EXTRACT TRANSFORM AND LOAD (ETL) BUSINESS INTELLIGENCE SYSTEMS AND PERFORMANCE OF MULTINATIONAL OIL AND GAS COMPANIES IN SOUTH –SOUTH, NIGERIA

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ABSTRACT

This paper surveyed Extract Transform and Load Business Intelligence Systems and Performance of Multinational Oil and Gas Companies in South-South, Nigeria. The general purpose of this study was to examine how Extract Transform and Load Business Intelligence Systems enhanced the Performance of Multinational Oil and Gas Companies in South-South, Nigeria.   The study adopted the cross-sectional survey approach for effective data collection and analysis. The population of this study consisted of five (5) Multinational Oil and Gas Companies that are operating in the six (6) States of the South-South Nigeria, this sum up the number of accessible companies to be thirty-three (33) from all the States. To eliminate bias, equal number of questionnaire were apportioned to the Multinational Oil and Gas Companies of the various States, which implies that each of the Multinational Oil and Gas Companies were adequately represented without bias. A total of thirty- three (33) respondents were distributed to each of the state that sums up to one hundred and seventy-six (176) respondents that formed the sample size. Structured questionnaire was designed on a 5-point Likert scale to collect data from the respondents of which out of the one hundred and seventy-six (176) copies of questionnaire distributed; one hundred and fifty (150) copies of the questionnaire was properly completed, retrieved used for the analysis.   The results of the correlation coefficient showed that there is a significant positive relationship between Extract Transform and Load Business Intelligence Systems and Performance of multinational oil and gas companies in South-South, Nigeria. It was therefore, concluded that Extract Transform and Load Business Intelligence Systems is an important Information System that improved Performance, especial in Oil and Gas Companies in South-South, Nigeria. Based on our conclusion, it was therefore recommended that Organizations that desire to improve their Performance in terms of quality service delivery and goal achievement, should implement Extract Transform and Load Business Intelligence Systems in their organization to enhance quality service delivery and goal achievement.

INTRODUCTION

In order to facilitate decision-making; complex IT-systems are assigned with the task of integrating heterogeneous data derived from algorithm for processing, loading, data analytics and storage of processed data to data warehouses, in a process known as Extraction Transformation Loading (ETL) and distribution for effective and efficient decision making (Miškuf, & Zolotova, 2015). This integration happens in real-time, commonly referred to as automated or data-centric business processes in a variety of workflow-based tasks (Ma, Gao, & Gu, 2015). Due to the amount of data received by oil and gas companies, they are always faced with the problem of data analyses. The volume of data at their disposal is always beyond the traditional tools. When data beyond the operational capability are received, it is difficult to turn the predefined periodic off-line mode execution into a dynamic, continuous operation that sufficiently meets the need of end-users (Ma, Gao, & Gu, 2015).

Oil and gas is a global economic sector, therefore, the traditional method of physical data acquisition and manual computation is no longer a global practice; Information Technology and Communication (ITC) is now the new tool of the modern businesses, government and nonprofit

organizations. The introduction of the new information communication and technology and the Internet of Things (IoTs) has drastically changed business concepts and operations; especially in the multinational oil and gas sector. Oil and gas sector is a global economic concern that needs to be integrated with global best practices. Business intelligence systems use dedicated mathematical and statistical tools; in which with the aid of information communication and technology components such as databases, data warehouse, data mining, extract, transform and load; and online analytical processing, are designed to deliver error-free results to the users. Business intelligence systems, as a real-time tool (internet), operates on a high speed which the natural human efforts cannot attain, therefore it is capable of maximizing the input variable to achieve greater level of output.
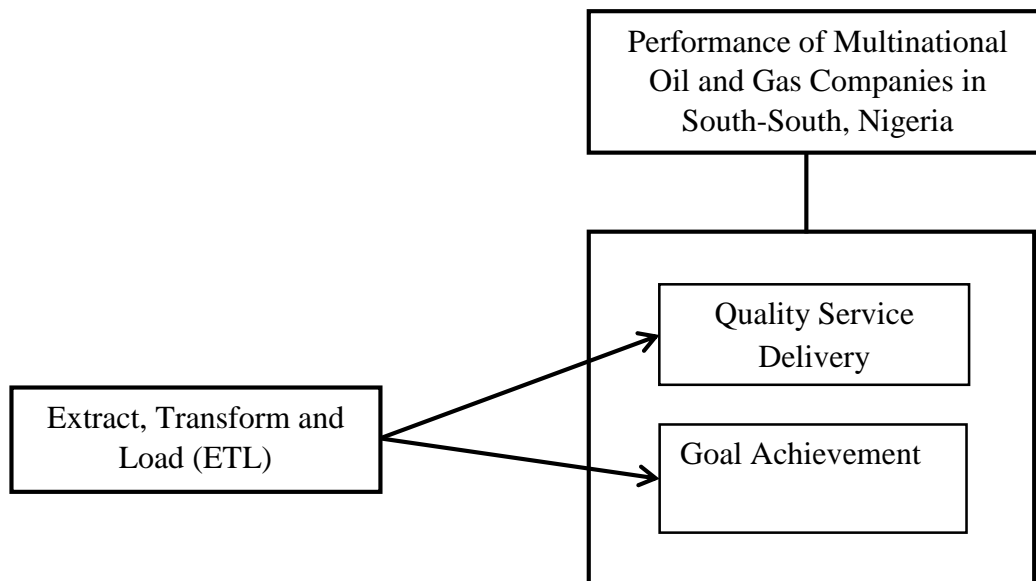

Figure 1: Conceptual Framework

THEORETICAL FRAMEWORK

This study anchored in the Socio Technical System Theory by Trist and Bamforth in 1951. It was coined from the two words social and technical. Socio (of people and society) and technical (of machines and technology) is combined to give 'sociotechnical. This theory is formed on the principles that the interaction of social and technical factors creates the conditions for successful (or unsuccessful) system performance. The socio-technical approach distinguishes between various dimensions of a given system through the concept of a subsystem. They identified the dimensions of a socio-technical system as socio-psychological, referencing the people and denoting the human aspects; the technological, as referring to the artifacts or the things; and the economic, as representing the effectiveness of interactions between the human and technological resources (Trist & Bamforth, 1951). Sociotechnical systems take the concepts and metaphors of general systems theory, in particular the notion of 'open systems' (Bertalanffy, 1950), as a way of describing, analyzing and designing systems with joint optimization in mind, particularly those that embody some degree of non-linearity within themselves as well as the environment they reside in. Sociotechnical systems theory, the term used throughout the current article (and seemingly the term in most widespread use at the present time) reflects certain specific methods of joint

optimization in order to design organizations that exhibit open systems properties and can thus cope better with environmental complexity, dynamism, new technology, and competition. This theory is adequate for this study because of the technical nature of Extract Transform and Load (ETL).

LITERATURE REVIEW

Concept of Extract Transform and Load (ETL)

Extract Transform and Load is a set of processes for collecting, filtering, cleaning and converting data mined from distributed database into the format suitable for storing and further analysis (Olszak & Zurada, 2015). The ETL process consists of Extracting, Transforming, and Loading processes. Extracting is the process of selecting and retrieving data from a data set of a company. Transforming is the process of cleaning and changing the data structure from its original to a form that suits the needs of the data warehouse. Load is the last process that functions to enter data into the Data Warehouse (Olszak & Zurada, 2015). The use of the warehouse data in companies aims to assist the process of storing and presenting data so that the companies can record all structured transactions. The application of the data warehouse is a place for data synchronization in which data structured equalization occurs so that the transaction data can be received in the data warehouse (Dhamotharan, 2023). The synchronization process in the data warehouse is known as the ETL (Extract, Transform, and Load) process which bridges the transaction data with the data warehouse storage media (Dhamotharan, 2023).

Business Intelligence (BI) is a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions (Watson, 2009). Data warehouses (DW) stand as the cornerstone of BI systems. According to Issa, Paris, Hamdi, and Cherfi (2019), Data Warehouses are subject-oriented, integrated, time-variant, non-volatile collection of data in support of management's decision-making process. Business Intelligence (BI) architecture deals with data gathered from company operational databases and e`xternal data. Gathered data is heterogeneous, and has different types and formats. Before being loaded into the Data Warehouse, these data are transformed and integrated using the ETL process (Vassiliadis, 2009). ETL tool increases data quality. Data quality characteristics which is seen as "fitness for use" and its assurance is recognized as valid for important activity, but in practice only a few people list it the highest priority (Macura, 2014). The quality of the data depends to a great extent on the use of data and synergies of customer needs, the usability and the access of data (Wang, & Strong, 2016). Therefore, during evaluating and improving data quality, the involvement of data users and other data groups is important because they play a high role in data entry, data processing, and data analysis (Pipino, Lee & Wang, 2002).

ETL tools play a vital role in data warehouses and data management systems. They are responsible for extracting data from multiple operational data source systems, cleaning, transforming as per business logic and loading it into a data warehouse (Mitesh, 2021). Data Warehouse will act as the source for reporting and data analytics environment. Extract, Transform, and Load jobs, are critical components of data processing (Mitesh, 2021). Its jobs is to extract data from various sources, transforming the data to make it consistent and usable, and then loading the data into a destination system, like a data warehouse or a data lake (Hameed et al. 2013). The importance of ETL jobs lies in their ability to enable organizations to make sense of their data by bringing it together from different sources and preparing it for analysis (Dhamotharan, 2023). Without ETL, data would

remain in silos, scattered across different systems and in different formats, making it difficult to gain insights and make data-driven decisions. ETL jobs allow organizations to consolidate, clean, and transform their data, making it accessible and useful for reporting and analysis (Dhamotharan, 2023).

The concept of Business Intelligence (BI) is not new and has been applied by many companies and other organizations. Lately, it has become even more popular because it includes concepts like analytics, big data and artificial intelligence that form an integral part of digital transformation, an important concept for business executives in companies of all sizes and industries, especially in the oil and gas sector. Decision-making based on BI use is valuable for organizations that have the ultimate goal of increasing their organizational performance (Audzeyeva and Hudson, 2016). Studies by Audzeyeva and Hudson (2016) show this promise is only realized when the information provided by BI is readily used to improve decision-making and, in turn, business processes, products, services, innovation, and agility.

Accordingly, it is recognized that BI (ETL) plays the role of an enabler, facilitating the organization's making of better decisions based on the information (Larson and Chang, 2016). Business Intelligence Extract Transform and Load Tool seem to have an indirect impact on organizational performance. By taking a holistic approach to ETL performance improvement, organizations can achieve more efficient and effective data pipelines and improve their ability to manage and analyze large amounts of data.

 ETL performance is important for several reasons. First, ETL jobs are typically used to load data into data warehouses or data marts. Data warehouses and data marts are used to support business intelligence activities such as reporting, analysis, and decision-making. If the ETL jobs that populate these systems run slowly, it can impact the timeliness and accuracy of the information available to decision-makers. Secondly, poor ETL performance can lead to data quality problems. For example, if an ETL job is extracting data from multiple sources and one of those sources change frequently, the ETL job may not be able to keep up with the changes and load them into the target system accurately. This can result in incorrect or outdated information being stored in the target system.

Oil and gas Companies are integrated global firm that require advanced tool to increase their performance in terms of quality services and achievement goals and to ensure business survival in a competitive global environment (Abubakar, 2016). The oil and gas sector in Nigeria had been criticized by many people regarding its failure to render quality services and for not achieving both social (environmental responsibility to the people in its immediate environment, increasing environmental degradation regarding air and water pollutions that had affected drinkable water, ocean fish and destruction of industrial machine) and financial goal (Uwaoma & Ordu, 2016). Business Intelligence nowadays involves identifying, extracting, and analyzing large amount of business data coming from diverse, distributed sources (Miškuf, & Zolotova, 2015). In order to facilitate decision-making, complex IT-systems are assigned with the task of integrating heterogeneous data deriving from operational activities and loading of the processed data to data warehouses, in a process known as Extraction Transformation Loading (Miškuf, & Zolotova, 2015).

This integration requires the execution of real-time, automated, data-centric business processes in a variety of workflow-based tasks (Ma, Gao, & Gu, 2015). One of the major challenges facing the oil and gas Companies in Nigeria is the inability to analyzes the volume of data at their disposal. There is how to turn the integration process design, which has been traditionally predefined for periodic off-line mode execution, into a dynamic, continuous operation that sufficiently can meet end-user needs. The migration of the data into the data warehouse using conventional ETL tools and methods performed on large sets of data creates information latency problem because of the time required to perform the ETL function and migrate the data to a separate OLAP platform. Real-time data exists in the OLTP (Online Transaction Processing) environment where the time horizon of data within the OLTP environment is much shorter because performance decrease can occur with growing amounts of data. This is opposite of the nature and goals of the OLAP environment where data is aggregated and the time horizon of data grows to some large amount as determined by the information life cycle policy of the organization.

Oil and gas Companies receive data from different sources, and they exist in different formats, structure, semi-structure and unstructured. ETL (Extraction-Transformation-Load) tools are responsible for extracting these different structured data, transforming and load the data for Online Analytical Process (in real time). Extraction involves obtaining access to data originating from different sources (databases, text files, HTML, XML documents and/or e-mail). As a result of extraction, data are usually stored in the relational database significantly facilitating further data processing at the transformation stage (Larson, 2008). Transformation of data is considered to be the most complex stage of the ETL process. The process is usually performed by means of traditional programming languages, script languages or the SQL language. Data transformation means data unification, calculation of necessary aggregates, identification of missing data or duplication of data. Data transformation rules may concern principles of physical data structure unification, business principles that ensure compatibility with a modeled domain and business principles that ensure semantic compatibility between related data. Data loading involves providing data warehouses with data that are aggregated and filtered (Larson, 2008).

Performance of Oil and Gas Companies in South-South, Nigeria

According to Richard, Devinney, Yip, & Johnson, (2009), organizational performance includes three specific areas of firm outcomes, it can be in the form of financial performance (profits, return on assets, return on investment, etc.) or quality services which may result to product market performance (sales, market share, etc.); and shareholder return (total shareholder return, economic value-added, etc.). Technical and technological potential, equipment quality, know-how, employee qualification, productivity level, etc. are factors that determine the present and future competitiveness of the enterprise and hence of its financial performance through financial policies (capital accumulation, investment, productive capital management). External socio-economic and political factors and internal factors (organization's structure and culture, strategy, management skills, employee's commitment, and stakeholders' implication) also influence the performance of the organization (Larson and Chang, 2016).

Oil and gas Companies in South South, Nigeria are rightly positioned to be major key players in the industry the world over. In almost a decade now the government and the oil and gas industry practitioners in Nigeria have sort to provide quality services and products in the industry that can

compete favorably with any other quality service provided by multinationals. 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 (ISO, 2010). 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.

For oil and gas companies in 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 and 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. Didier (2002) believes that performance consists of "achieving the goals that were given to you in a convergence of enterprise orientations." In his opinion, performance is not a mere finding of the outcome, but rather it is the result of a comparison between the outcome and the objective

Oil sand can be described as an unconventional source of petroleum which occurs naturally, it consists of a mixture of clay, sand, water and bitumen also known as heavy oil (Tenebaum, 2009). Achievement goals are self-regulatory commitments that provide direction to individuals as they interpret and respond to competence-relevant situations. Four types of achievement goals have been the primary focus of the literature: Mastery approach goals (master a task; improve over time), performance-approach goals (outperform others), mastery-avoidance goals (not fall short of mastering a task; not decline over time), and performance-avoidance goals (not be outperformed by others). Achievement goals focus on the attainment of desirable ends (i.e. Approaching Success), whereas in their avoidance form, they focus on the prevention of undesirable ends (i.e., avoiding failure). Performance-approach goals tend to be most strongly associated with outcome-driven processes and outcomes, predicting surface learning strategies, positive outcome emotions (e.g., pride), grade aspirations, and cheating behaviors while often being positively related to achievement. Since achievement goals are conceptually orthogonal, endorsing the two goals jointly could be adaptive on the whole, with individuals reaping the benefits of mastery-approach goals in terms of interest, as well as those of performance-approach goals in terms of achievement (Sommet, Quiamzade, Jury & Mugny, 2015). Oil and Gas Companies need to integrate ELT Business intelligence that will enhance goal achievement.

METHODOLOGY

The research design adopted in this study is the Cross-sectional design which involves the collection of data from the respondents or the population members. This study is thus structured based on the adoption of the quantitative methodology and thus designed to capture data using the relevant quantitative data generating tools and instruments. It entails data gathering process. There are two study settings namely; the contrived and the non-contrived. The contrived study takes place in a controlled environment such as the laboratory while the non-contrived study takes place in a natural environment where work proceeds. Social sciences research is conducted in a non-contrived setting. There are three units of analysis in social sciences studies; the individuals, groups and the organization. The unit of analysis of this study is the organizational level because data were collected from higher, middle and lower level management of the oil and gas Companies in South-South, Nigeria. Finally, the time horizon is determine between cross-sectional study and the longitudinal study. Descriptive studies are also called observatory research because it establishes only association between variables. Therefore, this study leveraged on the use of the quasi-experimental research design which is deemed suitable because it entails the use of structured questionnaire to be administered to respondents. This study adopted a cross sectional design study. Cross-sectional studies are research aimed at determining the frequency or level of a particular attribute in a defined population at a particular point in time (Lotta, 2012). Cross sectional design refers to one off data collection from the field. This study is a correlational study. This is because it examined how the implementation of Business Intelligence Systems will increase the performance of oil and gas companies in South-South Nigeria.

DATA ANALYSIS AND RESULTS

Table 1: ETL Respondents Rate

	N	Min.	Max.	Mean	Std. Deviation
To what extent is ETL Business intelligence tool critical tool for data integrating in data warehouses?	150	1.0	5.0	3.627	.8789
ETL increases Data quality characteristics seen as "fitness for use".	150	1.0	5.0	4.293	1.1559
ETL plays a high role in data entry, data processing, and data analysis	150	1.0	5.0	4.467	.9460
ETL jobs allow organizations to consolidate, clean, and transform their data, making it accessible and useful for reporting and analysis	150	1.0	5.0	4.307	1.1230
Valid N (listwise)	150				

Source: Research survey, 2024

Table 1 showed the respondent rate on ETL. Question one showed that ETL Business intelligence tool is a critical tool for data integrating is data warehouses with a mean of 3.63 and standard deviation of 0.8789, question two showed that ETL increases Data quality characteristics seen as "fitness for use" with a mean of 4.29 and standard deviation of 1.1559, question three showed that ETL plays a high role in data entry, data processing, and data analysis with a mean of 4.47 with a mean of 0.9460 and lastly question four showed that ETL jobs allow organizations to consolidate, clean, and transform their data, making it accessible and useful for reporting and analysis with a

mean of 4.31 and standard deviation of 1.1230 respectively. The various mean were all 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 Delivery Respondents Rate

	N	Min.	Max.	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	1.0	5.0	4.180	1.4002
To what extent can you rate your organizational quality in terms of performance?	150	1.0	5.0	4.133	1.1853
To what extent can you rate your organization in terms of customer's satisfaction?	150	1.0	5.0	4.107	1.3910
To what extent can you rate your organizational quality in terms of ecology?	150	1.0	5.0	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 service delivery and goal achievement Multinationalu 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: Goal Achievement Respondents' Rate

	N	Min.	Max.	Mean	Std. Deviation
Does your organization considered business intelligence resources as important tool needed to achieve its objectives and aspirations?	150	1.0	5.0	4.313	1.2856
To what extent do you believe that performance consists of achieving the goals that were given to you in a convergence of enterprise resources like ETL?	150	1.0	5.0	3.467	1.1853
To what extent does business intelligence performance help your organization to achieve it objectives/goals?	150	2.0	5.0	4.220	1.1636
To what extent does business intelligence tools supports your employees to complete difficult task?	150	1.0	5.0	3.613	1.3893
Valid N (listwise)	150				

Source: Research Survey, 2024

Table 3 showed that respondents rate on goal achievement. Question one showed that the organization considered business intelligence resources as important tool needed to achieve its objectives and aspirations with a mean of 4.31 and standard deviation of 1.2856, question two showed that the employees believed that performance consist of achieving the goals that were given to you in a convergence of enterprise resources like ETL with a mean of 3.47 and standard deviation of 1.1636 and question three supported that business intelligence performance helps the organization to achieve its objectives/goals with a mean of 4.22 and lastly question four supported that business intelligence tools supports the employees to complete difficult task with a mean of 3.61 and standard deviation of 1.3893 respectively. The various mean were all above the criterion mean of 3.00 for a 5-point Likert-type scale, therefore the respondents rate are classified as high.

Table 4: Relationship between ETL and `Quality Service Delivery

			ETL Tool	Quality Service Delivery
Spearman's rho	ETL Tool	Correlation Coefficient	1.000	.834[**]
		Sig. (2-tailed)	.	.000
		N	150	150
	Quality Service Delivery	Correlation Coefficient	.834[**]	1.000
		Sig. (2-tailed)	.000	.
		N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Research Survey, 2024

Table 4 showed the relationship between Extract Transform and Load (ETL) and Quality Service Delivery of Multinational Oil and Gas Companies in South-South, Nigeria. The correlation coefficient shows that there is a strong positive relationship between Extract Transform and Load (ETL) and Quality of Service Delivery of Multinational Oil and Gas Companies in South-South, Nigeria. The correlation coefficient of 0.834 confirms the magnitude and strength of this relationship which is statistically significant at ($\rho = 0.01 < 0.05$). Based on this value, the null hypothesis **Ho$_5$** was rejected and the research (Alternate) hypothesis **H$_{A5}$** accepted. Thus, there is a strong positive relationship between Extract Transform and Load (ETL) and Quality Service Delivery of Multinational Oil and Gas Companies in South-South, Nigeria.

Table 5: Relation between ETL and Goal Achievement

			ETL Tool	Goal Achievement
Spearman's rho	ETL Tool	Correlation Coefficient	1.000	.797**
		Sig. (2-tailed)	.	.000
		N	150	150
	Goal Achievement	Correlation Coefficient	.797**	1.000
		Sig. (2-tailed)	.000	.
		N	150	150
**. Correlation is significant at the 0.01 level (2-tailed).				

Source: Research Survey, 2024

Table 5 showed the relationship between Extract Transform and Load (ETL) and Goal Achievement of Multinational Oil and Gas Companies in South-South, Nigeria. The correlation coefficient shows that there is a strong positive relationship between Extract Transform and Load (ETL) and Goal Achievement of Multinational Oil and Gas Companies in South-South, Nigeria. The correlation coefficient of 0.797 confirms the magnitude and strength of this relationship which is statistically significant at ($\rho = 0.01 < 0.05$). Based on this value, the null hypothesis **Ho$_6$** was rejected and the research (Alternate) hypothesis **H$_{A6}$** accepted. Thus, there is a strong positive relationship between Extract Transform and Load (ETL) and Goal Achievement of Oil and Gas Companies in South-South, Nigeria.

FINDINGS
The result of this study show significant relationship between extract, transform and load tool in the performance of multinational oil and gas companies in South-South, Nigeria.

CONCLUSION
This paper surveyed the relationship between Extract, Transformed and Load Tool and Performance of Multinational Oil and Gas Companies in South-South, Nigeria. The contribution of Extract, Load and Transformed tools in data processing and analysis cannot be over-emphasized. Today, the rate at which data are mined and generated as a result of the new internet of things is at an alarming rate which the traditional databases and data warehouses cannot handle. They come in various forms, both structured, semi structured and unstructured which characterized

with high volume, velocity and varieties. These categories of data are not suitable for analysis without proper extraction, cleaning and conversion. ETL perform operations on data in real-time with high degree of accuracy. It enables the users of the information system to extract transform and load data into the required databases for proper analysis.

RECOMMENDATION

This study recommended that Multinational Oil and Gas Companies in South-South, Nigeria; and any other manufacturing companies that are interested in enhancing their performance in terms of quality service delivery and goal achievement; should embrace the contributions of Extract, Transformed and Load Tools for organizational performance. Oil and Gas Companies mine data from multiple sources, this tool is needed to clean, filter and transform suitable data for the organization.

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