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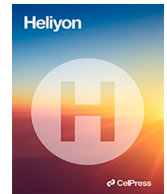
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Review article

A bibliometric review of global visibility, impact and adoption of electronic invoicing: The past and the future

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ABSTRACT

The objective of this study is to conduct a bibliometric review of literature on electronic invoicing to provide an understanding of the growing field and valuable sources for future research. A total of 191 papers within the period of 1997 to July 2021 were included in our analysis. The systemic analysis revealed several insights in research progression over two decades, relevant authors and leading institutions including countries, most frequent keywords, and the principal methodologies and theories adopted. Although the field of electronic invoicing is still emerging, it is interesting to see trending keywords such as ‘data mining’, ‘automation’, ‘blockchain’, ‘digital storage’, and ‘machine learning’ as demonstrated in recent publications. The study also attempted to develop a framework and proposed an integrated theory of electronic invoicing since the general theoretical framework does not exist in the literature. Several research gaps were exposed related to more studies in the emerging field of electronic invoicing and how future studies could further shape the field by addressing yet unanswered questions. We anticipate that the findings in this study will be a valuable contribution and resource for e-invoicing research.

1. Introduction

Electronic invoicing is making a big wave in academics, industry, and the environment worldwide with notable drivers, challenges, and trends of business transformation, efficiency, and accuracy. To buttress this invoicing innovation, Globe Newswire [1] shows that electronic invoicing can grow by \$15.49 billion with a steady Compound Annual Growth Rate (CAGR) of over 28% between 2021 and 2025. Electronic invoicing has become a global phenomenon and has in recent times witnessed increased adoption by governments and organizations as well as medium and large companies. For example, countries in the Latin America region, such as Brazil, Mexico, and Chile, have been pioneers and world leaders in implementing electronic invoices [2]. The overall adoption rate in North America is comparable to that of Europe; however, the growth rate for adoption in North America lags significantly behind that of Europe and Latin America [3,2]. While e-invoicing is spreading in the Asia-Pacific region on a country-by-country basis, the number of users is limited in Africa [4]. Although the benefits accrued to e-invoicing, such as taxation purpose for government and improvement in

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companies' productivity and gain, mandate enforcing e-invoicing systems has been the driving force of adoptions across jurisdictions.

The rampage of the Covid-19 pandemic contended against all business sectors and global economic activities [5,6,7]. Electronic invoicing directives, compliance, security, value-added tax, and other implementation move was no exception. The effects of Covid-19 are both positive and negative. Positively wise, real-time transmission of electronic invoicing for tax administration and other business activities aligns with social distancing and isolation regulations of Covid-19. Further, the electronic invoicing will aid the post-Covid-19 recovery process through effective and efficient tax administration and improve the accounts payable and receivable decision-making process. On the negative side, the Covid-19 pandemic has disrupted the introduction and implementation schedule and deadlines of electronic invoicing in different countries globally. Covid-19 has slowed down the speed of implementation, regulations, and legislation. Covid-19 also impact the author's productivity between 2018 and 2020. There was a 49% difference and a 64% increase in authors' productivity between 2018 and 2019. Likewise, there was a 20% difference and a 22% increase in authors' productivity between 2019 and 2020 (Fig. 23). There was a decrease in the author's productivity between 2019 and 2020 in comparison with 2018–2019 due to the Covid-19 disruption.

Several studies have been conducted about e-invoicing systems, such as the benefits of e-invoicing to companies [8,9], attack detection technology of electronic invoice systems (Tang, Qiu, Huang [10]), generation and communicational standards of electronic invoice process [11] and development of e-invoicing solution [12,13]. Despite the growing number of studies on this topic – reviews of the article coverage on electronic invoicing remain-critically limited. Due to this scanty literature review, this study gives a deeper understanding of the milestone, the relationship between the emerging vital concepts, current and lacking theories, and intercontinental gaps of electronic invoicing and demonstrates how to extend the study of electronic invoicing. One of the exceptions is a study by Cedillo, Garcia, Diego & Bermeo [14], which conducted a systematic literature review to know and clarify state of the art in the subject associated with electronic invoicing, technological aspects related to notification systems. The interplay of four decisive factors of directives, compliance, security, and value-added tax, has yet to be clarified [15], so it is not apparent which one is dominant in the actual ecosystem of e-invoicing in the existing empirical studies. Aside from empirical and theoretical gaps, no bibliometric study has been published that investigates the scientific production and thematic breakthroughs in electronic invoicing to the best of our knowledge.

Thus, this study is a bibliometric analysis intended to review articles related to electronic invoicing to identify top themes in these articles and investigate the status and evolution of the scientific studies. This study forms a contribution to the electronic invoicing field that can guide researchers to identify gaps in the production of electronic invoicing-related articles considering variables such as countries, institutions or organizations, and leading authors in the area. The study proposes a theoretical framework (Fig. 1.) since no general theoretical framework exists for e-invoices [8]. To the best of our knowledge, this is the first bibliometric study conducted in the field of e-invoicing and makes an important contribution to the body of knowledge.

This study uses the Web of Science (WoS) and Scopus databases as the primary search engines. It analyzes the data from 1997 to 2021 to offer an overview of studies related to electronic invoicing. The rationale for limiting the data collection on electronic invoicing to twenty-four years (1997–2021) is due to the timeline of the research's emergence, and to create an avenue to investigate performance quality, citation histories and ensure that relevant literature on electronic invoicing is included. Further, this timeline allows for handling of large volumes of scientific data and to examine high research impact. Also, this timeline will allow for uncovering emerging trends in article and journal performance, and to make comprehensive bibliometric data analysis.

This article does bibliometric analysis and creates data matrices for co-citation, coupling, scientific collaboration analysis, and co-word analysis on electronic invoicing using the science mapping technique and the Bibliometrix R-package. The rest of this study is structured as follows. In part II, this study suggests practical ideas and describes the pertinent theoretical framework found in the literature. The identification, retrieval, and cleansing of the data for the bibliometric analysis were covered in detail in Section III. The outcome of the bibliometric study is presented in Section IV, and the conclusions are discussed in Section V. The study is concluded in

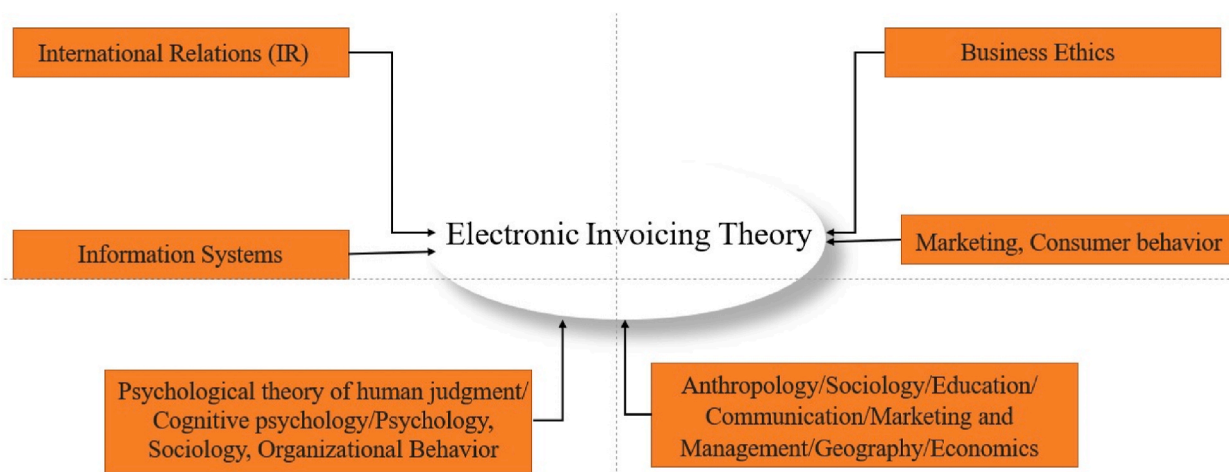


Fig. 1. Proposed integrated theories of electronic invoicing.

Section VI, which also identifies its limits and offers ideas for future research topics.

2. Theoretical framework

Revisiting theoretical positioning and practical application should not be a daunting task for researchers because of its importance and relevance. Abend [16] agreed that theory is critical but raised concerns for theory misunderstanding that often leads to miscommunication because of its multidisciplinary nature. For instance, there is a joint agreement that argument that hypotheses, references, data, variables, and diagrams are not regarded as theory [17]. The author opines that the solution to the semantic predicament of theory in sociology should be less ontologically and epistemologically demanding. Earlier before the proposition of Abend [16], Van de Ven [18] portrayed that a theory could be bad or good and sided the good theory and encourage the researchers to come out of their comfort zone to acquire lasting skills to develop a good theory that contributes to knowledge and application of knowledge to the practice of different professions. Weitz [19] spotlighted theory in the aesthetics field six decades and a half ago and emphasized its importance as a foundation for appreciation and criticism. The theory is an enduring journey for researchers and an unavoidable path of rigorous academic work. Nevertheless, the journals need to evaluate their empirical requirements [17].

There is a need to be an overarching theoretical framework for e-invoices, even though electronic invoicing is a rapidly expanding study area. As development happens in waves, the diffusion of innovations theory [20,21] may be a valuable framework for understanding the gradual spread of e-invoices [22]. Hernandez-Ortega's [23] research synthesizes the innovation and technology acceptance models [24]. The latter approach is grounded in the idea that characteristics like perceived usefulness and ease of use are crucial for adopting new technologies. If electronic invoicing systems were an example of an invention in technology, we might expect them to go through a series of stages before reaching widespread adoption [25,22]. The Organization for Economic Co-operation and Development (OECD), in 2004 [26], used a similar theoretical framework to analyze ICT developments. Three distinct stages are identified: readiness, intensity, and impact. Intensity (or use) reflects the percentage of enterprises that adopt and the level of use, whereas readiness relates to a firm's capacity to embrace an ICT innovation. Impact refers to modifications in behavior, economics, or productivity brought on by use.

Most of the literature reviewed did not employ theory in their studies. Using strong theory in the research domain of electronic invoicing will make the relevant journals more impactful and improve the academic output standard. Due to the scanty theory in electronic invoicing literature, this study recommends applicable theories in Table 1.

3. Methodology

This study followed the methodological process outlined by Massimo Aria and Corrado Cuccurullo for conducting bibliometric study [47] published on their website.¹ The process begins with the data collection, data loading, and analysis. In this research, Bibliometrix R-package was used to do bibliometric analysis. The Bibliometrix R-package is a quantitative research tool for scientometrics and bibliometrics that provides routines for importing bibliographic data from Scopus, Clarivate Analytics' WOS, PubMed, and Cochrane databases, to perform different bibliometric analyses and building data matrices for co-citation, coupling, scientific collaboration analysis, and co-word analysis [47].

The study reviewed relevant literature utilizing two databases which include WoS and Scopus. According to Zhu & Liu [48], WoS and Scopus are two global leaders and competing citation databases that house quality research across regions, countries, and knowledge domains. Wang & Waltman [49] also categorized WoS and Scopus as the two most important multidisciplinary bibliographic databases, while Singh et al. [50] stated that the two had been the most widely used databases for bibliometric analyses. At the same time, several comparison studies exist on the two databases (for example, [50,51,48]). The literature indicated that Scopus has a broader coverage of journals than WoS [52], whereas WoS continues to be more selective in its journal coverage. The combination of the peculiarities and strengths identified with each of the databases makes them suitable for this study. We searched the two databases to understand that while all the scientific papers related to electronic invoicing may not be included, a significant number of relevant publications would be captured for analysis. This study employed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) for data extraction criteria and classifications (Fig. 22).

Aside from conducting a bibliometric analysis focusing on either of the databases [53,54], previous studies have also been identified to have combined both databases for analysis [52,55].

The data collection was conducted in June 2021. In this study, the search strings include "electronic invoicing" or "e-invoicing", "e-invoice" or "electronic invoice". These strings were combined to execute queries in both WoS and Scopus databases. For example, the query in WoS combines search strings thus: *TOPIC: ("electronic invoicing") OR TOPIC: ("e-invoicing") OR TOPIC: ("e-invoice") OR TOPIC: ("electronic invoice")*. Similarly, the query in Scopus combined the search strings thus: *TITLE-ABS-KEY ("electronic invoicing" OR "e-invoicing" OR "e-invoice" OR "electronic invoice")*. In WoS, the search strings generated 99 papers inclusive of conference proceedings, book chapters, and journals. For the preference of only conference proceedings and journals and based on the language of the retrieved documents, the papers were reduced to 84 documents written in the English language. Excluded papers are three papers written in Portuguese, 2 in Polish, and one in Serbian and Turkish languages. The search of literature in Scopus yielded 225 documents while refining it to include conference and journal papers written in English resulted in 172 papers. The merger of the data from the

¹ https://www.bibliometrix.org/vignettes/Introduction_to_bibliometrix.html.

Table 1

Relevant theories for electronic invoicing literature (Organization readiness for change).

N0	Originating Author	Theory/Model	Independent Variables	Dependent Variable	Originating Area	Level of Analysis
1.	March [27,28]	Behavioral decision theory	Decision Inputs, Task Characteristics, Choice Framing, Decision Processes, Decision Strategies, Probability Assessment, Cognitive Processes, Cognitive Biases, Judgmental Heuristics, Data Completeness, Individual Differences, Information Processing, Decision Support	Decision Outcomes	Psychological theory of human judgment	Individual
2.	DeLone & McLean [29] DeLone & McLean [30]	Delone and McLean IS success model	System Quality, Information Quality, Service Quality	Net Benefits, (Intention to) Use, User Satisfaction	Information Systems	Individual, Organization
3.	Lazarsfeld, and Stanton [31] Rogers [32] Rogers and Shoemaker [33] Rogers [34]	Diffusion of innovations	Compatibility of Technology, Complexity of Technology, Relative Advantage (Perceived Need for Technology)	Implementation Success or Technology Adoption	Anthropology/Sociology/Education/Communication/Marketing and Management/Geography/Economics	Group, Firm, Industry, Society
4.	Lowry et al. [35]	Hedonic-motivation system adoption model (HMSAM)	Perceived ease of use, perceived usefulness, curiosity, joy, control	Behavioral intention to use, Immersion	Information Systems (native IS theory)	Individual
5.	Goodhue [36] Goodhue and Thompson [37]- Individual level Zigurs and Buckland [38]- group level	Task technology fit	Task characteristics, Technology characteristics	Individual performance, System utilization	Information Systems	Individual
6.	Arnold and Sutton [39]	Theory of Technology Dominance	Task Experience, Task Complexity, Decision Aid Familiarity, Cognitive Fit	Reliance, Dominance	Information Systems	Individual
7.	Oliver [40,41]	Expectation confirmation theory	Expectations, Perceived performance, Disconfirmation	Satisfaction	Marketing, Consumer behavior	Individual
8.	Bandura [42] Compeau & Higgins [43]	Self-efficacy theory	Computer anxiety, personal innovativeness in IT, trait anxiety, task characteristics, prior performance, perceived effort	Outcome expectations, Computer performance, Performance	Cognitive psychology	Individual
9.	Freeman [44]	Stakeholder theory	Stakeholder interests	Firm performance	Business Ethics	Firm
10.	Woodman, Sawyer, & Griffin [45]	Theory of Organizational Creativity	Individual, group and organizational characteristics	Organizational creativity	Psychology, Sociology, Organizational Behavior	Individual, group and organizational
11.	Eckersley [46] Barry & Eckersley [97]	Green Theory (sub-theory of IR)	–	–	International Relations (IR)	Environmental issues and international relations

two databases resulted in 191 after the duplicates were expunged. Biblioshiny app software was utilized for bibliometric data mapping to accommodate the weakness and strengths of the bibliometric data analysis software. The included articles are thereby presenting a network analysis of e-invoicing research.

After the data were retrieved independently from each of the databases, the data were downloaded in a CSV file and merged in R-studio software by the command line (Fig. 2). The main inclusion criteria were articles published in journal or conference proceedings and written the English language.

3.1. Data synthesis

Fig. 24 provides the general information on the dataset utilized in this study. It revealed that conference papers (n = 127) dominate the type of document published so far in the field, followed by journal articles (n = 64). The total citation of keyword plus remains 1028, whereas 440 authors have so far contributed to the field's scientific knowledge base. Regarding authors' collaboration, single-

```

install.packages("bibliometrix")
library(bibliometrix)
biblioshiny()
setwd("c:/Users/Intel/Desktop/Post_Doc_Application/emerge")
getwd()
DigitScopus=convert2df("scopus.bib", dbsource="scopus", format="bibtex")
View(DigitScopus)
digitwos = convert2df("wos.bib", dbsource = "isi", format = "bibtex")
View(digitwos)
CombinedData = mergeDbSources (DigitScopus, digitwos, remove.duplicated = TRUE)
View (CombinedData)
dim(CombinedDatabase)
library (openxlsx)
write.xlsx (CombinedData, file = "XlsCombinedData.xlsx")

```

Fig. 2. Line codes for combining WoS and Scopus.

authored documents account for 35 scientific papers, documents per author reveal 0.43, authors per document shows 2.3, co-authors per document reflect 2.97, and the collaboration index accounts for 2.62. The descriptive shows underscored expanded collaborations than single-authored work.

4. Results and discussion

This section presents the result of the quantitative bibliometric analysis. The presentation of the results is based on the research questions the study addresses, which aim to provide an extensive understanding of the research focus to readers.

4.1. Q1. How has e-invoicing research progressed over time?

This study conducted two analyses (annual scientific production and citation per year) that signify progress made over the years to understand the research landscape of electronic invoicing. These quantitative analyses provide explicit information on how the field has fared with insight into what the future holds. In order words, the first research question addressed in this study intended to investigate the electronic invoicing research landscape over the years and tries to forecast the future based on the data retrieved.

4.1.1. Annual scientific production

As summarised in Fig. 3, our dataset stated that the annual scientific production of research documents in the field of electronic invoicing started in 1997 with only one article published in that year. Ever since (between 1997 and the current year of 2021), there

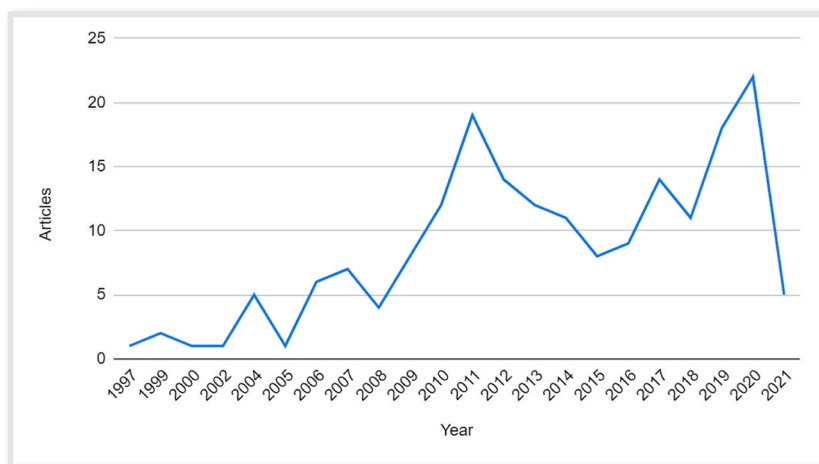


Fig. 3. Annual scientific production.

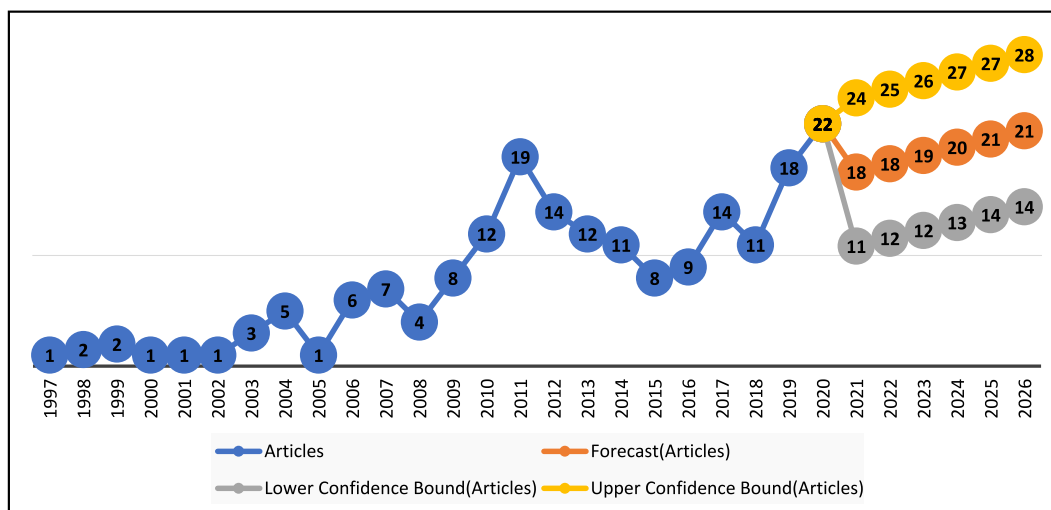


Fig. 4. Annual scientific production five years forecast.

have been 191 publications from 151 different sources, primarily journals (64 articles), conferences (127 conference papers). As shown in Fig. 3, there was a general rise and fall in article production between 1997 and 2021. Notwithstanding, an increasing interest in electronic invoicing was seen between 2006 and 2007, whereas a remarkable growth was witnessed between 2009 and 2011. Regarding the number of scientific articles produced, the most productive years were 2020 with 22 documents, 2011 with 19 documents, and 2019 with 18 documents, respectively. Every year, electronic invoicing of scientific papers increases by about 0.636, with a median of 8 papers.

This study creates a forecast worksheet with Excel version 2109 and delves into predictive analysis to understand the growth in the electronic invoicing field by conducting a five-year forecast (2022–2026). Fig. 4 delineates that there will be steady growth in the field of electronic invoicing in terms of scientific production between 2022 and 2026. However, the possibility of witnessing a faster growth is shown with the upper confidence bound indicator, whereas the tendency to decline the number of article production is depicted with the lower confidence bound indicator. Generally, the trend analysis suggests that the scholars will continue to advance the field of electronic invoicing with a steady growth rate but not exceptional with already recorded success.

4.1.2. Annual citation per year

Considering the number of citations of electronic invoicing publications per year, Table 2 and Fig. 5 presents the analysis result.

Table 2
Articles vs Citable Average.

Year	Articles	MeanTCperArt	MeanTCperYear	CitableYears
1997	1	1.0	0.0	24
1998	0	0.0	0.0	0
1999	2	0.0	0.0	22
2000	1	0.0	0.0	21
2001	0	0.0	0.0	0
2002	1	52.0	2.7	19
2003	0	0.0	0.0	0
2004	5	0.8	0.0	17
2005	1	0.0	0.0	16
2006	6	7.7	0.5	15
2007	7	8.9	0.6	14
2008	4	4.3	0.3	13
2009	8	6.5	0.5	12
2010	12	10.5	1.0	11
2011	19	5.1	0.5	10
2012	14	3.6	0.4	9
2013	12	13.3	1.7	8
2014	11	3.3	0.5	7
2015	8	13.8	2.3	6
2016	9	5.3	1.1	5
2017	14	2.8	0.7	4
2018	11	1.0	0.3	3
2019	18	0.5	0.3	2
2020	22	0.5	0.5	1
2021	5	0.0	0.0	0

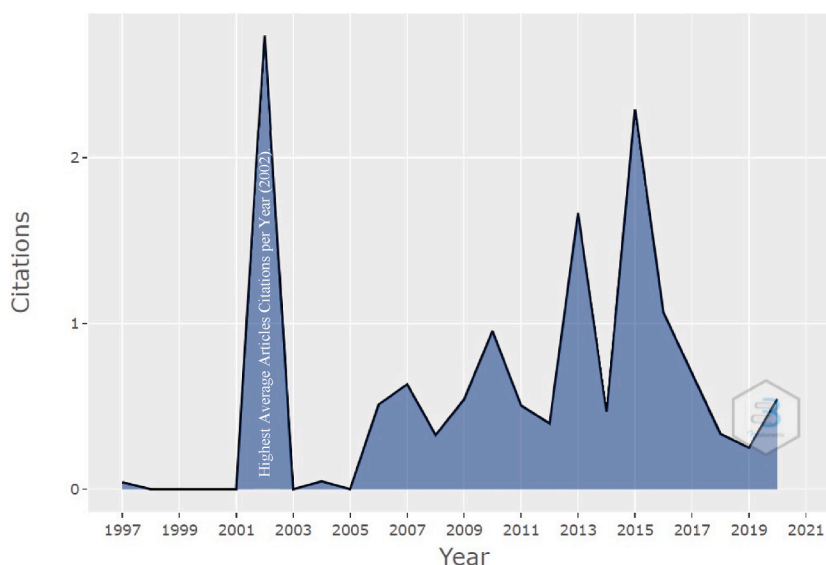


Fig. 5. Electronic invoicing yearly citation.

Concerning Table 2. The highest mean of total citation per year that accounts for 2.7 was recorded in 2002 against one publication with 19 citable years, which accounts for 24 years, and the second highest was 2.3 in 2015 registered on eight documents with six citable years followed by 1.7 recorded on 12 documents in 2013 with eight citable years. On the other hand, the lowest mean total citation per year was zero (0) recorded for four years (1998, 2001, 2003, and 2005, respectively). Ironically, 2020 recorded 22 articles with a total citation per year mean of 0.55; citable years account for one while the citable average has 3. This result indicates that the volume of scientific papers did not automatically depict an increase in the citation. The citation depends on the quality of the papers and accessibility to those that need them for academic work.

4.2. Q2 who are the most relevant authors publishing in e-invoicing research?

This study conducted authors analysis from two perspectives (number of documents per author and number of citations per author) to investigate prolific authors in the field of electronic invoicing and how relevant they have been. Regarding the number of documents published, Fig. 6 shows the top 20 authors in the field, with Penttinen E being the leading author. Penttinen has ten documents published in electronic invoicing, followed by Cha S., Chen S., and Kreuzer S. as other authors leading behind Penttinen with five documents each. Penttinen's productivity in the field of electronic invoicing doubled that of the author's close competitors. Penttinen, with ten articles and 4.08 fractional articles, shows the author's contributions to a published set of articles.

As a complementary analysis, Fig. 7 gives an overview of the top twenty (20) authors in the field of electronic invoicing between 2008 and 2020. The larger size of a circle in Fig. 7 indicates the more documents that have been published yearly by the author. In addition, the darker the circle, the higher the number of citations received that year. The number of production years for a given author begins from the year the author makes his/her first publication. As such, the total number of years of production varies with the authors. For example, Joung et al. [56] started publishing electronic invoicing in 2014; therefore, his total number of years is four. Given this understanding, it can be concluded that Penttinen E is the most productive author, followed by Cha S, Chen S., and Kreuzer S with five papers each. Additionally, the analysis shows that Bernius S., Hallikainen P., Pappel I. are ranked the third prolific authors contributing to the field of electronic invoicing, with each having a total of 4 publications. The remaining 13 authors, among the 20 prolific authors, had three publications each, as shown in Fig. 7.

Penttinen and co-authors' productivity and impact are interesting. The author published "The Adoption of Electronic Invoicing in Finnish Private and Public Organizations" with Hyytiäinen in 2008 as the 16th European Conference on Information Systems proceedings with 14 citations. Presently the authors have 33 citations of this paper on Google Scholar. It means the authors have some citations that did not measure up with the WoS and Scopus standard.

Similarly, in 2010, the author published three papers with 24 citations. Between 2011 and 2018, the productivity of Penttinen dropped to one paper per year. The peak years of production of Penttinen were 2009 and 2010 and the peak year for the author's impact was 2010, but between 2008 and 2018, the research activities of Penttinen in the field of electronic invoicing have been undulating. 2019 to date did not show any record of productivity for Penttinen in the research domain of electronic invoicing. Penttinen may have shifted research interest from electronic invoicing, or the author has a work-in-progress project in this field.

Regarding the impact of authors, the analysis of authors' citation in electronic invoicing, as shown in Table 3, revealed the top 20 authors and their performances. According to Choudhri et al. [57], the citation counts of a published article account for its weight regarding how such an article has influenced subsequent publications. Albayrak et al. [58] both receive the highest number of citations

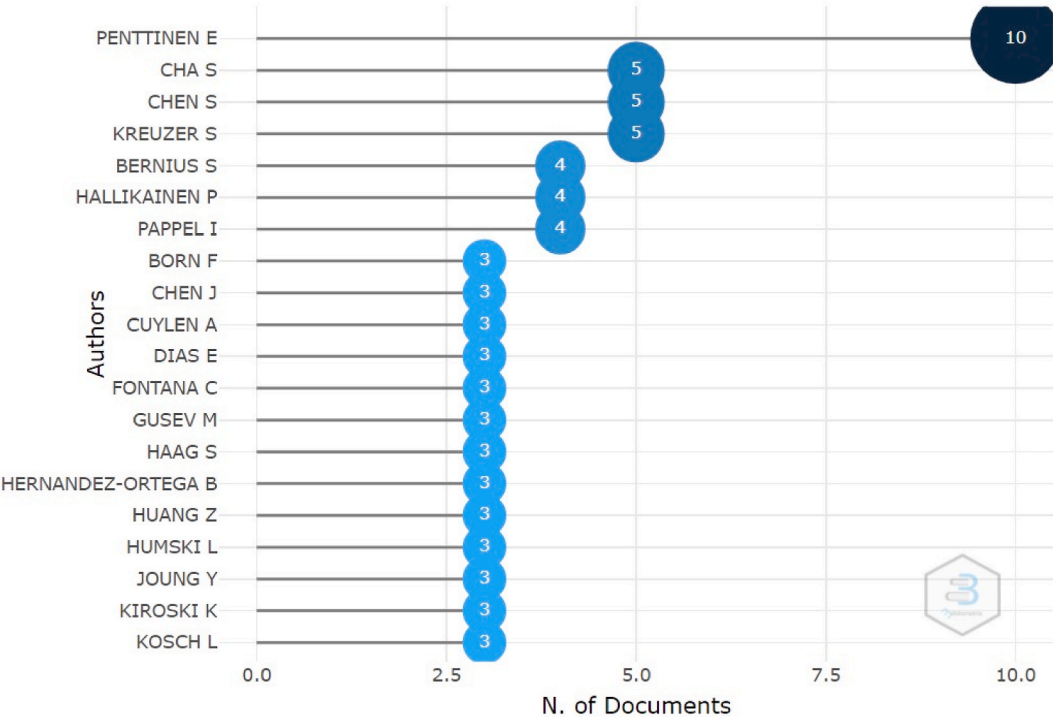


Fig. 6. Most relevant authors based on number of documents published.

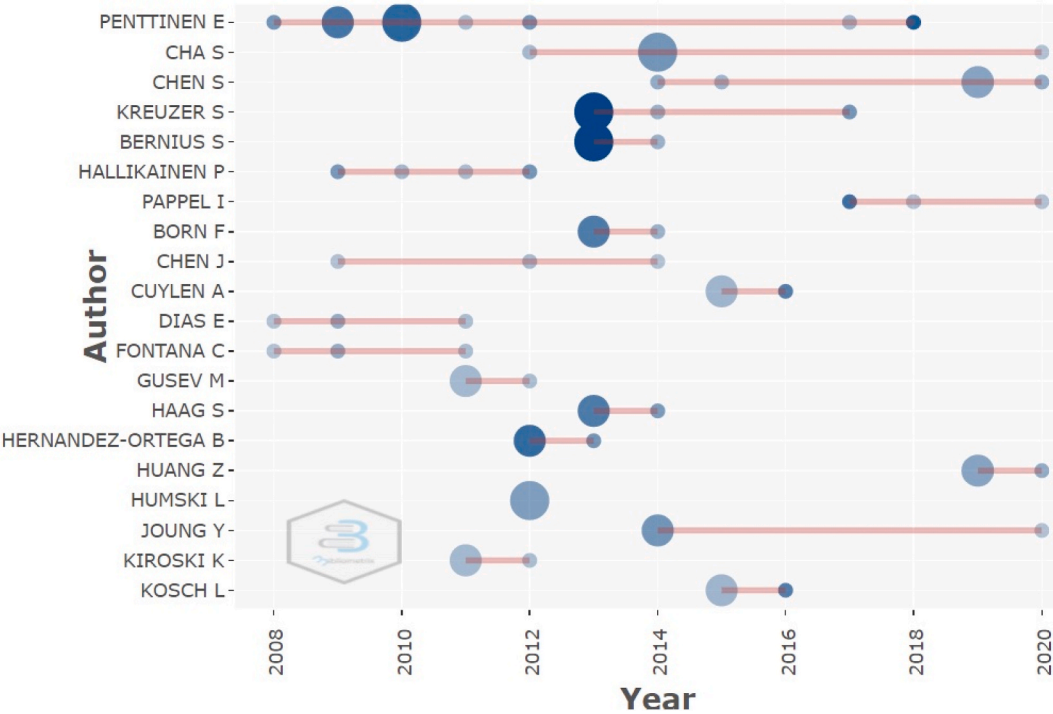


Fig. 7. Top authors production over Time.

Table 3
Top 20 most influential authors based on citations.

Authors	TC	NP	PY_start
Albayrak T	114	1	2013
Caber M	114	1	2013
Lian J	104	1	2015
Penttinen E	81	10	2008
Harald B	70	1	2010
Korkman O	70	1	2010
Storbacka K	70	1	2010
Bearden W	52	1	2002
Carlson J	52	1	2002
Hardesty D	52	1	2002
Rni A	50	2	2007
Hernandez-Ortega B	47	1	2011
Dahlberg T	43	1	2007
Kreuzer S	33	5	2013
Bernius S	28	4	2013
Hernandez-Ortega B	28	3	2012
Hallikainen P	26	4	2009
Cureton C	23	2	2016
Grannon K	23	2	2016
Hoolihan C	23	2	2016

($n = 114$), respectively. The next author closer to Ref. [58] is Lian J. with a total number of citations ($n = 104$). Below Lian is Penttinen E. with a total number of citations ($n = 81$). Surprisingly, Penttinen, who has the highest number of publications, was number 4 based on the citation counts. On the other hand, Albayrak et al. [58], who have one publication each and are not among the 20 top publishing authors, were seen to earn more citation numbers. The reason for this unexpected finding was not apparent. However, publication counts, and citation counts to measure scholars' impact have received criticism [57].

While it is challenging to justify why a scholar who has published ten articles since 2008 in the field of electronic invoicing could have a smaller number of citations compared to those who published only an article in 2013 and differing from the objection of Choudhri et al. [57], several reasons could be responsible. For instance, the practice of "irrelevant" self-citation could make an author gain a high number of citations. Besides, an author can ignore citing an article that influenced his/her work, leading to some relevant articles not receiving the number of citations they deserve.

This study investigates authors' relevance vis-à-vis articles' impact by analyzing the h-index, g-index, and m-index, respectively. The h-index is a metric that measures authors' impact based on the number of publications and the citation counts; the g-index measures authors' impact based on the distribution of citations received by that author, whereas the m-index measures authors' impact by using the number of citations across the production years [52]. As depicted in Table 6, Penttinen's publications remain the most influential with an h-index of 7, g-index of 8, and m-index of 0.5, respectively. In addition, kreuzer S. is another author below Penttinen whose articles have been impactful with an h-index of 4, g-index of 5, and m-index of 0.4. Other authors with impactful articles include Bernius S., Born F., Haag S., and Hallikainen P.

Bibliometrics analysis helps to assess the author's productivity and impact through the quantity, quality, and structural indicators. The quantity shows the volume of academic works they produced within a specified period. Quality measures the author's performance based on the criteria of the H-Index and other quality indicators. At the same time, the structure combines the author's connections and collaboration within and without the publications and research domain. The authors' production, performance and presentation are critical for the academic community, organizations, and society at large as it indicates the measurements used in funding decisions and allocations, appointments, and promotions of researchers. It also facilitates the citation frequency of the researchers and increases the author's visibility.

4.2.1. Authors' relevance over time and collaborative network

Moreover, our analysis of the authors' collaboration network in Fig. 8 revealed that most prolific authors already identified in the field had developed social networks among colleagues. While some of the authors do not have more than one co-author, the majority have multiple networks of co-authors. For example, Cha S. was seen to lead research with a collaboration network of 5 other co-authors, Chen S. has a collaboration network of 4 other co-authors, whereas Kreuzer S. also leads research with a collaboration network of 3 other co-authors. Further, Fig. 8 also represents the scientific collaboration network of the most ranked scholars in the field of electronic invoicing between 1997 and 2021, based on our data. The nodes denote the authors, and the links are the co-authorships. Co-authorship is generally considered an excellent measure of scientific collaboration; the more links, the stronger the author's collaboration network. According to Fig. 8, Cha S has the most robust collaboration network, followed by Chen S. In cluster 8, Cha has the highest betweenness of 6.5 while Tseng in the same cluster has 0.5 betweenness with Cha while other authors in the cluster have 0. These betweenness results indicate that Cha et al. [59], a focal author in cluster 8, has more control and plays a central role than the other authors, followed by Tseng in centrality.

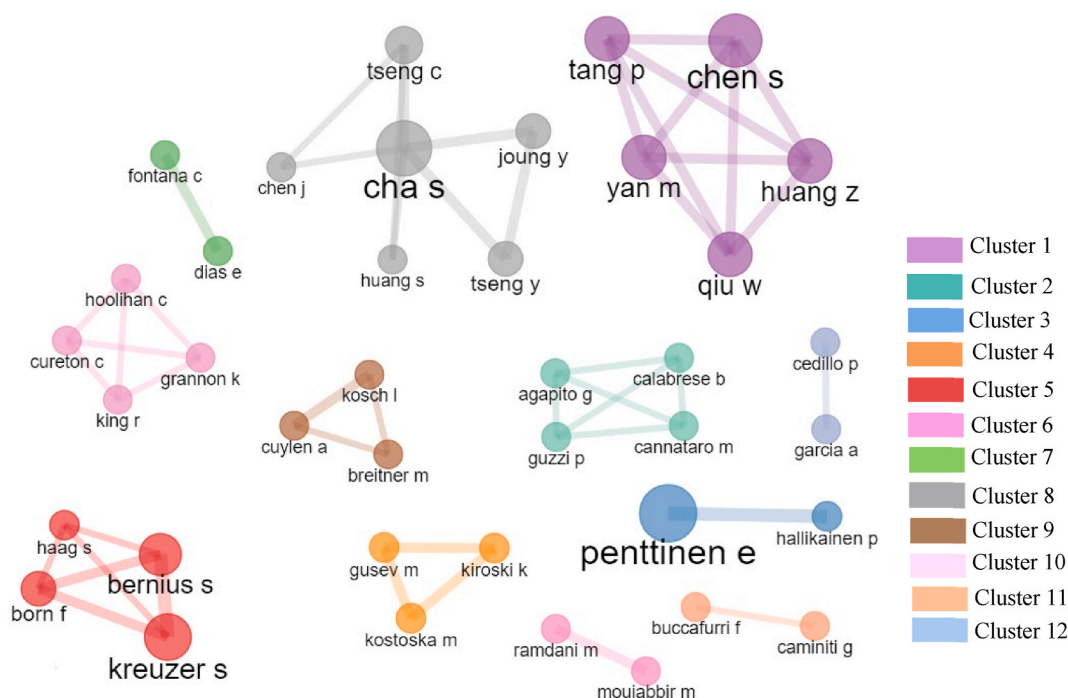


Fig. 8. Authors collaboration network.

4.3. Q3 what are the most frequent keywords in the e-invoicing domain?

4.3.1. Authors' keywords and keywords plus.

Fig. 9a demonstrates the most frequently used authors' keywords in electronic invoicing research between 1997 and 2021. According to our dataset, the three most frequently used keywords are e-invoicing (appeared 28 times), electronic invoicing (24 times), and e-invoice (21 times). Fig. 8a shows the word cloud generated by selecting the most frequently used authors' keywords. The bigger the font size of the keyword in the visualization, the more frequent it is. As a result, "e-invoice" emerged as the most frequently used keyword, followed by "e-government." The keywords used globally by the electronic invoicing authors show the close relationship of some critical concepts related to electronic invoicing. For instance, electronic invoicing has multiple channels of stakeholders that make an impact on its advancement. The author's keywords show the technology behind electronic invoicing operations and efficiencies, such as Electronic Data Interchange, character automatic recognition, and XML that facilitates the effort of taxpayers to include invoice data and images in the XML for proper reporting of the Tax to the Authority. The keywords also touch on converting all formats of existing invoicing to electronic format through a dematerialization process.

Further, it shows the interoperability of electronic invoicing with e-government, e-business, and e-commerce. It also shows the adoption and resistance of electronic invoicing in different parts of the world and cloud computing and blockchain intervention as electronic invoicing progress into the future. This emerging technology is one of the solutions to tax evasion in the future.

On the other hand, keywords plus are like the author's keywords, and it is a unit of analysis in a bibliometric study that focuses on the content and scientific concepts inherent in academic papers. Fig. 9b shows the most frequently used keyword plus in electronic invoicing research between 1997 and 2021. The three most frequently used keywords plus are electronic invoicing (frequency: 29) and e-invoice (frequency: 23), and electronic commerce (frequency: 21). The keywords pattern of concepts is different from the author's keywords. Like the author's keywords, the keywords plus emphasized the importance of e-invoicing and e-government. Authentication is one of the critical features of electronic invoicing that stands it out, and it was revealed in the keywords plus. Zhang et al. [72] argued in their study that keywords plus is as essential as the author keywords to examine the knowledge structure of scientific fields, but its intensity differs in article's content.

Five clusters are evident in Fig. 11a. Cluster one fused five keywords, and electronic invoicing is central to SME adoption, resistance, and diffusion with a betweenness value of 47. Cluster two showcases only three keywords of an electronic invoice, blockchain, and machine learning with small betweenness of one. Contrary to the two clusters (1 and 2), Cluster three did not have betweenness values but character automatic recognition, documents dematerialization, electronic invoicing dematerialization, formal concept analysis, fuzzy set, and Galois Lattices keywords relate together horizontally. In Cluster four, e-invoice and case studies are central to cloud computing, eXtensible Markup Language (XML), Universal Business Language (UBL), business service, e-signature, energy efficiency, and Hypertext Transfer Protocol Secure (HTTPS) with betweenness of 152 and 46. The fifth cluster shows e-invoicing, e-business, and e-government as the dominant keywords with 197, 83, 67 betweenness and connect e-ordering, innovation,

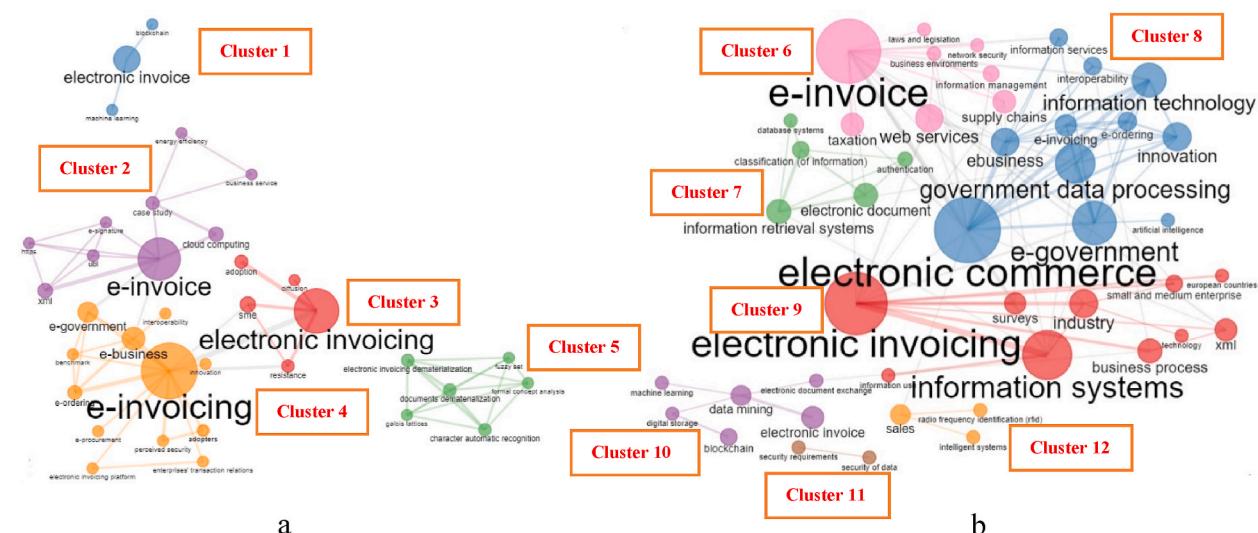


Fig. 11a. and b. Co-occurrence network of author's keywords and keywords plus.

Also, information retrieval systems had the highest betweenness (80) in cluster three, followed by electronic document and classification of information, but authentication and database systems were not central. Cluster four shows electronic document exchange as the domineering keyword plus with 185, data mining as a second with 157, and digital storage as third (41). Electronic invoicing, blockchain, and machine learning keywords plus were less noticed in this cluster. Sales (81) is central to radio frequency identification (RFID) and intelligent systems in cluster 5, while data security and requirements operate horizontally in cluster six. Lastly, in keywords plus cluster seven, e-invoice with a betweenness of 217 is crucial to web services (5), supply chains (4), information management (1), taxation, network security, business environments, and laws and legislation. This cluster gives a broader overview of the different arms that work with e-invoice.

4.3.1. Co-word factorial analysis map (keyword plus)

The target of factorial analysis is to map a framework's conceptual structure using word co-occurrences in a bibliography. This analysis can be performed using dimensionality reduction techniques like MDS, CA, or MCA. This study shows two clusters of documents that reveal some familiar concepts. Fig. 11 presents the conceptual structural map of research publications in electronic invoicing between 1997 and 2021 analyzed by factorial analysis of multiple correspondences using keyword plus. The following two clusters emerged: blue and red. The blue cluster has five topics of information technology and innovation that dwell on e-business, e-invoicing, and e-ordering, while the red cluster has sixteen topics with e-invoice that connect e-government, e-commerce in online or offline business environments. Online business environments employ authentication, interoperability, and machine learning for web services (Fig. 12).

4.4. Q4. Which countries are most relevant in the field of an e-invoicing research publication?

4.4.1. Country scientific production

The top twenty countries were showcased in Table 5 out of the total 45 countries. China's productivity as a mega country with about 1.402 billion as of 2020 was not a surprise, but Finland's performance and productivity is a surprise with the second position with a population of 5.531 million as of 2020. Finland has half of China's scientific production. There is no doubt that China will have more researchers than Finland. Fig. 13 spotlight the ten most productive countries in the field of electronic invoicing research publications out of the twenty shown in Table 5. China ranked first with 42 documents. Finland ranked second with 21 publications and Germany came third with 17 publications, Spain was close to Germany with 16 publications and likewise Brazil to Spain with 15. Also, the USA had 11, Italy 10, Turkey 9, and Croatia and Greece tally with six publications.

The world map displayed in Fig. 14 shows countries and continents' impact and nugatory observation on electronic invoicing. Major or minor impact reflects Europe, Northern America, Southern America, Asia, Australia, and Africa.

Due to the multifunctional role of electronic invoicing, it is essential to examine its impact in each continent, as shown in Fig. 15. Twenty-three countries in Europe participated and contributed to the research domain of electronic invoicing. Out of the six continents involved in electronic invoicing scientific production, Europe emerged with 106 papers. Finland led with 21 papers, followed by Germany with 17 papers, Spain with 16 papers, and Italy with ten papers. Most of the European countries appeared in the top ten of global productivity of electronic invoicing. Asia is the second productive continent in electronic invoicing with 63 papers, and China tops the list with 42 papers, followed by Turkey with nine papers. Out of eleven countries in the Asia continent, China dominates Asia's productivity.

Five countries from Southern America (Brazil, Ecuador, Chile, Colombia, and Peru) are active in electronic invoicing research with

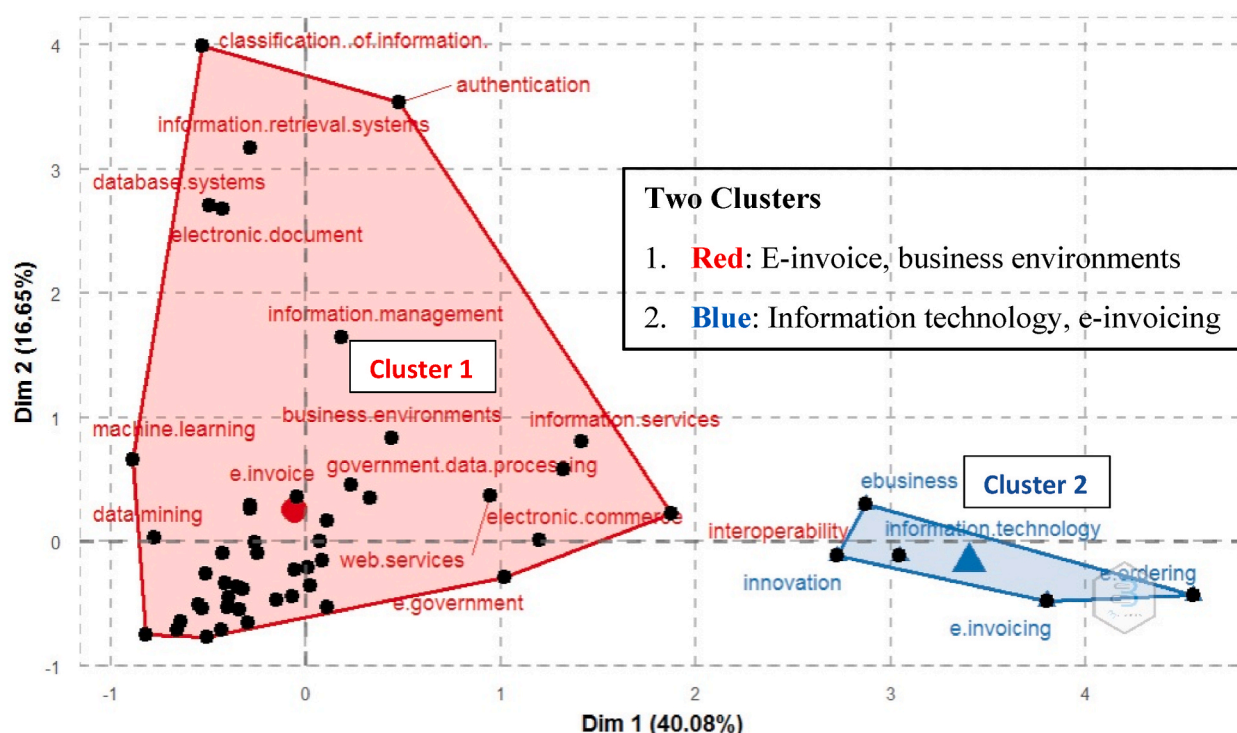


Fig. 12. Co-word factorial analysis map (keyword plus).

23 papers. Brazil was leading with 15 papers and followed by Ecuador with five papers. Northern America showed the United States of America, Canada, and Mexico as participants of electronic invoicing research with 13 papers and the USA leading with 11 papers. The USA is always at the forefront of different research disciplines when it comes to academic paper writing but concerning electronic invoicing USA is growing. Africa is lagging with three papers, and only Morocco, out of about 54 countries in Africa, is active in electronic invoicing research. Similarly, Australia as a continent only recorded two papers.

4.5. Q5. Which institutions are leading in e-invoicing research?

4.5.1. Most relevant affiliation

According to Fig. 16, the five leading institutions in the field of electronic invoicing are the University of Zagreb (7 articles), Helsinki School of Economics (5 articles), National Taiwan University (5 articles), Taiwan University of Science and Technology (5 articles), and the University of Minnesota (5 articles). It is not a surprise that the University of Zagreb led in relevant affiliation. The University has more than 50 partnerships globally, and the authors from the University have been active in electronic invoicing projects. Vanjak, Mornar & Magdalenic [60] wrote their paper 13 years ago when Croatia began planning to deploy electronic invoice infrastructure based on the formulated national e-Business strategy.

4.5.2. Institution collaboration network

Three main institution collaboration networks were identified in Fig. 17. The most extensive collaboration network is between National Taiwan University and the National Taiwan University of Science and Technology, while the other two networks are almost of equal sizes.

4.6. Q6 what are the predominant theories and methodologies utilized in e-invoicing studies?

This study selected some articles to understand the kind of methodologies and theories utilized in the e-invoicing articles. Out of the 53 studies selected, few articles applied theories in understanding e-invoicing adoption and applications. As shown in table 4, only eight of the articles introduced theories to understand the phenomenon under study. Fifteen of the literature selected report neither the method nor theories applied. However, all the articles detailed the methodologies applied even though we inferred based on descriptions of the methodical process in some papers. In all, the theories applied are primarily innovation adoption and diffusion theories. Specifically, the theories are Unified Theory of Acceptance and Use of Technology (UTAUT), Rogers's Innovation Diffusion Theory (IDT), and Technology Acceptance Model (TAM) infused with varying constructs bordering on social norms, influence, and other contextual factors. Incorporating two or more theories or models has helped bring meaning and understanding why an individual

Table 4
Predominant theories and methodologies in e-invoicing studies.

Source	Methodology	Utilized Theory
Olaleye & Sanusi [9]	Quantitative Structural Equation Modelling Data Analysis Technique	UTAUT (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Technology Literacy, Financial Risk, Anxiety, Image, Behavioural intention)
Olaleye & Sanusi [61]	Quantitative Structural Equation Modelling Data Analysis Technique	UTAUT (perceived compatibility, performance risk, financial risk, anxiety, effort expectancy, performance expectancy, social influence and perceived value and behavioural intention)
Kiroski, Gusev, & Kostoska [62]	Benchmarking Categorization and evaluation methods	x
Kreuzer et al. [63]	Qualitative Meta-model analysis	x
Sandberg, Wahlberg & Pan [64]	Quantitative Regression Model	Perceived benefits, organizational, readiness, external pressure, and owner/manager characteristics
Marinagi et al. [65]	Quantitative	
Edelmann & Sintonen [20]	Quantitative, Strategic option analysis	Perceived uncertainty, Demand of the environment, Knowledge, Know-how
Chang et al. [66]	Supervised Machine Learning KNN, SVM, Neural Network, Logistic Regression, Random Forest	x
Nedbal [67]	Quantitative Case Study	x
Tang et al. [68]	Machine Learning Anomaly Detection Method Deep Fusion Analysis	x
Wątróbski, & Karczmarczyk [69]	Quantitative Experiment	x
Tenhunen, & Penttinen [70]	Qualitative Expert Interviews Case Study Process Charts	x
Poel, Marneffe, & Vanlaer [71]	Quantitative Descriptive Linear Regression White's Test Willingness to Pay Analysis	x
Humski, Vrdoljak, & Skocir [72]	Design & development Business Analysis Process	x
Chen et al. [73]	Qualitative Participant observation-based case study Interview	x
Lian [74]	Quantitative Partial Least Square (PLS)	Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Performance Expectation, Effort Expectation, Social Influence, Facilitating Conditions, Security concerns regarding e-government, Perceived risk, Trust in e- government and Behavioral Intention)
Shim, & Song [75]	Quantitative Correlations Regression Analysis	x
Huemer, Zapletal, & Liegl [76],	Design & development Alternative Approach of Native ERP Integration	x
Vanjak, Mornar, & Magdalenic [60]	Qualitative Narrative Analysis of e-invoicing best practices	x
Cuylen, Kosch, & Breitner, [77]	Qualitative Maturity Model Focus Group Interviews	x
Marinagi et al. [78]	Quantitative descriptive	x
Hildebrand [79]	descriptive	x
Lumiaho, & Rämänen [80]	Expert Evaluation and Field Studies Interview and Contextual Inquiry	x
Cha et al. [59]	Proof of Concept (POC) Experiment Performance and Security Evaluation	x
Kreuzer [81]	Quantitative Field experiment	x
Papastergiou, Kaliontzoglou, & Polemi [82]	Interoperability Testing Implementation Testing Conformance Assessment	x

(continued on next page)

Table 4 (continued)

Source	Methodology	Utilized Theory
Hernandez-Ortega [23]	Quantitative Surveys Structural Equation Modelling	IDT and TAM. (Perceived ease of use, Perceived usefulness, Perceived compatibility, Perceived, security E-invoicing intentions to use.
Linh, & Phuong [2]	Narrative review	x
Joung et al. [56]	Case Study	x
Matus et al. [83]	Case study analysis Computer System Design	x
Haag et al. [84]	Analysis of Stakeholders Behaviour Mixed Methods Approach	x
Kivijärvi, Hallikainen & Penttinen [85]	Descriptive Exploratory Case Study Interview	–
Penttinen, Esko and Hyytiäinen [86]	Analytic Network Process Benefit, Opportunity, Cost and Risk (BOCR)-Analysis	Innovation Diffusion Theory (IDT)
Chen et al. [10]	Qualitative Interview Participant Observation Case Study Triangulation of multiple sources of information	
Hagsten, & Falk [8]	Quantitative Logit Ordinary Least Squares (OLS)	
Kuehne, Kosch, & Cuylen [87]	Case Study Review and expert interview Content Analysis Deductive and Inductive Categorization Paraphrasing and Generalizing	

or entity/organization chooses to adopt or resist a technology-based innovation. These findings suggest that articles on e-invoicing focused more on adoption decisions.

Regarding the methodologies applied in the identified literature, as expected, several methodologies were adopted, which include quantitative, qualitative, mixed-method, review, and design and development of frameworks for e-invoicing implementation. Of the 38 articles, the quantitative methodology was mainly adopted using questionnaire items to elicit relevant information from the respondents. A mixed methodology approach was also utilized with survey items and semi-structured interviews or the design of specific frameworks with interviews.

Table 5
Top 20 productive countries in electronic invoicing.

Country	Frequency
China	42
Finland	21
Germany	17
Spain	16
Brazil	15
USA	11
Italy	10
Turkey	9
Croatia	6
Greece	6
Ecuador	5
Sweden	5
Estonia	4
South Korea	4
Austria	3
Czech Republic	3
Morocco	3
Australia	2
India	2
Indonesia	2

Table 6
Most relevant authors based on h-index, g-index, and m-index.

Author	h_index	g_index	m_index
Penttinen E	7	8	0.5
Kreuzer S	4	5	0.4
Bernius S	3	4	0.3
Born F	3	3	0.3
Haag S	3	3	0.3
Hallikainen P	3	4	0.2
Hernandez-Ortega B	3	3	0.3
Cha S	2	3	0.2
Chen S	2	2	0.3
Cureton C	2	2	0.3
Cuylen A	2	2	0.3
Grannon K	2	2	0.3
Hoolihan C	2	2	0.3
Huang S	2	2	0.2
Joung Y	2	2	0.3
Kaliontzoglou A	2	2	0.1
King R	2	2	0.3
Kosch L	2	2	0.3
Magdalení I	2	2	0.1
Miau S	2	2	0.3

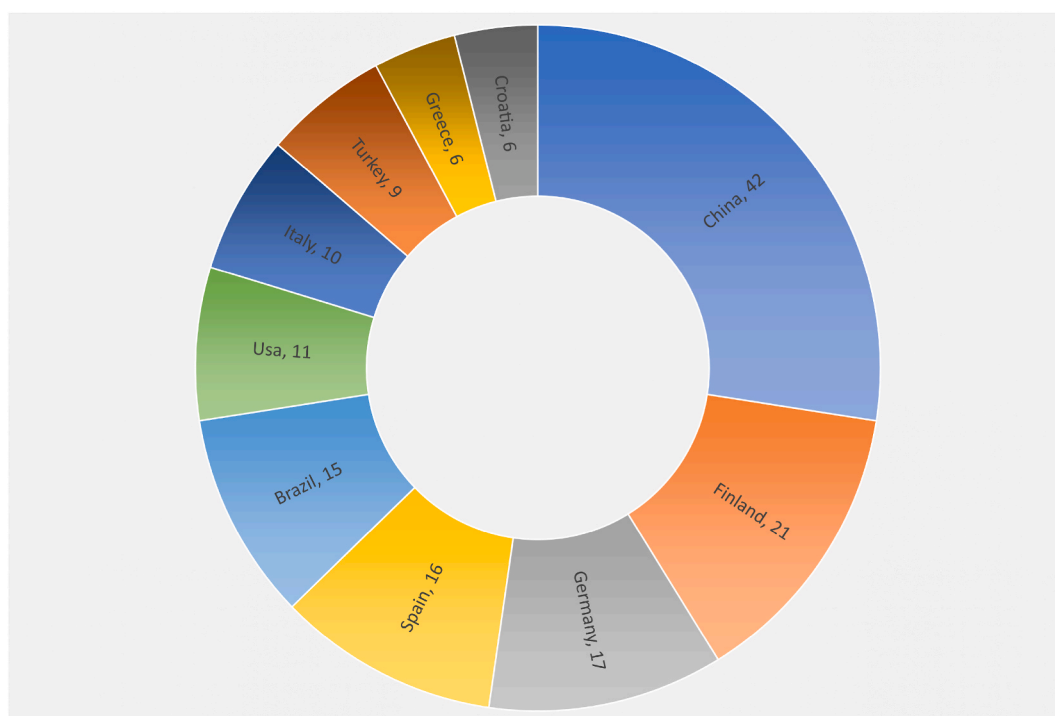


Fig. 13. The ten most productive countries in electronic invoicing research.

4.7. Q7. What are the trending topics in e-invoicing research?

4.7.1. Trend topics

Based on the author's keywords from our dataset, [Figure 18](#) gives an overview of the trending topics in the scientific production of research publications in the field of electronic invoicing for the period (2006 to 2020). Further, the hierarchical arrangement of the topics is presented per year. For instance, in 2019, the trending topics were electronic invoices and data mining. In 2020, blockchain, automation, as well as machine learning was trending. It is exciting that some trending topics with higher frequency were predominant between 2010 and 2018 but not extended to 2020.

An example is electronic invoicing with 29 frequencies and trends between 2010 and 2014, and e-government that trend between 2011 and 2018 with 14 frequencies. Likewise, taxation trends between 2014 to 2019 with nine frequencies. Data mining, automation,

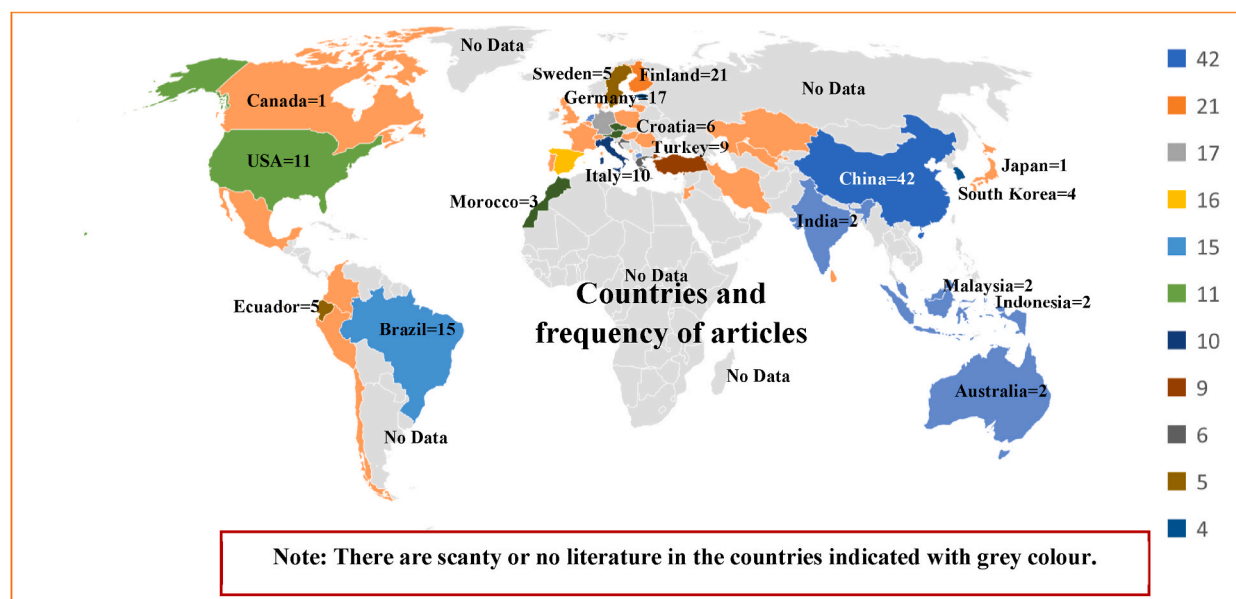


Fig. 14. Country specific production (Powered by Bing).

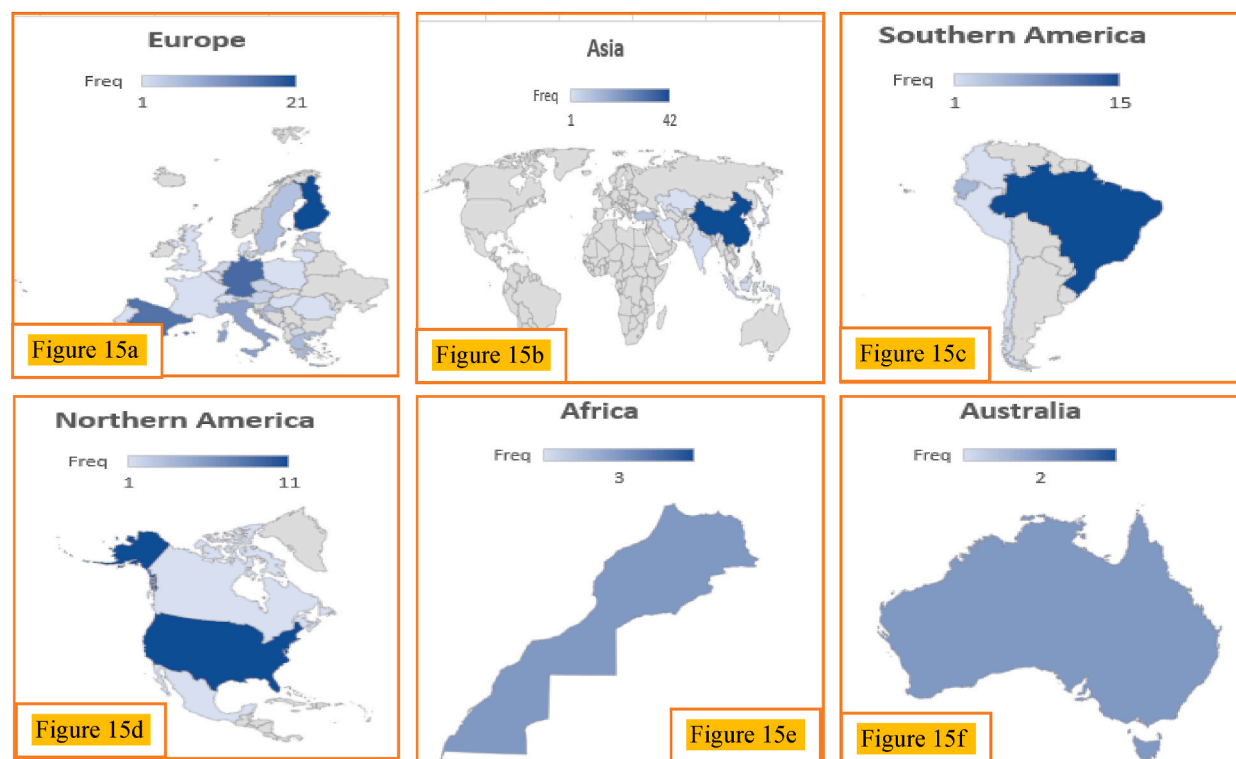


Fig. 15. (a–f). Continental impact of electronic invoicing (powered by Bing).

blockchain, digital storage, and machine learning trends between 2018 and 2020. Since the year 2021 is still progressing, maybe some of these topics extended until 2020 will continue to trend in the nearest future.

4.7.2. Thematic map

The thematic map of the field of electronic invoicing is represented by Figure 19 a and b using the following four quadrants: upper

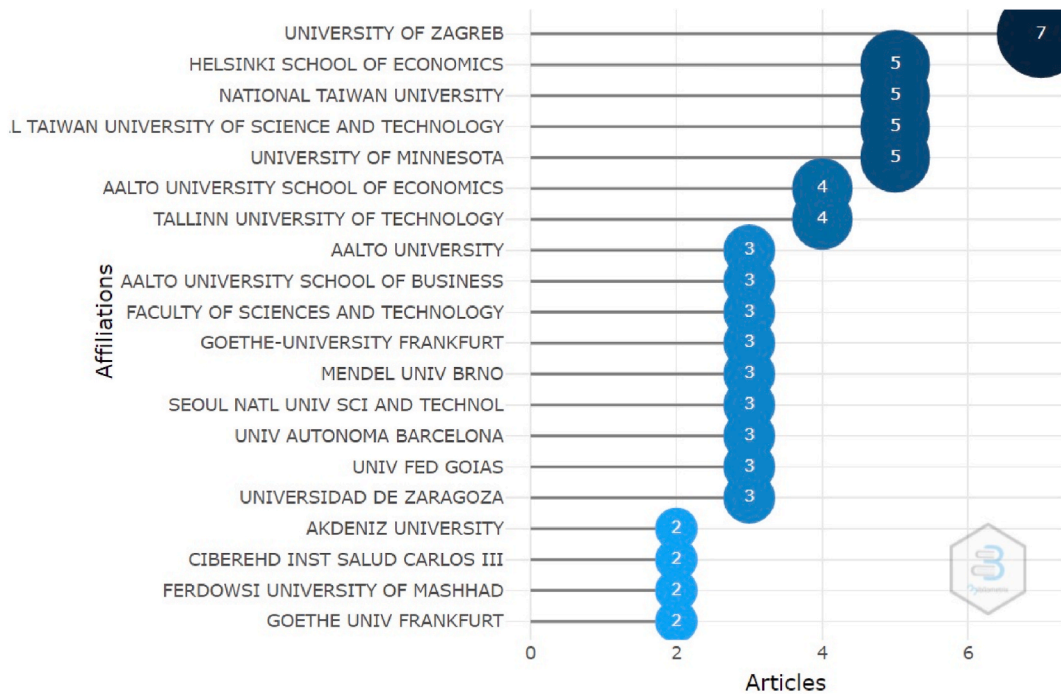


Fig. 16. Most relevant affiliation.

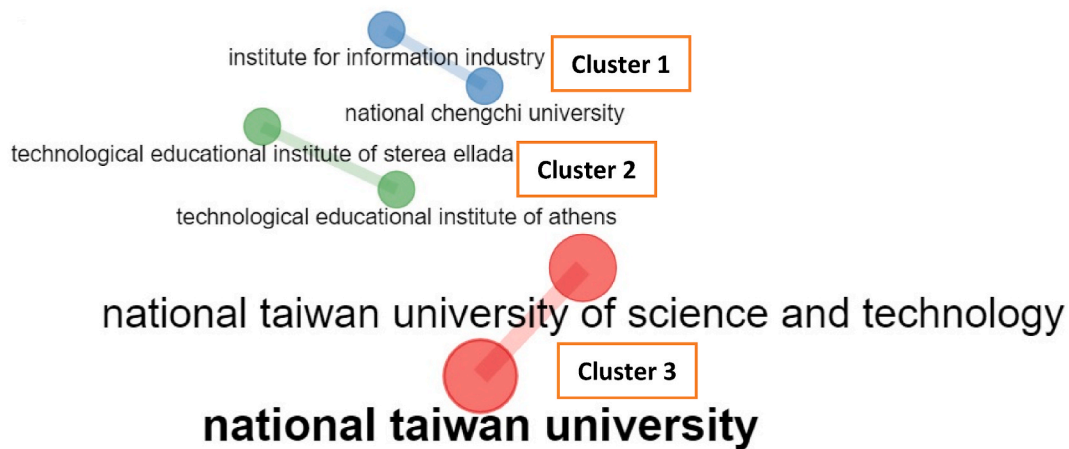


Fig. 17. Institution collaboration network.

right quadrant (Q1), upper left quadrant (Q2), lower left quadrant (Q3), and the lower right quadrant (Q4). In the context of electronic invoicing scientific production, Q1 denotes the “driving themes,” for example, cloud computing, e-invoice, and electronic invoicing. Q2 represents the “much-specialized themes” such as character automatic recognition. Q3 signifies the “emerging or disappearing themes,” for example, RFID, and finally, Q4 denotes the “underlying themes” such as e-commerce. Similarly, themes (carbon footprint, business documents, and RFID) in Q2 have evolved to be specialized, and finally, those themes (electronic document and electronic invoicing) are now the main drivers of the research domain of electronic invoicing. Also, Fig. 19ab gives clues as to the evolution of themes in electronic invoicing research. As XML is Q3, it suggests that XML is a disappearing theme, and those themes (e-invoice and electronic commerce) in the Q4 have evolved to be the underlying themes.

4.8. Q8. What are the most globally cited documents in the e-invoicing domain?

4.8.1. Most global cited documents

The most globally cited document in the electronic invoicing research domain is titled: “The effect of environmental concern and skepticism on green purchase behavior” Albayrak et al. [58] with 114 citations (Fig. 20). This leading paper was published in

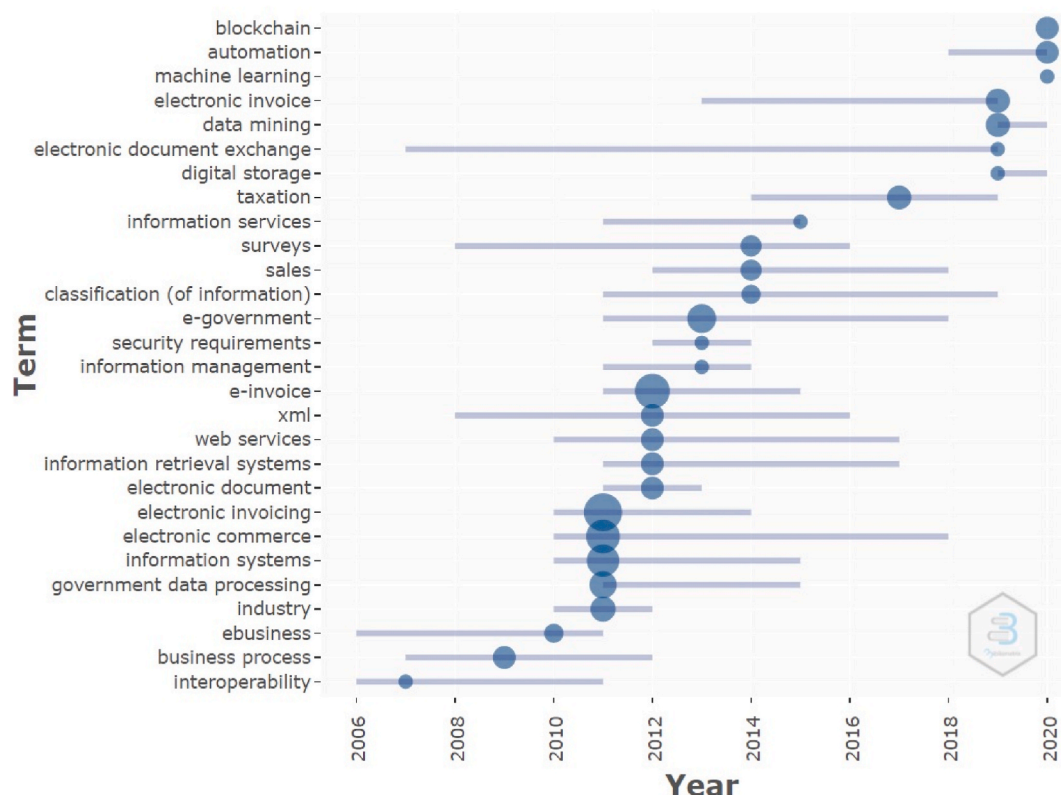


Figure 18. Trending topics in electronic invoicing research domain between 2006 and 2020

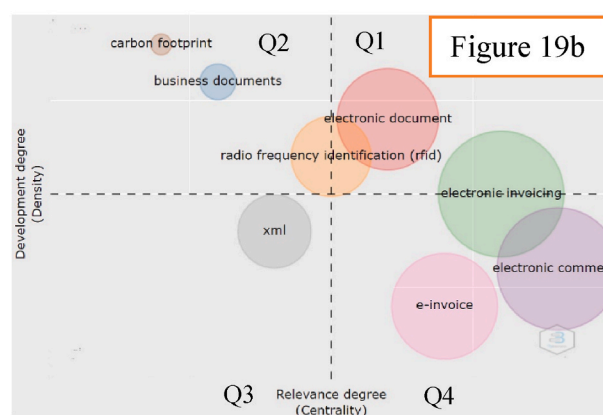
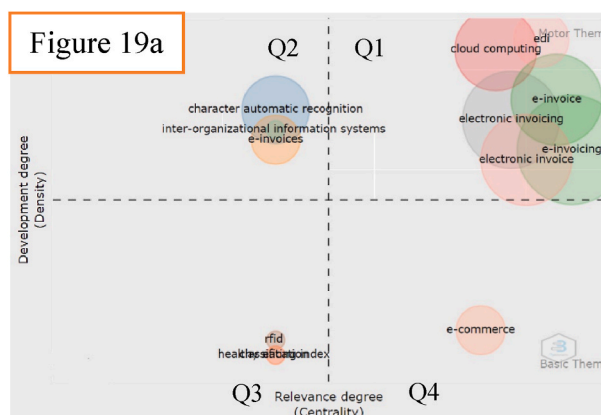


Fig. 19. (a and b). Thematic map of the field of electronic-invoicing research.

Marketing Intelligence & Planning. A journal with an impact factor of 2.164 as of 2020. The second most global cited document is titled: “Critical factors for cloud-based e-invoice service adoption in Taiwan: An empirical study” authored by Lian [74], recorded 104 citations. The outlet of this paper is the International Journal of Information Management, with an impact factor of 14.098. The journal has been elevated as number one out of 86 in information science and library science. The third most globally cited document is the “Practices as markets: Value co-creation in e-invoicing” by Korkman, Storbacka & Harald [88] received 70 citations. The paper was published by Australasian Marketing Journal (AMJ) with an impact factor of 3.29. Our results show that some of the leading authors published in high-impact journals. Though the impact factor is very relevant, in this study, a lower impact factor (2.164) commands more citations than the higher impact factor (14.098), as explained earlier in this paper, is attributed to different factors rather than the figures. The result indicates that topic relevance, content positioning, the topic trends lifespan, and accessibility of the paper count in electronic invoicing.

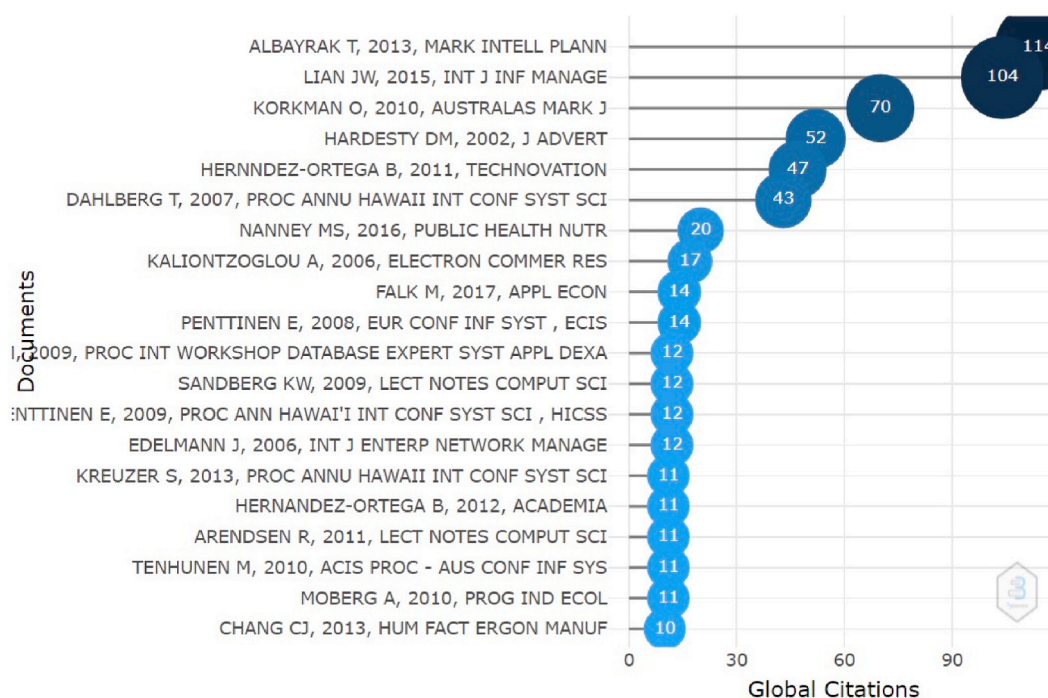


Fig. 20. Most globally 20 cited documents on electronic invoicing.

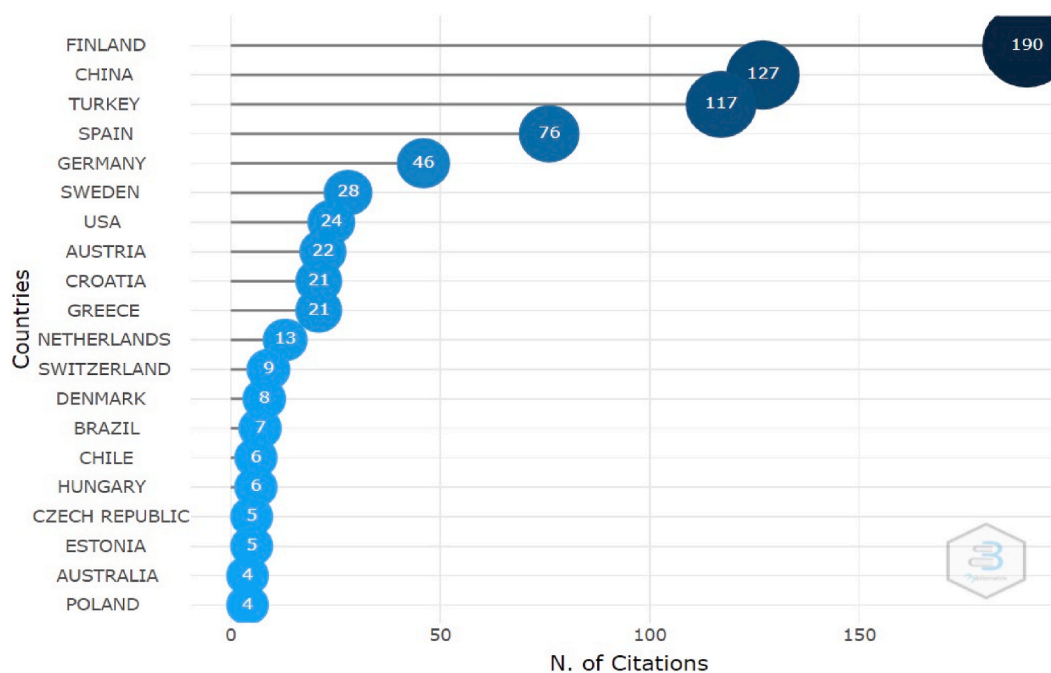


Fig. 21. Top 20 Most cited countries in the field of electronic invoicing.

4.8.2. Most cited countries

The three most cited countries in the field of electronic invoicing between 1997 and 2021 (Fig. 21) are Finland (190 citations), followed by China (127 citations), and then Turkey (117 citations). Finland's leadership in electronic invoicing confirms that Finland is a trusted country in emerging technology adoption, and since the emergence of electronic invoicing, Finland is among the leading countries to achieve EU set goals for electronic invoicing. Despite this attainment, Finland is still working towards the higher diffusion of electronic invoicing for automated account payable and receivable of different business models.

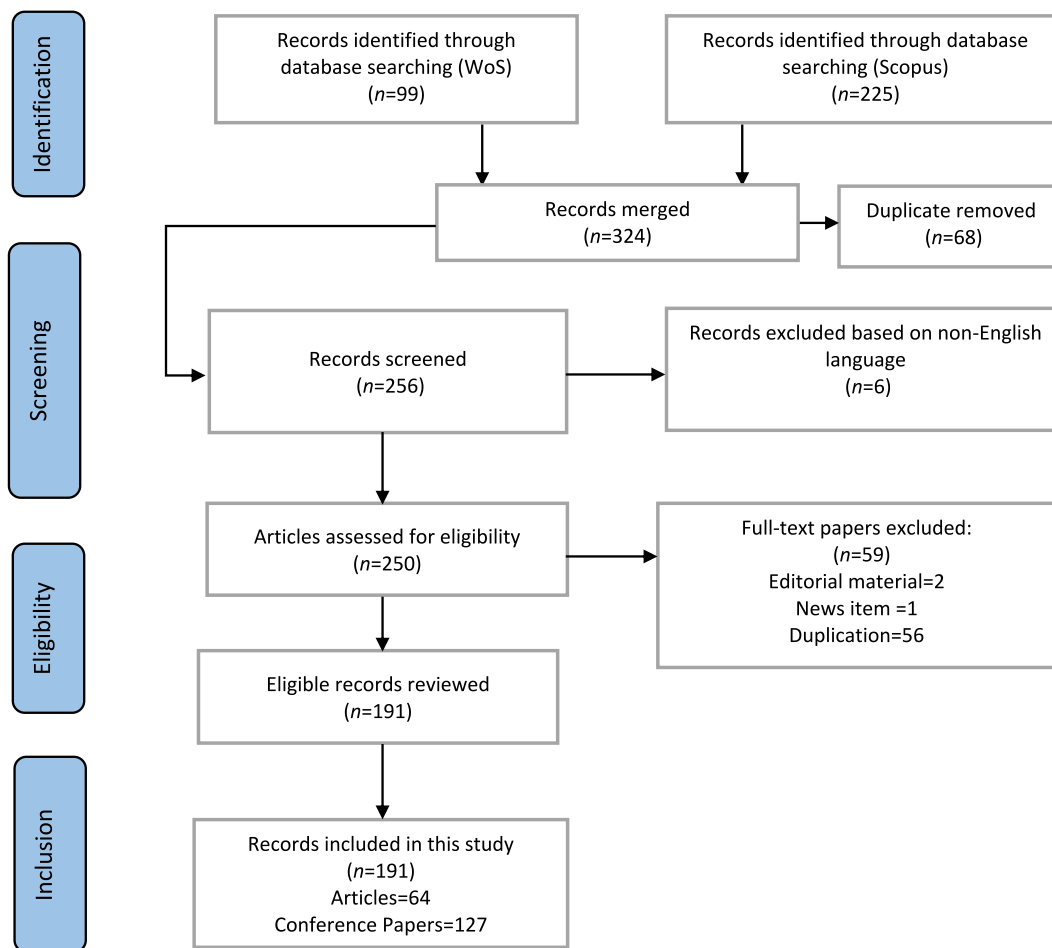


Fig. 22. Prisma flow chart for electronic invoicing bibliometric.

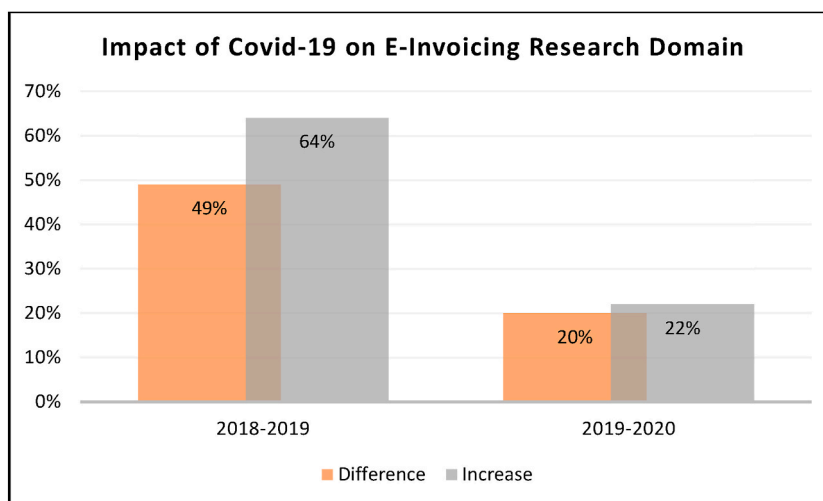


Fig. 23. Academic work difference and increase percentage for two years.

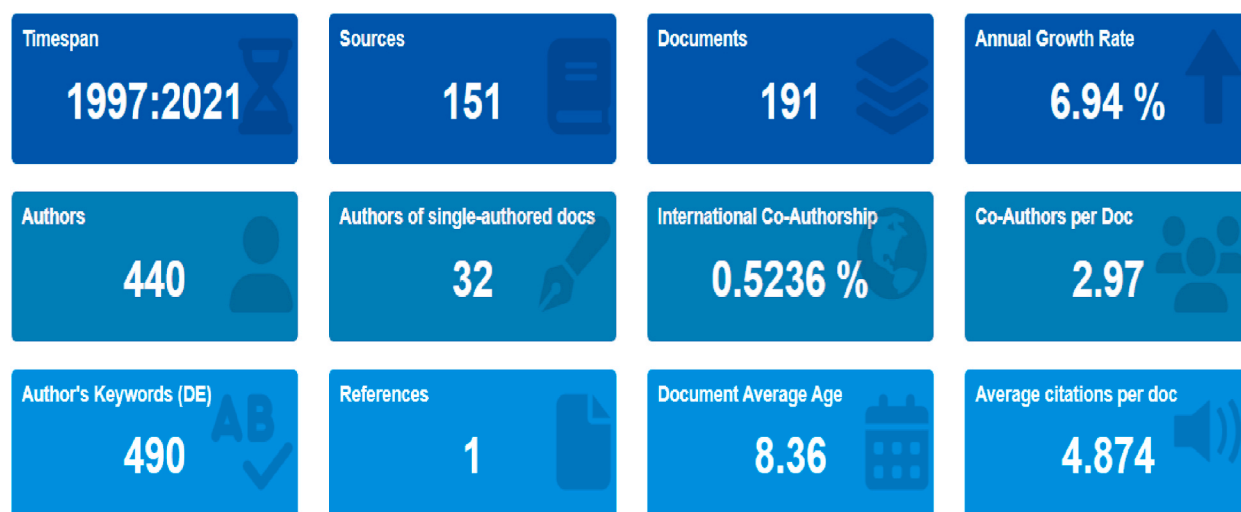


Fig. 24. Electronic invoicing literature descriptive statistics.

5. Research implication

This study examined the research landscape of electronic invoicing using a qualitative bibliometric approach. The analysis performed aimed to provide insight into how studies advancing electronic invoicing have evolved recently. Investigating articles on electronic invoicing is vital to substantiate research excellence through the lens of quantitative analysis that can provide reliable evidence and indicators for benchmarking the field [89]. The analysis on how electronic invoicing has advanced between 1997 and 2021 dwelled on the annual production and citations. The annual production of articles on electronic invoicing shows that the field witnessed the highest number of publications in 2020. This finding implies that, although the field of electronic invoicing is still maturing, there is a significant interest by scholars to publish more articles that can advance the field. Potentially, the field has been forecasted to witness steady growth in terms of articles production, and hopefully, recent studies could incite scholars worldwide to develop an interest in the field. This growth in article production is essential to justify Koch and Billentis's [4] prediction, envisaging massive global adoption of electronic invoicing by 2025.

This study showed that the scientific impact of articles on electronic invoicing was highest in 2002, where the field recorded the highest average article citation per year. Another year with remarkable citation counts was in 2015. The inconsistent nature of article citation counts across the years could be linked to several factors. First, electronic invoicing is still maturing, and many companies trying to adopt electronic invoicing found the experience new [70]. Besides, the dichotomy between industry players and researchers could have contributed to the lack of massive citation counts since not too many companies are actively researching the field even though companies derive enormous benefits from electronic invoicing [71]. Therefore, one way to foster rapid growth in terms of visibility of the scientific impact of electronic invoicing is to deploy more resources to develop industry-based research and engage scholars with a core interest in electronic invoicing.

Regarding the prolific scholars promoting electronic invoicing, this study revealed that Penttinen E. in Finland is leading among the top 20 authors. It seems that Penttinen's article titled "The adoption of electronic invoicing in Finnish private and public organizations" published in 2008 has gained impact and set the foundation for his further studies in 2009–2012, 2017, and 2018, respectively. With the highest number of articles in the field, Penttinen remains the leading author. Furthermore, other authors who have contributed immensely to research on electronic invoicing include Cha S., Chen S., and Kreuzer S. In addition, this study revealed that the work of Albayrak et al. [58] were most impactful with total citations (CT) 114 respectively. Next is Lian J. followed by Penttinen E. with CT of 104 and 81, respectively. This finding implies that although Penttinen E. has the highest number of publications, Cha S. and Chen S. were more impactful. Furthermore, the most influential authors in electronic invoicing remain Penttinen E. followed by Kreuzer S. based on their h-index computation. Overall, the measurement of authors' impact, influence, and contribution towards advancing a field is a topic of scholarly discussion since several factors can be involved [52,90].

This study further presented the authors' collaboration network, which typically depicts the extent to which scholars are building synergy locally or globally to advance a particular field or domain [91]. As revealed in the result, Cha S. and Chen S. had established stronger collaborations followed by Kreuzer S., whereas the general outlook of authors collaboration remains local where the authors are in the same institution or country. An international collaboration of expertise is essential in addressing global issues and fostering the research frontier of a field [92].

Furthermore, the analysis of keywords in published articles on electronic invoicing revealed essential information that showcases the knowledge structure of the field. Notably, the result shows different elements interplaying unique roles toward advancing the adoption of electronic invoicing. For example, technologies (cloud computing, XML, Blockchain, and machine learning) that drive the implementation of electronic invoicing are evident in the result. This result revealed that since electronic invoicing requires electronic

documentation, backbone technologies that guarantee security, privacy, and efficient data storage remain a critical aspect of the field. These technologies can sustain the global scalability and adoption of electronic invoicing in the future, while other emerging artificial intelligence (AI) technology can be integrated for further advancements [68].

The top 10 most active countries advancing electronic invoicing were analyzed where China top the list, followed by Finland, Germany, Spain, Brazil, USA, Italy, Turkey, Greece, and Croatia. From the regional viewpoint, researchers from Europe produced more scientific outputs compared to their Asia counterparts. One reason could be that researchers from European countries receive more funding to support research on electronic invoicing than researchers in Asia countries. Besides, from the American continent, a few studies were seen from Brazil and the USA. While Australia had witnessed some research outputs, the Africa continent has a few studies conducted in Morocco. This study shows that the global adoption of electronic invoicing is still an issue [70].

Regarding the institution and organizations actively researching electronic invoicing, specific affiliations such as the University of Zagreb in Croatia, Helsinki School of Economics in Finland, National Taiwan University in Taiwan, Taiwan University of Science and Technology in Taiwan, and the University of Minnesota in the USA were among the leading institutions. Some of these universities have close collaboration, as revealed in this study. However, the network of collaborating institutions remains at national or regional levels. Therefore, the international synergy to foster research on the adoption of electronic invoicing on a global scale remains a gap that future researchers must fill.

In electronic invoicing, the trending topics and research hotspots include blockchain, machine learning, data mining, and electronic document exchange. These topics emerged in 2019, reflecting how technology is being utilized to advance the implementation of electronic invoicing. Aside from the current relevance of the topics, they also portend future inclination of the field. Besides, the thematic analysis of electronic invoicing also shows that these topics, for example, “cloud computing,” are among the driving themes. Other thematic areas that are emerging in the field include automatic character recognition and inter-organizational information systems. This information can be helpful to scholars who may want to conduct future research on how these hot topics or themes impact electronic invoicing in general.

5.1. Limitation and future research

This study utilized the combination of two central databases – the Scopus and WoS. We posit that our sampling approach was sufficient to provide a representative reflection of the current state of electronic invoicing research. While these databases contain a comprehensive set of publications on electronic invoicing, they cannot be considered exhaustive, especially that the data collection process is dependent on a defined boundary [93], including search protocol and selected keywords. The interesting global overview of the state of the art of electronic invoicing presented in this study may not be all-inclusive, as the data sources influence it. Researchers may extend the search or validate the study using other available databases, such as Google Scholar or FT50 journals, among others. Scholars may include some valuable materials we may have missed in our analysis, including research reports, working papers, and white papers that could provide more insight. This study reveals some gaps in the literature that led to some critical future research directions. Future research should explore the identified literature in more detail, covering aspects such as research designs and research implications as we only provided an overview of 191 studies. Future studies may consider a meta-analysis or systematic literature review as Donthu et al. [94] assert that bibliometric studies can only offer a short-term forecast of the research field. The future researcher should offer answers to the following research questions. First, what are the factors limiting scientific production in the e-invoicing domain? Second, how has e-invoicing been implemented across different contexts? Third, how does e-invoicing influence governance and accountability? Finally, what is the role of the government and policymakers in e-invoicing adoption?

6. Conclusion

This review presents information on past scientific articles on electronic invoicing to provide a valuable source for future research. Over the past two decades, 191 conference and journal papers were recorded, indicating that electronic invoicing research is still growing. While most of the articles are presented at conferences, a sizeable number have been published in information systems outlets. The maximum number of publications was reported in 2020, which may imply a rise in article production in subsequent years. Throughout the literature, innovation adoption and diffusion theories predominate. This study demonstrates the important development of electronic invoicing research, which is increasingly the result of international collaboration among academics, mainly from China, Finland, Germany, Spain, and Brazil. Due to the increasing significance of e-invoicing, the growing tendency to consider its implementation, and the little study in this field, it is a viable subject for future research. Information about research on e-invoicing can be beneficial to find new opportunities and challenges in the research area. More so, most active journals and conference forums can be consulted while deciding to submit scientific contributions. Most prolific authors can also be consulted by journals when potential reviewers for papers are required in the field. Future directions could include evaluating and comparing different contexts regarding research performance and findings related to e-invoicing adoption. For instance, Australia and Africa as continents are almost inexistence in our search output which should be considered in future research. Further, global researchers in electronic invoicing should consider studies that interplay the compliance, security, and value-added tax of electronic invoicing ecosystems.

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