

Atanasovski, Atanasko; Tocev, Todor

Article

Research Trends in Disruptive Technologies for Accounting of The Future – A Bibliometric Analysis

Journal of Accounting and Management Information Systems (JAMIS)

Provided in Cooperation with:

The Bucharest University of Economic Studies

Suggested Citation: Atanasovski, Atanasko; Tocev, Todor (2022) : Research Trends in Disruptive Technologies for Accounting of The Future – A Bibliometric Analysis, Journal of Accounting and Management Information Systems (JAMIS), ISSN 2559-6004, Bucharest University of Economic Studies, Bucharest, Vol. 21, Iss. 2, pp. 270-288, <https://doi.org/10.24818/jamis.2022.02006>

This Version is available at:

<https://hdl.handle.net/10419/310831>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<http://creativecommons.org/licenses/by/4.0/>

Research trends in disruptive technologies for accounting of the future – A bibliometric analysis

Atanasko Atanasovski^{1,a} and Todor Tocev^a

^a*Ss. Cyril and Methodius University in Skopje, North Macedonia*

Abstract

Research Question: Is there a gap in research preferences on disruptive technologies between academia and practitioners?

Motivation: Disruptive technologies in accounting represent a new evolutionary phase of accounting impacted by emerging technologies that are part of industrial revolution 4.0. The relevance of emerging technologies, their potential, and the opportunities they offer for the accounting profession attract both academia and professionals with accelerated research efforts. Academia and scientific researchers must research and provide an appropriate theoretical basis to help practitioners better adapt and increase their awareness and trust in technology.

Idea: This paper provides early quantitative research data on publication trends related to most disruptive technologies in accounting such as big data, data analytics, cloud, artificial intelligence, and blockchain.

Data: The data were collected through detailed analysis and research of websites and publishing platforms on Big Four accounting firms, professional accounting associations, and institutes, and selected high-ranking journals for the period from 2016 to 2020.

Tools: The research was conducted using bibliometric analysis to identify how many articles were published by individual parties.

Findings: The results highlight that there are no significant discrepancies or different views of academia and practitioners. It is a positive result indicating that academia and scientific researchers exploit in the same direction as practitioners, thus providing support for adaptation and alignment to technology trends.

¹ *Corresponding author:* Atanasko Atanasovski, Department of Accounting and Audit, Faculty of Economics – Skopje, Ss. Cyril and Methodius University in Skopje, North Macedonia, Tel. (+389) 70398348, email addresses: atanasko.atanasovski@eccf.ukim.edu.mk

Contribution: The significance of the results of such research is important for obtaining directions in which the academy should research in the future but also for the regulators as well.

Keywords: big data, blockchain, accounting, emerging technologies, cloud, data analytics

JEL codes: M15, M41, O33

1. Introduction

Industry 4.0 is considered a new industrial revolution in which disruptive information technologies converge to provide digital solutions for business activities. According to the Global Institute McKinsey (2016), the rate of change is 10 times faster and 300 times higher than the industrial revolution, which began in the 19th century.

Digital disruption is a type of industrial upheaval caused by digital innovation, which erodes established methods of organizing, creating, and extracting value (Karimi and Walter, 2015). The advancement of disruptive technologies presents both opportunities and challenges for intensifying organizational governance within the lens of the accounting sector.

Accounting like all other professions is not immune or insensitive to the digitalization process. New technologies have the potential to dramatically change and disrupt the work of accountants and accounting researchers, but it is not enough to develop new software or tools based on advanced technologies unless there is a parallel development of new paradigms that provide a meaningful understanding of the new way of working (Marrone & Hazelton, 2019). All stakeholders have been motivated to develop accounting processes and tools that improve the way all accounting documents are generated, approved, and exchanged, as well as their records, analysis, and interpretation in financial statements, as a result of the development and availability of internet-based technologies. The current situation caused by the COVID-19 pandemic imposes and accelerates the widespread application of new technologies in organizations, to which accounting as a profession must respond.

Guided by the attractiveness and popularity of the topic, this paper aims to identify possible research and focus gaps in this area created by the work of practitioners and academia through extensive analysis of published articles. The paper is practically conceived in two parts, where the first part can be said to be divided into two subsections. The first subsection is a literature review of the technologies involved

in accounting research by academia and practitioners, i.e. the most disruptive technologies selected for further analysis, followed by the second subsection which summarizes the relevant literature on the essence, scope, and characteristics of these technologies. The second part of the paper uses the methodology of bibliometric analysis, through which publications on relevant technologies and different platforms are analyzed, to conclude whether and to what extent academic and professional research efforts converge in the field.

2. Literature review

The digital transformation of businesses supported by innovative and disruptive technologies is happening at an accelerated pace in many businesses that are part of the global supply chain, advanced manufacturing, logistics, finance, and health. Many of these emerging technologies will have a profound effect on accounting processes and professional practice. Among the technological innovations that are driving changes researchers emphasize the disruptive potential of cloud accounting, big data and data analytics, artificial intelligence and machine learning, and the blockchain (Kokina & Davenport, 2017; Moll & Yigitbasioglu, 2019). Richins *et al.* (2017) and Andersen (2019) describe the accounting industry as one of the few professions that will be continuously revolutionized and adapted as a result of the development and implementation of artificial intelligence, robotic process automation, data analytics, and big data, cloud, and blockchain. Ibrahim *et al.* (2021) specify big data and advanced analytics tools, cloud, and artificial intelligence as technologies that offer new opportunities and solutions to enhance and adapt accountants' ability to work in the complex and expeditious journey of this digital age.

KPMG International (2017) surveyed 580 participants from 16 countries covering key disruptive technology adoption trends and the impact of these technologies on businesses and their investment strategies. According to the participants in the study, big data and data analytics were ranked as technologies with the most significant impact of 77%, followed by cloud computing with 74%. Deloitte's (2018a) study of around 300 financial services executives, identified artificial intelligence, blockchain, and robots as technologies with fast gaining traction in the financial services business. That same year, Deloitte published a paper named "Data is the new gold", which indicates the potential and benefits of the massive amounts of data, data analytics, and cloud services for the accounting and audit profession (Deloitte, 2018b). In "Go Beyond Disruption", one of AICPA's monthly webcast series, significant representatives for the profession discuss the new challenges of the accounting profession led by disruptive technologies, highlighting blockchain, big data analytics, artificial intelligence, and robotic process automation. Their overall conclusion is that the technology already outlined will permanently transform the way accounting is done, as well as the people who perform it (AICPA, 2021).

2.1 Cloud accounting

Cloud computing is the provision of computing resources as ready-to-use services over the internet instead of providing traditional IT infrastructure in terms of selling and installing hardware and software and building capacity within organizations. In general cloud computing services fall into three broad categories (Du & Cong, 2010):

- Data storage as a service of storing and managing a large volume of business data remotely on the servers of the cloud service provider,
- Application software as a cloud service where the cloud service provider offers various business software applications and tools over the internet for handling business processes such as sales and customer relationship management, purchases or human resources management,
- Infrastructure/platform category where a cloud service provider offers computing services of computer hardware and system software, which involves operating systems, security, and network systems.

Most organizations deploy cloud technology through the public cloud deployment model. It allows companies to pay as they use the service, so future costs of usage can be easily monitored as the service is scaled up (Du & Cong, 2015). The capital investment in IT equipment and its maintenance is the responsibility of the cloud service provider, so organizations could allocate more resources and build competence around their core business (Mulholland *et al.*, 2010; Du & Cong, 2015).

The recent trends are that companies of different sizes rely on cloud platform software for accounting purposes. According to a Eurostat (2021) survey conducted by national statistical authorities, 41% of enterprises with more than 10 employees in the EU used cloud computing in 2021, with a 5 percentage points increase compared to 2020, mostly for hosting e-mails or storing files in electronic form. Around 47% of those enterprises use more sophisticated cloud-based end customer software applications for finance and accounting (Eurostat, 2021).

For small and medium-sized accounting practices the cloud accounting software means more flexibility at the workplace and improved efficiency in accounting processes with less time spent in communicating accounting information with clients. Also, ERP systems for larger companies are changing and vendors are transferring their solutions from company-located relational databases towards emerging cloud technology.

The decision to move towards cloud accounting software is not without drawbacks and limitations that must be considered by organizations. Generally, the service reliability of the cloud provider and reliability of the internet are major concerns for user organizations (Du & Cong, 2010). In addition, data security and confidentiality are relevant concerns, since user organizations could always have doubts about how their data is being handled or possibly misappropriated. Depending on the

jurisdiction, authorities could have easy access and directly exchange client data and information with the cloud service provider, which can be often disadvantageous for cloud service users.

2.2 Big data, data analytics, and artificial intelligence

The big data phenomenon is a direct repercussion of accelerated development in digital technologies dominantly around the internet and mobile technology. As a result, the volume of produced data in the world doubles every 18 months. Organizations collected more data in the past 2 years than in the previous 2000 years (Warren *et al.*, 2015). The concept of big data relates to the data, data storage, and computation power, as well as the new generation of IT tools and architecture for data analytics, identification of economic, social, and technological patterns, and provisions of valuable insights.

Gartner (2016) defines big data as high-volume, high-velocity, and/or high-variety information assets that demand cost-effective and innovative forms of information processing that can provide for enhanced insight, decision making, and process automation. Volume relates to the magnitude of the data i.e. large number of records, velocity refers to increased rate or frequency at which data is being generated, variety means a great diversity of the type of data being generated (social media postings, phone calls, web traffic, GPS data, pictures, etc.). The data derives from different sources such as industrial and individual users' sensors, satellites, social media feeds, photos, or data created from various internet sources and physical devices (GPS on cars and phones, phone signals, cameras, etc.). In addition, White (2012) emphasizes the veracity dimension of big data being the quality of the data and the level of trust in various data sources.

Vasarhelyi *et al.* (2015) and Warren *et al.* (2015) point out that big data and data analytics can impact modern methods for valuation of intangible assets, for example: customer base, the value of the brand or contingent liabilities, which appear only in the parent's consolidated financial statements or in the financial statements of the acquirer in the case of mergers, yet not in the individual companies' balance sheets.

Data generated from B2B (business-to-business) and B2C (business-to-customer) interactions, could favor more current cost valuation of assets such as inventories and PPE. Even classical cost valuation of PPE could benefit through a better estimate of depreciation charge through modern technology. For example, depreciation charges are calculated based on specific machinery sensor data on the actual utilization of the asset.

Financial statements could incorporate more decision-useful information for investors, based on exogenous data from sources such as social media, locational

data, web path analytics, and electronic sales data (Cong *et al.*, 2018). To achieve such transformation, accounting processes performed need to be amended with wide-ranging data capturing and analytics tools and activities that will provide information more reflective on future economic value creation (Bhimani & Willcocks, 2014). Through the introduction of big data analytics, corporate reporting can change its approach and accelerate its move towards real-time reporting with an emphasized perspective element of information content (Krahel & Vasarhelyi, 2014; Al-Htaybat & von Alberti-Alhtaybat, 2017).

Management accounting could benefit from big data analytics too, through expansion and improvements in performance metrics used within the management control system. According to Warren *et al.* (2015), big data can transform traditional management control systems into comprehensive monitoring and control systems. New information streams and data outside of the internal ERP system can improve performance metrics on customer service, product-service mix, employee and technology productivity, etc.

Big data and data analytics face increased exploitation within the auditing and assurance services industry as well. The increased use of GPS devices, RFID chips, and other IoT (internet of things) devices will enable auditors to obtain better audit evidence in respect of existence, completeness, and valuation assertions for inventories or items of property, plant, and equipment. Instead of traditionally vouching transactions against invoices and receipts, auditors could also use non-traditional and unstructured data and information such as photos, videos, GPS, and RFID signaling data. Big data analytics can enhance fraud risk analysis systems and improve their ability to identify fraud committed by employees. Text mining and analysis of e-mail messages of employees help for a more accurate prediction of organizational fraud risk (Holton, 2009). Supervised and unsupervised neural networks, genetic programming, sentiment analysis, and natural language processing tools are examples of approaches in big data analytics useful for building fraud detection models (Gepp *et al.*, 2018).

Artificial intelligence and machine learning will most likely find application in the accounting world for:

- Coding accounting entries and compliance financial reporting standards requirements when rules are changed,
- Improved fraud detection models through sophisticated machine learning,
- Software tools based on AI and machine learning enable predictive analytics for compliance supporting professionals through automated and cost-efficient review of numerous contracts and other documents.

Many audit procedures are highly repetitive and AI-enabled technology can help auditors to locate and extract relevant information, allowing the professional to focus

more on applying unstructured analysis and judgment. Leading professional accounting firms have started adopting cognitive AI technologies. Deloitte tries to develop technology-enabled cognitive capabilities for audit-specific tasks and technology-enhanced solutions for clients' businesses. In 2014 Deloitte US developed an AI-enabled document review platform that has automated the process of extracting relevant information from documents, helping them reduce the time spent or reviewing documents by up to 50%. KPMG built its portfolio of AI tools called KPMG Ignite and applied artificial intelligence in predicting future anomalous business events and document compliance assessment for lease and investment contracts (Faggella, 2020).

2.3 Blockchain technology

The blockchain is considered as distributed ledger technology designed to record all transactions since its creation, in a sequential continued archive. The technology was introduced through Nakamoto's (2008) paper on bitcoin as a peer-to-peer electronic cash system. The technology provides for transactions to be recorded on the blockchain once initiated and broadcasted to all nodes in the network, checked through the computational process, and then added and connected with previous blocks of transactions. This proof-of-work process is what preserves blockchain to be undermined with fraudulent data. The main characteristics of the bitcoin blockchain include decentralization, strong authentication, and tamper resistance (Dai & Vasarhelyi, 2017).

Researchers admit the potential of blockchain technology to transform the design of accounting information systems and impact the profession (Dai & Vasarhelyi, 2017; Kokina *et al.*, 2017). They recognize the technology will enhance the prevention of fraud in financial statements, increase efficiency and allow for real-time auditing. The triple-entry accounting mechanism could be introduced by the technology, providing for each two-party transaction to be verified by an intermediary creating an additional third verification entry (O'Leary, 2017; Schmitz & Leoni, 2019). The authentication of transactions with the technology prevents tampering with accounting entries. This is inherently beneficial for businesses nowadays that employ ERP systems with IT controls that make it harder to retroactively change the transaction data. However, there is no strict requirement in the current architecture to publicly verify the genuine nature of the transaction, and tempering could occur.

Traditionally during an audit of financial statements, auditors rely on sampling due to the high costs of reviewing all transactions. The use of distributed ledger technology such as blockchain allows for auditing of complete transactions population. In addition, the timing of the audit procedures near financial year-end could be changed into continuous or real-time audits throughout the year (ACCA, 2017; Schmitz & Leoni, 2019). Although the blockchain technology could largely

make the audit and assurance procedures automated, auditors will still be needed to gather evidence for the existence of transactions recorded on the blockchain and verify the consistency of recorded information with the physical world (Coyne & McMickle, 2017; Schmitz & Leoni, 2019).

One special feature of blockchain technology is smart contracts, programs stored on the blockchain that run automatically when predetermined conditions are met. Smart contracts could automate and improve compliance with financial reporting requirements, through the encoding of accounting rules derived from accounting standards. When established criteria are met by the underlining transaction, the smart contract applies the encoded accounting rule and the transaction is recorded autonomously (Dai & Vasarhelyi, 2017; O’Leary, 2017). Also, internal control procedures could be implemented through smart contracts and corrective actions can be perfectly executed in the organization based on predetermined rules. Smart contracts combined with IoT (internet of things) devices and technologies can automate additional accounting-related processes and internal controls.

Many businesses, governments, and regulators recognize the potential of blockchain technology and there are considerable investments in the technology by venture capitalists and tech-savvy entrepreneurs. However, the technology is not without considerable limitations for wider and accelerated adoption. Among the most highlighted limitations of the technology are its lack of scalability, the need for processing power and large transaction costs, interoperability, and confidentiality (Coyne & McMickle, 2017; Kokina *et al.*, 2017).

3. Research methodology

We conducted a co-word analysis to identify how many articles, i.e. papers were published by individual parties, and discover the trend and popularity of technologies for the period between 2016 and 2020. Bibliometric analysis was started as a methodology in the middle of the 20th century by E. Garfield and became generalized in the analysis of scientific research so it can be said that is one of the most applicable methodologies and tools that applies mathematical and statistical methods to scientific literature, to analyze a certain scientific field (Abad-Segura & Gonzalez-Zamar, 2020). As Zupic and Čater (2015) define co-word analysis, it is the only approach for constructing similarity metrics that uses the actual content of documents.

First, our qualitative research elaborated in the literature review section of this paper enabled us to identify the most influential disruptive technologies for the accounting profession, as well as professional firms, institutions, and academic journals that most actively engage resources and provide space for research and publishing-

related to these new technology developments. Based on this, we performed our bibliometric analysis on:

- Published articles on web pages of Big Four accounting firms: Deloitte, KPMG, EY, and PWC.
- Published articles, papers, and research documents by professional accounting associations and institutes, representing the voice of the global accounting profession: IFAC, AICPA, ACCA, ICAEW, and CIMA.
- Academic papers published in selected high-ranking journals that have provided sufficient publishing opportunities in the past five years on the topic of disruptive technologies in accounting. Journals were selected based on the qualitative results of our literature review and populated reference list of most frequently cited academic papers. We have identified eight journals that have published the predominant number of papers that were most cited and dealt with the topics of disruptive technologies and their impact on accounting.

Where appropriate the research was conducted through advanced search tools according to the following keywords: “Big Data” OR “Data Analytics” OR “Cloud” OR “Artificial Intelligence” OR “Blockchain” AND “Accounting”. In fewer cases where databases and web pages offered fewer options for advanced search, each technology term was searched separately.

After an article or paper was identified through search, the paper was reviewed by authors to ensure that the technology is conceptually covered, not just mentioned, which could appear through the search tool. Papers that cover more than one technology were coded separately for multiple technology options to maintain the relevance of the number of papers related to the respective technology. Articles and papers that briefly mentioned a technology without elaboration were excluded from subsequent analysis. In total, 8206 published articles, papers, and documents on disruptive technologies in accounting for the period 2016-2020 were analyzed.

All collected data were grouped by database and by years, which were then analyzed through:

- **Descriptive analysis** to display the summarized data and structure of selected papers and articles.
- **Trend analysis** through comparing the number of published articles/papers year by year, the total growth for the period from 2016 to 2020, and the average yearly growth.
- **Comparative analysis** to identify the possible gap in research and publication of technology-specific papers. We compare and present statistics on published papers from Big Four accounting firms, professional associations, and academic

journals in order to conclude whether there is a research discrepancy between academic researchers and technology leaders and professionals in practice investigating the potential benefits of technology developments.

4. Results and discussion

As presented in Table 1, we summarize the identified publications by publications platform/source. It can be analyzed that 87.2% of our analyzed articles/papers were published by Big 4 accounting firms, 10.4% by international institutions and 2.4% of articles were published in influential accounting journals.

Table 1: Descriptive analysis by publication platform/source

Emerging Technologies	Total Findings	Big 4	Databases	
			Accounting and Audit Associations/ Institutes	Accounting Journals
Big Data	2479 (30%)	1. Deloitte 2. PwC 3. KPMG 4. EY	1. AICPA 2. ACCA 3. IFAC 4. ICAEW 5. CIMA	1. Accounting, Auditing and Accountability Journal 2. Accounting and Business Research 3. Journal of Information Systems 4. Australian Accounting Review 5. Journal of Emerging technologies in Accounting 6. Accounting Horizons 7. Intelligent systems in accounting finance and management 8. Accounting Research Journal
Data Analytics	2517 (31%)			
Cloud Computing	1050 (13%)			
Artificial Intelligence	1486 (18%)			
Blockchain	674 (8%)			
Total Findings (2016-2020)	8206 (100%)	7157 (87,2%)	855 (10,4%)	194 (2,4%)
Published articles per year (avrg.)	1641	~1431	171	~39

Published articles per publication platform per year (avrg.)	~97	~358	~34	~5
---	------------	-------------	------------	-----------

According to our overall findings, the biggest four accounting firms are the most frequent publishers, publishing short articles, brief analysis, interviews, and discussions mostly. On the other hand, the journals publish papers on much broader topics and issues, through a peer-review process, which is one of the main reasons for the large difference in the number of publications.

Table 2 summarizes the trend of published articles for each of the analyzed technologies according to the publication platform/source, with 2016 serving as the base year. It can be analyzed that artificial intelligence and machine learning show the highest average percentage growth in research and published articles by Big 4 firms and professional accounting institutions. Although artificial intelligence does not dominate in absolute numbers, the percentage growth still indicates the greatest increased interest in that technology. From the scientific research journals' point of view, the highest average percentage growth for the period from 2016 to 2020 is shown by blockchain technology, which is obviously the most challenging for academic researchers.

Table 2: Percentage growth of the covered technologies

Big 4 % growing rate						
	2016	2017	2018	2019	2020	Average rate
Big Data	100	339.5	862.8	1586	2323.3	1277.9
Data Analytics	100	251.7	586.7	1108.3	1738.3	921.3
Cloud Computing	100	158.3	338.9	797.2	1147.2	610.4
Artificial Intelligence	100	584.6	5	3353.8	4476.9	<u>*2463.5</u>
Blockchain	100	219	461.9	800	495.2	494
Total articles per year	100	275.1	652.6	1293.6	1815.6	1009.2
Accounting and Audit Association/Institutions % growing rate						
	2016	2017	2018	2019	2020	Average rate
Big Data	100	86.3	74.5	68.6	37.3	66.7
Data Analytics	100	104.1	67.3	75.5	38.8	71.4
Cloud Computing	100	84.4	56.3	65.6	50	64.1
Artificial Intelligence	100	233.3	408.3	375	183.3	<u>*300</u>
Blockchain	100	205.3	415.8	226.3	152.6	250
Total articles per year	100	116	133.1	111.0	64.4	106.1
Accounting Journals % growing rate						

**Research trends in disruptive technologies
for accounting of the future – A bibliometric analysis**

	2016	2017	2018	2019	2020	Average rate
Big Data	100	260	260	180	220	230
Data Analytics	100	142.9	142.9	171.4	257.1	178.6
Cloud Computing	100	200	500	300	1500	625
Artificial Intelligence	100	50	400	300	950	425
Blockchain	100	600	700	1100	900	<u>*825</u>
Total articles per year	100	214.3	292.9	278.6	500	321.4

We continued our publication analysis focusing on Big 4 accounting firms' research and publication output. As presented in Chart 1 below, big data and data analytics are the most dominant technologies for which articles have been written in each of the last 5 years. The huge number of articles published on big data and data analytics is attributable to the fact that, in comparison to other technologies, they have been included in research from the early beginning because of their popularity and practical application in accounting. The curve of artificial intelligence shows the sharpest increase and fastest growth in the number of published articles over the years, which is a good indicator and promising for the application of this technology in the near future. Artificial intelligence, which ranks third in terms of the absolute number of technology-related articles published, is followed by cloud computing with a smaller but still significant positive trend, and finally, blockchain, which is least covered as technology for research and discussion in Big 4. The blockchain curve has the lowest growth, and in 2020 it starts even with a negative slope.

Chart 1. Big 4 articles

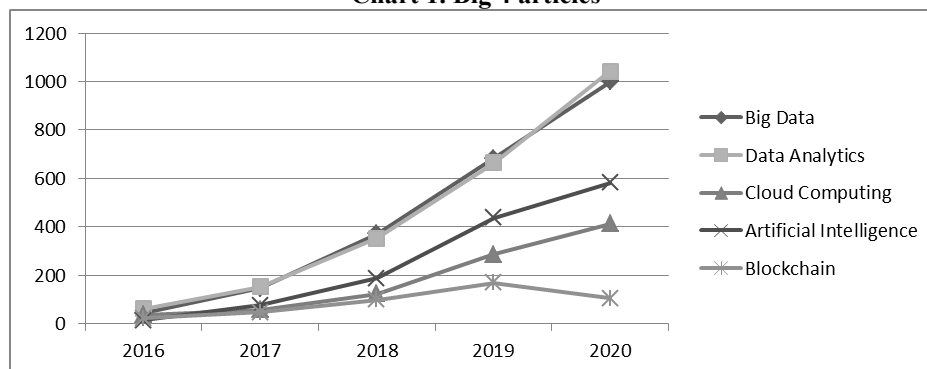
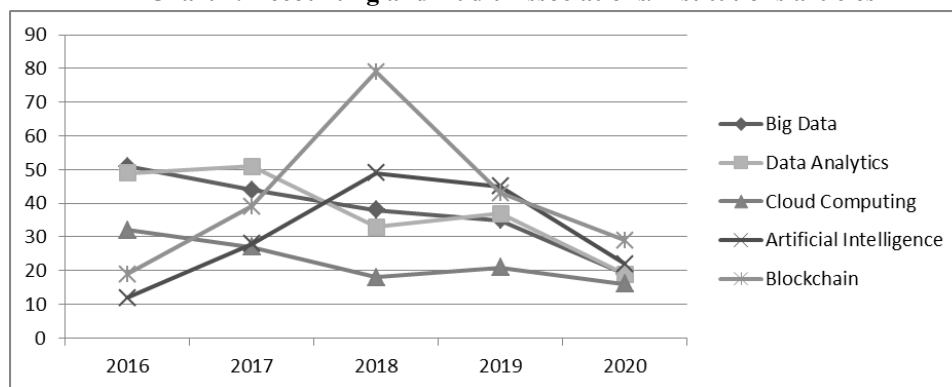


Chart 2 below shows the research and publication interest among global professional accounting associations and institutes. Among these institutions, artificial intelligence and blockchain show positive growth in the absolute number of published articles for the last five years, despite the two negative oscillations that appear in the number of articles in 2019 and 2020. Blockchain technology dominates the field of research and published articles by professional accounting associations, which is completely opposite to the publication interest of Big 4 firms. The increase in the number of published articles for blockchain is due to its popularity in 2017

and 2018, years well known for the sharp increase in the value of cryptocurrencies. Artificial intelligence has the highest percentage growth for the analyzed period starting from 2016, but for now, according to the absolute number of published articles that refer to it, it can be said that it is almost the least covered technology. Big data is the only technology for which we can see a continuous decline in the number of published articles, while other analyzed technologies have some small positive and negative changes, which overall reduce the number of published articles related to new technologies.

Chart 2. Accounting and Audit Associations/Institutions articles



Finally, Chart 3 shows the trends of the technology-related papers published in academic journals. Our analysis of published journal papers has shown that 46% of all published papers conceptually analyze one or more technologies in terms of their nature, potential, possibilities, and limitations, 33% of the papers provide evidence from quantitative research through survey questionnaires or interviews and 21% are papers with quantitative and qualitative research based on primary or secondary data. In general, the quantity of papers relating to disruptive technologies and their use in accounting has risen over time, both overall and for each technology individually. Cloud computing has the highest average growth for the period, however, it is still a technology with the lowest number of published papers. Due to accelerated interest in IT technologies for automated and remote work, caused by the pandemic COVID-19, 2020 is a year in which the number of published papers noted huge growth. Blockchain technology has the highest percentage growth from 2016 to 2020, but that result is due to the fact that in 2016 there were no published papers in the selected journals. Artificial intelligence is slowly but surely increasing the interest of academic researchers over the years and we expect it to grow continuously over the coming years.

Chart 3. Academic journals articles on disruptive technologies

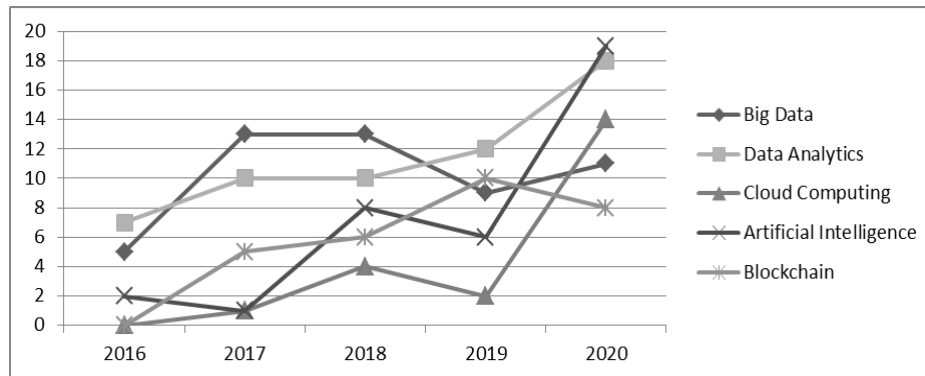
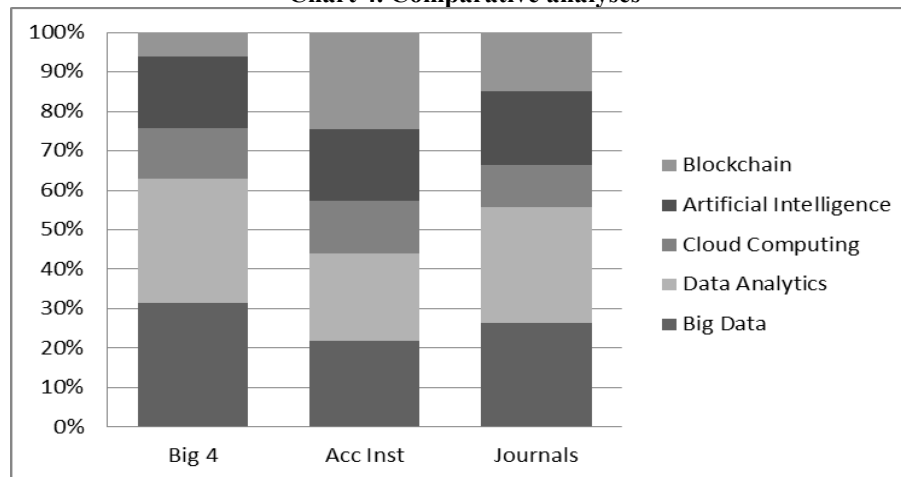


Chart 4 presents the percentage of specific technology papers within the total number of papers exploiting disruptive technologies published by different sponsoring platforms: Big 4 accounting firms, professional associations/institutes, and academic journals.

Chart 4. Comparative analyses



Through comparative analyses, we have concluded that:

- Big data and data analytics are the most dominant technologies for researching and publishing articles in all three publication platforms/sources. Among Big 4 firms and academic journals, the relative representation varies 63% and 56% respectively, while for professional accounting association the papers in this field represent in total 44% of all publications.
- Artificial intelligence is the third most attractive and represented technology in terms of the number of published articles by Big 4 and academic journals.
- However, Big 4 firms discuss mostly big data, while academic papers mostly cover data analytics.

- The academia does more research on artificial intelligence than practitioners. However, there is increased interest in this technology shown by Big 4 firms in recent years, which narrows the gap that is actually small but still significant.
- The biggest difference arises in the coverage of blockchain technology. This technology is mostly covered by professional accounting institutions. The academia has almost twice the percentage of blockchain-related papers than Big 4 firms' publications, where it has the lowest coverage, compared to other identified technologies.

5. Conclusion

The disruption caused by emerging technologies such as cloud computing, big data, data analytics, blockchain, artificial intelligence, and others, will impact the work and future operations of enterprises, accounting practitioners, and academia. Through Bibliometric analysis of publications for the period 2016-2020, our research shows early indication of similarities and differences in research and publication interests among academicians and technology leaders in professional accounting practice.

Based on research results we have concluded that, in general, academia and practitioners have the same research direction and show a positive trend in terms of the number of published articles related to disruptive technologies. Big data and data analytics undoubtedly predominate in published articles in the last 5 years. Also, artificial intelligence has seen significant growth in research by both academia and practitioners. Due to the huge and incompletely researched potential that this technology brings to accounting, the number of published articles and papers is considerable and it is the third most researched technology. However, there are notable differences in research interest for disruptive technologies among Big 4 firms, professional accounting associations, and influential accounting journals. Cloud accounting is a bit more researched by practitioners compared to academia, while blockchain is the other way around.

Based on the results we can see the pronounced tendency of interest in big data, data analytics, and artificial intelligence. Although all technologies are related and complementary in some way, our view is that these three technologies should be exploited through synchronous and collaborative research activities of academia and practitioners. Big 4 firms could engage resources and industry knowledge to exploit viable concept ideas on disruptive technologies in accounting identified and researched by accounting academics.

The results of such joint research efforts will contribute regulators' work in modernizing professional accountants' row and establishing the next generation of professional engagement standards. Knowledge derived from research implementation experience with disruptive technologies in accounting will certainly amend university curriculum and teaching methodologies followed by accounting educators in the future.

However, our research has some limitations that we plan to address in our future research efforts. Our study so far covered only published articles in 8 peer-reviewed and highly-ranked international academic journals publishing predominantly papers related to accounting and technology. We intend to broaden our database of journals and incorporate others that have provided publishing opportunities for papers

investigating emerging technology's impact on accounting. Also, it will be necessary to do an in-depth analysis on publications and segregate between journal articles, white papers, short online articles, discussions, and transcripts.

Nevertheless, we can expect with certainty that over time the number of articles on these disruptive technologies will increase considerably. Some of the above technologies will be more illuminated by researchers and technology leaders, and thus will be able to materialize their disruptive potential in the accounting world. In our opinion, the power of big data and data analytics tools with the application of artificial intelligence and machine learning bring the greatest potential for the accounting profession and will dominate research and publications in the forthcoming years.

References

- Abad-Segura, E. & Gonzalez-Zamar, D. M. (2020) "Research analysis on emerging technologies in corporate accounting", *Mathematics*, vol. 8, no. 9.
- ACCA (2017) "Divided we fall, distributed we stand. The professional accountant's guide to distributed ledgers and blockchain", available on-line at <https://www.slideshare.net/IanBeckett3/divided-we-fall-distributed-we-stand-the-professional-accountants-guide-to-distributed-ledgers-and-blockchain> (Retrieved December 12, 2021)
- AICPA (2021) "Go Beyond Disruption", available online at <https://www.aicpa-cima.com/disruption.html> (Retrieved November 9, 2021)
- Al-Htaybat, K. & von Alberti-Alhtaybat, L. (2017) "Big data and corporate reporting: impacts and paradoxes", *Accounting, Auditing & Accountability Journal*, vol. 30, no. 4: 850–873
- Andersen, C. (2019) "Technology in Accounting: Disruptive Innovations and Implications", An Honors Thesis (HONR 499), E-library, Ball State University, Muncie, Indiana, available online at <https://core.ac.uk/download/pdf/228159815.pdf> (Retrieved November 20, 2021)
- Bhimani, A. & Willcocks, L. (2014) "Digitisation, 'big data' and the transformation of accounting information", *Accounting and Business Research*, vol. 44, no. 4: 469-490
- Cong, Y., Du, H. & Vasarhelyi, M.A. (2018) "Technological disruption in accounting and auditing", *Journal of Emerging Technologies in Accounting*, vol. 15, no. 2: 1-10
- Coyne, J.G. & McMickle, P.L. (2017) "Can blockchains serve an accounting purpose?", *Journal of Emerging Technologies in Accounting*, vol. 14, no. 2: 101–111
- Dai, J. & Vasarhelyi, M.A. (2017) "Toward blockchain-based accounting and assurance", *Journal of Information Systems*, vol. 31, no. 8: 5-21

- Deloitte (2018a) "Emerging technology, similar risks", available at <https://www2.deloitte.com/us/en/pages/financial-services/articles/disruptive-digital-technologies-in-the-financial-services-industry.html> (Retrieved December 3, 2021)
- Deloitte (2018b) "Data is the new gold", available at <https://www2.deloitte.com/us/en/pages/real-estate/articles/future-real-estate-data-new-gold.html> (Retrieved December 3, 2021)
- Du, H. & Cong, Y. (2010) "Cloud computing, accounting, auditing, and beyond". *The CPA Journal*, New York, NY: New York State Soc. of Certified Public Accountants
- Du, H. & Cong, Y. (2015) "Going cloud for agility: Beyond financial, system, and control motives", *Journal of Emerging Technologies in Accounting*, vol. 12, no. 1: 153-167
- Eurostat (2021) "Cloud computing - statistics on the use by enterprises", available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Cloud_computing_-_statistics_on_the_use_by_enterprises#Use_of_cloud_computing:_highlights (Retrieved February 18, 2022)
- Faggella, D. (2020) "AI in the accounting big four - comparing Deloitte, PwC, KPMG, and EY" [WWW Document], *Emerj, The AI Research and Advisory Company*, available at: <https://emerj.com/ai-sector-overviews/ai-in-the-accounting-big-four-comparing-deloitte-pwc-kpmg-and-ey/> (Retrieved December 7, 2021)
- Gartner (2016) "IT glossary", available at: <http://www.gartner.com/it-glossary/big-data/> (Retrieved November 13, 2021)
- Gepp, A., Linnenluecke, M.K., O'Neill, T.J. & Smith, T. (2018) "Big data techniques in auditing research and practice: Current trends and future opportunities", *Journal of Accounting Literature*, vol. 40, no. 1: 102-115
- Holton, C. (2009) "Identifying disgruntled employee systems fraud risk through text mining: A simple solution for a multi-billion dollar problem", *Decision Support Systems, IT Decisions in Organizations*, vol. 46, no.4: 853-864
- Ibrahim, S., Wan sallha, Y & Rashid, I. (2021) "A systematic review of disruptive technology within accounting and accounting sector", *AIP Conference Proceedings* 2339,
- Karimi, J. & Walter, Z. (2015) "The role of dynamic capabilities in responding to digital disruption: a factor-based study of the newspaper industry", *Journal of Management Information Systems*, vol. 32, no. 1: 39-81
- Kokina, J. & Davenport, T.H. (2017) "The emergence of artificial intelligence: How automation is changing auditing", *Journal of Emerging Technologies in Accounting*, vol. 14, no. 1: 115-122
- Kokina, J., Mancha, R. & Pachamano, D. (2017) "Blockchain: Emergent Industry Adoption and Implications for Accounting", *Journal of Emerging Technologies in Accounting*, vol. 14, no. 2: 91-100

- KPMG (2017) "The disruptors are the disrupted - Disruptive technologies barometer: Technology sector", available at: <https://assets.kpmg/content/dam/kpmg/xx/pdf/2016/11/disruptive-technologies-barometer-tech-report.pdf> (Retrieved December 14, 2021)
- Krahel, J.P. & Vasarhelyi, M.A. (2014) "AIS as a Facilitator of Accounting Change: Technology, Practice, and Education", *Journal of Information Systems*, vol. 28, no. 2: 1-15
- Marrone, M. & Hazelton, J. (2019) "The disruptive and transformative potential of new technologies for accounting, accountants, and accountability", *Meditari Accountancy Research*, vol. 27, no. 5: 677–694
- McKinsey (2016) "Industry 4.0 after the initial hype - Where manufacturers are finding value and how they can best capture it", available at https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/getting%20the%20most%20out%20of%20industry%204%200/mckinsey_industry_40_2016.ashx (Retrieved October 23, 2021)
- Moll, J. & Yigitbasioglu, O. (2019) "The role of internet-related technologies in shaping the work of accountants: New directions for accounting research", *The British Accounting Review*, vol. 51, no. 6.
- Mulholland, A., Pyke, J. & Fingar, P. (2010) *"Enterprise cloud computing: A strategy guide for business and technology leaders"*, Meghan-Kiffer Press, USA.
- Nakamoto, S. (2008) "Bitcoin: A peer-to-peer electronic cash system", unpublished manuscript, available at: <https://bitcoin.org/bitcoin.pdf> (Retrieved October 3, 2021)
- O'Leary, D.E. (2017) "Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems". *Intelligent Systems in Accounting, Finance, and Management*, vol. 24, no. 4: 138-147
- Richins, G; Stapleton, A; Stratopoulos, T & Wong, C. (2017) "Big Data Analytics: Opportunity or Threat for the Accounting Profession?", *Journal of Information Systems*, vol. 31, no. 3: 63–79
- Schmitz, J. & Leoni, G. (2019) "Accounting and auditing at the time of blockchain technology: A research agenda", *Australian Accounting Review*, vol. 29, 331-342.
- Vasarhelyi, M.A., Kogan, A. & Tuttle, B.M. (2015) "Big data in accounting: An overview", *Accounting Horizons*, vol. 29, no. 2: 381-396
- Warren, J.D., Moffitt, K.C. & Byrnes, P. (2015) "How big data will change accounting", *Accounting Horizons*, 29, no. 2: 397-407
- White, M. (2012) "Digital workplaces: Vision and reality", *Business Information Review*, vol. 29, no. 4: 205-214
- Zupic, I. & Čater, T. (2015) "Bibliometric methods in management and organization", *Organizational Research Methods*, vol. 18, no. 3: 429-472