# Auditing in The Era of Big Data and Analytics: A Conceptual Examination

# Sebastine Abhus OGBAISI, PhD

Department of Accounting, Faculty of Management Sciences, Ambrose Alli University, Ekpoma, Edo State, Nigeria sebastine.ogbaisi@aauekpoma.edu.ng

# James Okeke UKWA

Department of Accounting and Finance, College of Management and Social Sciences, Glorious Vision University, Ogwa, Edo State, Nigeria ndubisi213@gmail.com

# Anthony O. UNUIGBOKHAI

Department of Accounting, Auchi Polytechnic, Auchi, Edo State, Nigeria

# Abstract

In Nigeria, the application of big data and analytics (BDA) is still at an embryonic stage. This is due to the weak data capacity and technological developments in the country. Besides, the infrastructure base and institutional constraints, inflexibilities also militate against BDA in Nigeria. This paper presents a conceptual-based approach in examining the audit profession in the era of BDA that has increasingly seen the use of advanced portfolio of data and technology in the auditing space. Based on the review of the pertinent literature, it was observed that while the utilization of BDA in auditing has reach a considerable and advanced level in developed countries, the situation is however not the same for developing countries, including Nigeria since BDA promotes greater audit effectiveness and efficiency. The paper recommends that higher adoption and utilization of big data and analytics be embraced in the auditing profession and consistent adaptability to new technologies and innovations in the auditing space be explored to keep pace with the ever changing, dynamic and competitive audit profession in line with evolving global standards and pace.

**Keywords:** Auditing, Big data and analytics, technological developments, Innovations, Risk assessment.

# Introduction

The last decade has witnessed increased empirical research on application of big data and analytics (BDA) to auditing. The auditing profession, without doubt has assumed greater level of flexibility to change in recent times due largely to innovations in digital technology. The sweeping change and dynamics in technology and innovation is subjecting the auditing profession to a radical change to meet new trends and handle more complex issues in the field. The evolution of technology is helping a greater deal to ensure greater effectiveness, efficiency and integration in auditing, simplifying hitherto complex tasks and introducing new methods of handling auditing issues. Big data analytics not only contributes to the traditional audit

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objectives of ensuring compliance and detecting fraud but also enables auditors to provide additional value to clients by generating meaningful insights from the audit data (Schoenfeld, 2022).

With big data and analytics, there has been a paradigm shift from the traditional mode of auditing and technology and innovative based audits. Businesses that exploit big data benefits have reported a significant reduction in operational costs, improved decision-making, and higher clients' retention and satisfaction rates (EY, 205; Arvindl, 2020). Modern day accounting and auditing practices have embraced the use of big data and analytics in line with the rapidly changing world of technology. Thus, big data analytics is greatly changing the conduct of business, financial transactions and recording. Auditing can therefore not be constrained to the traditional mode. Following this, accounting and auditing practices and principles are advancing greatly. Big data and analytics has made audit work more effective, efficient, result-oriented and demystified as a result of advances in innovative technology (see also Salijeni, 2019).

While several banks, manufacturing and construction industries apply big data, one of the industries that has not fully optimized the benefits of big data and analytics is the auditing industry. Without doubt, the ability of companies to gather and analyze information in real time is essential for growth and stability (Arvindl, 2020). Internal and external auditors have not fully utilized the benefits of real-time data insights in ensuring compliance and enabling companies realize their full potential. Big data (structured and unstructured) has vast applications in the auditing profession, as information gathering from past events has the capacity to help companies make well-informed decisions about the future. Big data offers critical insights for auditors as well as other stakeholders with respect to important audit operations. One of the key elements of audit quality is the individual assessments and decisions auditors make. Bell, Peecher and Solomon (2005) characterize the audit as a recursive process of evidence-driven, belief based risk assessment, which ideally results in risk assessments that stem from well-justified beliefs.

The use of big data in auditing space is a new development. Historically, data was hitherto structured and human –generated. Nevertheless, with the development in technology and analytical sophistication, the preparation of audit reports has considerably advanced. Studies opine that the traditional auditing system is no longer adequate, dynamic and fashionable to meet the current trends in providing critical information for management and stakeholders in making better decisions (Curtis & Payne, 2008). This has necessitated the urgent need to change the traditional auditing approach with the rapidly evolving technologies and innovations in line with the growing trend (Brown-Liburd, & Vasarhelyi, 2015). With the growing importance of BDA in auditing, the auditing practice cannot remain static but undergo a transformation in line with the changing demands of the environment. It is in this regard that this paper explores auditing in the era of big data and analytics . Aside the introductory section, section 2 contains a discussion on BDA and technological innovations in auditing. Section 3 examines big data and big data analytics in auditing. The review of literature involving theoretical and empirical studies is contained in section 4 and 5. Section 6 concludes the paper.

## **BDA** and Technological Innovations in Auditing

Within the period of 2014-2020, big four audit firms (Deloitte, Ernst & Young, Price Waterhouse Coopers and Klynveld Peat Marwick Goerdeler) have significantly either acquired or developed BDA tools. KPMG, for instance, went into collaboration with technological companies (such as the McLaren Technology Group, known for Formula One racing) established a huge investment fund of about \$100 million intended to developing data analytical capabilities that will enhance the value of stakeholders and further raise quality" (KPMG, 2014a, p. 57). EY, in the same vein, designated about US\$500 million to develop audit innovation, including new audit support tools involving BDA (EY, 2014).

Through the acquisition of companies with cutting-edge and innovative BDA capabilities, auditing capacity is to be stimulated (EY, 2015b; EY, 2016b, cited in Salijeni, 2019). Such increased

tendency in audit technology investment capacities is not new among audit firms; as several investments in audit technologies to include statistical sampling and Business Risk Auditing (BRA) and algorithm approaches have also been noticeable. By means of BDA, auditing approach has significantly changed, especially with respect to audit evidence (Matthews, 2006a).

The use of BDA's started in the late 1960s to the late 1970s, with the developments in audit technologies, as a means to address political and economic dimensions of the audit profession Lemon et al. (2000) and Robson et al. (2007) argue that it was motivated by the need to address the issue of audit evidence for establishing audit opinions (Matthews, 2006b). Higson (2003), for example, note that verification of transactions as an audit approach had reduced and the emphasis was on checking the strength of the client's internal control system under the approach called system-based auditing. As a means of justifying the reduction in audit evidence, audit firms introduced statistical sampling to control the size of audit evidence (Power, 1997).

The utilization of sample-based audit evidence in place of full precedes this period (Power, 1992). Statistical sampling, was accordingly, considered an innovative technology in the collection of audit evidence (Carpenter & Dirsmith, 1993). Subsequently, in the 80s, in conjunction with other technologies in the audit process, statistical sampling was used. The introduction of these technologies was motivated by the need to facilitate the same purpose of audit evidence collection and evaluation. The Audit Risk Model (ARM), a risk-based audit approach was introduced as technology providing prescribing the determination of the quantity and quality of audit evidence collected (Holstrum & Kirtland, 1983; Power, 1997; Matthews, 2006b). The model allowed quantification of audit evidence in terms of assessing clients' inherent risks and control environments, and the competence of auditors to detect material financial misstatements (Salijeni, 2019).

In the late 1990s, the risk-based audit approach advanced from focusing on audit risks to focusing on business risks, to allow auditors to focus more on the objectives and operations of the business than on transactional balances in the financial statement (Lemon et al., 2000; Higson, 2003; Robson et al., 2007). The contention is that BDA's are used to provide legitimacy for the audit profession by depicting that audit expertise is associated with scientific rationality (Dirsmith & Carpenter, 1993; Power, 2003; (Curtis & Turley, 2007). Thus, beyond its technical rationale, BDA is characterized by a long history and dynamics associated with its promotion and implementation.

## Big Data and Big Data Analytics in Auditing

Without doubt, the developments in BDA with the associated considerable attention could be linked with earlier developments in audit innovation. Starting from 2012, researchers and regulators in the US and Canada have been discussing BD and suggesting that the audit environment is either being populated with BD or becoming data-driven. For instance, though not particularly referring to BD, the American Institute of Chartered Public Accountants (AICPA) in 2012 set up initiatives which highlighted the importance and relevance of 41 data in the provision of audit and assurance services. The initiatives were meant to result in the possibility of developing audit data standards. In order to make this endeavor become operational and practical, a task force (Assurance Service Executive Committee Technologies Task Force) was set up to offer guidance on developing the conceptual frameworks for data being used in audits (Zhang et al., 2012).

This was followed by a white paper publication by same AICPA in the same year, entitled "Evolution of auditing: From the traditional approach to the future audit", which put into perspective the challenges associated with the current state of auditing and indicated a preference for a data driven audit approach. These initiatives, in no small measure, attracted considerable attention of other standard setters, as a result, in 2013, the International Auditing and Assurance Standards Board (IAASB) also acknowledged the importance of technology and the potential impact of BD on audits of financial statements.

Like AICPA, it created a task force, called the Innovation Working Group (which later became the Data Analytics Working Group) to explore emerging technologies, such as BDA, and how they could be used to exploit opportunities relating to the provision of assurance services, including auditing (IAASB, 2013). By 2013, professional bodies and some audit firms began making references to BD in their publications and presentations. The professional bodies in the UK started discussing BD in the context of the value it could generate in financial reporting and business in general (Accountancy Futures Academy, 2013; Institute of Chartered Accountants in England and Wales (ICAEW), 2014). These bodies acknowledged the pervasive use of BD and its capacity to significantly transform the audit environment (Cao et al., 2015), given that opportunities existed for other forms of data to be regarded as audit evidence due to their size and nature. Furthermore, such data is collected at high speeds from multiple sources within and outside of the client businesses (Gandomi & Haider, 2015, Salijeni, 2019).

While it is acknowledged that the use of BDA in auditing in Nigeria is in its infancy (Alles, 2015; IAASB, 2016a; FRC, 2017), the use of analytics in the audit process is not necessarily a recent phenomenon. Audit firms have been using computer based and non-computer based analytical tools since the 1960s, when some firms developed analytical review techniques and computer assisted audit techniques (CAATs). With the growing use of computer packages by practitioners, most audit firms began using them part of their analytical suites. These tools led to the development of BDA in auditing currently. The drive for structured audit methodologies influenced the introduction of automated decision support systems aimed at helping auditors on the ground to reach uniform conclusions when exercising professional judgments.

Studies such as Power (2003); Curtis and Turley (2007); Dowling and Leech (2014) posit that the growing tension between auditor autonomy in making professional judgments and the desire of audit firms to develop structured methodology that could demonstrate audit quality or be used as a means of defence in litigation also gave rise to BDA Thus, the proliferation of technological devices that could capture and process data gave rise to the acknowledgement that the business environment is characterized by the digital phenomenon called BD. With the developments in BDA in the audit environment, it could be argued that audit firms started using analytical tools in the context of BD in 2013 (Salijeni, 2019).

## Concept of Big Data and Analytics

Big data refers to the massive portfolio of data that is growing exponentially, with the expectation that such large data will have a dramatic impact on productivity, profits and risk management. Nevertheless, big data, in itself has limited value unless processed and analyzed.

Analytics involves the processing and analysis of the data generated for the purpose of drawing meaningful conclusions. Several companies and organizations have recognized the importance of big data and analytics, and are, therefore, investing heavily on big data to better understand the impact of these capabilities on their businesses. A critical sector where big data has significant potential transformation is the audit. Without doubt, the transformation of audit will significantly expand beyond sample-based testing to take account of the analysis of entire populations of audit-relevant data, using brilliant analytics to deliver a higher quality of audit evidence and more relevant business insights.

Big data and analytics are enabling auditors to greatly identify financial reporting, frauds and operational business risks, and thus, tailor-resilient and outcomes yielding approaches to deliver a more pertinent audit (EY Reporting, 2015). The traditional auditing arrangement involves the utilization and location of data files, which are kept on a local server or workstation, involving the purchase of software. Big data analytics overcome this challenge in traditional auditing system by the application of a massive data portfolio innovative technology that can preserve and analyzed such enormous data by means of a single multifarious data system EY Reporting, 2015).

## **Theoretical Literature**

To Carpenter and Dirsmith (1993;), Power (2003); Curtis and Turley (2007); Robson et al. (2007), cited in Salijeni (2019), there is considerable theoretical evidence in the audit literature as to how audit firms respond to change as regard the quality of audit work as well as the

social relevance of the audit function with technological developments designed to restore confidence in the effectiveness of the audit process. Accordingly, the motivation for firms to either develop or change technologies is influenced by two factors; regulatory requirements and profit-oriented interests.

For the profit oriented interest, technologies serve to increase assurance services that firms engage in, so as to generate greater revenue and profits. Various rationales that could be attributed to technological change in meeting regulatory imperatives are identified by the literature. Developments in audit technology have been promoted by auditors as technical improvements to the standard of audit work (Power, 2003). Following such developments, the process of conducting an audit is subjected to unceasing objectification, formalisation and streamlining (Newton & Ashton, 1989; Fisher, 1996).

## **Institutional Change Theory**

The theory was propounded by John Meyer and Brian Rowan in the late 1970's. Suddaby and Greenwood (2005), using the institutional change theory demonstrated how new practices or technologies are legitimised in a social setting like the audit field. They note that institutional change can engender technological developments that bring about greater institutional effectiveness (Power, 1997, 2003; Malsch & Gendron, 2013). Prior studies showed that audit firms struggle to maintain professional and commercial logics because of pressure from regulatory agencies (Holm & Zaman, 2012). According to Suddaby and Greenwood (2005), instigating institutional change involves audit firms' use of contradictory institutional vocabularies to expose difficulties or challenges in the institutional logics. Thus, to promote BDA, audit firms have to identify institutional vocabularies that could indicate contradictions or deficiencies in the institutional logics of professionalism and commercialism.

These vocabularies could include deficiency in audit quality (Khalifa et al., 2007) or the need to provide value to clients (Covaleski et al., 2003; Robson et al., 2007, among others. Since introduction of new technology entails an aura of uncertainty, there is a need to theorise change whereby actors manipulate the degree of uncertainty implied by innovation". To this end, audit firms have to employ rhetorical strategies in such a way that the proposed change or new technology connects to broader cultural values or addresses the contradictions exposed through the institutional languages. In this vein, Robson et al. (2007) and Curtis Turley (2007) showed how BDA is committed to addressing the problems associated with audit evidence as well as the economics of auditing.

## **Empirical Literature**

New auditing literature has provided some pertinent initial insights into the potential relevance of both BD and BDA. The studies are mainly conceptual (see Table 1)

			L .	
S/N	Author (s) and	Focus of Study	Area	Methodology (i.e.
	Years		(BD or	Research Approach)
			BDA)	
1	Zhang et al.	Links between BDA and the operationalisation of the	BDA	Conceptual
	(2015)	continuous audit approach		
2	Yoon et al.	BD as complementary audit evidence, taking into account the	BD	Conceptual
	(2015)	cost-benefits associated with it		1
3	Krahel and	The case for including BD in accounting and auditing	BD	Conceptual
	Titera (2015)	standards, problematising the existing standards as not		1
		suitable for the data driven environment		
4	Cao et al. (2015)	How BDA could be used to improve the efficiency and	BDA	Conceptual
-		effectiveness of financial audits		
5	Earley (2015)	Opportunities for BDA in auditing	BDA	Conceptual
6	Brown-Liburd	The effects of BD on auditors' cognitive abilities and factors	BD and	Conceptual
	et al (2015)	that could impair	BDA	Conceptuur
7	Brown-Liburd	Audit evidence in BD environment	BD	Conceptual
ľ	and Vasarbelvi			Conceptual
	(2015)			
0	(2013) Allos (2015)	Eastors that would aither influence or constrain the use of BD	BD	Concentual
0	Anes (2015)	How and items aculd improve the reliability of PD as and it	DD PD	Conceptual
9	(2016)	ridence by focusing on the provenence of PD		Conceptual
10	(2016)		BD	
10	Alles and Gray	Factors that inhibit the use of BD in financial statement audits	BD	Conceptual
11	(2016)		DD 4	
11	Curtis,	Contextual factors and individual characteristics affecting	BDA	Conceptual and
	Humphrey and	technology implementation decisions in audit		quantitative
	Turley (2016)			
12	Perols et al.	The predictive ability of BDA regarding traud, by identifying	BDA	Analysis of samples of
	(2017)	variables drawn from earnings management studies		companies, some of which
				are subject to fraud, on the
				SEC register
13	Appelbaum	Areas of potential research in BDA through a review of	BDA	Conceptual
	et al. (2017)	current studies on BDA	and BD	
14	Appelbaum	Development of a framework for BDA which identifies areas	BDA	Conceptua1
	et al. (2018)	to study analytical procedures in the BD environment		
15	Appelbaum,	Big data and analytics in the modern audit engagement	BDA	conceptual
	Kogan and	research needs		
	Vasarhelyi(2018).			
16	Salijeni (2019)	Big data analytics and the social relevance of auditing: An	BDA	Semi-structured interviews
		explorative study		with individuals dealing
				with BDA in the audit field
				and beyond, publicly
				available textual data from
				audit firms as well as
				observations of audit
				firms' proprietary BDA
				tools.
17	Schoenfeld 2022)	Big data and analytics in Auditing	BDA	Concentual

Table 1 Selected studies on BD and BDA in Auditing

**Source:** Authors' compilation, 2024

# Big Data and Analytics in Auditing in Nigeria

In Nigeria, the application of big data and analytics is still at an embryonic stage. This is due to the weak data capacity and technological developments in the country. Besides, the infrastructure base, as well as institutional constraints and inflexibilities also militate against BDA in Nigeria. While the utilization of BDA in auditing has reached a considerable and advanced level in developed countries, the situation is however not the same for developing countries, including Nigeria. Thus, significant progress is yet to be made in this direction. In current years, however, there have been shifts from traditional auditing to modern auditing dynamics, which has seen the use of digital technology and innovation in the accounting and auditing fields. With the emerging transformation in the auditing space, Nigeria cannot be left behind, as concerted efforts are needed to enhance the use of BDA in Nigeria. As the prospect of big data and analytics advances further, the effective tapping into this evolving and dynamic space will greatly drive the auditing practice in Nigeria to greater levels.

## Conclusion

The paper uses a conceptual based approach to examine BDA in the auditing profession. It revealed that BDA, has a great role to play in modern auditing, simplifying the auditing work, which has hitherto been based on traditional approach. Without doubt, BDA has greatly enhanced the effectiveness and efficiency of auditing reducing time and cost transactions. By developing the capacity of auditors in BDAs, greater value for clients' services can be generated using the opportunities associated with BDA. Therefore, auditors are encouraged to show commitment to using BDA during audits through recruitment, capacity building, incentives, personal reviews and the industrialization of BDA. BDA constrains auditors who may not have the relevant expertise to operate some of its functionalities need to be properly trained and skilled in data analytics.

Without doubt, with the use of BDA in modern auditing era, the auditing space has drastically and significantly transformed. Big data analytics not only contributes to the traditional audit objectives of ensuring compliance and detecting fraud but also enables auditors to provide additional evidence-based value to clients, which, no doubt has the capacity to stimulate audit effectiveness, efficiency and outcomes in a dynamic world of ours spurred by technology and innovations.

#### **Further Studies**

Future studies in this area should examine the subject matter using quantitative analytical tools such as interviews or questionnaire survey where individuals dealing with BDA in the audit field and beyond, as well as observations of audit firms' are used to gather the relevant information for analysis. Another area of study would be to identify coherent risk measures in audit analysis. Inter-temporal and multi-period audit risk analysis should also be an area of further study.

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