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Research Article

Emerging Technologies in The Audit Environment: Use and Perceived Importance Among Independent Auditors

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Abstract

To discover the possible weakness of knowledge and the use of a diverse group of technologies among independent auditors.

The descriptive survey study was used to describe the level of usable importance of innovative technologies among 196 auditors and find any correlation between 31 emerging technologies and the audit firms' quality ranking.

In general, this paper's results enumerate that Iranian auditors have a relatively acceptable knowledge and willingness to use emerging technologies, including Blockchain, Audit 4.0, etc. In auditing. However, due to various reasons such as lack of access to global markets, political and economic constraints, such facilitators are rarely used in auditing. For instance, technologies, including RPA, AI, and CPS, are not used by Iranian auditors. Although some items were deficient, the related tools' Importance level was moderate.

This research suggests that due to businesses' failure to grow as much as innovative technologies, partners and decision-makers may believe that there is no need for emerging technologies in auditing. However, this may not be the case, as auditors generally emphasized that the importance level of technologies was moderate and high. There seems to be a positive correlation between audit firm's quality rankings and the use of emerging technologies in audit processes. There is no meaningful correlation between audit firms' quality rankings and the importance of emerging technologies.

Keywords: Blockchain, Audit 4.0, Data Analytics, Social Media, Audit Firm Quality Ranking.

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1. Introduction

Technological innovations and their utilization in the auditing profession continue growing in this decade. Advances in various technologies, such as data analytics, data mining, RFID, Internet of Things, Blockchain, audit app, drones, etc., exert a deep influence on the life-style of human-beings (Dai J., 2017). Researchers are devoting efforts to explore using those technologies to investigate the entire population (Vasarhelyi, 2015). The emerging technologies have re-engineered business processes, redefined the business environment, and remodeled many aspects of the business (Huang, 2019). Information technology has made significant progress in the recent past, and this has had a profound global impact on contemporary human culture. Business operations have also dramatically evolved via information technologies, and this has facilitated numerous automation and redesign opportunities for the accounting profession (Lui & Vasarhelyi, 2014). Traditional auditing has changed considerably due to IT changes, including more advanced ERP systems, increasing the use of online transactions with both customers and suppliers, use of the cloud, and the rapid expansion of data available for use by management and auditors (AICPA, 2015). The potential use of nontraditional sources of information and the applications of disruptive technologies for auditing has recently captured the interest of the audit community (Hamm, 2018). Advances in technology occur at exponential rates and are transforming business practices (Rozario, 2019). Alles (2015) suggests that audit clients' use of advanced technologies is likely to be the driver of adopting such technologies by auditors. As a result, it is not surprising that the audit community, including academics, regulators, and audit professionals, is debating the extent to which technology will impact auditing (IAASB, 2016; PCAOB, 2017). New strategic and emerging technologies allow auditors to take advantage of the automation and monitoring tools that management has made possible through business process re-engineering efforts over the past few decades (Teeter, 2014). As the industry moves toward the next generation, auditing should also adapt to the new environment. Auditors can leverage new technologies to collect a large range of real-time, audit-related data, automate repetitive processes involving few or simple judgments, and eventually achieve comprehensive, timely, and accurate assurance (Dai & Vasarhelyi, 2016). The auditing area has lagged behind the business in technology adoption in the past (Oldhouser, 2016). However, it is prime for partial automation due to its labor intensiveness and range of decision structures. Furthermore, several technologies have been progressively developing that can serve as motivators of automation as well as change auditing methodology (Issa, Sun, & Vasarheyli, 2017). While the impact of information technology (IT) in business has grown exponentially in the past two decades, few studies examine IT's use and perceived importance, particularly outside of the largest audit firms (Fischer, 1996; Banker, 2002). This issue is important since IT has dramatically changed the audit process. Standards now encourage auditors and audit firms to adopt IT and use IT specialists, when necessary (American Institute of Certified Public Accountants[AICPA], 2001,2002b, 2005, 2006; Public Company Accounting Oversight Board[PCAOB], 2004b). However, auditing researchers and practitioners have little guidance on what IT has been or should be adopted (Janverin, Bierstaker, & Lowe, An Examination of auditor technology use and perceived importance., 2008). While IT has evolved over the past decade, limited guidance is available to help practitioners determine how IT can be used in their audits and its importance. This has prompted a call by the academic accounting community for additional research into understanding how and to what extent IT is used in conducting audits (Curtis, Jenkins, Bedard, & Deis, 2009; Mazza, Azzali, & Fornaciari, 2014; D'Onza, Lamboglia, & Verona, 2015). Furthermore, diffusion innovation theory suggests that innovations, such as new IT, are adopted at different points in time by different groups consisting of innovators, early adopters, early

majority, late majority, and laggards (or simply early and late adopters) (Agarwal, Ahuja, Carter, & Gans, 1998; Rogers, 2003). Thus, the adoption of IT in an audit context may vary by firm size, given differences in resource availability between large and small audit firms (Lowe, Bierskater, Janvrin, & Jenkins, 2018). Therefore, it seems compulsory to research to explore innovative technologies' significance and status, including audit apps, blockchains, data analytics, audit 4.0, etc., among Independent Iranian auditors. This study has also attempted to demonstrate any correlation between the use of innovative technologies and the audit firms' rankings. This paper also explores the extent of Use and level of Importance by auditors on current emerging technologies to provide the background for future researchers and business entities operating in the audit environment.

2. Research Background

The foundations and findings of many recent types of research have been used in this study. Two main research projects that I have used to develop the methods of this paper and the expression of key questions are those of (Janverin, Bierstaker, & Lowe, An Examination of auditor technology use and perceived importance., 2008) and (Lowe, Bierskater, Janvrin, & Jenkins, 2018). The research population in both studies is the auditors employed in national, regional, and local offices of big 4. Subsequently, in both papers, the extent of Use and Importance level of technologies have been measured.

Janverin, Bierstaker, and Lowe (2008) found that auditors' IT use at the national firms was more comparable to that of the Big 4 firms for some applications (sampling, internal control evaluation, fraud review, electronic working papers) and more comparable to the smaller firms for other applications (audit planning software, audit report writing) in 2004. Their research results indicate that some audit applications are used extensively (e.g., analytical procedures, audit report writing, electronic work papers, Internet search tools, and sampling), but others are not (e.g., digital analysis, expert systems, the test of online transactions, database modeling, and continuous transaction monitoring). Also, auditors indicated that several audit applications were important, although not used extensively (e.g., audit planning, client acceptance, client relationship management, fraud review, internal control evaluation, and risk assessment). Thus, practitioners may want to consider expanding their use of IT to include these applications. IT specialists do not appear to be used extensively in a typical audit, even by auditors who examine complex IT clients.

Zangabadi (2014), in his thesis titled Factors Affecting the Quality of Information Technology Audit, studies the influencing factor on the quality of IT audit from the standpoint of certified auditors working in the audit organization of Iran and Iranian Association of Certified Public Accountants. The results of this study show that from the standpoint of certified auditors working in audit organization of Iran and Iranian Association of Certified Public Accountants, independence, knowledge of accounting and auditing skills, business process awareness, appropriate audit team accountability, audit frameworks and procedures, business criteria and audit scope, audit capability, audit experience of the audited entity, information technology, and controls, planning, and execution of operations, access to resources, communication with the audited entity and the business environment affect the quality of the IT audit.

Mohsinia (2008), in the thesis on the impact of the use of audit software on audit operations in a set of Astan Quds Razavi companies and institutes to find answers to two key questions. (1) Is the use of software incorporate audit promoting the efficiency and effectiveness of the audit operations? (2) Does the use of this software reduce audit firm costs, especially personnel costs? Accordingly, the use of organization audit software in the audit operations of Astan Quds Razavi's small, medium, and large enterprises has

improved efficiency and effectiveness.

Bazgali (2015), in his dissertation entitled The Impact of Information Technology on the Quality of Internal Audit Services, to examine the impact of information technology on internal audit and identify the factors affecting the increase of internal audit quality. As a result of the relevant research, three hypotheses have been proved as follows: (1) In Iranian society, IT status is high in companies. (2) IT status is high in companies' internal audit department (3) status of internal audit staff from IT is high.

Rozario (2019), in a Ph.D. dissertation entitled Three types of research on Audit Innovation: Improving Audit Quality Using Social Network Information and Innovative Technologies, examined the usefulness of third-party entities' information company brands and products extracted from social networks to enhance existing methods of revenue account analysis. He also proposed an executive framework for the process of robotic audit automation process. So that the evolution of audit as a product line can be considered. In the third study, he proposes an independent blockchain audit that takes advantage of the reliability of the client's transactions recorded on the blockchain platform and the intelligent audit processes that automatically perform audit operations by the auditor. The results of this research in two areas have led to knowledge gains. First, change audit operations by technological innovations, including social network information, robotic process automation, blockchain, and smart contracts, and provide a solution for the practical use of these innovative tools in audit operations. Second, his research is among the first studies to evaluate the impact of progressive (rather than traditional) audit evidence and emerging technologies on audit quality.

Dai (2017), in a dissertation that included three research projects on audit technologies, including audit 4.0, Blockchain, and audit apps, examines the impact of these areas of technology on auditing. Accordingly, three relevant studies in this field include:

Predict the impact of the Fourth Industrial Revolution on the auditing profession. In this regard, the use of new technologies stemming from the Fourth Industrial Revolution in the auditing profession has been conceived. The challenges involved in moving auditors to the next generation of auditing as "audit 4.0" have been addressed. In the second study, she discussed how blockchain technology contributes to the accounting and auditing profession. The third study also discusses how applications are used in auditing and their use in current audit processes. The research results are classified into three categories: The first category is the result of the inclusion of the first research on the introduction of many emerging technologies such as audit 4.0, Blockchain, and audit apps to exploit them in the accounting and auditing profession. Discussion and explanation will enhance auditors, legislators, and technology developers' insights to incorporate relevant technologies into current auditing processes. It also promotes the transfer of the current audit model to its next generation. Third, these three studies provided insights into the challenges of applying and using relevant technologies, and subsequently, providing solutions capable of eliminating challenges.Thus, the first two questions (RQs) are:

RQ1: Which auditors most use technological innovations?

RQ2: Which technological innovations are most important to auditors?

Lowe, Bierskater, Janvrin, and Jenkins (2018) concluded that IT has significantly changed the audit environment over the last several years, few studies have examined and documented audit IT use longitudinally. They also mentioned IT's influence on how audits are performed and the potential for significant audit quality, effectiveness, and efficiency. Additionally, their research explains analytical procedures, risk assessment, sampling, internal control evaluation, internal control documentation, professional standards research software, and electronic work papers were among the most extensively used by independent auditors. In contrast, the use of applications such as continuous

transaction monitoring and database modeling was relatively low. Moreover, they found that auditors from Big 4 firms were significantly more likely to use IT than non-Big 4 auditors for relatively few audit applications (e.g., internal control evaluation and dashboards), suggesting that the dominance of the Big 4 firms in their use of IT has dwindled over the last ten years, consistent with the early majority phase of diffusion innovation theory. However, in terms of work paper review, the most common communication mode is still face-to-face (although this has decreased over the last decade), followed by email, collaboration (group) technology, telephone, and the rare use of video conferencing. The Big 4 firms continue to favor email (consistent with the 2004 data), and national firms have gravitated toward the use of email and the telephone more overtime. Regional firms have somewhat similar rankings of communication used as national firms. However, they are less likely to use each of the communication modes available, and local firms primarily use face-to-face communication. The most common group brainstorming mode was similar to that of the communication mode for work paper review, emphasizing face-to-face communication, a similar rank order of modes, and very little emphasis on video conferencing. Consequently, other research questions (RQs) are:

RQ3: Is the use of innovative technologies in audit firms ranked as "A" or "B" different?

RQ4: Is the importance of innovative technologies in audit firms ranked as "A" or "B" different?

3. Research Purposes

This research is expected to achieve a set of goals. Firstly, discovering the relationship between the use and importance of innovative technologies and the ranking of audit firms in the Iranian Association of Certified Public Accountants. It also identifies technological tools that are used most and classified as important by Iranian auditors and offers suggestions to enhance audit operations. This research could also play an effective role in future research projects.

4. Research Methodology

4.1. Participants

In this study, the scientific research design method was used. This research approach aims to produce scientific products (Hevner, March, Park, & Ram, 2004). to provide comprehensive guidance for discussing the proposed audit methods (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). To collect data from respondents First, the Iranian Association of Chartered Certified Accountants' audit firm membership is classified into four main groups. The results demonstrated that, based on audit firms' quality control ranking conducted in 2017, they were categorized into four main groups: A, B, C, and D (Iranian Association of Chartered Public Accountants[IACPA], 2018). Quality control has been implemented in all listed firms, and they are classified based on the ratings.

Score A: 801 to 1000
Score B: 651 to 800
Score C: 501 to 650
Score D: 0 to 500

Based on the latest results of audit quality control in member firms for the year 2017, 92 audit firms are in the "A" rank, 138 in the "B" rank, 27 in the "C" rank, and 8 in the "D" rank. Subsequently, as the rated firms' A and B (230 members) cover most of the target population, the survey has been purposefully conducted for A and B audit firm members of the Iranian Association of Chartered Public Accountants.

5. Methods of Data Collection

In this study, two complementary data collection methods will be used: study past research projects and questionnaire. Response options are categorized into 7 categories for respondents' familiarity with the technology, the extent of use, and the importance of the technology concerned. Accordingly, respondents choose the appropriate technology to use in their audit operations out of 7 options, the least of which 1 means no use and the number 7 means extensive use. To determine the level of importance of the relevant technologies to auditors, the number 1 means unimportant, and the number 7 means very important.

Participants included 196 auditors from audit firms ranked "A" and "B" among audit firm members of the Iranian Association of Chartered Public Accountants (see Table 1).

Table 1. Participant Demographics*

	Frequencies		**Mean or Percent (Std. Dev.)**
Years as an External Auditor			15.5
			(5.6)
Age			42.4
			(8.8)
Highest Education Level			
Bachelor Degree	101		51.5%
Master Degree	89		45.4%
Course Beyond Mater Degree	6		3.1%
Certification			
Certified Public Accountant (IACPA)	136		
Chartered Certified Accountant (ACCA)	10		
Official Court Expert	11		
Chartered Management Accountant	10		
Official Tax Consultant	7		
Other Certification	4		
Gender	M=151 F=45		
Firm Quality Level			
A	92		
B	104		
IT Expertise			
Novice	59		30.1%
Intermediate	133		67.9%
Expert	4		2%

*Data was collected in 2019.

**Out of the total number of auditing firms, no response was received from 5 Rank A and 7 Rank B firms. In this case, the total number of firms that have obtained data from their auditors has been reduced to 184. Also, out of 223 questionnaires, 196 questionnaires were completed by the respondents.

Respondents averaged 15.5 years of external audit experience; their average age was 42.4 years. Fifty-Three percent of respondents were employed by Quality B ranked firms, and Forty-Seven were employed by quality A ranked firms. The highest educational level (51.5% percent) was a bachelor's degree and after that master's degree (45.4%). Most Respondents (69.4 percent) held CPA certificates. The majority of the respondents (77

percent) were male. Participants varied in IT expertise, with 67.9 percent indicating intermediate IT expertise, 30.1 percent stating they were IT novices, and 2 percent indicating that they were IT experts.

6. Results

6.1. Use and Importance of Audit 4.0

MEANs analysis is used to demonstrate the extent use and importance level of innovative technologies by audit firms (i.e., RQ1 and RQ2). As noted earlier, we propose that audit emerging technologies encompasses Audit 4.0, Blockchain, Data Analytics, Audit Apps, Technology Productivity Tools, and Social Media. Descriptive statistics, shown in Table 2, indicate that audit 4.0 use and perceived importance vary significantly. Most Technologies categorized as Audit 4.0 innovative technologies in this area have not been used by auditors who work in A and B ranked firms. For example, respondents rated the extent of use as being None (means zero percent usage) for four technologies (Robotic Automation Process (RPA), Artificial Intelligence (AI), Cyber-Physical System (CPS), Internet of Things and Services (IOT/S). While assigning low extent of use ratings to other technologies, such as Drones, Censors, Global Positioning System (GPS), and Radio-Frequency Identification (RFID). However, participants assigned the highest importance ratings to Censors, Global Positioning System (GPS), Drones, Radio-Frequency Identification (RFID), Internet of Things and Services (IOT/S), Artificial Intelligence (AI), Robotic Automation Process (RPA), Cyber-Physical System (CPS). Interestingly, Auditors have argued that the use of audit 4.0 technologies in Iran has been very limited. However, given their comments, the use of these technologies in audit operations is so important.

Table 2. Descriptive statistics of the research

Audit 4.0	The extent of use* Mean (Std. Dev.)	Level of Importance** Mean (Std. Dev.)
Robotic Automation Process (RPA)	1	5.3 (1.2)
Artificial Intelligence (AI)	1	5.4 (1.4)
Drones	1.07 (0.29)	5.7 (1.4)
Censors	1.13 (0.41)	6 (1.3)
Cyber-Physical System (CPS)	1	3.7 (1.3)
Global Positioning System (GPS)	1.26 (0.63)	4 (1.4)
Internet of Things and Services (IOT/S)	1	5.4 (1.4)
Radio-Frequency Identification (RFID)	1.46 (0.79)	5.5 (1.5)

6.2. Use and Importance of Blockchain

No one responded positively to the Use of Blockchain as a tool in auditing. So, descriptive statistics for Consortium and Public Blockchain in addition to Smart contract use equal to zero. Based on the auditor's answers, these technologies' perceived importance in auditing is relatively moderate and high, as shown in Table 3. Consortium Blockchain had the highest importance means while respondents assigned a lower extent of Importance ratings to Smart contract.

Table 3. Use and Importance of Blockchain

Blockchain	The extent of use* Mean (Std. Dev.)	Level of Importance** Mean (Std. Dev.)
Consortium Blockchain	1	6.5 (1.1)
Public Blockchain	1	5.8 (1.6)
Smart Contract	1	4.9 (1.9)

6.3. Use and Importance of data analytics tools

As shown in Table 4, auditors did not use two data analytics tools on auditing operations (SAS and Knime). Additionally, other analytics tools' usage was also fairly low (R Programming, Tableau Public, Python, Apache Spark, QlikView, and Splunk). However, the only data analytics which had the highest percentage of use among auditors was Excel (5.2 percent). The result obtained can be explained by the fact that independent auditors only use Excel to conduct audit tasks.

Table 4. Use and importance of data analytics tools

data analytics tools	The extent of use* Mean (Std. Dev.)	Level of Importance** Mean (Std. Dev.)
R Programming	1.12 (0.4)	6.1 (1)
Tableau Public	1.02 (0.14)	5.5 (1.6)
Python	1.11 (0.37)	5.6 (1.7)
SAS	1	4.6 (1.7)
Apache Spark	1.04 (0.19)	4.1 (1.8)
Excel	5.2 (1.8)	5.4 (1.6)
Knime	1	4.6 (1.9)
QlikView	1.14 (0.4)	4.4 (1.7)
Splunk	1.08 (0.3)	4.7 (2)

6.4. Use and Importance of productivity tools

Descriptive statistics for productivity tool use and perceived importance also vary significantly. As shown in Table 5, cell phones, email, remote network access, wireless networks, and instant messaging had the greatest extent of use means, while respondents assigned lower extent of use ratings to extensible business reporting language and personal digital assistants.

Table 5. Use and importance of productivity tools

Productivity Tools	The extent of use* Mean (Std. Dev.)	Level of Importance** Mean (Std. Dev.)
Email	5.7 (1.7)	6.1 (1.5)
Cell Phones	6.2 (1.3)	6 (1.7)
Remote Network Access	4.9 (1.3)	4.1 (1.2)
Personal Digital Assistants (PDAs)	4.2 (1.3)	4.1 (1.8)
Wireless Networks	4.6 (1.6)	3.9 (1.6)
Instant Messaging	4.6 (1.5)	5.1 (1.9)
Extensible Business Reporting Language (XBRL)	1.09 (0.3)	4.1 (1.3)

It is noteworthy that auditors use the XBRL much less frequently than other tools. Similarly, respondents assigned higher importance ratings to email, cell phones, and instant messaging. Meanwhile, remote network access, Personal Digital Assistants, and

XBRL have the same importance ratings. Whereas, based on the ratings, wireless networks had the lowest level of importance. Productivity tools are a group of technologies adapted from Janverin, Bierstaker, and Lowe's (2008) research paper. These items have been used by auditors more than other innovative groups of technologies by Iran Independent auditors. Hence, they are considered to be older in comparison with other groups. This may have led to the relatively high use of auditors in Iran by such technologies

6.5. Use and Importance of Social Media

Auditors stated that they use social media in auditing. They use LinkedIn and Facebook more than Instagram and Twitter. While they believe that these tools have a higher level of importance in comparison to their usage. The result Illustrates that Facebook, Instagram, and LinkedIn are extensively important in auditing. However, they might find social media to be either a communication or advertisement tool.

Table 6. Use and Importance of Social Media

Social Media	The extent of Use Mean (Std. Dev.)	Level of Importance** Mean (Std. Dev.)
Twitter	3.4 (1.2)	4.8 (1.7)
Facebook	4.3 (1.3)	5.9 (1.5)
Instagram	3.5 (1.3)	5.7 (1.4)
LinkedIn	5.2 (1.6)	5.7 (1.5)

6.6. Association of audit firm quality rating with emerging technologies use and perceived importance

The remaining research questions examine whether innovative technologies use and perceived importance varies by audit firm quality rating.

Based on audit firms' rating, whether it is "A" or "B," the use and importance of technologies are evaluated. Additionally, the ANCOVA test is used to determine whether the importance and use of innovative technologies vary among audit firms with different quality ranking (i.e., RQ3 and RQ4).

As is shown in Table 7, generally, innovative technologies have a higher level of importance and use among "A" audit firms. However, several technologies have not been used by Iranian auditors (Robotic Process Automation (RPA), Artificial Intelligence (AI), Cyber-Physical System (CPA), Internet of Things or Services (IoT/S), Consortium and Public Blockchain, Smart Contract, SAS, Knime). Furthermore, employees of level "A" audit firms use Drones, Censors, Global Positioning System (GPS), Radio Frequency Identification (RFID), R Programming, Tableau Public, Apache Spark, Excel, QlikView, Splunk, Email, Cell Phone, Remote Network Access, Personal Digital Assistants (PDAs), Wireless Networks, Instant Messaging, XBRL, Twitter, Facebook, Instagram, and LinkedIn significantly More than employees of "B" audit firms. Subsequently, except technologies like Drones, Python, Knime, Splunk, Email, Cell Phones, Remote Network Access, PDAs, Facebook, and Instagram, all other technologies are more important in "A" rank audit firms than "B" ranking.

ANCOVA test for the use of innovative technologies by "A" and "B" audit firms demonstrates that some technologies use to have a negative relationship with audit firm rankings (Drones, Global Positioning System (GPS), Radio-Frequency Identification (RFID), R Programming, Python, Apache Spark, Excel, QlikView, Email, Cell Phones, Remote Network Access, Personal Digital Assistants (PDAs), Facebook, Instagram, and LinkedIn).

Some technologies have a negative importance correlation with firm rankings (Robotic

Process Automation (RPA), Artificial Intelligence (AI), Cyber-Physical System (CPS), Global Positioning System (GPS), Public Blockchain, Smart Contract, Python, SAS, Excel, Knime, Email, Remote Network Access, Personal Digital Assistants (PDAs), Wireless Networks, Instant Messaging, Extensible Business Reporting Language (XBRL), Twitter, Facebook, Instagram, and LinkedIn).

Meanwhile, ANCOVA and T-Test Identified the p-value among different audit firms based on both use and importance level of innovative technologies. Based on the ANCOVA results for the use of Technologies, Drones, R Programming, Tableau Public, Apache Spark, Splunk, Wireless Networks, Facebook, and LinkedIn, p-values are equal to or less than 0.01. Additionally, ANCOVA test for the level of importance of Drones, IoT\S identified $p \leq 0.01$. Subsequently, T-Test results for the use of Technologies demonstrate that Radio Frequency Identification (RFID), Email, Personal Digital Assistants (PDAs) and LinkedIn p-value were equal or less than 0.01 and Drones, Censors, Global Positioning System (GPS), R Programming, Python, QlikView and Instagram $p \leq 0.05$. Retrospectively, the level of importance t-test≤ 0.01 for Censors, Cyber-Physical System (CPS), SAS, Apache Spark, Excel, Wireless Networks, and Twitter.

Table 7. The Association of firm quality level with innovative technologies uses and perceived importance Means, ANCOVA and T-Test Results

	Extent of Use				Importance			
	A-Rank *	B Rank *	ANCOVA ***	T-Test ****	A-Rank **	B Rank **	ANCOVA ***	T-Test ****
Audit 4.0								
Robotic Process Automation (RPA)	1	1			5.43	5.29		
Artificial Intelligence (AI)	1	1			6.12	5.34		
Drones	1.12	1.03	⊗	⊗⊗	6.02	6.05	⊗	⊗
Censors	1.21	1.07	⊗⊗	⊗⊗	5.36	5.3		
Cyber-Physical System (CPS)	1	1			5.5	5.3		⊗
Global Positioning System (GPS)	1.36	1.16	⊗⊗	⊗⊗	4.03	3.37		
Internet of Things and Services (IoT/S)	1	1			6.19	5.9	⊗	
Radio-Frequency Identification (RFID)	1.62	1.32		⊗	5.6	5.33		
Blockchain								
Consortium Blockchain	1	1			6.54	6.42		
Public Blockchain	1	1			6.02	5.61		
Smart Contract	1	1			5.23	4.71		

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Table 7. (continued)

	Extent of Use				Importance			
	A-Rank *	B Rank *	ANCOVA ***	T-Test ****	A-Rank **	B Rank **	ANCOVA ***	T-Test ****
data analytics tools								
R Programming	1.19	1.06	⊗	⊗⊗	6.15	6.13		
Tableau Public	1.03	1.01	⊗		5.81	5.28		⊗⊗
Python	1.17	1.05	⊗⊗	⊗⊗	5.43	5.72		
SAS	1	1			5.04	4.3		⊗
Apache Spark	1.03	1.04	⊗		5.04	3.35		⊗
Excel	5.42	5.07			5.8	5.03		⊗
Knime	1	1			4.36	4.83		
QlikView	1.22	1.08	⊗⊗	⊗⊗	4.44	4.31		
Splunk	1.1	1.06	⊗		4.63	4.68		
productivity tools								
Email	6.13	5.36		⊗	5.98	6.15		
Cell Phones	6.17	6.27	⊗⊗		5.87	6.14		
Remote Network Access (RNA)	4.83	4.93			4.04	4.15		
Personal Digital Assistants (PDAs)	4.56	3.81		⊗	4.04	4.13		
Wireless Networks	3.49	3.28	⊗		5.3	4.37		⊗
Instant Messaging	4.79	4.5			5.28	5.02		
Extensible Business Reporting Language (XBRL)	1.14	1.04	⊗⊗		4.13	4		

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Table 7. (continued)

	The extent of use*				Importance**			
	A-Rank	**B Rank**	**ANCOVA *****	**T-Test ******	**A-Rank**	**B Rank**	***ANCOVA ****	**T-Test ******
Social Media								
Twitter	3.49	3.28	⊗		5.3	4.37		⊗
Facebook	4.54	4.15			5.75	5.95	⊗⊗	
Instagram	3.7	3.27		⊗⊗	5.7	5.79		
LinkedIn	4.87	5.48	⊗	⊗	5.7	5.63		

*Participants rated "the extent of use for each technology" using a seven-point scale where 1 _ none and 7 _ extensive.
**Participants rated "the importance of each technology" using a seven-point scale where 1 _ not important and 7_ very important.
***ANCOVA results for use and importance of rating differ based on the "A," and "B" quality ranking of audit firms where ⊗ indicates $p \leq 0.01$ and ⊗⊗ indicates $p \leq 0.05$ level.
**** T-Test results for use and importance of rating differ based on the "A" and "B" quality ranking of audit firms where ⊗ indicates $p \leq 0.01$ and ⊗⊗ indicates $p \leq 0.05$ level.

7.Conclusion, Implication, and Future Research

Innovative technologies have changed the environment of businesses during the past decades. There are few research projects to evaluate the existence and significance of these technologies by independent auditors. In this paper, the researcher tried to demonstrate the extent of Use and importance level of innovative technologies among Iranian auditors (Tables 2,3,4,5 and 6) and find any significant relationship between audit firms ranking and use or\and importance level of technologies in auditing (Table 7). In this respect, most technologies that have been categorized into groups of Audit 4.0, Blockchain, and Data Analytics are rarely used by Iranian auditors. Respectively, the level of use for other groups, including productivity tools and social media, is mostly less than or equal to 50 percent. In comparison, most of the technologies considered highly important by Respondents. On this basis, the key findings of this research can be categorized into the following criteria:

Auditors working at the Iranian Association of Certified Public Accountants audit firms commented on the Use and Importance of five groups of innovative technologies. According to the results, the overall use of some technologies including, Robotic Process Automation (RPA), Artificial Intelligence (AI), Cyber-Physical System (CPS), Internet of Things and Services (IoT/S), Public and Consortium Blockchain, Smart Contract, SAS, Knime was scratch (Tables 2,3 and 4). Surprisingly, auditors expressed their view on the Importance level of the same technologies as moderately Important. Respectively, the use of some items including Drones, Censors, Global Positioning System (GPS), Radio Frequency Identification (RFID), R Programming, Tableau Public, Python, Apache Spark, QlikView, Splunk, and Extensible Business Reporting Language (XBRL) was very low (Tables 2, 4 and 5). The Importance level of the related items was moderate. Thereupon, other groups, including Excel, Email, Cell Phones, Remote Network Access (RNA), Personal Digital Assistants (PDAs), Wireless Networks, Instant Messaging, Twitter, Facebook, Instagram, and LinkedIn are moderately used by auditors (Tables 4, 5 and 6). In comparison, the Importance level of most of them is considered to be moderate and high. There are several reasons for not using innovative technologies in auditing processes, but they are medium and high importance.

Since the 1970s, auditors have been able to use computing devices, software, and databases to examine electronic accounting data (Cash Jr, Bailey, & Whinston, 1977). These tools dramatically reduced auditors' effort on transaction tracking and calculation. Since then, an increasing number of technologies were used in the auditing profession to improve the efficiency and effectiveness of audit activities, and ultimately to enhance the overall assurance quality in the US (Dai J. , 2017). With the advent of 4 generations of audit tools, pencil and calculators are no longer exist. They have been replaced by audit applications, data analytics tools, Blockchain, etc., globally. But After the Iran revolution in 1979, most international accounting and auditing service providers quit the Iran market. As a consequence of audit leaders' absence, most traditional tools, including manual work papers and basic data analytical tools like Excel, are used by auditors in several auditing stages like planning, assessing risks, determining audit fees, and all other labor-intensive activities during past decades. However, these conditions have not diminished Iranian auditors' attention to the need to use technological tools.

Sequentially, because of the nature of Iran's economy and politics, Big 4 firms recognized as leaders in conducting, testing, and providing technological goods and services to consumers are not officially and legally allowed to operate in Iran. Subsequently, the development of technologies by many users is costly. Because Iran is isolated from international academic and professional communities, the possibility of training auditors to use these technologies is under restriction.

This research also suggests that due to businesses' failure to grow as much as

innovative technologies, partners and decision-makers may believe that there is no need for emerging technologies in auditing. However, this may not be the case, as auditors generally emphasized that the importance level of technologies was moderate and high (Tables 2,3,4,5 and 6). Meanwhile, the lack of research and development of such technologies by Iranian professional auditors and academics has made them unknown to decision-makers' strengths and weaknesses. Based on the auditor considerations, the Importance level of technologies is relatively moderate and high. This result has clarified the need for the existence of such tools in the audit environment. Most Iranian auditors are emphasized interest in innovative technologies. Hereon, this study's result should be considered before deciding the development and use of technologies in the audit environment. Subsequently, I found a positive correlation between audit firms' quality rankings and the use of emerging technologies in audit processes. The importance level of technologies has a positive correlation with quality audits ranking. Most employees of "A" ranked audit firms are used technologies in audit processes more than "B" audit firms. Most Auditors who work in "A" audit firms defined innovative technologies as more important than auditors of "B" ranked audit firms.

Another result about the correlation between use and importance of technologies by different ranked audit firms has proved that the higher the level of quality ranking, the more use and importance level is considered in practice by auditors.

This research has some limitations that need to be addressed. As noted earlier, this is one of the first research (at least among the Iranian auditors) to test a set of technological innovations in the audit field. Due to the limited resources and lack of clarity on all the features and capabilities of innovative technologies in their early stages, respondents' lack of knowledge and possible errors in answering questions were also other potential limitations of this research.

Future researches can focus on the detailed knowledge level of auditors about innovative technologies. Additionally, many potentials should be tested for defining the availability of the Iran market to accept technologies in different criteria. Future projects could also determine how audit firms with different rankings are confident to use innovative technologies in auditing. There are also opportunities for academics and practitioners to test and evaluate Iranian auditors' knowledge and compare the results with Big 4 employees' responses. Another area could focus on the quality factors for evaluating audit firms by the Iranian Association of Chartered Public Accountants (IACPA) and finding out how these attributes may affect audit firms to use technologies. This study's statistical population was limited to auditors working in member firms of the Iranian Association of Chartered Public Accountants (IACPA) that are private entities. At the same time, other audit agencies such as the Audit Organization of Iran and the Supreme Court of Iran can be considered the statistical population of future research. Future researchers also have opportunities to determine the extent to which the technologies currently used by auditors enhance audit quality.

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