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# MATERIALS MANAGEMENT AND ADOPTION OF BLOCKCHAIN TECHNOLOGY ON SUPPLY CHAIN EFFICIENCY: A STUDY OF NIGERIAN BREWERIES AMA ENUGU NIGERIA

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## ABSTRACT

**Objective: T**he objective of this study is to investigate materials management and adoption of blockchain technology on supply chain efficiency, with the aim of examining the effect of application of technology in materials management as drivers of profitability in Nigerian Breweries Plc Ama, Enugu in South East Nigeria.

**Theoretical Framework:** In this topic, the main concepts and theories that underpin the research are presented. These are the Resource-based view theory of the firm (RBV) and the theory of risk and uncertainty bearing on profit, stand out providing a solid basis for understanding the context of the investigation.

**Method**: The methodology adopted for this research comprises of survey research design anchored on descriptive statistic is adopted. The population consist of staff that are directly in charge of handling materials in the surveyed organization. These departments are retail, logistics, warehouse and production. The entire population was used given its small size. Data collection was the use of questionnaire comprising of 224 structured copies served to the participants.

**Results and Discussion:** The results obtained revealed a positive correlation between application of technology and increased level of profitability and the role of blockchain of technology in sustainable supply chain management. In the discussion section, these results are contextualized in light of the theoretical framework, highlighting the implications and relationships identified. The limitation of the study is that it is a one company investigation which might not be used to generalize the entire brewery sub-sector in South East Nigeria.

**Research Implications:** The practical and theoretical implications of this research are discussed providing insights into how the results can be applied or influence practices in the field of production and operation management. These implications could encompass application of technology in driving sustainable industrial operations through man power training. It could also reverse the intention of Nigerian Breweries from divesting from Enugu, South East Nigeria.

**Originality/value:** This study contributes to the literature by highlighting the originality of the research through the innovative approach on blockchain technology application on materials management operations. The relevance

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and value of this research are evidenced by how the results obtained may impact the area of the application of blockchain technology knowledge in production and operations management practice.

**Keywords**: Materials Management, Blockchain Technology, Supply Chain Efficiency, Cost Reduction, Sales Turnover.

## GESTÃO DE MATERIAIS E ADOÇÃO DE TECNOLOGIA DE BLOCKCHAIN SOBRE EFICIÊNCIA DA CADEIA DE SUPRIMENTO: UM ESTUDO DE CERVEJARIAS NIGERIANAS AMA ENUGU NIGÉRIA

### RESUMO

**Objetivo**: O objetivo deste estudo é investigar a gestão de materiais e a adoção da tecnologia blockchain sobre a eficiência da cadeia de suprimentos, com o objetivo de examinar o efeito da aplicação da tecnologia na gestão de materiais como motores de rentabilidade nas cervejarias nigerianas Plc Ama, Enugu no Sudeste da Nigéria.

**Estrutura Teórica:** Neste tópico, são apresentados os principais conceitos e teorias que sustentam a pesquisa. Estas são a teoria da visão baseada em recursos da empresa (RBV) e a teoria do risco e incerteza com relação ao lucro, destacam-se fornecendo uma base sólida para a compreensão do contexto da investigação.

**Método:** A metodologia adotada para esta pesquisa compreende a concepção de pesquisa de pesquisa ancorada em estatística descritiva é adotada. A população consiste em pessoal que é diretamente responsável pelo manuseio de materiais na organização pesquisada. Esses departamentos são varejo, logística, depósito e produção. A população inteira foi usada devido ao seu pequeno tamanho. A coleta de dados foi feita por meio de questionário composto por 224 cópias estruturadas atendidas aos participantes.

**Resultados e Discussão:** Os resultados obtidos revelaram uma correlação positiva entre a aplicação da tecnologia e o aumento do nível de rentabilidade e o papel da blockchain da tecnologia na gestão sustentável da cadeia de suprimentos. Na seção de discussão, esses resultados são contextualizados à luz do marco teórico, destacando as implicações e relações identificadas. A limitação do estudo é que é uma investigação de uma única empresa que pode não ser usada para generalizar todo o subsetor cervejeiro no Sudeste da Nigéria.

**Implicações da Pesquisa:** As implicações práticas e teóricas desta pesquisa são discutidas fornecendo insights sobre como os resultados podem ser aplicados ou influenciar práticas no campo da produção e gerenciamento de operações. Essas implicações podem englobar a aplicação da tecnologia na condução de operações industriais sustentáveis por meio da capacitação em energia do homem. Também poderia reverter a intenção das cervejarias nigerianas de se despojar de Enugu, sudeste da Nigéria.

**Originalidade/valor:** Este estudo contribui para a literatura, destacando a originalidade da pesquisa através da abordagem inovadora sobre aplicação de tecnologia blockchain em operações de gestão de materiais. A relevância e o valor desta pesquisa são evidenciados por como os resultados obtidos podem impactar a área de aplicação do conhecimento da tecnologia blockchain na prática de gestão de produção e operações.

**Palavras-chave**: Gestão de Materiais, Tecnologia Blockchain, Eficiência da Cadeia de Suprimentos, Redução de Custos, Rotatividade de Vendas.

## GESTIÓN DE MATERIALES Y ADOPCIÓN DE TECNOLOGÍA DE CADENA DE BLOQUES SOBRE LA EFICIENCIA DE LA CADENA DE SUMINISTRO: UN ESTUDIO DE CERVECERÍAS NIGERIANAS AMA ENUGU NIGERIA

### RESUMEN

**Objetivo:** El objetivo de este estudio es investigar la gestión de materiales y la adopción de la tecnología blockchain en la eficiencia de la cadena de suministro, con el objetivo de examinar el efecto de la aplicación de la tecnología en la gestión de materiales como motores de rentabilidad en Cervecerías Nigerianas Plc Ama, Enugu en el sudeste de Nigeria.

**Marco teórico:** En este tema se presentan los principales conceptos y teorías que sustentan la investigación. Se trata de la teoría de la visión basada en los recursos de la empresa (RBV) y la teoría del riesgo y la incertidumbre

que tienen que ver con el beneficio, que se destacan proporcionando una base sólida para comprender el contexto de la investigación.

**Método**: La metodología adoptada para esta investigación consiste en el diseño de la investigación de la encuesta basada en la estadística descriptiva se adopta. La población está compuesta por personal que se encarga directamente del manejo de los materiales en la organización encuestada. Estos departamentos son venta al por menor, logística, almacén y producción. Toda la población se utilizaba dado su pequeño tamaño. La recopilación de datos consistió en la utilización de un cuestionario compuesto por 224 copias estructuradas que se entregaron a los participantes.

**Resultados y Discusión:** Los resultados obtenidos revelaron una correlación positiva entre la aplicación de la tecnología y el aumento del nivel de rentabilidad y el papel de la cadena de bloques de la tecnología en la gestión sostenible de la cadena de suministro. En la sección de discusión, estos resultados se contextualizan a la luz del marco teórico, destacando las implicaciones y relaciones identificadas. La limitación del estudio es que se trata de una investigación de una sola empresa que podría no ser utilizada para generalizar todo el subsector cervecero en el sudeste de Nigeria.

**Implicaciones de la investigación:** Se discuten las implicaciones prácticas y teóricas de esta investigación, aportando ideas sobre cómo los resultados pueden ser aplicados o influir en prácticas en el campo de la producción y la gestión de la operación. Esas consecuencias podrían abarcar la aplicación de la tecnología para impulsar operaciones industriales sostenibles mediante la capacitación de la fuerza humana. También podría revertir la intención de Cervecerías Nigerianas de retirar sus inversiones de Enugu, en el sudeste de Nigeria.

**Originalidad/valor:** Este estudio contribuye a la literatura destacando la originalidad de la investigación a través del enfoque innovador en la aplicación de la tecnología blockchain en las operaciones de gestión de materiales. La relevancia y el valor de esta investigación se evidencian en cómo los resultados obtenidos pueden impactar el área de la aplicación de conocimiento de tecnología blockchain en la práctica de producción y gestión de operaciones.

**Palabras clave:** Gestión de materiales, Tecnología de cadena de bloques, Eficiencia de la cadena de suministro, Reducción de costes, Volumen de ventas.

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## 1 INTRODUCTION

Scientific evidences show that materials management comprises of a group of procedures that need to be integrated, administered, managed and assembled in manufacturing firms and their operations (Kayiranga, Nyamweya and Shukla, 2020). The beginning point of all phases in material management is planning. This must be assessed for the purpose to afford guidance to all components of activities. In a study conducted by (Gulghane, 2015) material planning involves the quantification, ordering, scheduling of materials and activities to be carried out. In this regard, the usage of appropriate materials management and adoption of right technology should stimulate higher production and profitability in any manufacturing firm and this can lead to an extra-ordinary level of performance and profit to major stakeholders. Materials managers need to have express access to the organizations information system to properly control materials flow into and within the manufacturing organizations. Some of the

information required includes demand forecasts for production, suppliers name and supplier characteristics, pricing data, inventory levels production, Schedules, transportation routing, scheduling of data, financial and marketing information (Lambert and Cooper, 2000). Therefore, modern information technology offers greater opportunities for fast and safe communication and processing of extensive amounts of data both internally for company staff and externally for suppliers and customers. New information technology offers greater opportunities for connecting the planning, controlling and processing functions of materials management. Adegbuyi and Kehinde (2018) remarked that information is the lifeblood of all organizations. Materials manager needs adequate information technology in order to succeed in his work. Computers can assist stock control in calculating the optimum number of stocks to hold and dispatch in order to satisfy the users' requirements. The computer can do this by checking inventory variables such as stock levels, demands and delivery dates.

Sohail, Mohammed, Arshid and Ali (2020) stated that for decades the highest achievement in supply chain management was the ability to cut down costs. Today, this goal is achieved through customer satisfaction, efficiency and sustainability. The goal of materials management is to provide an unbroken chain of components for production to manufacture goods on time for customers (Himanshu, 2020). The materials Department is saddled with releasing materials to a supply base, ensuring that the materials are delivered on time to the company using the correct suppliers. Supply chain management is a system's approach to viewing the supply channel and distribution channels as a whole rather than a set of fragmented parts. It differs from traditional approaches on inventory control and focuses on management of inventory through the entire supply chain. A supply chain refers to the way materials flow through different organizations' unit starting with basic raw materials and ending with the finished products delivered to the ultimate customers. It consists of a service of suppliers, warehouses, operations and retail outlets. Supply chains form complex networks involving many companies and materials co-ordination of all companies involved in a supply chain. The relevant aspects of supply chain management involve all management functions related to the flow of materials from companies direct suppliers to its direct customers (Ekpenyong, Adejare, Gbemi and Udofia, 2021).

Block chain technology is an innovative, decentralized and distributed "state of the art" system which maintains confidentiality, integrity and availability of all the transactions and data. It is a shared open and distributed ledger that can help record data and transactions backed by a cryptographic valve (Pankaj, Tsans-Ming, Surabhi and Richa, 2020). As factories around the world become increasingly interconnected, the influence of block chain is becoming more

prevalent (Tachyon, Jaeram and Doojin, 2018, Pandey et al, 2020, Schmidt, 2019; Singh, Kumar, Shoalb; Adebaye, Irfan, 2023 and Yontar (2023). Thus these previous studies on block chain technology adoption in manufacturing firms and other organizations for materials management, supply chain efficiency, competitiveness profit maximization and cost reduction, had showed the significance of adoption of block chain technology in the different parts of the world. This study also gives evidence that its adoption in a Brewery firm has the capacity to maximize performance and reduce costs.

Successful Nigerian manufacturing organizations of the future must not only be efficient, effective, competent and competitive within the business environment, but must also be in tune with the technology that could guarantee success with minimal hiccups. Such manufacturing firms must be proactive, able to adapt to technological changes and economic turbulence in their domain. This is why today's increasingly dynamic and complex, business environment presents manufacturing firms especially brewery sub-sector with challenges to create the innovative and competitive advantages that are immutable. Consequently, organizations rely heavily on technology and their human assets to continue to innovate in terms of products, services, methods and materials management. The environment for manufacturing business in Nigeria has changed tremendously especially now that the country is grappling with turbulent economic challenges. Just recently, the manufacturers Association of Nigeria (MAN) lamented on the continued decline of capacity utilization in the country, warning that the situation could pose major threats to the already comatose and ailing real sector of the economy which could result in massive dwindling performance, decreased revenue generation and job losses. These challenges have been exacerbated by the recent fuel subsidy removal and floating of foreign exchange rates in the country. These challenges had led to many of the multinational companies divesting from the country. It is against this backdrop that this study sought to investigate the effect of materials management and adoption of block chain technology on supply chain efficiency. Adequate literature reviews conducted revealed that blockchain technology adoption was only in vogue in advanced manufacturing nations of the world, like USA, China, Japan and the United Kingdom. Thus there seems to be a paucity of empirical researches on materials management and adoption of block chain technology in Brewery manufacturing sub-sector. Consequently, this study fills a lacuna in block chain technology, on supply chain efficiency in this part of the country. The study's findings would expose to the manufacturing firms on the opportunities and benefits derivable from block chain technology adoption in a manufacturing firm like Nigerian Breweries Plc in Ama 9$^{th}$ Mile in Enugu State Nigeria.

## 1.1 OBJECTIVES OF THE STUDY

The main objective of the study is to examine the effect of materials management and adoption of Block chain on supply chain efficiency. The specific objectives were as follows:

1. To examine the effect of application of technology in materials management as drivers of success/profitability in the manufacturing firms.
2. To ascertain the adoption of blockchain technology in improving materials management in manufacturing firm's supply chain efficiency.

## 1.2 RESEARCH QUESTIONS

The following questions were the focus of this study;

1. To what extent does the application of technology in materials management enhance profitability in the manufacturing firms?
2. How does blockchain technology improve manufacturing firms supply chain efficiency in materials management?

## 1.3 RESEARCH HYPOTHESES

The following hypotheses were formulated for the study:

## 1.4 HYPOTHESIS ONE

$H_O1$: The application of technology in material management does not lead to profitability of manufacturing firms.

$H_A1$: The application of technology in materials management leads to profitability of manufacturing firms.

## 1.5 HYPOTHESIS TWO

$H_O2$: The application of blockchain technology in materials management does not improve manufacturing firm's supply chain efficiency.

$H_A2$: The application of blockchain technology in materials management improves manufacturing firm's supply chain efficiency.

## 2 THEORETICAL FRAMEWORK

Materials are the lifeblood and heart of any manufacturing system and no organisation can operate without them. They must be made available at the right price, at the right quantity, in the right quality in the right place and at the right time in order to co-ordinate and schedule the production activity in an integrative way for an industrial undertaking. A manufacturing firm will remain shaky if materials are under stocked, overstocked, or in any way poorly managed (Banjoko, 2009, Cross, 2019 and Dagim, 2018). These authors affirms that the basic goal of material management is to make sure that the right item is purchased and made available to the manufacturing operation at the right place and at the minimum costs. Materials manager needs information technology in order to succeed in his work. Computers can assist stock control in calculating the optimum number of stocks to hold and dispatch in order to satisfy the user's requirements. The computer can do this by checking inventory variables (stock levels, demand and delivery dates). The Electronic Data interchange (EDI) is a system that enables direct communication between organizations without any human intervention. This technology has revolutionized inventory management. Electronic Data interchange (EDI) is the name given to the transmission and receipt of structured data by the computer systems of trading partners, often without human intervention. The international Data interchange association defines EDI as "the transfer of structured data, by agreed message standards from one computer system to another, by electronic means (Quesada & Gazo, 2012). Sohail, Muhammad, Arshid & Ali (2020) stated that for decades, the highest achievement in supply chain management was the ability to cut costs. Today, this goal is achieved through customer satisfaction, efficiency, and sustainability. Ethical behavior plays a big part in the strategic supply chain management decision-making process.

Staying competitive in materials management and supply chain management requires adopting the most advanced technology (Sohail, Muhammad, Arshid& Ali 2020). It takes an understanding in knowing what to go after to create supply chain efficiencies. Logistics Management is the management (i.e., the planning, execution and control) of all factors that affect the materials flow and the information about it, seen from the perspective of customer requirements, for the purpose of achieving high delivery reliability, a high degree of delivery completeness and a short delivery time. Logistics management function involves short - term materials planning, the supply of raw materials and other purchased goods, internal transportation, storage and physical distribution. It is sometimes also referred to as materials management and/or integrated business logistics (Karibo 2019).

Blockchain is an innovative, decentralized, and distributive "state-of-the-art" technology, which maintains confidentiality, integrity, and availability of all the transactions and data. It is a shared, open and distributed ledger that can help store/record data and transactions backed by a cryptographic value (Pankaj, Tsan-Ming, Surabhi, &Richa,2020).As factories around the world become increasingly interconnected, the influence of blockchain is becoming more prevalent (Taehyun, Jaeram & Doojin, 2018). Now, more than ever before, manufacturing firms face the challenge of securely sharing data within and outside factory walls.To work out the best place for blockchain, a manufacturer must conduct a structured assessment which begins with identifying the company's current business problems and future needs (Taehyun, Jaeram &Doojin, 2018). Subsequently, it can then explore how it leverages the technology to relieve the factory's pain points and addresses its needs. Equipped with a strong understanding of the opportunities and challenges it faces, the manufacturer can then choose the most appropriate option from the available technology solutions.

Blockchain has an immense potential to transform every step of supply chain (SC), from raw materials procurement through distribution to the consumers (Goyat, Kumar, Rai, & Saha 2019). It also enables SC reengineering by establishing a blockchain-based BPR (Business Process Reengineering) framework (Chang, Iakovou, & Shi 2020). Every transaction made can be restructured using blockchain technology and the journey can be made faster and more secure.

The structure of the blockchain is organized in a way such that it ensures security and transparency of SCs. Goyat, Kumar, Rai, &Saha (2019) outlined the related mechanism of a typical blockchain system as follows.

i. Each block in the blockchain has a hash number (256 bit), which is created with consensus by a scientific algorithm.
ii. The blocks are linked to each other with reference to previous block's hash which creates a secure and independent chain.

Pankaj, Tsan-Ming, Surabhi & Richa(2020) in their work noted that Blockchain can scale transparency and trust through all stages of the industrial value chain, from sourcing raw materials to delivering the finished product. Pain points it could help address, include:

- Supply chain monitoring for greater transparency
- Materials provenance and counterfeit detection
- Engineering design for long-duration, high-complexity products
- Identity management
- Asset tracking

- Quality assurance
- Regulatory compliance

There is great potential for blockchain in manufacturing. Increasing visibility across all areas of the process from suppliers, strategic sourcing, procurement and supplier quality to shop floor operations which include machine-level monitoring and service, blockchain could allow for an entirely new manufacturing business model. Supply chains are the basis of all manufacturing businesses, most of which are capable of making use of blockchain's distributed ledger structure and block-based approach to aggregating value-exchange transactions to improve efficiency. By scaling supplier order accuracy, product quality and track-and-traceability, manufacturing firms will be able to better hit delivery dates, enhance product quality and ultimately sell more.(Risso, Granga, Filho, Santa-Eulalia, Chikhi and Moscom (2023).A supply chain is the combination of activities involved in producing goods and services and supplying them to customers. This encompasses sourcing raw materials from suppliers, the movement of materials through the relevant manufacturing operations, and the distribution of finished goods to consumers (Daneshvar, Razavi, & Laura 2020).Supply chain efficiency focuses on the internal processes within the supply chain. It relates to using available resources (e.g., financial, human, physical etc) in the best possible way to meet the customer's demand at the lowest cost. Han, Wang, & Naim (2017) opined that technology can often play a pivotal role in optimising supply chains. By integrating modern solutions in chain management, you can make significant improvements in the efficiency and the performance of your supply chain, as such, an efficient supply chain is one in which orders are fulfilled by suppliers on time, while minimizing operational costs.

## 2.1 THE RESOURCE-BASED VIEW THEORY (RBV)

The Resource-Based View theory by Wernerfelt (1984) made important contributions towards developing the material management as a corporate strategy. From the 1980s onwards, Bowman and Ambrosini (2003) claimed that the focus of inquiry changed from the structure of the industry, e.g., Structure-Conduct-Performance (SCP) paradigm and the five forces model to the firm's internal structure, with materials and capabilities (which are the key elements of the Resource-Based View (RBV). The RBV suggest that the materials possessed, deployed and used by the organization are really more important than industry structure. Barney (1991) outlines an approach to organizational-base analysis that requires stocktaking of a firm's internal assets and capabilities. The assets in question could be physical materials, creative

assets (intellectual capital) as well as human resources, which in turn determine the capabilities of a firm. Strategic assets are difficult to trade and imitate, scarce and specialized resources and capabilities that bestow the firm's competitive advantage.

Researchers subscribing to the RBV argue that only strategically important and useful materials and competencies should be viewed as sources of competitive advantage (Barney, 1991). They have used terms like core competencies (Barney: 1991; Lin and Wu, 2014). Core competencies are distinctive, rare, valuable organizational-base resources that competitors are unable to imitate, substitute or reproduce (Lin and Wu, 2014). Barney (1991); Bowman and Ambrosini (2003) further distinguish between tangible and intangible materials and concluded that materials resources are often the most important ones from a strategic point of view. They argue that intangible materials are more likely to be a source of sustained competitive advantage rather than tangible ones.

## 2.2 EMPIRICAL REVIEW

Block chain has an immense potential to transform every step of supply chain from raw materials procurement to distribution to the consumer. It also enables supply chain re-engineering by establishing a lockchain-based Business Process Re-engineering (BPR) framework (Chang, Jakovou and Shi, 2020). Every transaction made can be restructured using block chain technology and the journey can be made more secure. The structure of a block chain is organized in a way such that it ensures security and transparency of supply chain.

Tanner and Valtanen (2017) explain the applicability and usefulness of blockchain technology in various fields of manufacturing industry. They also suggested the applications of blockchain technology to supply chains in the manufacturing industry. They describe the positive effects of blockchain technology on the transparency of a supply chain and the quality of products. Korpela, Hallikas, and Dahlberg (2017) in their work also discussed the digitalization of supply chain system through blockchain technology.

Pankaj, Tsan-Ming, Surabhi, &Richa (2020) opined that Blockchain is a technology with unique combination of features such as decentralized structure, distributed notes and storage mechanism, consensus algorithm, smart contracting, and asymmetric encryption to ensure network security, transparency and visibility. They agreed that Blockchain has immense potential to transform supply chain (SC) functions, business process reengineering to security enhancement. In their paper, a total of 178 articles were considered and examine all the relevant research done in the field associated with the use of blockchain integration in SC operations.

They highlighted the corresponding opportunities, possible societal impacts, current state-of-the-art technologies along with major trends and challenges. They examined several industrial sectors such as shipping, manufacturing, automotive, aviation, finance, technology, energy, healthcare, agriculture and food, e-commerce, and education among others that can be successfully revamped with blockchain based technologies through enhanced visibility and business process management.

Vineet, Shalini & Suneel (2020) investigate the role of blockchain technology in sustainable supply chain management. They propose a reusable classification framework-emerging technology literature classification level (ETLCL) framework-based on grounded theory and the technology readiness level for conducting literature reviews in various focus areas of an emerging technology. Subsequently, the study uses ETLCL to classify the literature on focus area. The results show traceability and transparency as the key benefits of applying blockchain technology. They also indicated a heightened interest in blockchain-based information systems for sustainable supply chain management. The findings demonstrate the disruptive power and role of blockchain-based information systems.

## 3 METHODOLOGY

The study adopted a descriptive survey design. Descriptive survey design was utilized when collecting data about people's attitudes, habit, beliefs or on any other social issues. The survey method was chosen because it allowed the researchers to make informed decisions about the research outcome (Uzoagulu, 2011).

The population of the study consists of departmental staff of Nigerian Breweries Plc who were directly involved in handling materials in the organization. These departments were retail; logistics; warehouse and production. The total population of the staff involved in the study was two hundred and twenty four as at 16-06-21. This was obtained from the Human Resources Department of the organization (See table 1.0).

**Table 1**

*Distribution of Departmental staff in Nigeria Breweries Ama Plant Enugu*

| S/No | Departments | Number of staff |
|---|---|---|
| 1. | Retail | 71 |
| 2. | Logistics | 36 |
| 3. | Warehouse | 45 |
| 4 | Production | 72 |

| | | |
|---|---|---|
| | **Total** | **224** |

Source: Field survey, 2021

The researchers did not carry out sample size determination. The entire population was utilized because of its manageable size (Uzoagolu, 2011).

The study used primary source of data through the administration of self administered structured questionnaire. The questionnaire was accompanied with an introductory letter detailing the purpose of the study to the respondents. Respondents were told to select their answers guided by a Five –point Likert scale. Likert scale is a psychometric response scale utilized for this study. The questionnaire had two sections. Section A consisted of information on the bio-data of the respondents while Section B had information based on the study's research questions. The validity of the study was conducted through face and content validation. The questionnaire and research questions were given to educational experts in Godfrey Okoye University Enugu to check for weaknesses in the design and to ensure that it actually measured what it was supposed to measure. The reliability was measured numerically through the use of correlation formula. This was done by calculating the Cronbach's Alpha for all the variables tested. The essence of Cronbach's Alpha was to determine the internal consistency or average correlation of items in a survey instrument to get its reliability.

From the total population of the study of 224 respondents, a total of 224copies of questionnaire were distributed to the entire respondents, 195 were returned representing 87% of the entire population, 29 copies of the questionnaire were not returned amounting to 13% of the population, while 5copies representing2% of the returned questionnaire were poorly filled hence not usable. 190 usable copies of the questionnaire were used for this research representing 85% of the population as calculated in table 2.0. Therefore, the analysis was based on 190 copies of properly filled questionnaire.

## 4 RESULTS AND DISCUSSIONS

**Table 2**

*Return rate of questionnaire*

| S/N | Description if questionnaire | Number returned | Percentage (%) |
|---|---|---|---|
| 1 | Number of copies of distributed | 224 | - |
| 2 | Number of copies of questionnaire returned | 195 | - |
| 3 | Number of questionnaire not returned | 29 | 13% |
| 4 | Poorly filled copies of questionnaire | 5 | 2% |
| 5 | Usable copies of questionnaire | 190 | 85% |

| | | | |
|---|---|---|---|
| | | | **100%** |

Source: Field Survey, 2022

**Table 3**

*Sex distribution of the respondents*

| **Response option** | **Number of responses** | **Percentage (%)** |
|---|---|---|
| MALE | 158 | 83.2% |
| FEMALE | 32 | 16.8% |
| TOTAL | 190 | **100%** |

Source: Field Survey, 2022

Table 3.0 indicates that Nigerian Brewery employed more males than female as at the time of the study. It is evident in table 3.0, 158 of the respondents were male representing 83.2% while 32 of the respondents were female representing 16.8% of the respondents.

**Table: 4**

*Educational background/ qualifications of the respondents*

| **Response option** | **Number of responses** | **Percentage (%)** |
|---|---|---|
| WAEC/GCE/SSCE | - | - |
| ND (National Diploma) | 15 | 7.9 |
| HND (Higher National Diploma) | 30 | 15.8 |
| B.Sc | 45 | 23.7 |
| MBA | 34 | 17.9 |
| M.Sc | 40 | 21.1 |
| OTHERS /ACCA/ACA | 26 | 13.6 |
| **Total** | **190 respondents** | **100 (%)** |

Source: Field Survey, 2022

Table 4.0 shows the analysis of data on academic qualifications of the respondents. WAEC/GCE/SSCE holders were not considered in this study because the job meant for them were outsourced to other organizations as confirmed by Nigerian Brewery Human Resources, Nigerian Brewery has no need for such category of workers. ND were 15 represented 7.9% and HND were 30 representing 15.8%, B.Sc were 45 representing 23.7%, while MBA were 34 representing 17.9%, M.Sc were 40 representing 21.1% and Other/ ACCA/ACA were 26 represented by 13.6.%. Nobody at the time of the study had aDoctor of Philosophy degree in the company.

**Table 5**

*Length of work experience*

| ***Response option*** | ***Number of responses*** | ***Percentage (%)*** |
|---|---|---|
| under 5 years | 35 | 18.4 |
| 5-10 years | 40 | 21.1 |
| 11-16 years | 38 | 20.0 |
| 17-22 years | 45 | 23.7 |
| above 22 years | 32 | 16.8 |
| **Total** | **190** | **100 (%)** |

Source: Field Survey, 2022

In table 5.0, the length of work experience as distributed showed that the under 5 years were 35 representing 18.4%, 5-10 years were fully completed and returned copies of questionnaire with number of 40 representing 21.1%, 11-16 years returned 38 representing 20.0% and 17-22 years returned 45 representing 23.7%, above 22years returned 32 representing 16.8%.

**Table 6**

*Responses from Departments in charge of materials, management*

| ***Response option*** | ***Number of responses*** | ***Percentage (%)*** |
|---|---|---|
| Retail | 45 | 23.7 |
| Logistics | 31 | 16.3 |
| Warehouse | 42 | 22.1 |
| Production | 72 | 37.9 |
| **Total** | **190** | **100 (%)** |

Source: Field Survey, 2022

Departmental responses showed that retail was 45 representing 23.7%, 31were from logistics representing 16.3%, 42 respondents were from warehouse representing 22.1%, while production department were 72 representing 37.9%.

**Table 7**

*Distribution of responses for the application of technology as driver of success and profitability in the manufacturing firms*

| **S/N** | **Questionnaire Items** | **SA (5)** | **A (4)** | **UD (3)** | **D (2)** | **SD (1)** | **Mean** |
|---|---|---|---|---|---|---|---|
| | **Technology Adoption and Modern Tools** | | | | | | |
| **1** | We use new technologies to handle materials. | 34 | 46 | 5 | 65 | 40 | 2.8 |
| **2** | Technology helps us to meet targets. | 35 | 62 | 11 | 47 | 35 | 3.1 |
| | **Level of Profitability** | | | | | | |
| **3** | Using new technologies improved our performance. | 84 | 85 | 10 | 5 | 6 | 4.2 |
| **4** | We made more profit when we adopt innovative ideas. | 68 | 97 | 18 | 7 | - | 4.1 |

Source: Field Survey, 2022

Table 7.0 revealed the distribution of responses for adoption of technology and modern tools like computer applications etc. in materials management and level of profitability in Nigerian Brewery, Ama Plant 9th Mile. the Table indicates that all, except questionnaire item 1 are accepted for being greater than 3. The expression of this result revealed adoption of technology improved material management efficiently.

**Table 8**

*Distribution of responses on the impact of Blockchain Technology on material management and effect on supply chain efficiency*

| S/N | Questionnaire Items | SA (5) | A (4) | UD (3) | D (2) | SD (1) | Mean |
|---|---|---|---|---|---|---|---|
| | **Blockchain technology** | | | | | | |
| **1** | My organization uses blockchain technology. | 10 | 18 | 74 | 62 | 26 | 2.6 |
| **2** | Blockchain technology improves our material management. | 20 | 33 | 68 | 40 | 29 | 2.9 |
| | **Supply chain efficiency** | | | | | | |
| **3** | We use blockchain to monitor our supply chain for greater efficiency. | 9 | 12 | 87 | 53 | 29 | 2.6 |
| **4** | Blockchain implementations will help to streamline operations, gain greater visibility into supply chains and track assets with unprecedented precision. | 92 | 63 | 15 | 12 | 8 | 4.06 |

Source: Field Survey, 2022

Table 8.0 presented the distribution of responses for **Blockchain Technology on material management and effect on** supply chain efficiency in Nigerian Brewery, Ama Plant. The table disclosed that only item 4 of the questionnaire items was accepted as being true because the mean is more than 3, while items 1, 2 and 3 were rejected because their means were below the benchmark of 3. It showed that Nigerian Brewery,Ama Plant is yet to adopt the use of blockchain technology. The respondents indicated that its use would enhance their operations. This was attested by the mean result of 4.06 in item 4.

## 4.1 TEST OF HYPOTHESES

### 4.1.1 Hypothesis One

$H_A1$: The application of technology leads to success in material management and profitability of manufacturing firms.

**Table 9**

*Correlation Analysis for the application of technology and level of profitability*

**Correlations**

| | | TECH | PROF |
|---|---|---|---|
| TECH | Pearson Correlation | 1 | .900** |
| | Sig. (2-tailed) | | .000 |
| | N | 190 | 190 |
| PROF | Pearson Correlation | .900** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 190 | 190 |

**. Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey, 2022

**Keys:**

TECH: Technology and profitability

PROF: Profitability

Table 9 Illustrated the correlation analysis between technology and success in materials management and level of profitability in Nigerian Brewery, Ama Plant 9th Mile. The result revealed that there is a significant positive relationship (r = .900) between the variables as the p-value obtained is lesser than the .05 level of significant.

**Decision rule:** Accept the alternate hypothesis

$H_A2$: The application of technology leads to success in material management and profitability of manufacturing firms.

### 4.1.2 Hypothesis Two

$H_A2$: The application of blockchain technology improves manufacturing firms supply chain efficiency.

**Table 10**

*Correlation Analysis for blockchain technology and supply chain efficiency in manufacturing firms.*

**Correlations**

| | | TECH | PROF |
|---|---|---|---|
| TECH | Pearson Correlation | 1 | .900** |
| | Sig. (2-tailed) | | .000 |
| | N | 190 | 190 |
| S. CHAIN | Pearson Correlation | .900** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 190 | 190 |

**. Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey, 2022

**Keys:**

TECH: Blockchain Technology

S. CHAIN: Supply chain efficiency

Table 10 showed the correlations analysis between blockchain technology and supply chain efficiency of materials management in manufacturing firms. The result revealed that there was a significant positive relationship (r = .900) between the variables as the p-value obtained was lesser than the .05 level of significant.

**Implication:** Accept the alternate hypothesis

$H_A2$: The application of blockchain technology improves manufacturing firms supply chain efficiency.

## 4.2 DISCUSSION OF FINDINGS

The result of hypothesis one showed that there was a correlation between technology and success in material management and level of profitability in the Nigerian Brewery Plc

Ama Plant Enugu. It revealed a significant positive relationship between and amongst the variables. This assertion is in consonance with what Sohail etal. (2020) stated. They affirmed that staying competitive in materials management requires adopting the most advanced technology. It is equally note worthy that application of technology such as artificial intelligence and machine learning have the capacity to create fully or semi-automated processes for supply chain optimization. This is because optimization improves forecasting, planning, implementation and maintenance in logistics by using artificial intelligence and machine learning to emulate human performance knowledge (Ekpenyong, etal. 2021).

The question for objective two was designed to establish if the application of blockchain technology improves manufacturing firms supply chain efficiency? Hypothesis two showed the correlations analysis between blockchain technology and supply chain efficiency of materials management in manufacturing firms. The result revealed that there is a significant positive relationship (r = .900) between the variables as the p-value obtained was less than the .05 level of significant. This result is in consonant with Vineet etal. (2020). This study investigated the role of blockchain technology in sustainable supply chain management. The results showed that traceability and transparency are amongst the key benefits of applying blockchain technology. They also indicated a heightened interest in blockchain-based information systems for sustainable supply chain management.

## 5 CONCLUSION

This paper has provided useful insights that technology can be applied successfully in the management of materials especially on supply chain efficiency. Through the application of technology such as artificial intelligence and machine learning in manufacturing, an organization can achieve substantial cost reduction, increase supply chain efficiency and overall increase in profitability. The paper also elicits that the logic of block chain technology has the capacity of driving the sustainability of the Nigerian) Brewery and positively impacts on the corporate governance allowing shareholders to monitor easily their managers/employees.

## 6 RECOMMENDATION FOR FUTURE RESEARCH

This study has several strengths which enhanced its validity. Consequently,, it is recommended that future researchers should focus on service sectors of the Nigerian economy such as healthcare, education, agriculture, banks and other financial institutions. Doing so would go a long way in increasing the generalizability of the current study's findings (Lalayants & Tripodi (2009). Understanding the application of blockchain technology on the management of materials in brewing industry could influence positively the performance of these other sectors to a great extent. Since the study was conducted in Ama Enugu in Enugu State of South East Nigeria, it is recommended that future researches be conducted in other geopolitical zones of Nigeria. This is because other geopolitical zones have different cultures that could impact the result of such studies. Different cultures in Nigeria could interpret the results of their findings differently.

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