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Mohammed Obeidat *

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Auditors' Perception Towards the Impact of Big-Data Technology on the Level the Audit Risk

Mohammed Obeidat

Jadara University, Jordan; m.ibrahim@jadara.edu.jo

Abstract

The study objects for determining how independent practicing auditors perceive the effect of employing big-data technology in performing the tasks od financial statements auditing, on the level of audit risk. A questionnaire is used as the key instrument for the collection of data from respondents. A sample of 190 practicing independent auditors in Jordan had been selected following the random sampling method. Employing the one sample t-test in hypotheses testing, the results demonstrated that the practicing independent auditors in Jordan perceive that employing big data in performing audit risk, leads to a reduction in the level of audit risk, and each of the five big-data techniques plays a role in the entire effect, based on the perceptions of independent auditors. The findings of the study can be applied by audit profession all over the word. More and more investigations for big-data and other artificial intelligence technologies and its implications in the overall accounting field is recommended.

Keywords: inherent risk; control risk; detection risk; clustering; classification; association rule; regression; social network analysis

1. Introduction

One among the hard dilemmas facing business environment is the undetected misstatement in financial statements by the audit of financial statements. Auditing the financial statements of business organizations adds value to the statements, but the audit profession provides reasonable assurance, that the financial statements of business organizations are free of misstatements and presents fairly the financial position, results of operations, and the change in cash flows of an entity during the accounting period. Undetected misstatement in financial statements leads to bad results for investors, creditors, and for the reporting firm itself. Since the last few years of the past century and along the first decade of the current century, many users of financial statements lost their wealth, because of the fail of audit profession to detect misstatement in financial statements.

Audit risk received enough attention by the legislation bodies all around the World. Audit risk occurs when the auditor conducts an adequate audit, and makes the different audit procedures, and concludes that the financial statements are fairly stated, when actually the financial statements are materially misstated (Arens, et al., 2014). In other words, the auditor and the audit teems are unable to detect a misstatement in financial statements, despite they followed the different procedures of audit and followed the correct phases of audit in an engagement. Therefore, the current study comes to help filling the expectation gap between the audit actual responsibilities and what users of financial information expects from auditors.

Big data is a technology that can be adopted by auditors in performing different tests and procedures with less time and efforts. A 100 percent test of transactions, events, and records, can be performed by employing the big data in audit procedures, and the auditor can avoid using samples, where 100 percent test leads to more reliability of the auditor opinion towards the financial statements of clients. The term, big-data, was used for the first time by Roger Mougalas in 2005, despite the applications in data processing since a long period before. Isaa and Subramanianb (2024) referred to big data as a new technology that can handle structured and unstructured, complex, and

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large data, where this data can't be operated using traditional processing techniques. Manykia, et al. (2011), referred that big data is " a large population of datasets gathered, which has a large size, beyond the ability of the software tools to capture, store, manage and analyze".

A strong attention nowadays is given to the audit profession since the starting of the current century, especially next to the series of scandals occurred to some of international firms such as Enron and WorldCom (Alrashidi, et al., 2021), (Aledwan, et al., 2017), and (Al-Beshtawi et al., 2014). In addition, the audit work became increasingly sophisticated since tow decades ago, where external independent auditors nowadays can provide more services to their clients including external reports, business analysis, and audit risk (Ulerich, et al., 2019). Moreover, audit firms are nowadays required to transfer from traditional audit to data-driven audit because of the challenges these firms encounter regarding information age, and the need for audit clients. The increasing cases of litigation and lawsuits against audit firms and auditors, and investors losses, are considered a strong motivation for more analysis and investigation of audit risk. Fraud is more difficult to be detected than errors, because fraud is intentional procedure, and the committing of these intentional fraud normally take enough action to conceal these actions. The authors believe that the employment of such developed technologies will lead to more detection of fraud, misstatement, and errors. The ability of Big data technology to process large volume of data and transactions, is considered beneficial to be adopted by auditors, and it may lead them to decrease the level of audit risk. Therefore, the problem of the study can be expressed through the following question. Does employing the big data technology by auditors in their engagements, leads to more accuracy in auditors' opinions, and reduces the level of audit risk?

The study is of great importance, where it clarifies whether using big-data is beneficial in performing audit procedure, and leads to more accurate and correct audit opinion, and thereafter less level of audit risk. In addition, the study is beneficial to auditors and to the entire audit profession. Using big data leads to higher detection level of misstatement in the financial statements and increases the accuracy of auditors' opinions.

The key objective of the study is to determine whether using the technology of big-data by the auditors in their engagements, will lead to higher detection of fraud, misstatement, and errors. Moreover, the study aims to clarify audit risk, big data, and focus on determining whether an impact of using big-data exist on the level of audit risk. The study adds to the available literature regarding big data and audit risk.

The remaining of the study is structured to be as follows. Section two presents the literature review of both audit risk and big data, in addition to the empirical prior related research. The hypotheses are developed based on the literature review and prior research and listed in section 3. The methodology followed by the authors while preparing the study, is shown in section 4. Section 5 shows the results and discussion, whereas section 6, lists the conclusions and finding.

2. Literature Review and Prior Research

Auditors cannot check all transactions that occurred in the auditee or client whatever their capabilities, and professionally. Therefore, audit risk is considered fundamental to the audit process. In most firms, especially large firms, there are thousands or millions of transactions related to some accounts occurring during a year. I addition, assuming that auditors have the abilities and time to check 100 Percent transactions, their fees will be too much high, then no or few clients will be ready to pay high amounts of money for the auditors. Checking less than 100 percent of transactions means that an audit risk should be available.

According to the IAASB, audit risk is defined as "The risk where an auditor expresses an inappropriate audit opinion when the financial statements are materially misstated". Audit risk is a function of material misstatement and detection risk". Audit risk is the collection of two components including, risk assessment and business risk. Risk assessment is the risk occurring during the collection and assessment of evidence, while business risk is the economic influence of audit. To minimize the level of audit risk, and to increase the level of fraud, misstatement, and errors detection,

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the auditor is required to plan and perform adequate audit procedures, audit tests, and analysis. Auditors are required to understand the environment and the internal control of the client in order to be able to identify the areas of high risk, and then, to give the areas of high risks enough attention and to focus on such areas. Audit risk is a complex concept within the overall audit process. Audit risk occurs when the external independent auditor issues an inappropriate audit opinion when there is a material misstatement in the financial statements. Therefore, audit risk is considered as a function of material misstatement and detection risk, occurring in three forms including, planned risk, Extracellular post, and estimated risk. Planned risk is the risk exists when concluding the contract, while extracellular risk, is the risk that still unknown up to the completion of the audit process. Estimated risk is normally known while the auditor performs the audit process (Nikolovski, et al. 2016).

According to Nikolovski, et al. (2016), audit risk is a unity of risk assessment and business risk, where risk assessment refers for risk that occurs during the collection and evaluation of audit evidence, whereas business risk refers for the economic impact of risk assessment. Because the overall risk is very difficult, or impossible, to be considered, it is necessary to perceive that the risk affecting the financial statements is categorized in three groups of risk, including inherent risk, control risk, and detection risk. Inherent risk is the probability of failure when no enough control exists, whereas control risk is the probability that errors occurring while the controls exist. Detection risk occurs independently of the control exercised by the auditor. It is necessary to understand that the auditor can assess the inherent risk and control risk, but can't affect these two types of risk, and only can control detection risk.

Inherent or systematic risk is associated with the nature of operations, nature of accounts, and to account balance. Inherent risk is uncontrollable, where is an auditor is required, within the planning phase of audit engagement, to examine the existence of this type of risk, keeping in mind that the factors affecting this type of risk, like the environment and accounts.

Control risk is related to the internal control of the client. When the client has a reliable internal control, the level of control risk declines, while in opposite, when the internal control is less reliable, the level of control risk increases. Therefore, the auditor is required to assess the internal control of the client in an early stage of the audit process. In case the auditor finds that the internal control of the client is less reliable, more audit procedures, tests, and evidence should be performed by the auditors.

Detection risk results normally from inadequate procedures and insufficient tests, that the auditor performs. Detection risk refers for the existence misstatement in the financial statements, that the auditor did not detect. A mutual dependent relationship exists between inherent risk and control risk. Therefore, the auditor should check inherent and control risk together, but detection risk is different, Where an inverse relationship exists between inherent and control risk, in one hand, and both the inherent and control risk, in the other hand.

The last few years ago witnessed the evolution of big data technology with high capacity to deal with a huge volume of data, that can be structured, semi structured anon structured. This technology can be used to improve the quality of decisions regarding business organizations. The applications of big data in business can be used in different aspects of business organizations, including accounting and auditing of financial statements. It can be used in marketing, encompassing customer survey, market research, promotion, and introduction of new products. Big data can be used to handle large volume of data received from the production activities. It can be used in financial data analysis, and in different phases of accounting cycle and analysis. Accounting and auditing domain is not exceptional regarding the benefits that can be achieved as a result of employing the big data technology, especially because big data originates from a wide range of traditional systems in addition to new systems such as emails, phone calls, internet, social media, et al. (Zhang, et al., 2015).

Big Data, was invented by Roger Mougalas in 2005, but its application is developed in an increasing rate during the following years of its invention. Now it is of a widespread adoption by many organizations. Big Data is defined as "the structured and unstructured data sets, which are

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complex and large in number, where cannot be operated using the traditional processing techniques (Isaa and Subramanianb, 2024). According to Joshi and Marthandan (2018), big data is "a structured, semi-structured, and non-structured large data, that cannot be operated with using traditional methods, but needs for recent new technologies to deal and analyze". Alles and Gray (2016), define big data as "a large volume of data involving a mix of traditional structured financial and nonfinancial data including logistic, electronic mail, phone calls, and social media data, which cannot be dealt with employing traditional tools of databases analysis". Others refer to big data as "datasets that surpass the capacity of database software tools to capture, collect, organize, and analyze" (Mckinsey, 2011). This definition refers for the superiority of big data on different databases, and the ability of big data to process a large volume of data in comparison with big data.

Some definitions of bag data focused on the dimensions and characteristics of big data. With regard to its characteristics, big data, is defined in terms of volume, velocity, variety, and veracity (Alles and Gray 2016). According to Kuurila (2016), there are three features (3Vs) of big data including, volume, variety, and velocity. Volume refers for the amount of data contained in a big data dataset, while velocity refers for the rate at which data arrives. Veracity refers for the reliability of the data and how the size and form of data impact the accuracy and quality. Other authors added more features of big-data, where the entire number of features reached to 10 features (10Vs) nowadays, including volume, variety, velocity. Veracity, value, validity, volatility, variability, visualization, and vulnerability (Saeed and Husamaldin, 2021).

Volume refers for the immense or large size of the data that is growing in a continuous manner for each industry, which enable better future predictions, while velocity refers for the fast analysis of data, which enables decisions making. Variety refers to a heterogeneous data sources both at the level of the schema (structured, unstructured and semi-structured) including text, sensor, audio, video, graph, and more. Veracity refers to the significant differences in data coverage, accuracy, and timeliness, whereas value is the individual or organizational capability of turning big data into real values, that involves the ability to collect data and then using the collected data in achieving specific goals. Validity and volatility are two additional features added by Khan, et al. (2021). Validity seems similar to veracity, but it is different. A data may be characterized with its veracity, but it is not valid. Validity means that the data is correct and accurate for the intended purpose. Volatility is the dramatic and unexpected change in data.

Ranjan (2019) added three additional features to the above mentioned 7 above features, and stated that the features of big data are 10Vs, including Volume, Velocity, Variety, Veracity, Value, Validity, Volatility, Variability, Visualization, and Vulnerability. The three featured added by Ranjan (2019) are; variability, visualization, and Vulnerability. Variability seems resembling variety but it is used along time in the calculations of incoming data accuracy. Variability means within the context of big-data analytics, to the inconsistency of results because of the multitude of data dimensions resulting from the multiple sources of data. Visualization refers for the demographic presentation of data to be easily and quickly understandable, where it can be understood from the first glance. Vulnerability means the security measures that need to be used in data processing.

According to Connolly (2012), there are seven drivers of big data, as follows.

1. The opportunity to enable new models of business.
2. Possibility of new insights driving the competitive advantage.
3. The collected and stored data continuously growing exponentially.
4. Data increasing at different directions and forms.
5. The fail of traditional solutions under the new requirements.
6. The continuous growth of data system costs, as a percentage of IT.
7. The cost advantages of commodity hardware and open software sources.

According to Isa. et al. (2024), there are five techniques of big-data technology. The first technique of big data is clustering, which is in fact, a collection of unstructured learning techniques that used to identify and group related data into subgroups. The second technique is called classification, where this technique is a collection of well-established methods with the most

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fundamental big data analysis technique, categorizing data objects to pre-defined groups. The third technique is called the association rule. Association rule technique is an approach used that attempts to determine some patterns that occurring in a regular manner in the data set. Regression is the fourth technique of big data, where it can reduce the dimension, extract information, predicts and explores the relationships among variables to be beneficial for forecasting and for the decision making process. The last technique is the social network analysis, which is an approach that investigates both of connections and contents in a vast information stack for the purpose of building a social network (Isa, et al. (2024).

Big data is a new technology, that different industries adopt the technology or consider the adoption of the technology. Employing big data in an industry for the purpose of information analysis, or for control, needs enough attention, because big data is recently evolved, but its usage is increasing. Prior research investigated the impact of big data on the auditing in general, but the role of using this technology in reducing the audit risk is rare or unavailable. Audit risk, is the most important issue in the audit profession, since audit risk refers for the issuance of audit opinion that the financial statements are correct and fairly present, when the statements involve fraud and material misstatement.

The adoption of big data is considered beneficial for different organization, whether these organizations are profit or non-profit organizations. The application of data analytics tools to big data is expected to replace the traditional tools used in accounting and auditing performance of tasks (Richins, et al., 2017). For instance, creating full-on access to clients' accounts receivable reduces the bias that may be involved in sampling. Big data can be employed in the analysis of relationships among the items of financial statement, and in the computations of different ratios, where this increases the evidence accumulation by auditors, and therefore more correct audit opinion in the financial statements. Sampling procedures can be avoided when auditors are allowed and authorized using the big data, and have the abilities to use the technology, so the tests will be 100 percent when big dta is adopted in auditing. In addition, the management of firms can improve the decision making process, and take more beneficial decisions, since these decisions are based on more information, and more accurate information.

Nobody can deny that employing the big-data technology by firms is beneficial for the audit profession. Auditors were using traditional methods and procedures in their engagements. The evolution of big data, and the adoption of this technology by auditors, the different audit procedures can be replaced by big data. The existence of big data enables editors to replace the performance of traditional audit tasks by automated processes, and evaluate the account receivables by dividing accounts receivable into different variables. Employing big data in audit engagements allows auditors to compare variables and identify the patterns, that were undetectable using the traditional method, and common bottlenecks, and auditors can modify their approaches and methods using big-data technology. A material misstatement, fraud, errors, or unfair presentation of financial statement, are easier to be detected when auditors use the big data technology. Examination of operational business risk ca be made using the big data technology. More evidence can be accumulated with lower cost and less time and efforts, when auditors are allowed to use big-data.

Hima, (2024), made an extensive review of research concentrating on big data applications in audit quality. The study is structured on three primary types of effects of applying big data in accounting, auditing, and audit quality. The study reveals findings regarding audit quality and financial statements. The study mentions that the lack of empirical research and empirical evidence of big data, in addition to recent technological development, created an opportunity for future research regarding that focuses on audit quality and auditing.

Nguyen, et al. (2023), carried out an analysis for big data and its applications in audit firms. The primary objective of the study was to examine the factors associated with the adoption and application of big data analysis by audit firms in Vietnam. The study is based on thorough analysis of secondary data, and interviews for data collection. In details, the authors interviewed 37 auditors of long experience practicing auditors. The results showed that several factors affecting the adoption

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of bid data by audit industry, including the size of the client, adopted global strategies by audit firms, and the competitive landscape of the Vietnamese audit market. In addition, the study revealed the difficulties and challenges of adopting big data by Vietnamese audit firms.

Eulerich, et al. (2023), carried out an empirical study to determine the effect of audit technology on audit task outcomes. The authors stated that academics and practitioners raised more concern with the costs and benefits of using audit technologies by auditors in their engagements. They examined how internal auditors use the technology based audit techniques, and how the audit technology based techniques affect their audits efficiency and effectiveness. Two surveys in addition to interviews with auditors and chief audit executives, are made in the study, where the first survey to examine their perceptions regarding the technology based audit techniques. The results showed that auditors perceive that the technology based audit techniques are beneficial, especially because using these technologies leads to higher number of audits performed, and decrease of audit days. In addition, the results revealed that chief audit executives perceive that technologies based audit techniques are costly, and the increase in the use of these technologies is associated with the increase in the size of audit internal function. The interviews that made the chief audit executives revealed that those chief audit executives suggest the technology based audit techniques are not widely used because of the difficulties in quantifying its benefits, and observing these benefits in a timely manner, in addition to the need of hiring auditors having the skills to use this technology. The study recommended future research to help regulators, practitioners, and researchers regarding these technologies and how it impacts the audit profession.

Alrashidi, et al. (2021), carried out a study objecting for determining whether big data analytics affect the procedure that the external auditors take in an engagement. To achieve the objective of the study, the authors used a questionnaire as the major instrument for the collection of the needed primary data. Using the stratified sampling technique, a sample consisting of 361 in work auditors, had been used from several Middle East countries including, Kuwait, Saudi Arabia, United Arab Emirates, Jordan, Bahrain, Lebanon, Egypt, and Iraq. Employing the bootstrapping statistics in Smart PLS (3.3.3), the results demonstrated that big data analytics affect audit procedures in the entire phases of audit process, staring from client acceptance face and through, choice od audit procedures, estimating a client risk, and assessing the client internal control. The study recommended that external independent auditors are required to develop their abilities in using big data analytics, since these analytics add value to both auditors, and to their clients.

Nakhal (2020), investigated the impact of big data on the entire components of audit risk including, control risk, detection risk, and inherent risk. The author of the study used a questionnaire as the instruments of data collection, where a sample of 110 respondents from three groups including faculty members, auditors, and graduate students, is selected. Employing the one sample t-test, the results showed that using big data technology has a significant impact on each of control risk, detection risk, and inherent risk.

Alles and Gray (2016), carried out a study regarding incorporating big data in audit practices. One objective of the study, was to provide a discussion of inhibitors of incorporating big data into financial statements, and to present a research to identify approaches to ameliorate inhibitors. They also mentioned that In this study, the authors referred to the huge amounts of money that is invested in big data from 2013 and through 2016, and that the 4 big data firms of USA were aiming to be at the forefront of big data implementations. The authors also question whether there is a place for big data in auditing, still its application in other fields such as marketing and medical research.

3. Hypotheses Development

Based on the consideration of the literature of big-data and audit risk, and based on the related prior research, five hypotheses had been developed based on the three features of big-data technologies. The consideration of the literature regarding the big-data technology revealed that there are five techniques or dimensions of big-data including, clustering, classification, association rule,

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regression, and social network analysis. The developed hypotheses are listed below, in null form, as follows.

Ho1. Practicing auditors in Jordan do not perceive that the involved clustering technique in big-data technology, has a significant impact at ($\alpha \leq 0.05$), on audit risk.

Ho2. Practicing auditors in Jordan do not perceive that the involved classification technique with big-data technology, has no impact at ($\alpha \leq 0.05$) on audit risk.

Ho3. Practicing auditors in Jordan do not perceive that the involved association rule technique in big-data technology, affects at ($\alpha \leq 0.05$), the audit risk

Ho4. Practicing auditors in Jordan do not perceive that the involved regression technique with big-data technology, affects ($\alpha \leq 0.05$), the audit risk.

Ho5. Practicing auditors in Jordan do not perceive that the involved social network analysis technique with big-data technology, affects at ($\alpha \leq 0.05$), the audit risk.

4. Research Methods

The population of the study includes the different practicing external independent auditors. A sample consists of 120 auditors is selected using the random sampling method, among the entire number of auditors working in Jordan, while 7 did not respond despite three times reminding had been issued to them. In addition, 4 responses had been excluded because of shortages of responses to all items, or no enough consideration had been given by the respondents of these 4 responses. Therefore, 109 responses where used in the analysis and hypotheses testing.

In addition to the secondary data that available in text-books, magazines, periodicals, journals, internet, et al., primary data is collected, classified, and used in data analysis and hypotheses testing. Primary data is collected through a questionnaire that developed and used for data collection. When the development of the questionnaire is completed, it had been submitted for 5 academics and five senior auditors for the purpose of review. The different comments of the questionnaire reviewers had been taken in consideration and reflected in the final version of the questionnaire. Moreover, to avoid any mistake, shortage, or vagueness in the items of the questionnaire, a pilot study had adopted before the final submission for 10 practicing auditors.

The questionnaire is designed based of 5-Likert scale including, strongly agree, agree, neither agree or disagree, disagree, strongly disagree. The questionnaire had initiated and submitted in Arabic language to practicing auditors in Jordan, because their mother language is Arabic, and most of them have difficulties in understanding English. Later, the questionnaire items had translated from Arabic to English to be consistent with the research language. In addition to the letter directed to the practicing auditors in Jordan, by the starting of the questionnaire, 44 items are included in the questionnaire, where several different items are used to measure each variable. In more details, section 1, is used to collect the data necessary for measuring the clustering technique, where 5 items used for this purpose. Section 2, had been used to collect the primary data regarding the classification technique of big-data technology, where 6 items is used for this issue. With regard to the association rule technique, 4 items had used to collect the appropriate data from respondents. Section 4 of the questionnaire, is dedicated for the regression technique of big-data technology, where 4 items had used for this purpose. The last technique of big data is social network analysis, and section 5 in the questionnaire is used for this issue, where this section consisted of 5 items. The audit risk, as the dependent variable is used through the items included in section 6 of the questionnaire, where this section consists of 9 items.

Several descriptive statistics are used in the study to describe the sample, including the mean, as the most common measure of central tendency, and the standard deviation as an appropriate measure of variation. In addition to the mean and the standard deviation, the least and the maximum value of each item in the questionnaire were also computed and presented. The one sample-t test method had been used in hypotheses testing, where all hypotheses are tested based on 5 percent predetermined coefficient of significance. Therefore, a null hypothesis is accepted when the

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computed coefficient of significance is more than 5 percent, and rejected when the computed coefficient of significance equals or less than 5 percent.

5. Results and Analysis

5.1. Sample Description

The study is based on primary data of a sample consisted of 109 working auditors in Jordan. The instrument of the study had been designed to collect data regarding 5 demographic variables including, gender, year-experience, age, area, and qualification of the working external independent auditors in Jordan. Staring with gender, Jordan is a developing Islamic Arab country, where in general, still the number of male employees is greater than the number of female employees, especially in professions that require employees to move from one site to site, and outside office work. Nevertheless, Table 1, shows that among the sample size consisting of 109 auditors, 82 were female, while 27 are female auditors. This means that 75.2 percent of the sample elements were male auditors, while 24.8 percent are female auditors. Actually, this means that females started practicing field jobs, where a part of the job is done outside the office, but from the location of clients.

Considering the year-experience of respondents, Table 1, reveals the number of respondents in each class, where the biggest class of experience among the respondents is that class of 10 years and less than 15, where it composes 36.7 percent, while the least year experience class includes those having 25 years or more, where 6 respondents have 25 year-experience, and this class composes only 5.5 percent. This means that the profession of auditing in Jordan keeps some of long year experience, and attracts new of low year-experience auditors.

Table 1, also shows that practicing auditors in Jordan vary according to their age, where some of them are young but others are somewhat old. The highest age class is the class of 40 years and less than 50, where 53 respondents are attributed to this class, while those having 60 year-age, are attributed to 60-years or more. this class.

The area that auditors practice their audit profession within Jordan is among the demographic variables of respondents that the study takes into consideration. It is apparent that most auditors exercise their audit tasks within Amman (capital) Governorate, where slightly above the half of the sample, exercise their jobs within the capital of Jordan, while the least number of auditor exercise. T table shows that 56 out of 109 auditors, exercise their audit profession in Amman, but only 6 auditors exercise their audit tasks out of Amman, Irbid, Zarqa, and Aquaa. The majority of the sample elements are working in Amman, because most of auditing firms are in Amman, where firms' headquarters are available in the capita.

Most of sample elements have the bachelor degree, where 77.1 of the sample element work in the audit profession based on the bachelor, and few have a degree of less than bachelor. These numbers and percentages of qualification refer that this profession attracts well educated and qualified employees and prepare them to exercise the audit profession.

Table 1. Sample Description.

Variable	Class	Number	Percent
Age	Male	82	75.2
	Female	27	24.8
Year-Experience	Less than 5 years	8	7.3
	5 years and less than 10	27	24.8
	10 years and less than 15	40	36.7
	15 years and less than 25	28	25.7
	More than 25 years	6	5.5
Age	Less than 30 years	4	3.7

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	30 years and less than 40	16	14.7
	40 years and less than 50	53	48.6
	50 years and less than 60	26	23.9
	60 years or more	10	9.2
Area	Amman	56	51.4
	Irbid	22	20.8
	Zarqa	17	15.6
	Aqaba	8	7.3
	Other	6	5.5
Qualification	Less than Bachelor	8	7.3
	Bachelor	84	77.1
	Master	13	11.9
	PhD	4	3.7

5.2. Data Reliability

To ensure that the data of the study is reliable, and the authors can depend on, Cronbach Alfa test had used in testing the data reliability, for the individual sections of the questionnaire, and for the entire items of the questionnaire. Table 2, shows the results of employing Cronbach Alfa test. As appearing in the table, Cronbach Alfa is high enough for each individual section, and for the entire items included in the questionnaire as a whole. All Cronbach Alfas are above 0.90, where the highest is attributed to the entire questionnaire, and reaches 97.4, whereas the least Cronbach Alfa is due to the regression technique section, that equals 0.925.

Table 2. Cronbach Alfa Tests.

Section No.	**Variable**	**No. of Items**	**Cronbach Alfa**
Section 1	Clustering	12	0.954
Section 2	Classification	11	0.942
Section 3	Association Rule	12	0.951
Section 4	Regression	08	0.925
Section 5	Social Network Analysis	08	0.930
Total Items	The Entire Questionnaire	51	0.974

5.3. Descriptive Statistics

Several descriptive statistics are used in data analysis including. The mean is used as the best indicator for the central tendency, whereas the standard deviation as the most common used indicator for data variation. Moreover, the minimum and the maximum value of responses for each item, in addition to frequencies are found to enrich the analysis of the primary data that had been collected from respondents. Table 3 shows the descriptive statistics of clustering feature of big data.

The instrument of the study includes 12 items used in the collection of data required to measure whether a relationship exists between the clustering technique of big-data technology and the level of audit risk. Table 3 shows the 12 items used in the collection of data required for the clustering technique of big-data.

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Table 3. The Means and the Standard Deviations of the Items used in Testing Auditors' Perception of the Effect of the clustering Technique on the Level of Audit Risk.

Ser. No.	Item Text	Mean	Standard Deviation
1.	Employing Big data that can collets and identify unstructured data into subgroups helps auditors of financial statements in fraud detection.	3.6422	1.34387
2.	The ability of big-data to process structured, semi structured, and unstructured data improves auditor's abilities to detect the available misstatement in financial reports.	4.1651	0.87680
3.	Processing unstructured data when can lead to less intentional and unintentional audit risk.	4.0550	1.13721
4.	Inherent risk can be declined when auditors benefit from the data clustering technique of big data.	3.7431	0.88615
5.	The existence of clustering technique of big data enables auditors to assess the internal control of the audit client firm.	4.0000	1.10554
6.	The detection level of misstatements, fraud, and errors in financial statements increases as a result of auditors' ability to process different data forms, whether it is structured, or unstructured.	3.8624	0.90746
7.	The overall audit risk will decline when auditors of financial statements possess a technology that can process the different forms of data.	4.1376	1.00432
8.	A technology that enables auditors to perform 100 percent of economic transaction and accounts, will save the time and reduce the auditors performing their duties while engaged in auditing financial statements.	4.0275	1.07547
9.	Auditors can manage their time better while performing their audit engagement when they have the use of big data.	3.7248	1.12934
10.	Auditors can accumulate more evidence supporting their opinion using the big data that enables them to benefit from structured and unstructured data.	3.5596	1.09232
11.	The existence of clustering technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing.	3.6330	1.05111
12.	Because of clustering technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling.	3.9174	1.18734

Table 3, shows that item 2, which states that "The ability of big-data to process structured, semi structured, and unstructured data improves auditor's abilities to detect the available misstatement in financial reports" has the highest mean, that equals 4.1651, with 0.8768 standard deviation, and item 10, which states that "Auditors can manage their time better while performing their audit engagement when they have the use of big data", has the least mean within the group, and recorded

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3.5596, with 1.09232 standard deviation. The mean and standard deviation of the entire items seem with normal values and refer for the existence of a significant relationship between the clustering technique of big-data and the level of audit risk.

Table 4, shows the mean and the standard deviation of the classification, as a technique, among several techniques of big-data technology. The table shows that the means and standard deviations of the different items within the group seem normal. The highest mean in the items measuring the classification technique is 4.062, with 1.08249 a standard deviation, where these values are due to item number 9, which states that, "The existence of classification technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing". In opposite, the least mean equals 3.5505, with a stand deviation of 1.08428. where these values are attributed to item number 7, where this item states that, "The existence of data classification in big-data enables auditors to perceive the misstatements and fraud in financial statements while performing their engagements.

Table 4. The Means and the Standard Deviations of the Items used in Testing Auditors' Perception of the Effect of the classification Technique on the Level of Audit Risk.

Ser. No.	Item Text	Mean	Standard Deviation
1.	The classification technique of big-data enables auditors to accomplish more tasks in audit engagements.	3.8165	1.01073
2.	Data classification in groups helps the auditor testing the internal control with less time and efforts.	3.7339	1.15984
3.	Classifying data into smaller groups of similar data leads to a reduction in inherent risk, and the entire audit risk.	3,6972	1.13451
4.	Classifying data into smaller groups of similar data leads to a reduction in detection risk, and therefore the entire audit risk.	3.8440	1.16408
5.	Detection risk can be reduced when the auditor use big-data than can classify data into smaller groups, with similar data in each group.	3.9266	1.13616
6.	The existence of classification technique in big data save the time and effort of auditors while performing their audit engagements.	3,5596	1.10077
7.	The existence of data classification in big-data enables auditors to perceive the misstatements and fraud in financial statements while performing their engagements.	3.5505	1.08428
8.	Data classification techniques that available in big-data technology provides auditors with more information regarding the internal environment and the nature of work in the client firm.	3.7890	1.12277
9.	The existence of classification technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing.	4.062	1.08248
10.	Because of classification technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling.	3.9450	0.92130

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Table 5, reveals the means as well as the standard deviation of the different items used in measuring the relationship between the association rule technique and the level of audit risk. The table shows that item 1 and item 2 share the highest mean, that equals 4.0275, with a standard deviation of 1.04933 for item 1, and 1.14227 item 2. Item 1 states that "Because big-data includes the technique of association rule, control risk declines, and the entire audit risk also declines", while item 2 states that "Because big-data includes the technique of association rule, control risk declines, and the entire audit risk also declines". In the other hand, it is notable that item 9, which states that "The existence of association rule technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing", has the least mean, which equals 3.6606, with a standard deviation of 1.25625. In general, the values of means seem normal, and refer that auditors believe that the existence of association rule technique in big-data technology lead to a reduction in audit risk.

Table 5. The mean and the Standard Deviations of the Items used in Testing Auditors' Perception of the Association Rule Technique Impact on the Level of Audit Risk.

Ser. No.	Item Text	Mean	Standard Deviation
1.	Because of the association rule that it is available in big-data, the level of inherent risk is decreased when big-data technology used by auditors.	4.0275	1.04933
2.	Because big-data includes the technique of association rule, control risk declines, and the entire audit risk also declines.	4.0275	1.14227
3.	The association rule technique availability in big-data technology, several audit tasks can be avoided or performed with less efforts and time.	3.7248	0.98950
4.	The association rule technique that it is involved in big-data technology leads to more detection of misstatements and fraud in financial reports by auditors employing this technology in their engagements.	3.7339	1.14376
5.	The overall audit risk is declined when auditors use big-data that involves the association rule technique.	3.6789	1.03531
6.	The time and efforts needed by auditors for the internal control assessment is decreased, where this leads to a reduction in the level of audit risk.	3.9633	1.08804
7.	More evidence can be accumulated by auditors using the big-data technology, especially because of the existence of association rule in big data.	3.8991	0.91231
8.	Because big big-data involves the association rule techniques, auditors using big data, can express more correct opinion.	3.7431	1.20496
9.	The existence of association rule technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing.	3.6606	1.25625

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10.	Because of association rule technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling.	3.8807	1.08632

Table 6, lists the items used in measuring whether a relationship exists between the regression technique of big-data and the level of audit risk. The highest mean within this group is recorded for item 1, which states that "The regression technique of big-data simplifies the performance of analytical procedures by auditors, where item 1 recorded a mean of 3.9541, with a 1.15779 standard deviation. In opposite, item 9, which states that "Because of regression technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling", has the least mean. Item 1 has a mean of 3.1101, with a standard deviation of 1.13317. Based on the mean values, it is apparent that most responses are among the supporters of the idea that the existence of the regression technique has a relationship with audit risk.

Table 6. The Means and the Standard Deviations of the Items used in Testing Auditors' Perception of the Effect of the Regression Technique on the Level of Audit Risk.

Ser. No.	Item Text	Mean	Standard Deviation
1.	The regression technique of big-data simplifies the performance of analytical procedures by auditors.	3.9541	1.15779
2.	The regression technique of big-data enables auditors of financial statements to accumulate more evidence with less effort and shorter time.	3.7706	1.12738
3.	The existence of regression technique in big-data enables auditors using this technology to express more accurate and correct opinion.	3.6681	1.15227
4.	The regression technique of big-data is beneficial for auditors since it enables them understanding the nature of the client's operations.	3.7689	1.15374
5.	The use of big-data, that includes the regression technique can reduce the inherent risk when auditors use the big-data technology.	3.8532	1.16130
6.	I believe that the existence of the regression technique which included in big-data technology, can lead to a reduction in control risk when the technology is used by the auditors of financial statements.	3.7523	1.11518
7.	The level of detection risk can be reduced when auditors of financial statements employ the big data technology that involves the regression technique.	3.6514	1.17360
8.	The existence of regression technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing.	3.8165	1.17193
9.	Because of regression technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling.	3.1101	1.13317

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Table 7, shows the items used in testing the relationship between the social network analysis technique of big data and the level of audit risk, as well as, the mean and the standard deviation of responses for each item. The table reveals that the highest mean within the group is 4.0917 with a standard deviation of 0.95783, and due to item 8, which states that "The existence of social network analysis technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing", whereas the lowest mean is 3.5872, with a standard deviation of 0.79595, and due item 9, which states that "Because of social network Analysis technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling". The related means and standards deviation include no exceptions, and the responses are reasonable. Based on the mean and standard deviations of the items included in the group, a relationship exists between the social network analysis and the level of audit risk.

Table 7. The Means and the Standard Deviations of the Items used in Testing Auditors' Perception of the Effect of the Social Network Analysis Technique on the Level of Audit Risk.

Ser. No.	Item Text	Mean	Standard Deviation
1.	Because the big-data technology involves the technique of social network analysis, auditors of financial statements, can collect more evidence that increase the correctness of their opinion regarding the statements.	3.7982	1.16889
2.	The existence of social network analysis within the big-data technology, enables auditors to collect more related information, and therefore more correct opinion they can issue.	3.8073	1.07563
3.	The inherent risk declines as a result of the existence of social network analysis technique in big-data technology, when auditors use this technology.	3.9358	1.02085
4.	Using bag-data technology involving the social network analysis technique by auditors results in less control risk.	4.0275	1,00424
5.	The level of detection risk declines when auditors use this technology because it the technology includes the social network analysis.	3.6881	1.15227
6.	When auditors use the big-data technology they will be able to accomplish their engagement within less time.	3.6697	1.20227
7.	Big-data technology the includes the social network analysis technique, enables auditors to examine the client's internal control, and issue timely reasonable opinion.	3.8807	1.02492
8.	The existence of social network analysis technique in big-data technology enables auditors transferring towards continuous auditing instead of periodic auditing.	4.0917	0.95783
9.	Because of social network Analysis technique involvement in big-data technology, auditors can follow 100 percent testing instead of sampling.	3.5872	0.79595

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5.4. Hypotheses Testing

Each hypothesis of the study is tested using the one sample t-test, under 95 percent level of confidence, which is equivalent to 5 percent (1 – 0.95) coefficient of significance. The results of running the one sample are listed in Table 8. In more details, the table reveals the t-value, the computed coefficient of significance, degrees of freedom, mean difference, and the lower-upper limits of 95 percent confidence interval of difference, for each of the five hypotheses that listed above.

Table 8. Statistics of hypotheses.

Hypothesis	t-value	Degrees of Freedom	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
H1	45.634	108	0.000	3.82232	3.6563	3.9884
H2	39.350	108	0.000	3.67987	3.4945	3.8652
H3	45.711	108	0.000	3.73349	3.5716	3.8954
H4	40.916	108	0.000	3.64951	3.4727	3.8263
H5	47.047	108	0.000	3.78180	3.6225	3.9411

The first hypothesis had been developed to enable testing whether the practicing auditors in Jordan perceive that the big-data involvement to the clustering technique, affects the level of audit risk. The hypothesis is listed again, as follows.

Ho1. Practicing auditors in Jordan do not perceive that the involved clustering technique in big-data technology, has a significant impact at ($\alpha \leq 0.05$), on audit risk.

Reminding that the listed 12 items in table 3, are used in the collection of required data to test the first hypothesis. Table 8, shows the result of employing one sample t-test in testing the different hypotheses including the first one. The table shows a 45.634 computed t-value, and zero computed coefficient of significance. Because the computed t-value is greater than the tabulated one, that equals 1.96, and because the computed coefficient of significance is less than the predetermined one, that equals 0.05, the null hypotheses is rejected, and instead, its alternative is accepted. This result means that a significant impact exists of the clustering technique in big-data on the level of audit risk. The result also means that the ability of big data to prepare data clustering leads to a reduction in the level of audit risk. This result seems in consistent with logic because when data can be clustered, auditors will have more ability to detect the misstatement in the financial statements of business organizations.

The second hypothesis had been developed to enable testing whether an impact exists of the classification technique of big data technology on the level of audit risk. It was mentioned above that the classification technique of big-data is the collection of well-established methods with the most fundamental big data analysis technique, categorizing data objects to pre-defined groups. The hypothesis is listed again, as follows.

Ho2. Practicing auditors in Jordan do not perceive that the involved classification technique with big-data technology, has no impact at ($\alpha \leq 0.05$) on audit risk.

Reminding that the listed 10 items in Table 4, are used in the in the collection of the required data to test the first hypothesis. Table 8, shows the result of employing one sample t-test in testing the different hypotheses including the first one. The table shows a 45.634 computed t-value, and zero, computed coefficient of significance. Because the computed t-value is greater than the tabulated one, that equals 1.96, and because the computed coefficient of significance is less than the predetermined one, that equals 0.05, the null hypotheses is rejected, and instead, its alternative is accepted. This

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result refers that the practicing auditors in Jordan perceive that a significant effect exists of the classification technique on the level of audit risk. In other words, the result means that the existence of the classification technique in big-data technology leads to a reduction in the level of audit risk.

The third hypothesis had been developed to enable testing whether an impact exists of the association rule technique of big data technology on the level of audit risk, as the issue is perceived by the practicing auditors in Jordan. It was mentioned above that the technique of association rule is an approach attempting to determine some patterns that occurring in a regular manner in the data set. The third hypothesis is listed again, as follows.

Ho3. Practicing auditors in Jordan do not perceive that the involved association rule technique in big-data technology, affects at ($\alpha \leq 0.05$), the audit risk

The listed 10 items in Table 5, are used to determine whether the practicing auditors in Jordan perceive that the involved association rule technique in big-data technology affects the level of audit risk. Table 8, shows the result of employing one sample t-test in testing the different hypotheses including the third hypothesis. The table shows a 45.711computed t-value, and zero, computed coefficient of significance. Because the computed t-value is greater than the tabulated one, that equals 1.96, and because the computed coefficient of significance is less than the predetermined one, that equals 0.05, the null hypotheses is rejected, and instead, its alternative is accepted. This result means that the practicing auditors in Jordan perceive that a significant effect exists of the association rule technique on the level of audit risk. In other words, the result means that the existence of the association rule technique in big-data technology significantly affects the level of audit risk while auditing the financial statements of business organizations in Jordan.

The fourth hypothesis had been developed to enable testing whether an impact exists of the regression technique of big data technology on the level of audit risk, as the issue is perceived by the practicing auditors in Jordan. The regression technique in big-data reduces the dimension, extract information, predicts and explores the relationships among variables to be beneficial for forecasting and for the decision making process. The fourth hypothesis is listed again, as follows.

Ho4. Practicing auditors in Jordan do not perceive that the involved regression technique with big-data technology, affects ($\alpha \leq 0.05$), the audit risk.

The 9 listed items in Table 6, are used to determine whether the practicing auditors in Jordan perceive that the involved regression technique in big-data technology, affects the level of audit risk. Table 8, shows the result of employing one sample t-test in testing the different hypotheses including the fourth one. The table shows that the computed t-value equals 40.916, and the computed coefficient of significance equals zero, or a very closed value to zero. Because the computed t-value is greater than the tabulated one, that equals 1.96, and because the computed coefficient of significance is less than the predetermined one, that equals 0.05, the null hypotheses is rejected, and therefore, the alternative form of the hypothesis, is the one that it is accepted. This result means that the practicing auditors in Jordan perceive that a significant effect exists of the involved regression technique in big-data technology, on the level of audit risk. In other words, the result means that the existence of the regression technique in big-data technology significantly affects the level of audit risk while auditing the financial statements of business organizations in Jordan.

The fifth or last hypothesis had been developed to enable testing whether the practicing auditors in Jordan perceive that the involved social network analysis technique in big-data technology has an effect on the level of audit risk. In this context, it deserves reminding that social network analysis technique is considered as an approach investigating the connections and contents in a vast information stack for the purpose of building a social network. The fifth hypothesis is listed again, as follows.

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Ho5. Practicing auditors in Jordan do not perceive that the involved social network analysis technique with big-data technology, affects at ($\alpha \leq 0.05$), the audit risk.

The 9 listed items in Table 7, are used to determine whether the practicing auditors in Jordan perceive that the involved social network analysis technique in big-data technology, affects the level of audit risk. Table 8, shows the result of employing one sample t-test in testing for the different hypotheses of the study including the fifth hypothesis. The table shows that the computed t-value equals 47.047, and the computed coefficient of significance equals zero, or a very closed value to zero. Because the computed t-value is greater than the tabulated one, that equals 1.96, and because the computed coefficient of significance is less than the predetermined one, that equals 0.05, the null hypotheses is rejected, and therefore, the alternative form of the hypothesis, is the one that it is accepted. This result means that the practicing auditors in Jordan perceive that there is a significant impact of the social network analysis as a technique in big-data technology, on the level of audit risk. In other words, the result means that the existence of the social network analysis technique in big-data technology significantly affects the level of audit risk while auditing the financial statements of business organizations in Jordan.

6. Findings and Conclusions

The study objects for determining whether the practicing independent auditors perceive that the adoption of big-data technology in auditing the financial statements of business organizations, affect the level of audit risk. For the purpose of the study, Audit risk consists of three types affecting the risk of auditing financial statements including, inherent risk, control risk, and detection risk. Big-data technology is analyzed based on the five techniques, this technology including, clustering, classification, association rule, regression and, social network analysis. Therefore, a questionnaire had been developed to measure the effect of each technique involved on each of the three types of audit risk.

Employing the one sample t-test, the results showed that independent auditors perceive that the adoption of big–data technology by auditors while they exercise audit activities and perform the different audit tasks in the engagements, significantly affect the audit risk, and when auditors apply the big-data technology that involves the five previously mentioned techniques, the audit risk declines, and therefore, auditors will issue more correct audit opinion. Each involved technique in big-data technology leads to a decline in the audit risk. These are the perceptions of independent auditors towards using the big-data technology in performing the financial statements audit tasks.

The contributions of the study seem apparent since these findings refer for benefits of the audit profession when auditors have the possibility and ability to employ the big-data technology. As a result of big-data technology in financial statements audit, users' trust with auditors' opinion and with the entire audit profession will increase, and auditors will be less likely to be sued in courts, and will have more protection. Moreover, performing audit tasks by auditors of financial statements will need for less time and effort, and the performance of most of these tasks don't need for physical availability of auditors in the location of clients. More studies regarding the adoption of big-data technology in audit profession are strongly recommended to be carried out in the near future.

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