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Screening the recent uses of Artificial intelligence in accounting firms: a scoping review

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Introduction

Over the past two years, we have witnessed a profound change in the way organizations operate. The COVID-19 pandemic has intensely enhanced the adoption of artificial intelligence (AI) in various fields including the accounting field. We have experienced the equivalent of two years of digital transformation compressed to just a few months (Piccialli & Francesco, 2021). Artificial intelligence is a general term for the technology that makes machines "smart and clever". Organizations invest in research on artificial intelligence and its applications to automate, extend or replicate human intelligence.

In the scientific sphere, there is no widely accepted definition of artificial intelligence (AI), Consequently, the term artificial intelligence has been used with many different senses, both within the field and outside it. (Wang & Pei, 2019).

The birth year of AI is now generally accepted as 1956, with the Dartmouth conference, where John McCarthy defined the terminology of Artificial Intelligence. In Europe, several researchers recognize the paper of Alan Turing, published in 1950, as the start of AI. However, while the concept was the same, the terminology in the 1950 paper was Machine Intelligence (MI). Whatever the case, Alan Turing is regarded by many as the founding father of computer science due to his seminal contributions, including the halting problem, the Turing test, the Turing machine. (Luo & Jiaxin, 2018)

In the last decade, AI has made great progress and it is set to shape the future. It has penetrated to all fields of life and its ever-increasing use in business decision-making has made it a vital tool for success for all major corporations around the world.

"The implementation of artificial intelligence in accounting work must replace all aspects of traditional accounting work, including entering original supporting documents, training accounting information, generating financial reports, and providing recommendations. For proper decision making, to improve overall financial work"(Luo Jiaxin, 2018).

If the field of accounting has already a history of artificial intelligence (AI) applications dating back more than 40 years (Baldwin & Amelia, 2006), the expansion of scientific research in this direction remains less settled, which gives more chance to the exhibition of institutional or press opinions to judge and highlight trends in this area.

Accordingly, it is unclear what kind of information is available in the literature about what place does AI occupies in accounting firms and what is its role. For these reasons, a scoping review was conducted to systematically map the research done in this area, as well as to identify any existing gaps in knowledge.

The purpose of this scoping study is to explore the existing worldwide literature in the context of AI and its uses in accounting firms for the last five years (from 2016 to 2020), also, this paper tries to discover what is currently happening in the context of AI in the accounting field and outline scientific productions in this area of research?

With this research, we aim to address this apparent knowledge gap by asking and answering the following research question: What is known from the literature about artificial intelligence uses, challenges, and potentialities in accounting firms for the last five years?

The remainder of this article is organized as follows: The methodology employed to develop the scoping review and the protocol is described in the first position. then, we analyze the sources of evidence screened, present characteristics for which data were charted and provide the citations and summarize the charting results.

Methodology

The scoping review has become an increasingly popular approach for synthesizing research evidence (Pham and Mai T,2014). It aims to map the existing literature in a field of interest in terms of the volume, nature, and characteristics of the primary research (Arksey and O'Malley, 2005). A scoping review of a body of literature can be of particular use when the topic has not yet been extensively reviewed or is of a complex or heterogeneous nature (Mays et al., 2001).

Arksey and O'Malley (2005) specify five stages to the scoping review. These stages will be integrated throughout this article:

- identifying the research question
- study selection
- charting the data
- collating and reporting on the results

in addition to the above, this scoping review is reported, partly, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) updated in 2018 by Tricco et al. The PRISMA flowchart that exemplifies the numerous steps in this scoping literature review is shown in Figure 2.

Search strategy

Article Gathering

The gathering of articles relevant to the matter under study was carried out on 4 databases: Scopus, JSTOR, Science Direct, springer link. assumed their scope, quality, and prestige, which ensures the quality of the articles collected [34]. Although the research was carried out in only two databases, they cover the majority of the high-quality publications in the social sciences (Gasparyan et al,2013).

The keywords were defined to associate accounting firms or the accounting profession with Artificial intelligence areas.

We started the scoping review with a literature search which was conducted to identify peer-reviewed, English language, academic literature that was relevant to this article's question. Boolean search expressions, as shown in Figure 1, were used to narrow the search results.

The study uses Endnote, covidence, and Microsoft Excel to answer the study questions efficiently and accurately. covidence is the primary screening and data extraction tool conducting standard intervention reviews. The tool is designed to perform the following functions to make review production more efficient:

- upload search results
- screen abstracts and full-text study reports
- complete data collection
- conduct risk of bias assessment
- resolve disagreements
- export data into Excel

Inclusion and exclusion criteria

The scoping review included studies that:

- Focused on the application of AI in accounting firms.
- Contains keywords related to the AI field concerning the accounting firms (all keywords adopted are detailed in figure 1).
- Published between 2016 and 2020

On the other hand, Articles were excluded if:

- They were not published in the English language.

- They are duplicate
- They are published outside the set number of years
- They are irrelevant

Boolean search expressions, as shown in Figure 1, were used to narrow the search results.

"Artificial intelligence" **AND** "Accounting firms" **OR** "auditing firms" OR "accounting profession" **OR** "audit profession" **OR** "Accounting companies" **OR** "chartered accountants" **OR** "Accounting services"	"Machine intelligence" **OR** "Machine learning " **AND** "Accounting firms" **OR** "auditing firms" OR "accounting profession" **OR** "audit profession" **OR** "Accounting companies" **OR** "chartered accountants" **OR** "Accounting services"	" Expert Systems" **OR**" Robotics" **AND** "Accounting firms" **OR** "auditing firms" OR "accounting profession" **OR** "audit profession" **OR** "Accounting companies" **OR** "chartered accountants" **OR** "Accounting services"
Figure 1. Boolean search expressions used in the research process		

Screening and data abstraction

This step is divided into two stages:

1) Title and Abstract Screening: For preliminary screening, titles and abstracts are rated as to whether they met our eligibility criteria mentioned earlier: (1) reported on the research, (2) mentioned or alluded to AI, and (3) mentioned accounting firms or professionals.
2) For our full-text screening: in this stage, the full text of each document is examined according to the following eligibility criteria: (1) was a research study, (2) developed or used AI

For each article included in the scoping review, citation information was exported from Covidence into Excel a single reviewer manually abstracted spreadsheet, and harm domains.
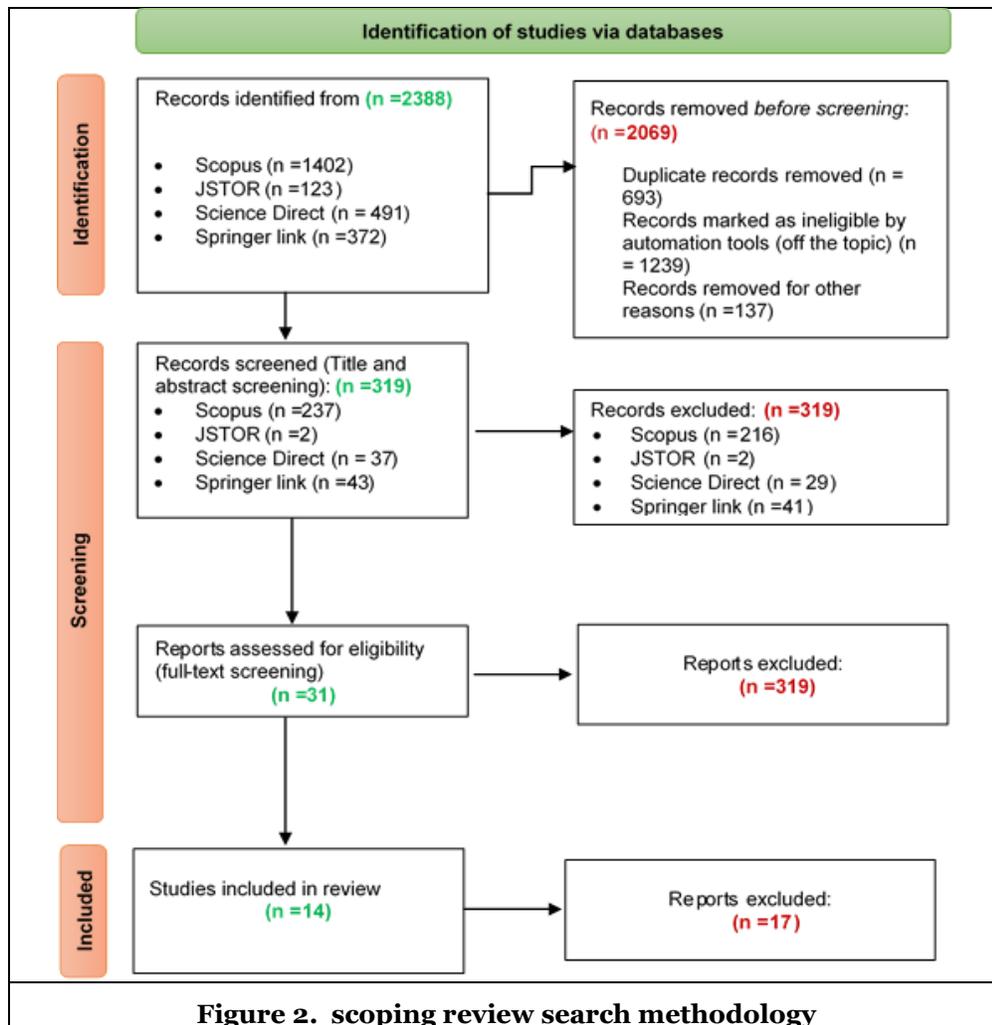
Figure 2. scoping review search methodology

Figure 1 systematically establishes the process of keywords selection. This study consults 4 databases (Figure 2) to extract the relevant documents. Having conducted the manual examination of each selected research paper, the study narrows its scope to the most 14 relevant papers.

Results

Descriptive results

The results described in Table 1 shows three main AI groupings and the methodology used by the researchers. As suggested by scoping review methodology, the articles were not analyzed in depth aside from their initial categorizations (Arksey & O'Malley, 2005).

Our first observation is that most of the published articles refer to conceptual analysis in the form of a literature review or a theoretical discussion on the theme (64%), the rest of the articles used a qualitative methodology (28%) except one article published using a quantitative method of analysis.

Finally, a more detailed investigation was carried out to analyze publication year (figure 4), citations (Table 3), and geographical focus (table 3 & figure 4).

Figure 3 illustrates the annual evolution of the total number of publications for the 14 articles included in the analysis. From 2016 on, there was a systematic growth in publication, noting that 2020 was the most productive year with six publications; this reveals the topic's interest and relevance.

Artificial intelligence:	Type of research/methodology			
	Conceptual study	Qualitative Study	Quantitative study	Total
as a portion of the context	4	1	0	5
as a predictor variable	4	3	1	8
as an outcome variable	1	0	0	1
Total	9	4	1	14
Table 1. Summary of Selection of 14 Research papers on artificial intelligence in accounting firms				

Another observation is that most of the research based in the United States, Finland, and Jordan.

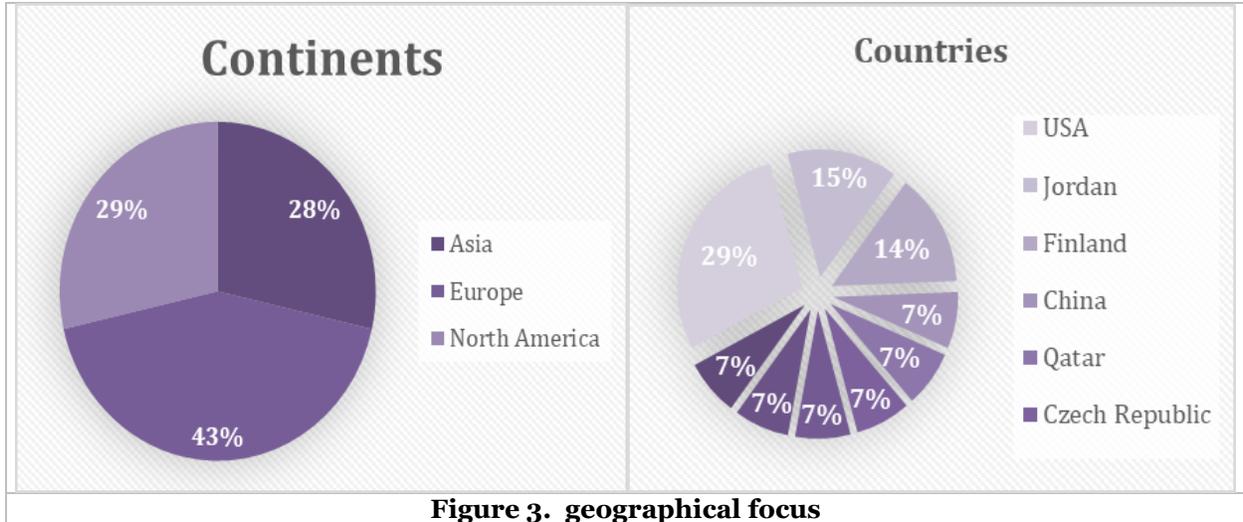| Country	Papers	Sum of Citations	Citation per document
USA	4	133	33,25
Jordan	2	41	41
Finland	2	40	40
China	1	19	19
Qatar	1	14	14
Czech Republic	1	8	8
United Kingdom	1	6	3
France	1	1	0,5
Germany	1	1	1
Grand Total	**14**	**263**	
Table 3. papers by country			

Figure 3. geographical focus

Figure 4 and Table 3 represent the geographic area where the institutions in which the authors of these articles belong are located. It was found that 43% of the studies originate from North America, mainly the USA. The second continent with the highest number of publications is Europe, with 29% of publications, followed by Asia (28%).

Therefore, we note the absence of publications from countries of the African continent on the subject studied.

Figure 4. Publication volume per year
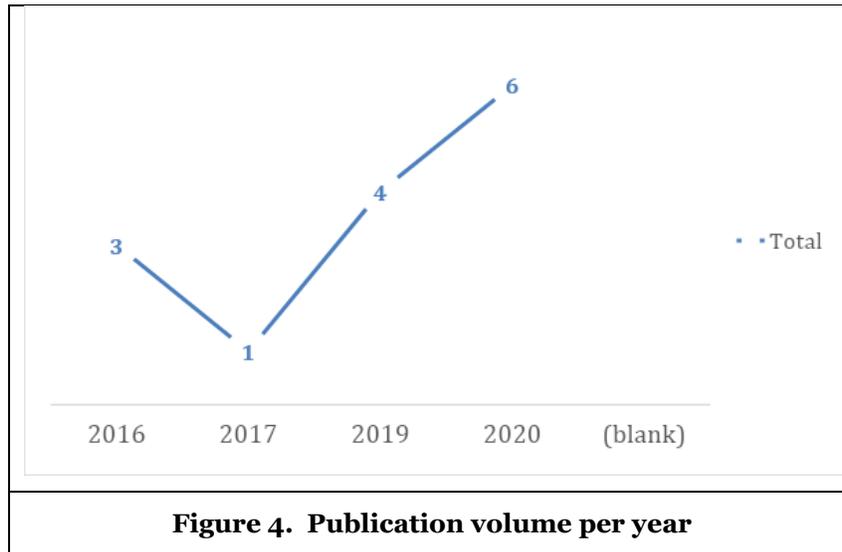
Content Analysis Results

This part analyses and synthesizes the most significant conclusions of the included papers, which will provide answers to the research questions.

For the sake of grouping the results obtained in this direction, we have classified the different combinations of themes linking accounting firms with the different uses of AI in the articles included, into 4 categories:

(1) the themes affecting areas of accounting firm's activities (AF-activities);
(2) the managerial aspect of the accounting firm in connection with the use of AI technologies (AF-management);

(3) the topics treating the component "skills" in accounting firms and their interaction with the adoption of AI technologies (AF-Skills)
(4) the strategic aspect of the firms concerning the implementation of AI (AF-strategy).

Table 4 and Table 5 present a summary of ideas and themes mentioned in the articles about AI uses in accounting firms respecting the mentioned categorization.

Accounting firms' areas	topics mentioned in the articles about AI use in accounting firms
AF-activities	Improving the audit relevance using AI applications
	Management accounting tasks and machine learning
	Assessment et evaluation of AI
	AI and screening high-risk
	Data mining applications in accounting
AF-management	Enabling the culture of innovation within audit firms
	The ethical implications of the use of AI emerging technology
	The challenges involved in the implementation of AI
	Governance mechanisms Required to ensure legitimacy and accountability of decisions supported by AI
	Tensions arising from the use of AI inside organizations
	Bias or risks may AI introduce to auditing
	Potential Threats of the Application of Artificial Intelligence in the Field of accounting
	Inhibitors and obstacles of incorporating AI into audit
	Deep learning and financial statement fraud identification
AF-Skills	Allowing audit firms to extend their offers by proposing new services using.
	The Impact of Artificial Intelligence on the Auditing Industry and Higher Education
	The impact of artificial intelligence on the upcoming generation of an accountant
AF-strategy	Improving the audit quality mainly by analyzing all data's customer
	The usage of new technology to increase productivity
	AI and the competitive advantage in accounting firms
	The cost and benefits of the investment in AI

Table 4. summary of ideas and themes mentioned in the articles about AI uses in accounting firms

Over the years, the accounting industry has undergone several changes due to the natural evolution of its environment. There is no doubt that artificial intelligence has a positive impact on the accounting field, and a consensus that basic accounting and audit work will be replaced by artificial intelligence has been reached. The transformation from financial accounting to management accounting has become an inevitable trend. (Moll & Yigitbasioglu, 2019).

Starting from this fact, the use of artificial intelligence technologies can therefore bring a plus in terms of strengthening audit relevance and the quality of its process, correspondingly, AI can also intervene in management and Risk Assessment (Manita et al, 2020). The expansion of artificial intelligence drives the rebuilding of the accounting profession. in this sense, new mechanisms must be adopted to follow the changes resulting from the implementation of AI technologies, namely: the encouragement of employees of accounting firms to develop a culture of innovation (Manita et al,2020)., as well as the strengthening of

individual skills and collective in the working group (Mohammad, S. J et al. 2020) and the consideration of the ethical aspect related to the use of these new technologies (Munoko, L, 2020).

Finally, if the use of AI technologies can bring benefits and opportunities to accounting firms, it can also constitute a danger and a threat to this category of the organization (Mohammad, S. J, 2020). in this regard, an empirical and in-depth analysis of the risks and biases must take place to measure the impact of these elements on the efficiency and effectiveness desired by the accounting firms (Gotthardt, M.,2020).

Assessment risk	*Culture of innovation*
Accounting firms' productivity	*Data security and privacy*
Accounting routine functions	*Decision making*
Accounting Data	*Accountability and legitimacy*
Asset management	*Financial accounting*
Assurance and compliance	*Financial statements audits*
Audit quality	*Forensic accounting*
Audit relevance	*Inherent Risk Analysis*
Auditing process	*Management accounting tasks*
Auditor judgment	*Managerial accounting*
Auditor training programs	*Managerial accounting*
Auditor's code of ethics	*New digital competencies for auditors*
Auditor's training programs	*New skills adoption*
Business health	*risk assessment*
Turnover in accounting firms	*Tax compliance*
Table The main influence of AI in accounting firms as stated in the articles	

Strengths and Limitations of the study

Given that this review includes all AI technologies used for accounting firms regardless of their characteristics, study design, study setting, and country of publication, it may be considered among the most comprehensive review in this research area. This helps readers to speculate how AI is being leveraged in the accounting profession. Reviewers searched the most commonly used databases in the field to identify as many relevant studies as possible. Thus, the number of studies included in this review is very limited due to the restriction linked to the study period (2016-2020) and other exclusion criteria. Furthermore, the study minimized selection bias by having two independent reviewers conducting study selection and data extraction, with a very high agreement in both processes.

This review, therefore, might not identify all potential uses of AI the in accounting field. Due to practical constraints, the search was restricted to English studies. Therefore, we probably missed several studies written in other languages. The search question did not include terms related to specific types of AI algorithms or technical keywords. Consequently, we likely missed some studies that used such terms in their title and abstract instead of the terms that we used (ie, AI, machine learning, and deep learning). The findings of this review are mostly based most of the time on manual analysis, which is more likely to have inaccurate or missing information. Therefore, the accuracy of the information in the included studies may affect the accuracy of our findings.

Number	Authors	Article's title	Research question/objective	Type of research
1	Manita, R., Elommal, N., Baudier, P., & Hikkerova, L. (2020).	The digital transformation of external audit and its impact on corporate governance	"The purpose of this paper is to study the influence of digitalization on audit's business and to understand how it can improve the role of audit as a governance mechanism"	Qualitative Study
2	Munoko, I., Brown-Liburd, H. L., & Vasarhelyi, M. (2020)	The Ethical Implications of Using Artificial Intelligence in Auditing	"The study focuses on practical ethical issues that arise, given the features of AI at the technology and artifact levels. We then consider these issues in the context of the nature of auditing, the social functions that auditing is intended to serve, and the existing ethical codes of conduct that auditors must follow"	Conceptual study
3	Wang, Z., & Lin, Y. (2020, April).	Talent Training Model of Auditing under the Background of Artificial Intelligence	"Under the background of artificial intelligence, auditing students must not only master a large amount of professional knowledge in accounting and auditing theory, but also the supporting role of artificial intelligence in auditing."	Conceptual study
4	Gotthardt, M., et Al. (2020)	Current state and challenges in the implementation of smart robotic process automation in accounting and auditing	"This study presents a summarized overview of the transforming RPA ecosystem and indicates what challenges are critical to being confronted for a successful implementation of such systems in accounting and auditing."	Conceptual study
5	Al-Aroud, S. F. (2020)	The Impact of Artificial Intelligence Technologies on Audit Evidence	"To what extent does expert system affect the audit evidence from the point of view of certified auditors of IT companies in Jordan?"	Quantitative study
6	Mohammad, S. J., et al. (2020).	How artificial intelligence changes the future of the accounting industry	"The study aims to assess the effects of the introduction of AI-based systems in the field of accounting and answer the question of how it has changed the world of accounting professionals and to forward relevant suggestions to policymakers."	Qualitative Study
7	Tiberius, V., & Hirth, S. (2019).	Impacts of digitization on auditing: A Delphi study for Germany	"The objectives of this paper are to provide a discussion of both the inhibitors of incorporating Big Data into financial statement audits; and present a research agenda to identify approaches to ameliorate those inhibitors."	Qualitative Study
8	Moll, J., & Yigitbasioglu, O. (2019)	The role of internet-related technologies in shaping the work of accountants: new directions for accounting research	"This paper reviews the accounting literature that focuses on four Internet-related technologies that have the potential to dramatically change and disrupt the work of accountants and accounting researchers shortly. These include cloud, big data, blockchain, and artificial intelligence (AI)."	Conceptual study
9	Zemankova A.(2019)	Artificial intelligence and blockchain in audit and accounting: Literature review	"The main goal of the paper is to provide an analysis of audit tasks benefiting from artificial intelligence implementation, including risk assessment. Another goal is to analyze blockchain technology and its implications in the audit. A great part of the paper focuses on smart contracts and smart audit procedures, working based on blockchain technology."	Conceptual study
10	Jylhä, T., & Syynimaa, N. (2019)	The Effects of Digitalization on Accounting Service Companies	". The results of the study will help estimate the changes the rapidly developing technology will bring to the industry in focus. The results will also help the organizations in the industry to learn from the experiences of the other organizations, see the potential benefits, and prepare for the forthcoming change through strategic choices, management, and personnel training."	Qualitative Study
11	Amani, F. A., & Fadlalla, A. M. (2017)	Data mining applications in accounting: A review of the literature and organizing framework	"The objectives thus to systematically examine published research on data mining applications in accounting to understand the current status of, discern any central themes in, and offer an organizing framework for."	Conceptual study
12	Alles MS, Gray G.L(2016)	Incorporating big data in audits: Identifying inhibitors and a research agenda to address those inhibitors	"The objectives of this paper are to: provide a discussion of both the inhibitors of incorporating Big Data into financial statement audits; and present a research agenda to identify approaches to ameliorate those inhibitors."	Conceptual study
13	Sutton, S. G., Holt, M., & Arnold, V. (2016)	"The reports of my death are greatly exaggerated"—Artificial intelligence research in accounting	"The purpose of this study is to revisit the foundations underlying Gray et al. (2014) with an emphasis on the artificial intelligence side of the expert systems/artificial intelligence nexus to reconcile these differences in the literature and to better understand the role accounting academics should play in the future of artificial intelligence in accounting."	Conceptual study
14	Issa H.,Sun T.,Vasarhelyi M.A. (2016)	Research ideas for artificial intelligence in auditing: The formalization of audit and workforce supplementation	"This paper proposes various areas of AI-related research to examine where this emerging technology is most promising. Moreover, this paper raises a series of methodological and evolutionary research questions aiming to study the AI-driven transformation of today's world of audit into the assurance of the future."	Conceptual study

Appendix 1. Research question/objective

Conclusion

Following the scoping literature review methodology, this article analyzed and structured 14 articles published between 2016 and 2020. The approach was taken from the AI uses perspective, making a connection with emerging technologies in accounting field. The main results reveal that several studies have discussed the changes caused by AI technologies on accounting firms' dimensions (activities, skills, management, and strategy). Anyhow, a significant gap still exists in the studies especially when the majority of them presented without empirical. One of the contributions of this study is identifying emerging technology types that impact the accounting profession. We identified this gap in our literature review. Even though it is not the scope of this study, we may conclude that there is a lot of topics still not yet thoroughly treated about the relationship between AI new technologies (machine learning or deep learning) and the accounting and auditing field.

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