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Abstract

Purpose: Several studies have found that data and tools help managers make better decisions. Proper infrastructure might prevent half of all health-care deaths. Health practitioners in Nigeria have made numerous mistakes by relying on their intuition rather than digital technology such as analytics to gain insights into patients' health records, profiles, lab findings, drug histories, and so on, leading to the premature deaths of many patients. Nigerian healthcare has also faced challenges. Despite Nigeria's strategic importance in Africa, health care is still underfunded. Health facilities, workers, and equipment are insufficient in remote areas. This study investigated the effect of big data analytics on the operational value of healthcare service firms in Lagos State, Nigeria.

Methodology: The study adopted a survey research design. The population of the study comprised 3931 employees of accredited healthcare service firms in Lagos State. The study utilised mixed sampling techniques comprising purposive, proportionate, and random sampling techniques. A sample size of 676 participants was obtained using Cochran's sample size formula (1977). An adapted questionnaire was used, and an 83.3% response rate was achieved. The Cronbach's alpha reliability coefficients for various constructs ranged from 0.769 to 0.904. The data were analysed using inferential (regression) analysis.

Findings: The findings revealed that big data analytics dimensions had a significant effect on operational value (Adj.R^2 = 0.932; (F (6, 556) = 1284.42), $p<0.05$). The study concluded that big data analytics affected the operational values of healthcare firms in Lagos State, Nigeria.

Recommendation: It was recommended that the management of designated healthcare service firms in Lagos State, Nigeria invest in the improvement of their ICT tools, skills, and capabilities. Investing in big data analytics increases the value of services or operations by a significant margin. Investing in the training of personnel in big data analytics enhances their analytical skills.

Keywords: *Big Data Analytics, Healthcare Firms, Operational Value, Internet of Things Application, Cloud Computing, Data-Driven Decision Making*

1.0 INTRODUCTION

The COVID-19 pandemic has intensified the global need for a robust healthcare management infrastructure. With millions of lives lost worldwide, leading healthcare institutions recognise the urgency to leverage modern technologies in their decision-making processes. By embracing these technologies, they can access new resources, enhance recovery and response rates, and mitigate the negative impact of relying solely on intuition and assumptions. Efficient time management enables them to compete effectively, expand their customer base, and improve operational effectiveness, all of which are crucial for their long-term sustainability. Unfortunately, healthcare service firms in Nigeria have yet to fully harness the potential of modern technologies like big data analytics. As a result, their ability to ensure sustainability is being questioned. The healthcare system has a blend of private and public health care providers. In the public sector, health care providers are under the three tiers of government; Federal (tertiary hospitals and some hospitals in federal institutions like universities), state (state specialist and general hospitals) and local government areas (primary health care centers and health posts). In the private sector, they are broadly categorised into those that provide primary care (general practitioners), those that provide secondary care and those that provide both primary and specialist care. There are also several non-governmental organisations and donor-owned and operated facilities.

Several scholars such as Alnoukari (2020); Iyamu (2020); Kaufmann (2019); Moretto, et al., (2017); and Raghupathi and Ragupathi (2014) have conducted research work on confirming and verifying the contents of the ten factors that include organisation dimension (such as big data strategy, top management support, resource commitment, organisational relationship), people dimension (such as analytics skills, managerial skills and analytics culture) and technology dimension (includes data infrastructures, information processing and quality) and whether they were appropriate for the research model. Their studies revealed that BDA investment in decision making did not have any prominent influence on any of the operational dimensions and there seems to be paucity of research linking BDA to operational value in healthcare organisations. Contrary to the technological perspective, the management perspective of big data focuses on operational value-related questions. In the light of that, this research field is fairly fragmented in scope and limited in methodologies and displays several gaps.

According to Omoluabi (2014) the Nigerian health sector is characterised by mal-distribution of health work force and poor co-ordination amongst key players, lack of effective stewardship role of government, fragmented health service delivery, inadequate and inefficient financing and a weak infrastructure". These aspects therefore, include, organisation and management of healthcare system, health indicators, human resources for health and expenditure on health.Value creation for companies has become a major sustainability factor, in addition to profit maximisation and revenue generation, and, nowadays, modern companies collect Big Data from various inbound and outbound data sources with this in mind (Rehman et al., 2016).

The effective utilization of data is becoming very competitive since data is perceived to create value for businesses. However, the demand for greater insight and knowledge from information so as to make smarter, real time and informed decision has promoted the evolution of big data tools, platforms and technologies (Oluigbo et al., 2017). Therefore, this study investigated the effect of big data analytics dimensions (agility capability, data-driven decision making, business intelligence, information technology capability, internet of things (IoT) application software, and cloud computing) on the operational value of the healthcare service firms in Lagos State, Nigeria. It also expands the body of existing literature by providing information

on enlightening the operational value of healthcare firms in Nigeria through the development of Big Data Analytics. This significance is to the management and owners of healthcare firms, the government, industry regulators and policymakers.

2.0 LITERATURE REVIEW

In the study, there are two main variables, Big Data Analytics and six sub-dimentions (agility capability, data-driven decision making, business intelligence, information technology capability, Internet of Things (IoT) application software, and cloud computing), and operational values.

2.1 Big Data Analytics

Organisations nowadays, especially the health sectors have more technologies and devices that generate and capture more data in various categories such as the hospital administrative process automation, electronic medical records, disease predictions, streamlined patient data sharing, monitoring health conditions through data from medical wearable /smart gadgets, pulse recording, temperature, brain activity, sleep patterns, Electro-Cardio-Graphy (ECG) and various metadata from biological body parts as well as the Global Positioning System(GPS) locations that are exchanged with associated parties of insurance, physicians and medical technicians. These immense amounts of data that is being produced continuously is what can be referred to as Big Data (Mukherjee & Shaw, 2016; Russom, 2011). Arunachalam et al., (2018); Elgendy and Elragal (2016) referred to big data as the datasets that have grown to the point where they are difficult to work with using typical computer or database management methods.

Gupta and George (2016) described the concept, big data as a large, complex, and real-time data streams that necessitate sophisticated data management, analysis, and processing techniques in order to extract valuable information. Mukherjee and Shaw (2016) opined big data decodes previously undiscovered data to produce new insights that can be integrated into business processes and decisions. However, the researchers submits that the size of big data has grown beyond the ability of commonly used software tools and storage systems to capture, store, manage, and process the data in a reasonable amount of time (Elgendy & Elragal, 2016; Gupta & George, 2016; Russom, 2011). Boyd and Crawford (2012) discussed big data as a cultural, technological and scholarly phenomenon that rests on the interplay technology, analysing, and mythology. A Gartner analyst, Laney (2001) presented a well-known definition known as the 3Vs to describe what constitutes big data: volume, velocity, and variety in addition to the challenges of data size. The 3Vs definition implies that the data is large, that it will be created quickly, and that it will exist in several types and from various sources. In addition, Gantz and Reinsel (2011) describe a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide range of data, by enabling high-velocity capture, discovery, and/or analysis. This thereby add the fourth V (value) to the 3Vs model making it 4Vs. The 4Vs draw light on the meaning of big data by examining the concealed values.

The paper defines Big Data Analytics (BDA) as a comprehensive concept that comprises multiple components. These components include agility capability, data-driven decision making, business intelligence, information technology capability, Internet of Things (IoT) application software, and cloud computing. Each of these components plays a crucial role in the realm of BDA and contributes to its overall effectiveness and impact. By considering these various components, the paper aims to provide a comprehensive understanding of BDA and its implications in healthcare service firms in Nigeria.

2.2 Empirical Review

Big data comes from multiple diverse sources collected for many purposes including IoT data, logs, clickstreams, and social media. For all of those sources to be used for analytics requires joining up unstructured data (such as texts in natural language) and semi-structured data. Adrian et al., (2018) examined expert review on Big Data Analytics implementation model, in data-driven decision-making. The findings from the reviewed literature revealed that Data-driven decision-making can offer improved insights for information value and create new business opportunity. Consequently, in Mandal (2019) investigated the influence of Big Data Analytics capabilities on supply chain preparedness, alertness and agility an empirical investigation. The results indicated BDA planning, BDA coordination and BDA control are critical enablers of SC preparedness, SC alertness and SC agility. BDA investment decision making did not have any prominent influence on any of the SC resilience dimensions. Chatfield and Reddick (2018), explored customer agility and responsiveness through Big Data Analytics for public value creation: A case study of Houston 311 on-demand services. Findings from the study revealed that localized Big Data Analytics use by some of the 22 departments for enhanced customer agility and on-demand 311 services, city-wide systemic change in on-demand service delivery through Big Data Analytics use was not evident.

Furthermore, Turet and Costa (2018) conducted a study on Big Data Analytics to improve the decision-making process in public safety: A case study in Northeast Brazil. The study found that the greatest problems and challenges faced by public safety is how best to analyse large volumes of data, since regions with a higher level of crime must be constantly identified in order to make better decisions. Also, Kościelniak and Puto (2015) examined big data in decision making processes of enterprises. The study indicated the significance of an attempt to present the stages of decision support since only the organisations which formulate and implement new solutions in the field of decision-making processes can satisfy clients' expectations and establish business rivalry with competitors.

In a related study, Wang et al. (2019) investigated using data-driven safety decision-making to realise smart safety management in the era of big data: A theoretical perspective on basic questions and their answers. Findings from the study indicates that smart safety management is actually a perfect combination of traditional safety management modes and data-driven Safety Decision Making (SDM). Hajar, et al., (2017) sought the roles of big data and knowledge management in business decision making process. The study found that organisations have realised the importance of huge amount of data that are collected to make enhanced decision. Cech, et al., (2018) investigated data competence maturity: developing data-driven decision making. The findings also revealed that one of the most difficult challenges to full implementation of data analytics is that many organisations do not have the necessary training and skill sets to use the analyses produced. Grander et al., (2021) examined big data as a value generator in decision support systems: a literature review. The findings revealed that techniques of Big Data Analytics, machine learning algorithms and technologies predominantly related to computer science and cloud computing are used on decision support systems

Similarly, Ajah and Nweke (2019) examined big data and business analytics: Trends, platforms, success factors and applications. The study found that benefits of big data are potentially tremendous. To a business class, technology is merely a means of keeping the company close to its customers. Akinnagbe et al., 2018) conducted a study on prospects of Big Data Analytics in Africa healthcare system. Based on the systematic literature review, it was found that the use big data has been very effective in other areas of the world but Africa seems

to be left behind especially in the area of healthcare system. Based on the foregoing, this study thus supports the hypothesis that:

H_{01}: Big Data Analytics dimensions have no significant effect on operational value of the healthcare firms in Lagos State, Nigeria.

2.3 Theoretical Framework

This study is hinged on the Dynamic Capabilities Theory (DCT) which is primarily centered on the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments. The theory by its assumptions demonstrates simple, experiential and iterative measures to addressing complex and dynamic hypercompetitive situations confronting businesses these days in contrast to more stable markets harmonises and the variables of this study. Thus, high velocity markets are characterised by non-linear and unpredictable change. In such markets, existing knowledge is less relevant and the challenge is to create innovative, situation specific knowledge. This study focused on big data analytic and operational value.

The assumptions maintained that dynamic capabilities are simple, experiential and iterative, in contrast to more stable markets, where they are complex, analytic and linear. Thus, high velocity markets are characterised by non-linear and unpredictable change. In such markets, existing knowledge is less relevant and the challenge is to create innovative, situation specific knowledge. Organisations face difficulties where leaders use existing knowledge to generalise from past experiences (Argote, 2012). Organisations experiment to learn new knowledge and to innovate quickly. Ideas that are demonstrated to be ineffectual are abandoned. There is extensive reliance on real time information, cross-functional relationships, multiple options, and intensive communication, all organised in ways that adjust as new knowledge becomes available. Zollo and Winter (2002) propose "dynamic capabilities emerge from the co-evolution of tacit experience accumulation processes with explicit knowledge articulation and codification activities". Development of dynamic capabilities invokes mechanisms that go beyond tacit accumulation of experience. Implicit knowledge is articulated through collective discussion, debriefing sessions and performance evaluation processes.

3.0 METHODOLOGY

This study adopted (survey research design) and this is consistent with previous studies on Big Data Analytics (Olugbohungbe & Awodele, 2021; Müller et al. 2022; Ndambo, 2016). The adoption of survey research design is appropriate for this study because it allowed the collection of information for independent and dependent variables using questionnaires (Orodho, 2009). The population of this study comprised three-thousand, nine hundred and thirty-one (3931) employees of accredited healthcare service firms in Lagos State. These health service firms were considered because they provide the qualitative and cost-effective healthcare and Medicare services to the individuals and companies and adjudged to have adopted modern IT equipment in discharging their services. The sampling unit for this study were ICT staff, data analysts, Chief Information Officer (CIO), Chief Medical Director (CMD), chief pharmacists, and chief lab technicians, and front desk personnel, who are responsible for data custody and in charge of information technology of the organisation and also policies makers related to adoption of Big Data Analytics for the selected healthcare service firms.

The sampling frame for this study is the list of employees from the 3, 931 health insurance/HMOs accredited and registered by Lagos State Health Management Agency; phamaceutical premises registered by Pharmacists Council of Nigeria (PCN), general hospitals; primary health care centres (Hospitals, Pharmaceuticals, Diagnostics centres, and Health

insurance companies/HMOs) in Lagos. A sample size of 676 participants was obtained using Cochran's sample size formula (1977) and utilized for the study. The study adopted mixed sampling techniques comprising purposive, proportionate and random sampling techniques. This study used purposive sampling technique to identify and select eligible Healthcare Service firms and the departments to be included in the study. Applying purposive sampling technique, this study sought data from people with practical knowledge in both Big Data Analytics and disease management. The sample was proportionally selected from the population. A pilot study was conducted using 10% of the sample size.

The study made use of a well-structured questionnaire adapted by the researcher which reflected the study objectives and questions. The questionnaire is based on a 6-point Likert-type scale ranging from "very high" to "very low." A pre-test of the questionnaire was conducted using 10% of the sample size as recommended by Connelly (2008) from other respondents with similar characteristics with the population of study. This was done in order to evaluate the relevance and proper understanding of the research instrument by the respondents. Data collected were analysed by descriptive and inferential statistical technique. Multiple linear regression analysis was applied to test hypothesis to establish the effect of the independent variables (agility capability, data driven decision making, business intelligence, information technology capability, IoT application software, and cloud computing) on the dependent variables (operational value). Statistical Package for Social Science (SPSS) version 27 software was used to process the data.

Equations to test the hypotheses formulated are:

$OVL = f(AC, DDDM, BI, ITC, IAS, CC)$

$OVL = \beta_0 + \beta_1 AC + \beta_2 DDDM + \beta_3 BI + \beta_4 ITC + \beta_5 IAS + \beta_6 CC + ei$ ---------- Eqn. 1

4.0 FINDINGS

Multiple linear regression analysis was used to test the hypothesis formulated. The independent variables are the dimensions of big data analytics (agile decision making, data-driven decision making, business intelligence, information technology capability, IoT application software, and cloud computing), and the dependent variable is operational value. In the analysis, the data for big data analytics was generated by adding together the responses of all the items under the various sub-variables to generate independent scores for each measure. To generate operational value data, the responses of all items under the variable were added together to create an operational value index. Table 1 presents the obtained results of the analysis and parameter estimates.

Table 1: Summary of Results of Linear Multiple Regression Analysis for Effects of Big Data Analytics on the Operational Value

Model	*B*	Beta	*T*-test	Sig.	*R*	Adjusted R^2	*F* (6, 556)	Sig.
(Constant)	-0.246		-1.047	0.296	0.966	0.932	1284.42	0.000
Agility Capability	0.122	0.122	3.352	0.001				
Data Driven Decision Making	0.197	0.199	4.561	0.000				
Business Intelligence	0.177	0.173	4.249	0.000				
Information Technology Capability	0.139	0.136	3.178	0.002				
IoT Application Software	0.189	0.190	4.555	0.000				
Cloud Computing	0.174	0.171	4.253	0.000				
Predictors: (Constant), Cloud Computing, Agility Capability, Information Technology Capability, IoT Application Software, Business Intelligence, Data-Driven Decision Making								
Dependent Variable: Operational value								

Source: Researchers' Findings 2023

Table 1 shows the results of multiple linear regression for the effect of big data analytics dimensions on operational value. Table 1 shows that the correlation coefficient (*R*) was 0.966, demonstrating a strong, positive, and statistically significant relationship between big data analytic dimensions and the operational value of chosen healthcare service organisations in Lagos State, Nigeria. The adjusted *R*-squared (R^{-2}) for the model was 0.932, indicating that big data analytics dimensions predicted 93.2% of the variations in the operational value of selected healthcare service firms in Lagos State and that variables other than big data analytics dimensions explained 6.8% of the variations in this study. The overall significance of the regression coefficients and *F*-test statistic at $p<0.05$ was 1284.42 (F (6, 556) = 1284.42), indicating that the big data analytics dimensions of cloud computing, agility capability, information technology capability, Internet of Things application software, business intelligence, and data-driven decision making were significant predictors of the operational value of selected healthcare service firms in Lagos State. This validates the statistical fitness of the model that links the dimensions of big data analytics to the sustainability of the chosen healthcare service organisations, expressed as operational value in this model.

Table 1 also displayed the resultant coefficients for the effect of big data analytics dimensions on the operational value of selected healthcare service firms in Lagos State, Nigeria. According to Table 1, agility capability (β = 0.122, t = 3.352, $p<0.05$), data-driven decision-making (β = 0.179, t = 4.561, $p<0.05$), business intelligence (β = 0.177, t = 4.249, $p<0.05$), information technology capability (β = 0.139, t = 3.178, $p<0.05$), IoT application software (β = 0.189, t = 4.555, $p<0.05$), and cloud computing (β = 0.174, t = 4.253, $p<0.05$) all have a positive and significant effect on the operational value. The results indicated that all the big data analytics dimensions are determinants of operational value of selected healthcare service firms in Lagos

State, Nigeria. Hence, the selected healthcare service firms should consider these variable in their big data analytics strategy to increase their sustainability through operational value. The established predictive and prescriptive regression equations for the direct effect of big data analytics dimensions on operational value are formulated as follows:

OV = -0.246 + 0.122AC + 0.197DDDM + 0.177BI + 0.139ITC + 0.189IAS + 0.174CC ------ Eqn. 2a (Predictive Model)

OV = -0.246 + 0.122AC + 0.197DDDM + 0.177BI + 0.139ITC + 0.189IAS + 0.174CC ------- Eqn. 2b (Prescriptive Model)

Where:

OV = Operational Value

AC = Agility Capability

DDDM = Data-Driven Decision Making

BI = Business Intelligence

ITC = Information Technology Capability

IAS = IoT Application Software

CC = Cloud Computing

The regression equations formulated show that holding big data analytics dimensions to a constant zero, the operational value of selected healthcare service firms would be -0.246, which is negative. This shows that inadequate application of big data analytics across selected healthcare service firms may have a negative influence on operational value. From the regression equations, the predictive model is the same as the prescriptive model, as all the dimensions of the big data investigated were statistically significant. The prescriptive model further depicted that a rise in agility capability, data-driven decision making, business intelligence, information technology capability, IoT application software, and cloud computing will lead to a 0.122, 0.197, 0.177, 0.139, 0.189, and 0.174 unit increase in the operational value of selected healthcare service firms, respectively. Based on the magnitude as shown by the beta coefficients, data-driven decision-making had the highest effect, followed by IoT application software, business intelligence, cloud computing, and information technology capability, while agility capability had the least effect. Based on these results, the null hypothesis (H0), which states that big data analytics dimensions do not have any significant effect on the operational value of selected healthcare service firms in Lagos State, Nigeria, was rejected. Based on the data in the tables above, big data analytics dimensions have huge positive impact on operational value of selected healthcare service firms in Lagos State, Nigeria.

4.1 Discussion

The study examined the effect of big data analytics on operational value of healthcare firms in Nigeria. Findings from the study revealed that agility capability, data-driven decision making, business intelligence, information technology capability, IoT application software, and cloud computing which all dimensions of big data analytic used in this research are strong and significant predictor of operational value. As a result, in order to promote operational value, which has the ability to enhance their sustainability, healthcare firms should invest in developing agility capability, promoting data-driven decision making, leveraging business intelligence, enhancing information technology capability, adopting IoT application software, and embracing cloud computing. These actions can contribute to improved operational value,

better patient care, and increased competitiveness in the healthcare sector. A considerable number of studies were found to support this result.

Some of the extant studies that are in consistent with this finding include Adrian et al (2018), Mandal (2019), Chatfield and Reddick (2018), Turet and Costa (2018), Kościelniak and Puto (2015), Wang et al. (2019) and Grander et al; (2021). Drawing on some of the studies mentioned above, the research conducted by Adrian et al. (2018) established that Data-driven decision-making offered improved insights for information value and create new business opportunity is in consonance and sync with the findings of this study. The findings is also comparable to the results of Mandal (2019) research who investigated the influence of Big Data Analytics capabilities on supply chain preparedness, alertness and agility an empirical investigation. The results indicated agreement with the output of this study that BDA planning, BDA coordination and BDA control are critical enablers of SC preparedness, SC alertness and SC agility.

Moreover, the findings corroborate Chatfield and Reddick (2018) in exploring customer agility and responsiveness through Big Data Analytics for public value creation: A case study of Houston 311 on-demand services. In their results, revealed that localized Big Data Analytics use by some of the 22 departments for enhanced customer agility and on-demand 311 services, city-wide systemic change in on-demand service delivery through Big Data Analytics use was not evident is in concordance. Therefore, the finding of hypothesis offer support for different previous studies in which big data analytics, help healthcare service firms to improve their ability to respond quickly to emerging challenges, such as changes in patient needs, resource allocation, and regulatory requirements. Also, by leveraging big data analytics, healthcare service firms can gain valuable insights from large volumes of data, enabling them to make informed decisions that lead to improved operational performance and patient outcomes.

5.0 CONCLUSION AND RECOMMENDATIONS

This study examined the effect of big data analytics dimensions on the operational value of healthcare service companies in Lagos State, Nigeria. The study specifically examined the effect of agility capability, data-driven decision making, business intelligence, information technology capability, internet of things (IoT) application software, and cloud computing on the operational value of healthcare service firms in Lagos State, Nigeria. The conclusion of the study is that big data analytics has an effect on the operational value of healthcare service firms in Lagos State, Nigeria.

On the basis of the findings of this study, it is deemed appropriate to recommend that big data analytics dimensions have a substantial impact on the operational value of healthcare service firms in Lagos State, Nigeria. By applying big data analytics to generate actionable insights, healthcare organisations can gain a deeper understanding of market dynamics, patient preferences, and operational efficiencies. This enables strategic planning, resource optimisation, and competitive advantage. The research recommends that the management of designated healthcare service firms in Lagos State invest in the improvement of their ICT tools, skills, and capabilities. Investing in big data analytics increases the value of services or operational value by a significant margin. Investing in the training of personnel on big data analytics enhances their analytical skills. Skilled personnel in the healthcare sector in Lagos State, across the spectrum of data analytics roles, are in short supply, and those who are available are now migrating to developed nations such as Canada, the United Kingdom, the United States, and Australia, to name a few, in search of greener pastures. Consequently, it is crucial to take aggressive measures to resolve this issue.

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