

DATA MINING (DM) BUSINESS INTELLIGENCE SYSTEMS AND PERFORMANCE OF MULTINATIONAL OIL AND GAS COMPANIES IN SOUTH-SOUTH, NIGERIA

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ABSTRACT

This paper surveyed Data Mining (DM) Business Intelligence Systems and Performance of Multinational Oil and Gas Companies in South-South, Nigeria. It examined how Data Mining (DM) Business Intelligence Systems enhance the Performance of Multinational Oil and Gas Companies in South-South, Nigeria. Based on the nature of the study, cross-sectional survey approach was applied to enhance effective data collection and analysis. The study population consisted of five Multinational Oil and Gas Companies operating in the six States of South-South Nigeria. The accessible respondents from each states were thirty-three, the sum of the respondents from the six states were one hundred and seventy-six (176), this constituted the elements for data analysis. Structured questionnaire was designed on a 5-point Likert scale for accurate rating of the responses from the respondents. One hundred and seventy-six (176) copies of questionnaire was distributed to the various Oil and Gas companies in South-South, Nigeria, out of which one hundred and fifty (150) copies of the questions were properly completed, these were the number of copies used for data presentation and analysis (descriptive and bivariate). The results of the correlation coefficient showed that there was a significant positive relationship between Data Mining (DM) Business Intelligence Systems and Performance of Multinational Oil and Gas Companies in South-South, Nigeria. Data Mining Business Intelligence Systems is viewed as an important tool that enhanced performance, especially in Oil and Gas Companies in South-South, Nigeria. It is therefore recommended that Multinational Oil and Gas that are desiring to improve their Performance in terms of quality service delivery and responsiveness should implement Data Mining Business Intelligence Systems in their organization.

Keywords: Data mining, Business Intelligence, Organizational performance, Quality Service delivery and Responsiveness

INTRODUCTION

Multinational Oil and Gas Companies are data driven organizations, they require huge amount of data from distributed databases and data warehouse. This is beyond the capability of the relational databases and data warehouses, it is classified with high volume, high velocity and varieties commonly referred as big data (Muhammed & Syed, 2020). Data mining is the discovery of hidden data pattern in organizational databases and data warehouse, data mining is also referred to as knowledge discovery (Mostafa & Mahmoud, 2022)). Data Mining is an integral part of Business Intelligence (Al-Ajlouni, Al-Maaitah, & Al-Maaitah, 2024). The use of data mining in organization supports strategic decision-making, and enhanced competitive edge over other competitors (Al-Ajlouni, Al-Maaitah, & Al-Maaitah, 2024). Business Intelligence (BI) is a process driven by technology, it analyzed business data in order to provide information that can be used by business executives and managers to make better informed decisions (Jake, 2024). According to Tripathi, Bagga and Aggarwal (2020) Data mining is the extraction of hidden predictive information from large databases; it is a powerful technology with great potential to help organizations focus on the most important information in their data

warehouses. It refines data, rendering it valuable insight for informed decision making (Yang, Liu, Li & Jia, 2020).

Data mining play the role of uncovering hidden patterns, relationships, and trends within large datasets. Data mining enable the multinational to gain deeper understanding of their customers, operations, product and market trends, it improved operation, personalize customer experiences, and improve forecasting accuracy (Gupta & Chandra, 2020).

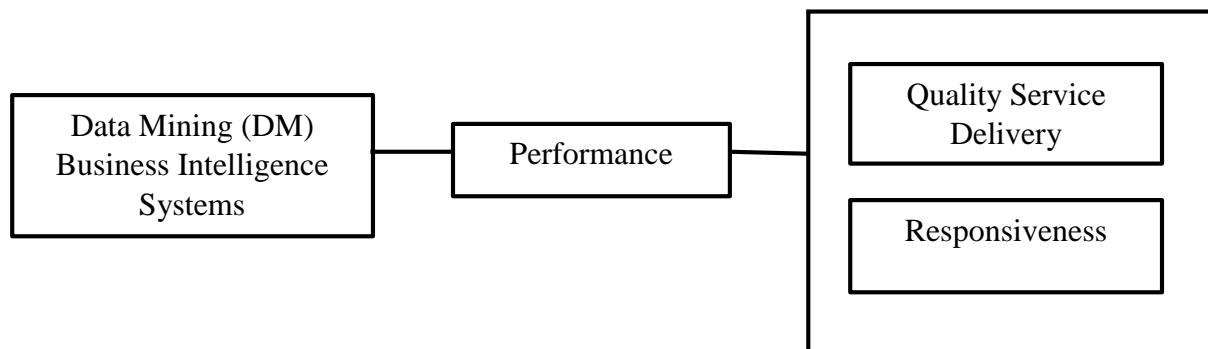


Figure 1: Conceptual Framework

THEORETICAL UNDERPIN

This paper anchored in Resource-Based View Theory. Barney's 1991 proposal of the main concepts of the RBV was considered one of the most influential ideas in the RBV (Foss & Knudsen, 2003). In the article, Barney (1991) examines the link between firm resources and sustained competitive advantage. He argued that Sustained competitive advantage comes from exploiting "internal strengths, through responding to environmental opportunities, while neutralizing external threats and avoiding internal weakness" (Barney, 1991). The firm identifies opportunities and threats (external analysis) as well as its internal strengths and weaknesses (internal analysis), and then defines what the strategy should be. Now, the firm has certain heterogeneous resources over which it has control. Barney defines firm resources as including: "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by the firm". Only with appropriate data mining is it possible to set a range of activities and strategies constrained by the firm's assets, but also by their interaction (Barney, Ketchen. & Wright, 2011). Therefore, it is important to understand the relationship between these components for management to take informed decision in organizations.

CONCEPT OF DATA MINING

Analyzing and Linking of business activities has gained more focus in recent years because of its viable potential in shaping employee attitude and work behavior for the attainment of business sustainability (Obagbuwa, Oladipupo & Atiku, 2019). However, exploring data mining for hidden pattern discovery is still an innovation in business organization (Obagbuwa, Oladipupo & Atiku, 2019). Data is the fuel that powers the corporate economy of the 21st Century. It's key to unlocking human productivity in every area of life, especially in information management and the main tool in problem-solving. It helps in future road mapping and numerous business processes that keep the profit-wheel rolling through simplified data sharing. It leverages the organization to limit the data sharing task (Alminqash, 2020).

According to Han and Kamber (2006) data mining refers to extracting or mining knowledge from large amounts of data. The term is actually a misnomer. Remember that the mining of

gold from rocks or sand referred to as gold mining rather than rock or sand mining. Thus, the data mining should have more appropriately been named knowledge mining from data, which is unfortunately somewhat long. Knowledge mining, a shorter term may not reflect the emphasis on mining from large amounts of data. Nevertheless, mining is a vivid term characterizing the process that finds a small set of precious nuggets from a great deal of raw materials.

Data mining tools are designed to identify relationships and rules within a data warehouse, it then creates a report of these relationships and rules (Singh & Singh, 2021). The data mining process involves discovering various patterns, generalizations, regularities and rules in data resources. Knowledge from data mining may be used to predict an outcome of a decision and can also describe reality. The predictions generated by data mining use known variables to predict the outcome of a situation, while reality is measured by graphing, tabling, and creating formulae based on the existing data (Olszak, 2016). There are several basic strategies for data mining. The most common are: classification, estimation, prediction, time series analysis, and market basket analysis (Chien & Chen, 2008). These strategies can be aligned with the needs of an organization and help decision making by discovering various patterns, generalizations, regularities and rules in data resources.

Han and Kamber (2006) maintained that the major reason data mining has attracted a great deal of attention in information industry in recent years is due to the wide availability of huge amounts of data and the imminent need for turning data into useful information and knowledge. The information and knowledge gained can be used for applications, ranging from business management, production control and market, to analysis, to engineering design, medical and science exploration. Data mining tools are designed to establish relationships and rules in a data warehouse and then create a report of these relationships and rules (Hevner & March, 2005). The process of data mining involves ascertaining the patterns, regularities, rules and generalizations of data resources. Knowledge from mining of data might be utilized to project an outcome of a decision or to describe a reality. The prediction that is produced by data mining utilize variables to forecast the outcome of a situation which is determined by graphing, tabling and developing formulae in line with the available data (Olszak & Ewa, 2007)

The first concept associated with a large amount of data is “Data Mining”. Data Mining (DM) is a process which discovers the patterns and relations within data by using many analytical tools; and uses such patterns and relations for making valid estimations (Saad, Nagarur & Shamsan, 2021). The purpose of data mining is to create decision making models related with estimation of the future conducts based on the analysis of the past activities (Koyuncugil & Özgülbaş, 2009). Data mining is capable of evaluating the outcome of the natural development process of the information technologies. Very large scale data may be considered as a data mine which accommodates valuable data within their large scale databases in different fields (Kavika, 2022). Data mining is defined as the process of producing meaningful information, which was unknown previously, based on such data (Khademizadeh, Rafienasah & Iran 2023). It is the process of revealing the previously undiscovered information based on various data maintained in data storages and using them for realizing the action plan. At this point, it is not a solution alone but it is also a tool which supports the decision making process to reach the solution and which provides information required for solving the specific problem (Khademizadeh, Rafienasah & Iran 2023), it is the process of extracting information from large data sets while data analysis is the process used to find patterns from the extracted information.

It trawled through data to find previously unknown relationships among the data that are interesting to the user of the data (Spring, Faulconbridge & Sarwar, 2022). Data mining is the process of analyzing data from different perspectives and summarizing it into useful information". As a whole, Data mining can be understood as the process to extract valuable knowledge from big data "its techniques are the results of a long process of research and product development" (Singh, Gosawi & Dubey, 2014). Moreover, several terms having a similar meaning to DM emerged such as knowledge mining from data, knowledge extraction, data/pattern analysis, data archaeology, and data dredging (Li, Yu, Zhang & Xiang, 2020). Some researchers see data mining as an entire Knowledge discovery in Data bases from Data (KDD), so they tend to use "data mining process" instead of "KDD process" while some people describe data mining as a sub process in knowledge discovery of databases (KDD) with the other sub processes including data cleaning, data integration, data selection, data transformation, pattern evaluation, knowledge presentation (Hariri, Fredericks & Bowers, 2019).

Data analysis is a primary component of data mining (Gupta & Chandra, 2020). Chen and Liu (2018) opined that organizations are now able to extract important knowledge and insights from enormous volumes of information because to the exponential expansion of digital data. Big data analysis and collecting, in particular, provide substantial privacy-related difficulties. Data mining and analytics methods that respect individual privacy offer a way to take use of big data's advantages while respecting privacy. In the context of big data analytics, this suggested solution presents a thorough architecture that solves privacy issues (Chen & Liu, 2018). Data mining term always contain "data analysis". However, following Vilela, Leme, Pinheiro & Carpinteiro ((2019). data mining uses well-established statistical and machine learning techniques to build models. Consequently, DM can contain statistical and machine learning. Data characterization is a synopsis of general features of the target class of data. For example, to study who and which group or age are susceptible to depression; the data involved in depression can be collected by executing SQL queries (Sarker, 2021).

Data mining assists in obtaining information and resolving issues through the execution of various duties. Since this technology can carry out one or more of the abovementioned duties (Deshpande, 2021). Data mining identifies unexpected relationships by analyzing and extracting knowledge from vast quantities of data made available by theoretical and scientific methods. In the same context, data mining is viewed as scouring for data to remove valuable information from a large database or sub-data warehouse (Chandra & Gupta, 2018). Therefore, these systems enable firms to make informed decisions, resulting in accurate predictions and advantageous outcomes (Durand & Hattingh, 2020; Gupta & Chandra, 2020). This is consistent with the objective of data mining, which is to facilitate decision-making processes via prediction and scenario formulation. Decision support systems that combine data with personal insights employ mathematical models for prediction and simulation. Forecasting models, driven by quantitative methods and computer technology, provide decision-makers with timely forecasts and vital information for mitigating risks and avoiding potential crises (Sarker, 2021). Data mining process includes problem identification and definition, data collection, cleaning, integration, transformation, application of mining techniques, pattern discovery, evaluation, knowledge presentation, and utilization, all of which contribute to the objective of extracting valuable insights and facilitating informed decision-making (Dogan & Birant, 2021). Data mining is known as a knowledge discovery in database (KDD). certainly, the database is the storage for data. If there are considerable magnitudes of data, the information from those data is needed to be extracted in a format to be symbolized as information. In fact, it is a difficult process to extract information from considerable databases. Data mining is technique of

analyzing a lot of data and abstracting it to detect a model and expose the knowledge due to this knowledge which is obtained from information which is taken out from data. Though, statistics, machine learning, pattern recognition, and revolutionary systems have utilized data mining widely. These procedures of data mining indicate to a substantial area of decision-making (Reddy, 2011).

PERFORMANCE OF MULTINATIONAL OIL AND GAS COMPANIES IN SOUTH-SOUTH NIGERIA

Oil and gas Companies in South-South, Nigeria are rightly positioned to be major key players in the international market. In almost a decade now the government and the oil and gas industry practitioners in Nigeria have sort to provide quality services and products that can compete favorably with any other multinationals in the globe. To achieve this feat, there is the need to achieve quality service delivery through Quality Management System (QMS). Quality Management System is a general and regular methodology that has become one of the most popular solution strategies for productivity improvement. Effective quality delivery is driven by the need to increase performances of business units in terms of quality, efficiency, customer's satisfaction and profitability (Sadikoglu & Zehir, 2010). Like other standards QMS ensures vital features such as quality, ecology, safety, reliability, compatibility, interoperability, efficiency and effectiveness. It facilitates trade, spreading of knowledge and sharing of technological progress and good management and leadership practices (Dublin & Onuoha, 2020). It is essentially driven by the fundamentals of quality. Quality in services can be assessed both at the macroeconomic level by indicators such as value added tax, investments, employment, and at microeconomic level by performance and competitiveness (Spring, Faulconbridge & Sarwar, 2022). For oil and gas companies in developing cities such as South South, Nigeria, relevance and business sustainability is assessed by these microeconomics indexes highlighting the importance of Service Quality driven by an efficient Quality Management System. In recent times, various researchers have carried out a lot of studies on quality management systems. Worrell, Laitner, Ruth, & Finman (2013) for instance investigated the improvement of service quality. Pfeifer, Reissiger and Canales (2004) identified that quality management systems sigma must be integrated with management systems concepts, they recommended a combination of their common features for maximum profit.

Every organization carry out its business activities in a specific business environment, the environment in which these organizations operate is known to have a grip of influence on their operations. It is an obvious fact, that many firms conduct their business in environment whereby they are expected to meet expectations and needs of its diverse publics, hence the need to formulate strategies that would help them not only meet their need but surpass the expectations in a bid to accomplish goals (Ambie, 2021). Responsiveness enables organizations to detect market changes quickly, reconfigure their processes to meet new market requirements, share information across organizational units, take maximum advantage of information processing systems, and adopt new product and process technologies ahead of competitors (Ekweozor, & Obara, 2020). Change is the only certain and consistent phenomenon in the business-scape; and marketers plan and provide for change with a view to reducing its negative effect on their operations (Ebenuwa, 2022; Ateke & Nwulu, 2021). The marketers have increasingly come to terms with is increased enlightenment and sophistication of today's customers; highly disruptive transformation that characterize the business environment; globalization of markets that has weakened national boundaries and socio-economic and health concerns that ravage the world. Most institute therefore, deliberate programmes and practices

that enhance their capacity to effectively and timely respond to market-dynamics, by adapting their operations to emerging challenges or at least, rebound from setbacks (Ateke & Nwulu, 2021).

Responsiveness is also the ability to configure or reconfigure resources and processes to respond promptly to environmental demands (Ebenuwa, 2022). It represents the ability to respond to market demands in terms of quality, speed and flexibility (Asree, Zain, & Razalli, 2010). From service-marketing perspective, responsiveness is related to the willingness to help customers and speed of service delivery; while from operations management perspective, it is related to the speed and variety of products offered (Nwulu & Ateke, 2018). According to their study, however takes an integrated view of responsiveness and represents it as the ability to respond promptly to market shifts, as well as the willingness to (re)configure marketing programmes, practices and activities to deliver consistent value and maintain a consistent image. Responsiveness is thus a cumulative capability in terms of multiple performance measures such as quality, speed and flexibility (Hoyt, Huq, & Kreiser, 2007). It is an aspect of the market orientation construct where it represents the swift and seamless response to market intelligence about current and future market situations; as well as threats and opportunities embedded in those situations. It entails the capacity to speedily summon individual and collective competencies to address issues relating to the firm itself, its customers, as well as all other factors in the environment (Hoyt, Huq, & Kreiser, 2007).

The ability and capacity to respond to challenges posed by the environment is often a strategic one for most marketers. Organizational responsiveness refers to the organization's propensity to act based on market information generated. It is the capacity for change expressed through its learning and the incorporation of related knowledge in the behaviour and actions of the organization (Hult, Ketchen & Slater, 2005). From their own perspective (Hult, Ketchen & Slater, 2005) described organizational responsiveness as information utilization within the organization, which was composed of two sets of activities, namely (a) response design and (b) response implementation. Hult, Ketchen and Slater (2005) also described organizational responsiveness based on the organization's capacity to identify the specific needs and challenges of its market and also the capacity to adapt its features and services to suit and address the identified needs. However, according to Day (2005), the need for organizational responsiveness is hinged on the inevitability of change and the volatility of the environment of the organization (Hult, Ketchen & Slater, 2005). Scholars tend to agree that the organization's capacity for responsiveness is one of the factors that drive the organization's relevance and functionality (Ngo & O'Cass, 2012), especially since responsiveness is considered a major factor in service quality (Day, 2005: Hill & DeLisi, 2021).

Data Mining Tool and the Performance of Oil and Gas in South-South, Nigeria.

Data mining tools are designed to identify relationships and rules within a data warehouse, and then create a report of these relationships and rules (Hevner & March, 2005). The data mining process involves discovering various patterns, generalizations, regularities and rules in data resources. Knowledge from data mining may be used to predict an outcome of a decision and can also describe reality. The predictions generated by data mining use known variables to predict the outcome of a situation, while reality is measured by graphing, tabling, and creating formulae based on the existing data (Olszak & Ziemba, 2007). As for conceptualizing organizational performance, there has often been confusion between "productivity" and "performance". Productivity is typically measured by computing the ratio of the volume of work completed by the organization over a given period of time. While this is important, particularly when the focus of investigation is on the financial results of a particular strategy,

performance is actually better understood as a broader concept that includes not only measures of result-oriented behavior such as productivity but also relative (normative) measures such as effectiveness, efficiency, economy, quality, consistency behavior and development and implementation of tools necessary for building skills and attitudes of performance management (e.g., education and training, concepts and instruments) (Ghamari, Zeinabadi, Arasteh & Behrangi, 2018). Effective quality delivery is driven by the need to increase performances of business units in terms of quality, efficiency, customer's satisfaction and profitability (Hill & DeLisi, 2021). Overall, measuring organizational performance is critical for organizations that want to remain competitive, identify areas for improvement, and make informed strategic decisions. By taking a balanced and comprehensive approach to measuring performance, organizations can achieve their objectives, build trust with stakeholders, and create long-term value (Anderson & Trujillo, 2022).

METHODOLOGY

The research design adopted in this study was the Cross-sectional design which involves the collection of data from the respondents or the population members. This study was thus structured based on the adoption of the quantitative methodology.

DATA ANALYSIS, RESULTS AND INTERPRETATION

Table 1: Data Mining Respondents Rate

	N	Mean	Std. Deviation
To what extent does data mining tool turn data into useful information and knowledge?	150	3.207	1.5030
Data mining tools are designed to establish relationships and rules in a data warehouse and then create a report of these relationships and rules.	150	3.213	1.3979
Knowledge from mining of data might be utilized to project an outcome of a decision or to describe a reality.	150	3.307	1.4514
To what extent does the purpose for data mining create decision making models related with estimation of the future conducts based on the analysis of the past activities?	150	4.160	1.2905
Valid N (listwise)	150		

Source: Research survey, 2024

Table 1: Showed the respondents rate on data mining too. Question one showed that data mining tool turn data into useful information and knowledge with a mean of 3.21 and standard deviation of 1.5030, question two showed that data mining tools are designed to establish relationships and rules in a data warehouse and then create a report of these relationships and rules with a mean of 3.21 and standard deviation of 1.3979, question three indicated that knowledge from mining of data might be utilized to project an outcome of a decision or to describe a reality with a mean of 3.31 and standard deviation of 1.4514 and lastly question four showed that does the purpose for data mining create decision making models related with estimation of the future conducts based on the analysis of the past activities with a mean of 4.16 and standard deviation of 1.2905. All the calculated means were above the criterion mean of 3.00 for a 5-point Likert-type scale therefore the respondents rate are classified as high.

Table 2: Quality Service Respondents Rate

	N	Mean	Std. Deviation
To what extent does Business intelligence systems support increase performance of business units in terms of quality, efficiency, customer's satisfaction and profitability?	150	4.180	1.4002
To what extent can you rate your organizational quality in terms of performance?	150	4.133	1.1853
To what extent can you rate your organization in terms of customer's satisfaction?	150	4.107	1.3910
To what extent can you rate your organizational quality in terms of ecology?	150	4.267	1.2406
Valid N (listwise)	150		

Source: Research Survey, 2024

Table 2 showed the respondents rate on quality service delivery. Question one showed that Business intelligence systems supports increase performances of business units in terms of quality, efficiency, customer's satisfaction and profitability with a mean of 4.18 and standard deviation of 1.4002, question two showed that because of the application of business intelligence the organization make high profit with a mean of 4.13 and standard deviation of 1.1853, question three showed that customers are satisfied with the product and services with a mean of 4.11 and standard deviation of 1.3910 and lastly question four showed that the oil and gas maintain a high level of ecology with a mean of 4.27 and standard deviation of 1.2406 respectively. This description was classified as high.

Table 3: Responsiveness Respondent's Rate

	N	Min.	Max.	Mean	Std. Deviation
Able to meet expectations and needs of its diverse publics or customers	150	1.0	5.0	4.313	1.2856
Formulate strategies that would help them not only meet their need but surpass the expectation in a bid to accomplish organizational goals	150	1.0	5.0	3.467	1.1853
Detect market changes quickly and configure their processes to meet new market requirements, share information across organizational units.	150	2.0	5.0	4.220	1.1636
Able to adopt new product and process technologies ahead of competitors	150	1.0	5.0	3.613	1.3893
Valid N (listwise)	150				

Source: Research Survey, 2024

Table 3 showed that respondents rate on responsiveness. Question one showed that the organizations are able to meet expectations and needs of its diverse publics or customers with a mean of 4.31 and standard deviation of 1.2856, question two showed that the management formulate strategies that helped them not only meet their need but surpass the expectation in a bid to accomplish organizational goals with a mean of 3.47 and standard deviation of 1.1636 and question three supported that managements are able to detect market changes quickly and configure their processes to meet new market requirements, share information across organizational units with a mean of 4.22 and lastly question four supported that managements are able to adopt new product and process technologies ahead of competitors with a mean of 3.61 and standard deviation of 1.3893 respectively. The various mean was all above the criterion mean of 3.00 for a 5-point Likert-type scale, therefore the respondents rate was classified as high.

SUMMARY AND RECOMMENDATION

This paper surveyed data mining (DM) business intelligence systems and performance of multinational oil and gas companies in South-South, Nigeria. Data mining is a real time information technology (analytical) tool, capable of mining huge amount of data from distributed databases and data warehouse in real time, it analyzed the data mined from the different databases and using the various data mining techniques such as classification, cluster, predictive, sequential etc. to review the hidden patterns that exist between the data in the database or data warehouses. Appropriate data mining enhanced timely decision making which supports quality service delivery in organizations. As a real time tool, it is responsive and capable of finding solution to problems that exist in organizational databases and data warehouses in real time. Therefore, the multinational organizations desiring to enhance their performance in terms of quality service delivery and responsiveness should adequately implement data mining business intelligence systems in their respective organizational management information systems (database and data warehouse).

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