Digital Accounting Research	60	5	1	2011
9.	Journal of Management Control	47	5	3	2017
10.	Journal of Management Information and Decision Sciences	45	1	3	2021
	TOTAL in top 10 journals	*2 024*	*62*	*49*	
60.	…	…	…	…	…
	TOTAL in sample journals	*2 561*	*97*	*167*	

Thus, within the sample, 29.34% (49 out of 167) of articles published in 16.67% (10 out of 60) of journals provided 79.03% (2,024 out of 2,561) of all references to the researched issue during the analysed period; these are 41.31 citations on average per article.

As can be seen from Table 4, only the International Journal of Accounting Information Systems managed to transform its quantitative gains in terms of publications and their citations into the highest values of the *h*-index and the *g*-index, which indicates the influence and productivity of this edition in the analysed field of research.

Table 4*. Top 10 Scopus journals by h-index of sample articles (as of 11 July 2023).*

No.	Journal title	*h*-index	*g*-index	*m*-index	Publication start year
1.	International Journal of Accounting Information Systems	14	23	0.583	2000
2.	Journal of Information Systems	5	5	0.357	2010
3.	International Journal of Supply Chain Management	4	5	0.8	2019
4.	Journal of Asian Finance, Economics and Business	4	5	1	2020
5.	Management Accounting Research	4	4	0.174	2001
6.	Academy of Accounting and Financial Studies Journal	3	4	0.6	2019
7.	Information and Management	3	3	0.115	1998
8.	Journal of Management Control	3	3	0.429	2017
9.	Polish Journal of Management Studies	3	3	0.5	2018
10.	Academy of Strategic Management Journal	2	3	0.4	2019

At the same time, in terms of the *m*-index, which reflects the *h*-index for the year since the first publication, the International Journal of Accounting Information Systems ranks third, which is most likely because the first article from the studied sample was published in this journal back in 2000, when the topic of AIS was not too popular among scientists.

At the same time, Figure 6 presents a graph of the distribution of the article authors' productivity with the distribution predicted by Lotka's Law of Scientific Productivity (hereinafter referred to as Lotka's Law), which demonstrates an asymmetric distribution with a concentration of articles among several authors, while the rest of the articles is distributed among a large number of authors with low distribution. It turns out that 365 authors (94.6%) published only one article each; 17 authors (4.4%) published two articles, while 1 author (0.25%) published three, four, six or seven articles, respectively.

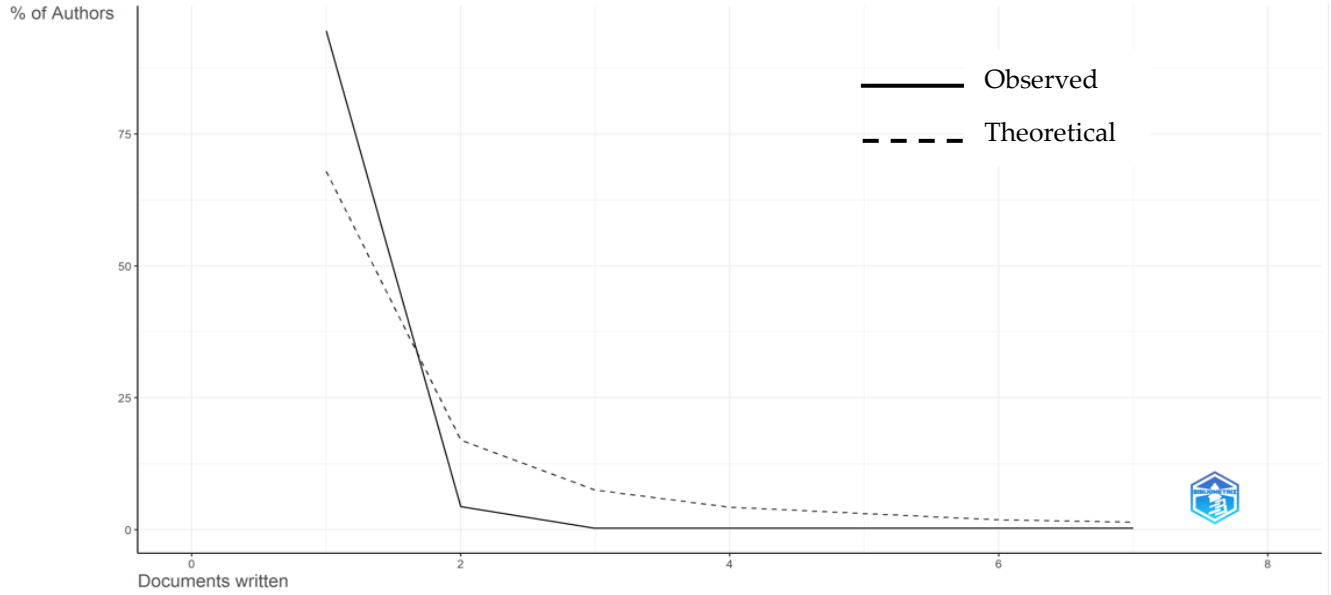


Figure 6. *Assessment of productivity of authors of scientific publications of sample for 1973-2023 (as of 11 July 2023) based on Lotka's Law.*

Taking into account the specified features of authors' productivity, the assessment of their personal achievements requires comprehensive consideration of a number of diverse indicators (Table 5).

Table 5. *Top 10 authors in terms of h-index for sample articles (as of 11 July 2023).*

No.	Author	*h*-index	*g*-index	*m*-index	Number of articles		Citations		Publication start year
					Total	Author's contribution*	Total	Local	
1	Mulyani S.	5	6	0.625	7	2.2	37	1	2016
2	Napitupulu Ih.	4	6	0.444	6	4.5	38	9	2015
3	Choe J.	3	3	0.107	3	3	174	6	1996
4	Farida I.	2	2	0.333	2	0.5	13	0	2018
5	Suharman H.	2	2	0.4	2	0.4	5	0	2019
6	Susanto A.	2	4	0.25	4	1.7	31	1	2016
7	Sutton S.	2	2	0.083	2	1.5	90	4	2000
8	Vasarhelyi M.	2	2	0.125	2	0.58	28	0	2008
9	Machmuddah Z.**	1	2	0.25	2	0.67	13	2	2020
10	Sukmadilaga C.**	1	2	0.2	2	0.5	10	0	2019
	TOTAL	*x*	*x*	*x*	*32*	*x*	*439*	*23*	*x*

*Notes: * The author's contribution is determined by weighting each article written with the participation of this author by the number of co-authors; the partial contributions of each of them are considered equal. ** The selection of authors with the h-index equal to 1 for this rating was carried out with additional consideration of the value of the g-index, since Bibliometrix ranks authors with identical values of the rating indicator only in alphabetical order.*

As with the top 10 journals in terms of the number of publications (Table 3) and the *h*-index (Table 4), seven out of ten authors presented in Table 5 started their publication activity on AIS in 2015. At the same time, the average total citation rate of their publications is only 5.88 references per article, while the

average local citation rate is 0.52. On the other hand, the average citation rate of the three authors from the top 10 in terms of the *h*-index (Table 5), who started doing AIS research no later than in 2008, is almost three times higher: a total of 41.71 references per article, while the local figure is 1.43.

The results of the analysis of the top 10 most cited articles in this sample (Table 6) indicate that none of them was published after 2013. At the same time, their average total citation rate is 114.8 references per article (versus 15.34 in the entire sample), while the average local citation rate is 2.8 (versus 0.58 in the entire sample).

Table 6. *Top 10 most cited Scopus articles in sample (as of 11 July 2023).*

No.	Title	Authors	Source	Year	Citations		
					Total	Per year	Local
1	Management accounting and integrated information systems: a literature review	Rom, A., Rohde, C.	International Journal of Accounting Information Systems, 8(1), pp. 40–68	2007	157	9.24	7
2	A review of IT governance: A taxonomy to inform accounting information systems	Wilkin, C. L., Chenhall, R. H.	Journal of Information Systems, 24(2), pp. 107–146	2010	154	11	2
3	A design science research methodology and its application to accounting information systems research	Geerts, G. L.	International Journal of Accounting Information Systems, 12(2), pp. 142–151	2011	126	9.69	1
4	Changes in accounting and financial information system in a Spanish electricity company: A new institutional theory analysis	Tsamenyi, M., Cullen, J., González, J. M. G.	Management Accounting Research, 17(4), pp. 409–432	2006	125	6.94	0
5	A contingency model of perceived effectiveness in accounting information systems: Organizational coordination and control effects	Nicolaou, A. I.	Management Accounting Research, 17(4), pp. 409–432	2000	124	5.17	7
6	The relationships among performance of accounting information systems, influence factors, and evolution level of information systems	Choe, J.-M.	Journal of Management Information Systems, 12(4), pp. 215–239	1996	120	4.29	6
7	Interactive data visualization: new directions for accounting information systems research	Dilla, W., Janvrin, D. J., Raschke, R.	Journal of Information Systems, 24(2), pp. 1–37	2010	93	6.64	1

No.	Title	Authors	Source	Year	Citations		
					Total	Per year	Local
8	Exploring the use of the Delphi method in accounting information systems research	Worrell, J. L., Di Gangi, P. M., Bush, A. A.	International Journal of Accounting Information Systems, 14(3), pp. 193–208	2013	89	8.09	1
9	Management accounting and information systems: ERP versus BOB	Hyvönen, T.	European Accounting Review, 12(1), pp. 155–173	2003	86	4.01	3
10	On the convergence of management accounting and financial accounting - the role of information technology in accounting change	Taipaleenmäki, J., Ikäheimo, S.	International Journal of Accounting Information Systems, 14(4), pp. 321–348	2013	74	6.64	0
	TOTAL	*x*	*x*	*x*	*1 148*		*28*

RQ 3. What is the content orientation of the AIS research themes based on the frequency of use of author keywords?

After applying the list of synonyms and removing geographical names, the total list of author keywords has 459 positions now, which were mentioned in the publications of the sample 681 times. Moreover, 390 terms were mentioned only once; 37 were mentioned twice as keywords, while the authors mentioned only three keywords 10 or more times: "accounting information system" (72 times), "accounting" (11 times), and "small and medium enterprises" (10 times). Taking into account such a significant scatter of keywords used by the authors, and in order to optimize the visual display of the word cloud, a weighted list (Figure 7) of 32 terms that were used more than twice was constructed based on the logarithmic value of the appearance of such author keywords.

Figure 7. *Word cloud of author keywords in sample publications for 1973-2023 (as of 11 July 2023).*

Further study of the thematic structure of the researched publications was carried out by analysing the relationships between author keywords and building a co-occurrence network. Frequent keyword sets are treated as potential topics, and the process of their ranking is a modified PageRank algorithm (Kleminski

et al., 2022). Basic measurements of graph theory, such as betweenness centrality and closeness centrality, will allow us to quantify the behaviour of the network, identifying the main relationships between keywords, and identifying the research topic hubs that enable prediction of future research trends.

Taking into account the features of the list of author keywords discovered when generating the word cloud, in order to improve the visual perception of the co-occurrence network, the number of nodes was limited to 32, which corresponds to the number of terms that were used more than twice, and the additional condition for removing isolated nodes was also established.

The co-occurrence network of author keywords built under these conditions (Figure 8) has 26 nodes, which are grouped into four clusters. The size of the nodes in the figure indicates the number of times the authors used the keywords, and the colours in the figure indicate the different keyword clusters. Thus, four keyword clusters were identified with representative keywords for accounting information system (red boxes), small and medium enterprises (blue boxes), user satisfaction (green boxes) and information system (purple boxes).

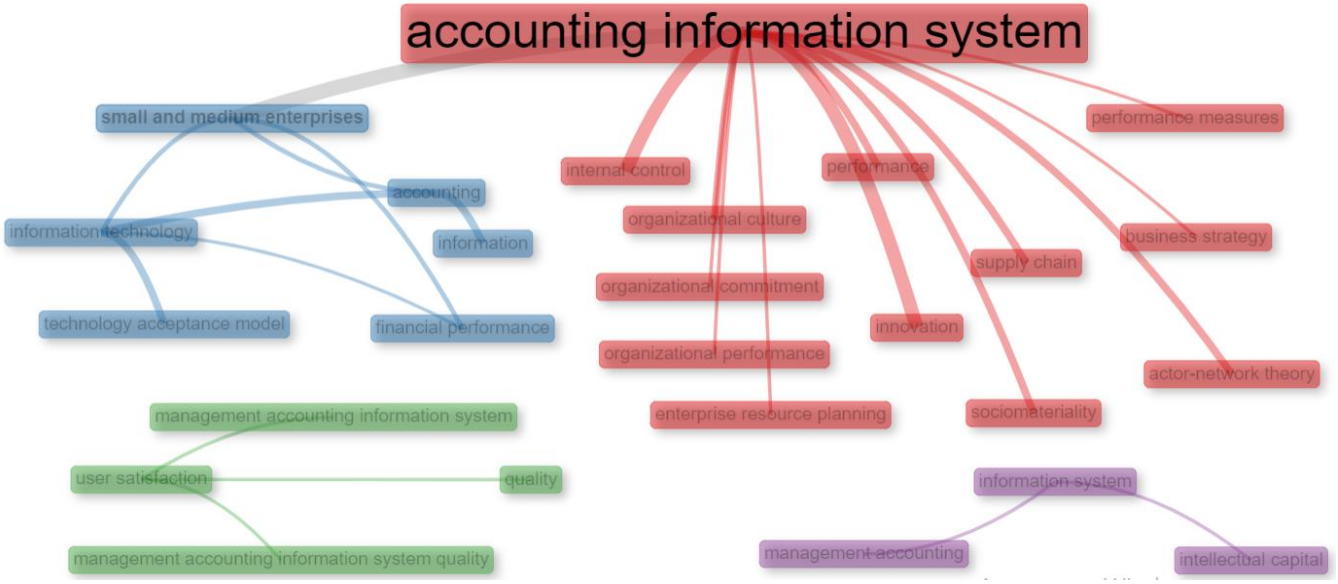


Figure 8. *Co-occurrence network of author keywords in sample publications for 1973-2023 (as of 11 July 2023).*

The largest cluster (red) consists of 13 nodes, thus combining 50% of all keywords that entered the co-occurrence network, and is generated around the "accounting information system" – the term mentioned by the authors most often. The first clustering theme is accounting information system, and the main keywords include internal control, innovation, supply chain, performance, actor-network theory, sociomateriality, etc. Articles on this topic mainly focus on the use of emerging technologies and AIS innovations in order to increase firm performance (Hutahayan, 2020; Yoshikuni et al., 2023), the impact of AIS on the effectiveness of internal control (Arif et al., 2020; Alrabei, 2021), and the content and quality of information provided to stakeholders as a result of the use of AIS (Ruggeri & Rizza, 2017).

The two next most frequently mentioned keywords ("accounting" and "small and medium enterprises") are included in the second largest cluster (blue) of six nodes. They have a direct connection with the red cluster at the level of central nodes "accounting information system" – "small and medium enterprises". It indicates the existence of significant interest of scientists in implementation of IS/IT in the accounting systems of this particular business segment, namely the effect of AIS on innovation and productivity of SMEs (Kareem et al., 2021; Latifah et al., 2021), including implementation of AIS via outsourcing (O'Connor & Martinsons, 2006).

Although the two smallest clusters (purple and green) are completely isolated both from the rest of the clusters and from each other, they generally characterize the research areas related to the application of

IS/IT in management accounting. The papers in these themes mainly discuss the use of IT as a basis for a convergence of financial and management accounting (Taipaleenmäki & Ikäheimo, 2013) or the determinants of MAIS productivity (Napitupulu, 2015), MAIS quality (Knauer et al., 2020) and satisfaction of MAIS users (Napitupulu & Dalimunthe, 2016).

4.2 Research field evolution and systematic review

RQ 4. What patterns of evolution do the AIS research themes show in dynamics in terms of time slices of the thematic map?

In order to identify patterns in the development of the topics of scientific publications in the sample, the analysis of dynamic trends in using author keywords during the studied period was carried out by constructing a thematic evolution (Figure 9) with the following additional metrics: minimum cluster frequency of 5, minimum weight index of 0.1, and inclusion index weighted by word occurrences.

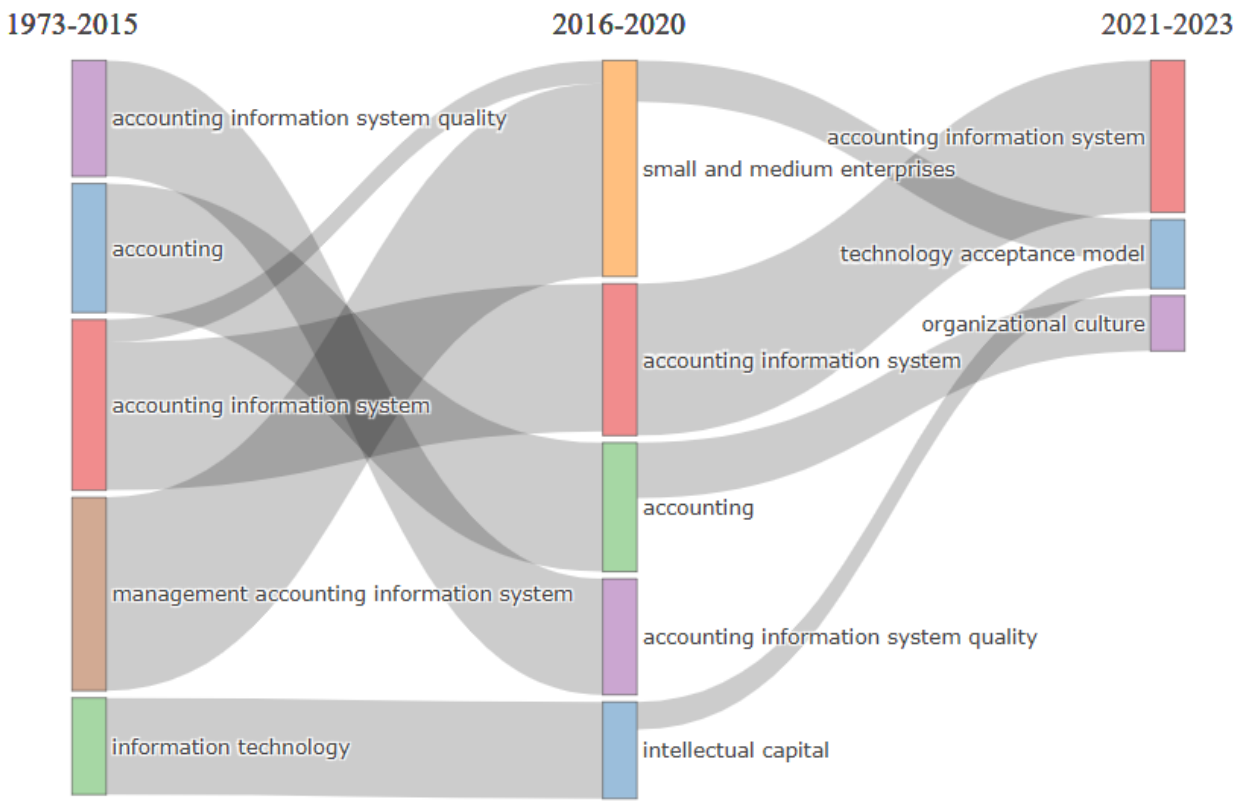


Figure 9. *Thematic evolution of author keywords in sample articles in editions indexed in Scopus for 1973-2023 (as of 11 July 2023).*

To do this, the total number of articles was divided into three groups within automatically determined time intervals, the separation of which fully corresponds to the dynamics of the number of articles in the sample presented in Figure 3. Thus, during the first period (from the first publication in 1973 to the beginning of a steady increase in the annual numbers in 2015), 56 articles were published in which five keywords meet the requirements of the thematic evolution construction. In the second period (2016-2020), which is the peak of academic interest in this issue, there are 75 publications with five keywords, three of which coincide with the keywords of the first period. In the last period (2021-2023), when downward trends began to be observed in this field, there are 36 articles with three keywords, two of which are new.

Further deepening and holistic understanding of the revealed trends of bibliometric indicators require conducting a cluster analysis of the thematic peculiarities of the scientific publications of the sample that

existed within each of the defined periods (Cobo et al., 2011) based on the thematic map (time slice), which was constructed with the same parameter values that were used during the formation of the thematic evolution (Figure 9). The thematic map involves evaluating each author keyword as a separate topic using parameters such as development degree (density) and relevance degree (centrality), on the basis of which they are grouped into four aggregates:

1) motor themes have the highest density and relevance;
2) basic themes are characterized by high relevance, but they have a low level of development;
3) emerging or declining themes have low density and relevance;
4) niche themes are characterized by a high level of development and low relevance.

The data presented in Figure 10, which displays the thematic map (time slice 1), shows that the themes related to keyword drivers in this area such as "accounting", "accounting information system" and "information technology" have aroused considerable interest in the followers, as indicated by the display of these clusters in the basic themes quadrant.

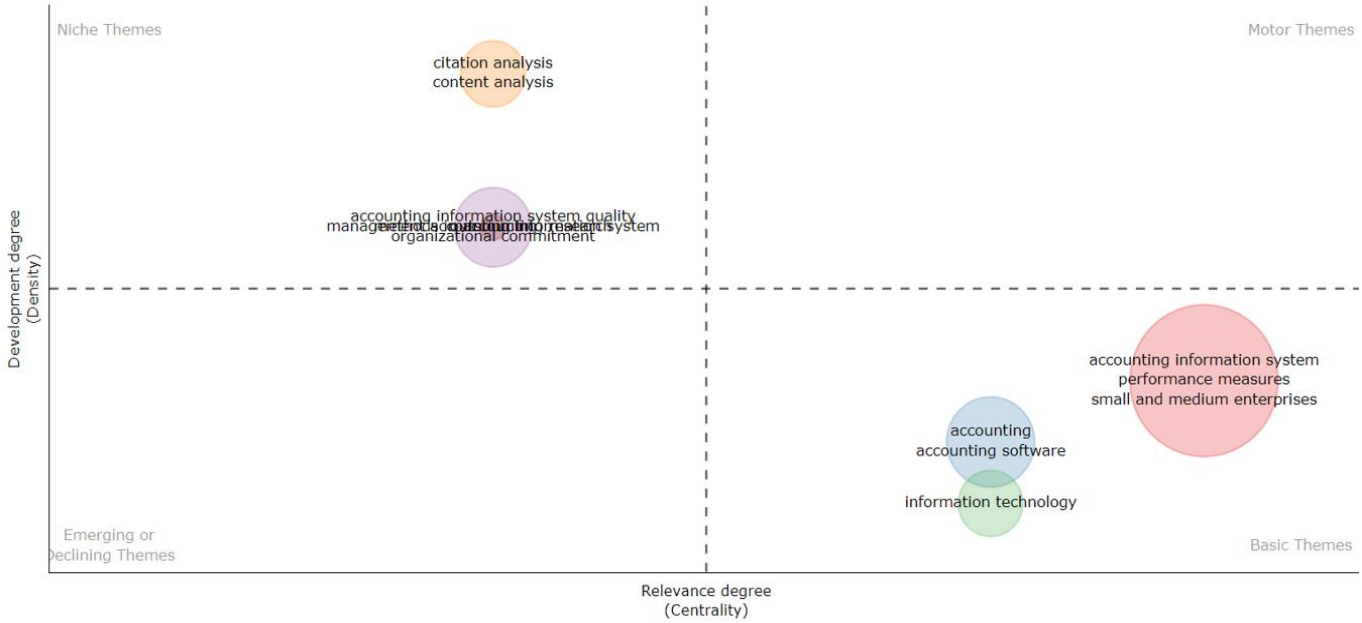


Figure 10. *Thematic map (time slice 1) of author keywords in sample publications for 1973-2015.*

A significant part of research was devoted to some similar factors that characterize efforts and potential of the developers and/or users of the corresponding software aimed at improving the results of its use (Nicolaou, 2000; van der Veeken & Wouters, 2002; Hyvönen, 2003; Tsamenyi et al., 2006). However, some special attempts were also made to take into account the evolution of IT as a higher-level factor that affects the intensity of action of other studied AIS productivity factors (Choe, 1996). In addition, the authors of this cluster focused on assessing the satisfaction of users of accounting software as a determining factor of its further use by the company (Ali et al., 2012), and identified the relationship between the use of accounting software products and the efficiency of the main activity of SMEs in various areas of economic activity (Grande et al., 2011). A special place is occupied by the most cited publication of the cluster dedicated to designing a science research methodology for information systems and its application to AIS research through retroactive analysis (Geerts, 2011).

Furthermore, in this period, the clusters with the keywords "accounting" and "information technology" were included among the basic themes. They are characterized by common issues in information security, as well as the convergence of IT-based accounting subsystems. Moreover, in the "accounting" cluster, information security issues are researched in the context of the cluster's general focus on determining the

impact of computerization on the organization of accounting, in particular, the obligations of the accounting department regarding the rights of access to information and data security in software packages used (Salwani et al., 2009), while the "information technology" cluster is characterized by studying the role of IT management components in automation of company business processes and the information streams that arise (Wilkin & Chenhall, 2010) under conditions of ensuring data protection, which affects the formation of company value from unauthorized access (Kauffman, 2011). IT and software, including ERP, are also considered in these clusters as a fundamentally new ideological basis for a full-fledged convergence of financial and management accounting (Taipaleenmäki & Ikäheimo, 2013).

Niche themes, in turn, include five much smaller clusters, three of which ("management accounting information system", "methods in accounting research", "outsourcing") have the same indices of rank density (5.5) and cluster frequency (2), due to which they completely overlap each other, and also overlap with the fourth cluster ("accounting information system quality"), which has the same rank density (5.5), but a much higher cluster frequency (5). This circumstance determines a certain thematic affinity of the publications in the above-mentioned clusters, which were devoted to researching the concept of AIS quality (Anggadini, 2015; Rapina, 2015), the productivity of management accounting software products and the factors that influence them (Choe, 1998; Napitupulu, 2015), and as well as a comparative assessment of the effectiveness of the alternative of implementing and supporting AIS through outsourcing (O'Connor & Martinsons, 2006; Cullinan & Zheng, 2015). The specificity of the qualitative characteristics of AIS requires the use of unique research methods, including the Delphi method (to determine the impact of IT risks on business processes and management areas) (Worrell et al., 2013a) and social network analysis (to study the interaction of AIS with other network nodes and impact on organizational outcomes and company performance) (Worrell et al., 2013b).

Cluster 5 ("citation analysis") of this quadrant includes original bibliometric reviews and thematic historical synopses where the authors analyse the content, citations and downloads of articles to assess the success of the leading AIS journals (Hutchison et al., 2004) and also to identify the existing research areas in AIS by structuring the trends determined by main theories, research methods and themes of the IS life cycle in the articles of specialized AIS journals (Poston & Grabski, 2000).

As follows from the thematic map (time slice 2; Figure 11), during 2016-2020, the topics represented by keywords such as "small and medium enterprises", "user satisfaction" and "management accounting information system" were developed most powerfully in the context of motor themes. Publications belonging to this cluster were devoted to determining the impact of AIS quality on productivity, competitiveness and sustainable development of SMEs (Diaz & Villamizar, 2017; Mohamad et al., 2019; Binh et al., 2020; Hien et al., 2020), factors that encourage SMEs to outsource accounting under conditions of using traditional and cloud-based AIS (Asatiani et al., 2019), as well as finding a connection between the involvement and satisfaction of users of management accounting information systems (MAIS) and the role of the quality of such systems as an intermediate factor (Napitupulu & Dalimunthe, 2016).

The authors of publications included in the clusters labelled with "accounting" and "accounting information system" as part of the basic themes focused their efforts on identifying the impact of AIS on the effective and sustainable performance of business entities in various sectors of the economy (Muhammad et al., 2019; Al-Delawi & Ramo, 2020; Huy & Phuc, 2020), the content and quality of information provided to stakeholders as a result of using such systems (Suhayati, 2016; Ruggeri & Rizza, 2017), organization and improvement of internal control system performance (Arif et al., 2020; Sumaryati et al., 2020) and improvement of supply chain management (Nurdiono et al., 2018; Kadhim & Latif, 2019; Utomo et al., 2020) as additional mechanisms for creating competitive advantages. Special attention was paid to studying the impact of company organizational culture on the effectiveness of the use of accounting software products (Napitupulu, 2018; Ha, 2020), as well as the need to expand the skills and

abilities of staff in data processing, risk assessment and threats to the confidentiality of information due to the permanent automation of accounting processes (Huerta & Jensen, 2017).

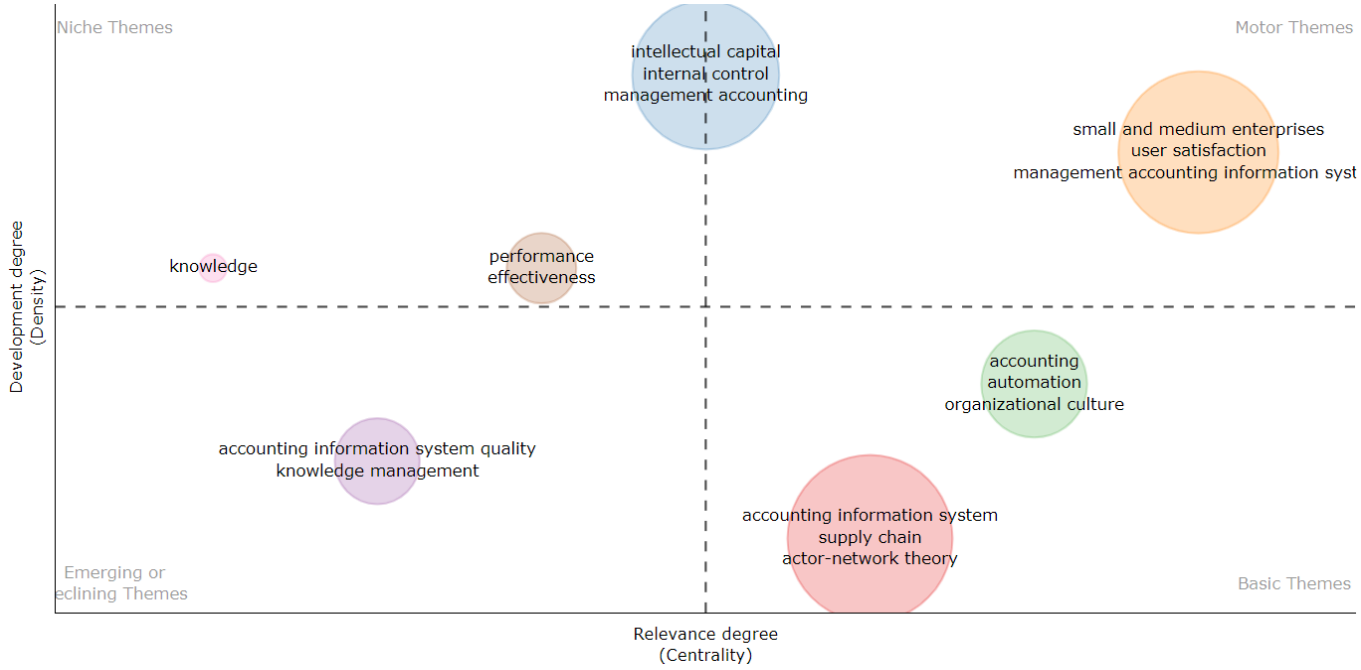


Figure 11. *Thematic map (time slice 2) of author keywords in sample publications for 2016-2020.*

Furthermore, the basic themes include publications by authors engaged in determining research trends in the field of AIS by analysing the content of specialized journals such as the International Journal of Accounting Information Systems (Kumar et al., 2020), as well as exploring the prospects for increasing the level of complexity of AIS under the conditions of transition to technosocial relations that will allow creating, not only representing the reality, and the extent to which ethical and legislative considerations can be taken into account by technology (Weber, 2020).

Despite a decline in the "accounting information system quality" cluster, which shifted from niche themes to emerging or declining themes in the second period it is generally worth noting the originality of research into the impact of the role of knowledge management on AIS quality in combination with the use of ERP by coordinating personnel training activities of all organizational lines of a business entity (Bakri & Mulyani, 2019), institutional isomorphic pressure to invest in upgrading the AIS, which improves its performance (Djanegara et al., 2018) the positive impact of AIS quality among agricultural commodity producers on improving the efficiency of supply chain management and thus achieving sustainable competitive advantages (Ditkaew et al., 2020), and the decisive role of relevance and credibility of AIS in improving non-financial performance of Islamic banks including their financial perspective (Qatawneh & Bader, 2020).

In this period, the niche themes are represented by the third-largest cluster of "intellectual capital", which partially moved to the motor themes quadrant, as well as by the two smallest clusters of "performance" and "knowledge". The intermediate status of "intellectual capital" may be a consequence of the multi-vector topics of the articles included in this cluster. Thus, among the publications that intersect with motor themes issues, it is worth noting the studies aimed at determining the relationship between the quality of management accounting data and IT investments, internal and external IT knowledge, innovative technologies as determinants of MAIS quality (Knauer et al., 2020), as well as highlighting original factors that affect the satisfaction of AIS users, such as the information quality and perceived usefulness (Muda et al., 2020). At the same time, the most cited publications of this cluster were devoted to the mediating effect of management accounting information systems, intellectual capital and human capital on the

relationship between innovation strategy and financial performance (Hariyati et al., 2019; Hutahayan, 2020).

The two other clusters of niche themes represent highly specialized areas of research into the effectiveness of software products ("performance") and the relationship between the use of AIS and the peculiarities of the behaviour of management personnel ("knowledge"). Thus, when using ERP, the effectiveness of AIS increases due to design, organizational and user characteristics, among which design characteristics have the most significant impact (Le et al., 2018), and high performance of AIS is a guarantee of reducing accounting fraud (Meiryani et al., 2019). A manager's knowledge about MAIS work significantly affects their style of control and increases the availability of such systems in practice (Astuty, 2016), while organizational commitment and professional competence of managers contribute to a more successful implementation of AIS (Suratman & Ridwan, 2017).

The "accounting information system" cluster remains in the basic themes thematic map (time slice 3; Figure 12) despite a 30% percent decrease in cluster frequency and again having updated its composition with keywords such as "cloud computing", "enterprise resource planning" and "internal control".

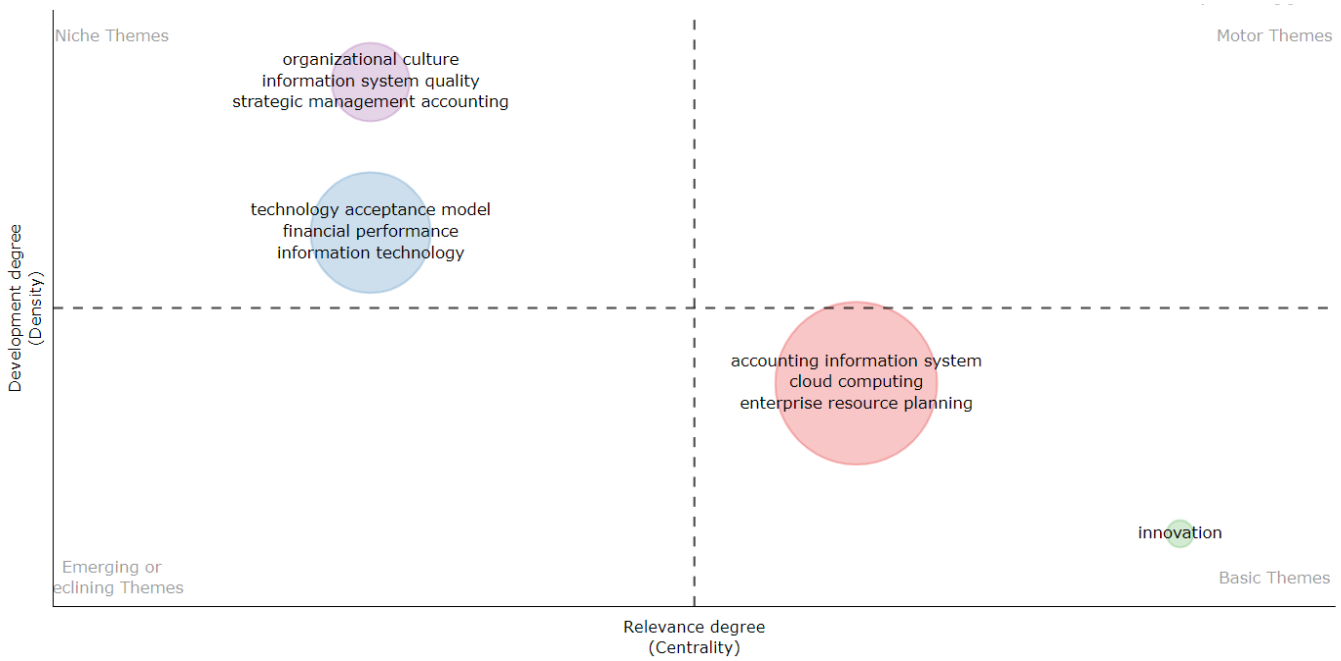


Figure 12. *Thematic map (time slice 3) of author keywords in sample scientific publications for 2021-2023 (as of 11 July 2023).*

A special place in this cluster is occupied by publications devoted to the specifics of the development of information and communication technologies under the influence of the consequences of COVID-19. Among them, it is worth noting the key advantages of cloud AIS, which activate their urgent introduction (Ahmad et al., 2022; Al-Okaily et al., 2023), in particular, as a result of strengthening the connection between AIS availability, security and integrity with firm performance (Alshawabkeh et al., 2022), as well as updating the list of risks, threats and cyber security violations in order to modernize the means of control and guarantees of cyber security (Cram et al., 2023). Also, there is a positive effect of AIS implementation under ERP on useful information and successful decision-making (Lata & Lata, 2021) and the quality of the MAIS itself, which was determined by such characteristics as reliability, efficiency and flexibility (Astuty et al., 2022). In general, the "accounting information system" cluster is represented by theoretical and empirical publications that are characteristic of it in the previous periods as well, which are devoted to the analysis of the impact of AIS on financial stability (Ali & Oudat, 2021), productivity and sustainability (Tingey-Holyoak et al., 2021), organization and effectiveness of internal control of business

entities (Alawaqleh, 2021; Alrabei, 2021) and evaluation of success parameters of AIS implementation, including based on the DeLone and McLean model of information system success (Al-Hattami, 2021).

The smallest cluster in this period, "innovation", which is also part of the basic themes, includes research into the relationship between AIS and innovation, which further determines the business strategy and productivity of SMEs (Latifah et al., 2021), as well as prospects for the integration of emerging technologies (particularly business intelligence and analytics) with traditional AIS in order to increase strategic flexibility, performance and innovations of organizations (Yoshikuni et al., 2023).

Niche themes in this period are represented by two clusters labelled "organizational culture" and "technological acceptance model". The former includes the study of qualitative characteristics of IT as a modern driver for the development of strategic planning (Namazi & Rezaei, 2023), management accounting (Hadid & Al-Sayed, 2021) and control (Papiorek & Hiebl, 2023), as well as the impact of the quality of AIS elements on company organizational culture and working atmosphere (Jarah & Almatarneh, 2021). As for the "technological acceptance model" cluster, it is worth noting the study of the influence of MAIS and knowledge management capabilities on innovation and operational performance of SMEs (Kareem et al., 2021; Sunarta & Astuti, 2023), innovative strategies, the state of management accounting and financial performance of companies (Gyamera et al., 2023; Saleh & Al-Nimer, 2022).

5 Discussion

RQ 1. How many articles devoted to AIS are indexed in the Scopus database? How has this field developed in dynamics? Authors from which countries have made the greatest contribution to the total scientific production?

In terms of the quantitative parameters of the studied sample and trends in their change, the obtained results (167 articles) have a high degree of correspondence with the results obtained by Monteiro and Cepêda (2021) based on a sample of 144 articles indexed in the Web of Science during 1973-2021, including the date of the first publication. However, despite the use of the Scopus database, the results of Ezenwoke et al. (2019) were formed based on a study of 727 publications dated 1975-2017 due to significant differences from the present study in terms of approaches to sample formation. Thus, the volume of the sample of articles dedicated to AIS research depends to a greater extent on circumstances such as the formulation of the search query and the establishment of limitations on the type of publications and fields of knowledge, rather than the scientific metric base within which the sample is made.

The revealed trends in the dynamics of the publication of articles devoted to AIS are largely correlated with the trends detected by Ezenwoke et al. (2019) and Monteiro and Cepêda (2021). In particular, despite the active widespread use of information and communication technologies, which characterize the period from the 1980s to 2011 (the so-called Industry 3.0 Digital Revolution), it did not cause an adequate increase in the publication activity of scientists specializing in AIS. The decline in annual scientific production, which is again observed in this area in 2021-2022, could be caused by reorientation of applied development in IT implementation for the purpose of accounting automation to the creation of algorithms for complex automation of business processes and management solutions. It is highly likely that the current interest of scientists (since 2023) in the AIS research domain is due to the new ergonomic realities that have been formed under the COVID-19 pandemic and require an urgent review of approaches to ensure the preservation of data in AIS and authorized access to it. This correlates with the vision of Monteiro and Cepêda (2021), who suggested that AIS construction issues would become one of the key research trends in this field after 2021.

Among the scientists from countries that made the greatest contribution to the development of this area during the research period, the representatives of the United States published the results of their research on a regular basis from 1973, while authors from Malaysia became interested in it after 2009, from Jordan

after 2012, and from Indonesia after 2015. At the same time, authors from Indonesia and Jordan whose articles were included in this sample are not inclined to cooperate with foreign colleagues. The authorship of such publications is characterized by belonging exclusively to one country. In general, this correlates with the results of Monteiro and Cepêda (2021), but differs somewhat from the findings of Ezenwoke et al. (2019), who identified the most productive authors from the USA, China and Indonesia in their sample.

RQ 2. Which countries, journals, articles and authors from the publication sample are the most cited?

The high productivity of authors from the USA and Indonesia became an indirect reason for the low values of their average article citations. Thus, the USA ranks eighth only among the top 10 most cited countries in terms of this indicator and its value is lower (23.20) than the average article citations of the top 10 most cited countries (24.41), while in Indonesia this indicator is generally twice as low (7.50) for the corresponding value of the entire sample (15.34). In our opinion, one of the explanations for the current situation may lie in the authority of the editions in which the articles were published.

Out of 75 journals in which articles of the analysed sample were published, at least one citation is present in the publications in 60 editions, which is 80% of their total number. Based on the titles of the journals ranked in the top 10 in terms of AIS publications, at least five editions specialize in research into accounting and/or IS/IT. In our opinion, this is additional evidence of the scientific niche nature of the chosen issue, which requires multifaceted approaches to the evaluation of its scientific output.

Despite the single thematic affinity of the analysed articles, the aggregate of journals in which they were published is not completely homogeneous, which makes it difficult to determine important parameters of scientific editions such as productivity, influence, coverage and prestige. In bibliometrics, the combined dynamics of such heterogeneous aggregates are traditionally assessed on the basis of the *h*-index (Hirsch, 2007) and its alternatives – the *g*-index and the *m*-index (Costas & Bordons, 2008). Only four publications from the entire sample managed to simultaneously occupy places in the top 10 by the number of publications, citations and the *h*-index. At the same time, in terms of the *h*-index, *g*-index and *m*-index rating in the top 10, the top position is occupied by the International Journal of Accounting Information Systems. Its authority in the field of AIS has also been confirmed by the results of the bibliometric analysis of publications indexed in Scopus (Ezenwoke et al., 2019) and Web of Science (Monteiro & Cepêda, 2021).

In terms of the number of citations, the leading editions in the top 10 are those in which the first publications of the analysed sample appeared more than 10 years ago, but in terms of the number of publications and the *h*-index, there are more journals in the top 10 that showed their interest for the first time in the articles on the researched topic during its growing popularity in 2015. If the detected trends persist in the future, we should expect an increase in the number of influential editions where publications will be able to form new stable trends in scientific research into AIS.

It was found that the productivity of authors included in the sample, 90% of whom published only one article, does not correspond to Lotka's Law, according to which about 60% of authors will publish only one article on a certain topic (Friedman, 2015). This does not contribute to the systematic deepening of the initiated scientific developments, but it complicates the emergence of absolute authorities and using common approaches to conducting research.

Whereas 128 (76.65%) out of 167 articles in the sample were cited as of 11 July 2023, the real value of the total citation rate for the entire sample is an average of 20.0 references per cited article. However, the index of local citation within the sample is much lower at 97 references. Thus, one article in the sample accounts for only 0.58 local citations. Taking into account the fact that only 45 articles (26.95%) were cited within the sample, then the real local citation rate increases to 2.16 references, remaining almost ten times lower than the real total citation rate. This is a vivid manifestation of contradictions of the interdisciplinarity of this issue, which is simultaneously under the influence of trends inherent in both exact sciences (informatics) and social and humanities (accounting and management), in particular, the culture of

citation (Todd & Ladle, 2008). Thus, the total citation rate of articles included in the sample is a proof of significant interest in them among authors specializing on accounting and management with a prevailing opinion about the importance of using journal sources, mostly no older than five years (Aistleitner et al., 2019), whereas local citations correspond to approaches to the preparation of articles by computer scientists, who prefer book sources that are referenced outside of Scopus without affecting a citation rate within the subject area (Kelly, 2015).

All the most cited articles in this sample were published before 2013, which is confirmed by the results of other similar studies (Ezenwoke et al., 2019; Monteiro & Cepêda, 2021). At the same time, their total citation rate is 44.83% (1,148 out of 2,561) of the citations of the entire sample, while their citation rate within the sample is one and a half times lower – 28.87% (28 out of 97), and two articles do not have any citations at all within the sample. Moreover, eight articles were published in the top 10 Scopus journals on AIS and *h*-index publications, which is an additional confirmation of their high scientific significance. At the same time, 70% of the most productive authors began to publish the results of their AIS research after 2015, when the development of this topic acquired a stable positive trend. The total citation of their publications provides only a third of the aggregated total citation rate of the top 10 authors by *h*-index, while their citation within the sample accounts for slightly more than half of the local citation. In our opinion, these circumstances may be signs suggesting that this field of research is gradually becoming localized, and its issues/themes are becoming less interesting to scientists in related fields probably due to the narrow specificity of the topics of the publications.

RQ 3. What is the content orientation of the AIS research themes based on the frequency of use of author keywords?

The most frequently used author keywords in the sample such as “accounting information system”, “accounting” and “small and medium enterprises” form the two largest clusters in the co-occurrence network of author keywords.

The relationship that exists between these clusters at the level of central nodes indicates that a significant part of AIS research is conducted in the context of strategic planning and development of small and medium-sized businesses. Moreover, social, material, technological and organizational factors of successful implementation of AIS are in focus, as well as the use of financial and non-financial indicators as measures of the effectiveness of AIS use. This partially correlates with the results of the author keywords analysis in other similar studies, in which the most frequently mentioned ones were “accounting information system”, “information system”, “internal controls”, “auditing”, “regulatory”, “compliance”, “management control” (Ezenwoke et al., 2019), as well as “accounting information systems”, “performance”, “management accounting” and “information system” (Monteiro & Cepêda, 2021).

RQ 4. What patterns of evolution do the AIS research themes show in dynamics in terms of time slices of the thematic map?

The thematic evolution of the author keywords shows that the keyword “accounting information system”, used by the authors most often, maintains its popularity during all three automatically determined time intervals into which the studied period of AIS publications was split. Also, in the second period, it partially supported “small and medium enterprises”, which owes its appearance to the “management accounting information system”. “Accounting” and “accounting information system quality” were actively used by the authors as keywords during the first two periods, but at the third stage of the development of the studied topic, the popularity of “accounting” was enough only to start a new keyword “organizational culture”, while “accounting information system quality” did not receive any further development at all. Another new keyword “technology acceptance model” appeared in the third period thanks to the

simultaneously declining use of "small and medium enterprises" and "intellectual capital", which, in turn, appeared from "information technology".

A specific feature of the thematic map (time slice 1), built on data from 56 articles of the sample published during 1973-2015, is the complete absence of motor themes and emerging or declining themes, which correlates with previous conclusions about the insignificant interest of scientists in the problems of applying AIS during Industry 3.0 (Digital Revolution). The largest cluster in this period, "accounting information system", which refers to basic themes, is primarily associated with publications devoted to features of accounting automation such as analysis of the productivity of used software products and the search for ways to improve it.

The thematic map (time slice 2) illustrates the rapid development and diversity of interest of scientists in the development of AIS issues during 2016-2020, when 75 articles were published. The dynamism of the development of the researched themes during this period emphasizes not only the presence of topics in all four quadrants of the thematic map, but also shows the transition of the third largest cluster of "intellectual capital" from niche themes to motor themes. In time slice 2, the clusters labelled "accounting" and "accounting information system" not only retained their presence in the basic themes quadrant, but also significantly increased their frequency compared to time slice 1. This was probably facilitated by a certain update of the content of these clusters, which include such keywords as "actor-network theory", "automation", "organizational culture" and "supply chain". It is also worth noting in this period the de facto migration of narrow-profile articles of a conceptual and methodological nature and bibliometric reviews from niche themes to basic themes, which indicates their popularity among scientists; meanwhile, the displacement of the "accounting information system quality" cluster from niche themes to emerging or declining themes in the second period suggests that the topic of this cluster failed to gain sufficient popularity, which can be proved by the low citation of publications associated with it, and the authors gradually lost interest in it.

The pattern of the thematic map (time slice 3) shows a return to the trends that took place during time slice 1. However, if in 1973-2015 the presence of thematic clusters in two quadrants only can be considered a sign of too slow development of the theme, then after the diversification of the thematic map (time slice 2), the reduction in the number of clusters and quadrants in which they are represented may indicate the degradation of this scientific direction as such. Even taking into account the shortest duration of time slice 3 (2.5 years – from 1 January 2021 to 11 July 2023), it should be noted that the 38 publications that appeared during this period partially due to challenges caused by COVID-19 are quite comparable to the 75 publications during time slice 2 (5 years – from 1 January 2016 to 31 December 2020). Thus, despite the preservation of the number of publications, there is now a substantial exhaustion of the scientific issues of the use of IS and IT in accounting and analytical practice. Similar conclusions have been made by other scientists, who have noted the presence of significant gaps in the development of the trajectory of AIS research, which lacks comprehensive studies on the influence of human and technological factors on the development of AIS, the introduction of artificial intelligence, the use of cloud technologies in accounting systems, and the analytical component of the role of an accountant in the adoption of management decisions based on the expanded use of big data and business intelligence (Guragai et al., 2017; Kocsis, 2019; Kumar et al., 2020; Monteiro & Cepêda, 2021).

6 Conclusions

The impact of the further development of the scientific and practical aspects of the implementation and use of AIS on the effective processing of accounting data and the formation of reliable financial reporting will continue to increase due to the role of operational and qualitative information in management decision-making that ensures increasing operational efficiency and profitability of businesses (Kocsis, 2019; Ali & Oudat, 2021). Since the productivity of AIS operation depends on a number of technical,

financial, social, industrial and other factors (Poston & Grabski, 2000; Kauffman et al., 2011; Moffitt et al., 2016; Guragai et al., 2017), the impact of which has been studied by exact and social sciences (Rom & Rohde, 2007; Ezenwoke et al., 2019), the analysis and systematization of research results devoted to the implementation of AIS are burdened by the need for the combined use of specific methods of bibliometric and cluster analysis.

The chronological approach to the interpretation of key bibliometric indicators and clustering of scientific publications used in this research provides a comprehensive assessment of the features of the development of the field of AIS research, taking into account the general context of the dynamics of trends in the automation of business management processes under conditions of the significant economic, social, technological and ergonomic transformations that took place during the last 50 years. The revealed patterns of the development of key thematic directions of AIS publications indicate the need to find new, promising research objects that correspond to the leading trends of Industry 4.0, which involves the transition to fully automated production under the control of intelligent systems in real time in interaction with the external environment that goes beyond the boundaries of one enterprise, with the prospect of merging into a global industrial network of things and services. The attention focused on emerging technologies will contribute not only to the actualization and increasing popularity of this scientific field, but also to a deeper understanding and, on this basis, wide and prompt implementation of the most progressive technologies into the practice of accounting and analytical work. Taking into account the things mentioned above, this review has identified the following major areas on which AIS research should focus:

- Expanded implementation of artificial intelligence and the use of machine learning for accounting that will allow increasing the range of processes performed without the involvement of a specialist (registration of typical facts of economic activity in account books, generation of reports in real time, analysis of large volumes of data). This will contribute not only to minimization of cases of errors and fraud, but also to conducting a continuous automated audit of primary documentation, which, in turn, will increase the level of reliability of financial reporting.
- Activation of the integration of local AIS to ERP as a system of complex automation and management of key business processes aimed at achieving optimal productivity. This will increase the efficiency and effectiveness of management decisions due to the creation of a single information base for their adoption.
- Application of blockchain to increase the transparency of accounting due to the immutability of the chronological order of records and ensuring the consistency of consecutive data streams in digital registers. This will protect the accounting system from possible manipulation of primary data and further distortion of reported indicators.

Besides following the main research directions mentioned above, other AIS-related research ideas may be devised based on:

- the use of cloud computing for instant access to data, permanent backup and end-to-end encryption, which will minimize the risk of losing accounting information and save on hardware;
- development and implementation of new cyber security measures in the conditions of remote technologies for organizing the work of accounting staff, which will protect against the risks of unauthorized access to accounting data and loss of confidentiality of clients and employees;
- adaptation of the use of data and information visualization techniques and tools to intensify the involvement of accountants in management decision-making processes based on accounting and reporting data.

This study makes several theoretical contributions to the field of AIS research. Firstly, we identified the specific features of the field of AIS research and offered an explanation of their formation. Secondly, we analysed the key topics of AIS research in the chronological order of their publication, provided an

assessment of the current status and determined the prospects for further development of the themes of scientific research.

The findings of this paper are limited to articles published in journals indexed in the Scopus database. However, in mitigation of this limitation, we believe a strength of our study is our ability to make comparisons with the findings of an earlier study of AIS-related work conducted by Monteiro & Cepêda (2021), who reviewed articles published in journals indexed in the WoS database. Another possible limitation of this study, which could affect the obtained results, is the use of the Bibliometrix toolkit for bibliometric analysis and clustering of publications. Therefore, it would be interesting to see if the results are available in other academic research databases, both multidisciplinary (ScienceDirect, DOAJ) and specialized (IEEE Xplore), as well as non-academic databases (Google Scholar), using other software products for conducting bibliometric and cluster analysis.

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