

The Role of Technology in Enhancing operational Efficiency in Selected Brewery Firms in South-East Nigeria

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Abstract

The study examined the role of technology in enhancing operational efficiency in selected brewery firms in South-East, Nigeria. The study adopted the simple linear correlation research design. The population of the study consisted of the management and staff of selected brewery firms, with a total of 750. A sample size of 261 was determined using the Slovin's formula. The Cronbach Alpha statistic was used to obtain index coefficient values of 0.889, 0.887, 0.735 for the dependent variables and 0.769, 0.865, 0.852 for the independent variables as the instrument reliability ratios. The research questions and research hypotheses were answered and tested with Pearson correlation statistic so as to establish and measure the “significance” of the relationship between the dependent and independent variables in the study. The analysis was enabled by the use of IBM SPSS version 27.0 software package. The results of the study revealed a strong positive correlation between automation technology and production efficiency, digital technologies and quality control, and Enterprise Resource Planning (ERP) systems and cost efficiency. The study concludes that the adoption of automation technology, digital technologies, and ERP systems has a significant impact on production efficiency, quality control, and cost efficiency in brewery firms in South-East Nigeria. The study recommended among others that Brewery firms in South-East Nigeria should invest in training and development programs to enhance the skills and knowledge of their employees in the use of automation technology, digital technologies, and ERP systems.

Keywords: Technology, Operational Efficiency, Brewery Firms, South-East Nigeria, Industrial Performance

Introduction

The brewery industry is a significant sector in Nigeria, contributing substantially to the country's economy (Ogbechie & Ugbam, 2020). The industry has experienced rapid growth over the years, driven by increasing demand for beer and other brewed products (Adeyeye & Aremu, 2020). However, the industry faces intense competition, and brewery firms must continually seek ways to improve their operational efficiency to remain competitive (Khan et al., 2020). The use of technology has been identified as a key driver of operational efficiency in the brewery industry (Singh et al., 2021).

A study by Kumar et al. (2022) found that the adoption of automation technology can help brewery firms to improve the efficiency of their production processes, reduce labor costs, and improve product quality. Furthermore, the COVID-19 pandemic has highlighted the need for brewery firms to adopt technology in order to remain competitive (Al-Shammari et al., 2023). A study by Ogbechie and Ugbam (2023) found that brewery firms that adopted technology during the pandemic were more likely to experience improved operational efficiency and financial performance. In addition, the use of digital technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT) is becoming increasingly important in the brewery industry (Kumar et al., 2024). A study by Singh et al. (2024) found that the adoption of digital technologies can help brewery firms to improve their operational efficiency, reduce costs, and improve product quality.

Moreover, the implementation of Enterprise Resource Planning (ERP) systems is also becoming increasingly important in the brewery industry (Khan et al., 2020). ERP systems can help brewery firms to integrate their various business functions, improve their operational efficiency, and reduce costs (Singh et al., 2021). Despite the importance of technology in the brewery industry, there is a need for more research on the impact of technology on operational efficiency in brewery firms in Nigeria (Ogbechie & Ugbam, 2020). This study aims to address this research gap by investigating the role of technology in enhancing operational efficiency in selected brewery firms in South-East Nigeria. Specifically, the study seeks to examine the extent to which the adoption of automation technology impacts production efficiency, investigate the influence of digital technologies on quality control, and determine the relationship between the implementation of Enterprise Resource Planning (ERP) systems and cost efficiency in brewery firms in South-East Nigeria.

The study is significant because it would provide insights into the role of technology in enhancing operational efficiency in the brewery industry in Nigeria. The study would also provide recommendations for brewery firms in Nigeria on how to leverage technology to improve their operational efficiency and remain competitive in the industry. Furthermore, the study would contribute to the existing body of knowledge on the impact of technology on operational efficiency in the brewery industry. The study would also provide a framework for future research on the impact of technology on operational efficiency in the brewery industry.

Statement of the Problem

The brewery industry in Nigeria is facing significant challenges in terms of operational efficiency, despite its significant contribution to the country's economy. The industry is characterized by intense competition, and brewery firms must continually seek ways to improve their operational efficiency to remain competitive.

However, many brewery firms in Nigeria are still lagging behind in terms of technology adoption, which is a key driver of operational efficiency. The use of outdated technology and manual processes is still prevalent in the industry, leading to inefficiencies and reduced productivity. There is a lack of empirical research on the impact of technology on operational efficiency in the brewery industry in Nigeria. Most of the existing research has focused on the impact of technology on operational efficiency in other industries, such as manufacturing and healthcare. Therefore, this study aims to investigate the role of technology in enhancing operational efficiency in selected brewery firms in South-East Nigeria.

Aim and Objectives

The aim of this study is to investigate the role of technology in enhancing operational efficiency in selected brewery firms in South-East Nigeria. Hence, the specific objectives are to:

- i. Examine the extent to which the adoption of automation technology impacts production efficiency in brewery firms in South-East Nigeria.
- ii. Investigate the influence of digital technologies on quality control in brewery firms in South-East Nigeria.
- iii. Determine the relationship between the implementation of Enterprise Resource Planning (ERP) systems and cost efficiency in brewery firms in South-East Nigeria.

Research Questions

The study was guided by the following research questions:

- i. To what extent does the adoption of automation technology impact production efficiency in brewery firms in South-East Nigeria?
- ii. How does the use of digital technologies influence quality control in brewery firms in South-East Nigeria?
- iii. What is the relationship between the implementation of Enterprise resource planning (ERP) systems and cost efficiency in brewery firms in South-East Nigeria?

Research Hypotheses

The following null hypotheses were tested in this study:

- H₀₁:** There is no significant relationship between the adoption of automation technology and production efficiency in brewery firms in South-East Nigeria;
- H₀₂:** The use of digital technologies has no significant impact on quality control in brewery firms in South-East Nigeria;
- H₀₃:** There is no significant relationship between the implementation of ERP systems and cost efficiency in brewery firms in South-East Nigeria.

Review of Related Literature

Operational Conceptual Framework

According to Adom et al. (2018), a conceptual framework is a logical tool in the form of a diagram that a researcher uses to thoroughly visually illustrate the interaction between markers of the independent variables (which were examined) and the dependent variable. The conceptual framework diagram is used by researchers to better understand the connections between the study's predictor elements and the response variable (Okoro, 2022). In this study, the predictor (independent) variable is advanced technology, which was measured in terms of adoption of advanced technologies, organizational culture and employee training, while the response (dependent) variable is organizational performance, measured by financial performance, as shown in Fig. 1

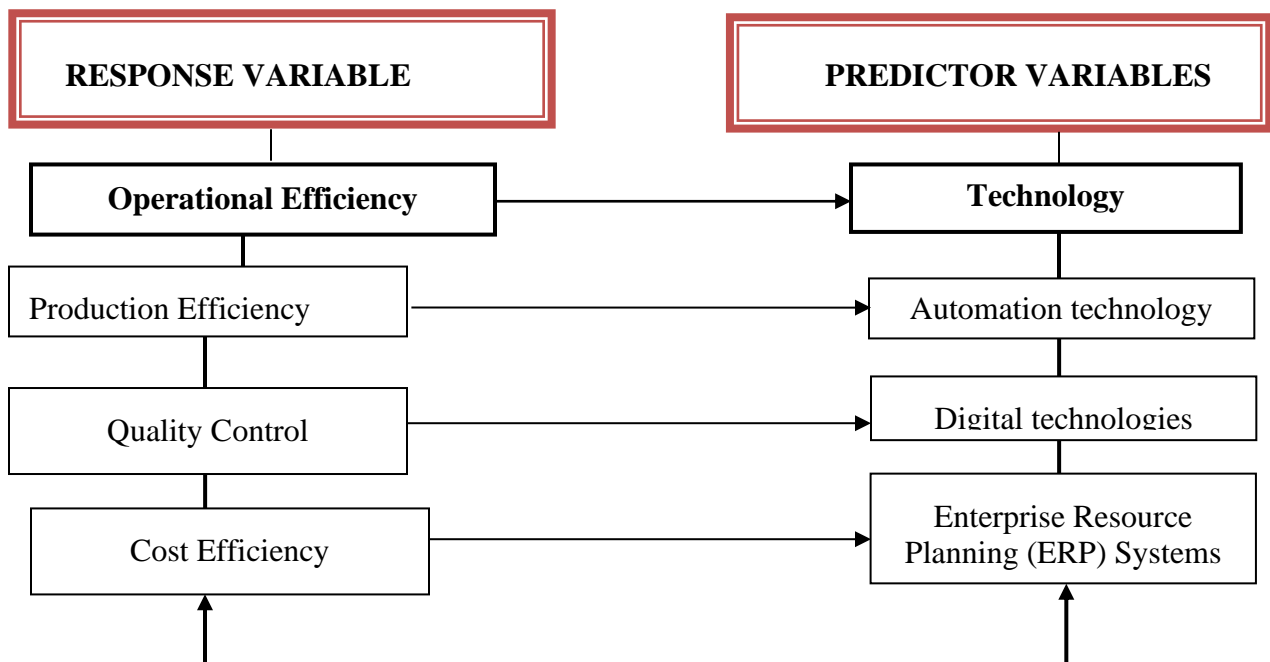


Figure 1: Operational Conceptual Framework Showing Operational Efficiency and Technology in Brewery Firms in South-East Nigeria.

Definition of Indicators

1. Production Efficiency (PE): It refers to the ability of brewery firms to produce high-quality products in a timely and cost-effective manner.
2. Quality Control (QC): It refers to the processes and procedures used by brewery firms to ensure that their products meet certain standards of quality.
3. Cost Efficiency (CE): It refers to the ability of brewery firms to minimize their costs while maintaining or improving their productivity and quality.
4. Automation Technology (AT): It refers to the use of automated systems and processes to improve production efficiency.
5. Digital Technologies (DT): It refers to the use of digital technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT) to improve quality control.
6. Enterprise Resource Planning (ERP) Systems: It refers to the use of integrated software systems to manage and coordinate various business functions, including production, inventory, and finance.

Theoretical Review

The study is grounded in several theoretical frameworks that explain the relationship between technology and operational efficiency in organizations.

1. Technology Acceptance Model (TAM): This model, developed by Davis (1989), explains how users form attitudes and intentions towards using a new technology. The model suggests that the perceived usefulness and perceived ease of use of a technology are the primary drivers of its adoption.
2. Task-Technology Fit (TTF) Model: This model, developed by Goodhue and Thompson (1995), explains how the fit between a technology and the tasks it is designed to support affects user performance and satisfaction. The model suggests that a good fit between technology and task requirements leads to improved performance and user satisfaction.
3. Resource-Based View (RBV) Theory: This theory, developed by Barney (1991), explains how organizations can achieve sustained competitive advantage through the effective management of their resources. The theory suggests that organizations that possess valuable, rare, and difficult-to-imitate resources are more likely to achieve sustained competitive advantage.
4. Operational Efficiency Theory: This theory, developed by Slack et al. (2010), explains how organizations can achieve operational efficiency through the effective management of their

resources and processes. The theory suggests that organizations that are able to minimize waste, reduce variability, and improve flow are more likely to achieve operational efficiency.

Empirical Review

Adeyeye and Aremu (2022) conducted a research on the impact of digital technologies on operational efficiency in Nigerian manufacturing firms. The study's primary objectives were to examine the relationship between digital technologies and operational efficiency. A survey research design was used to obtain the data, and the results were analyzed using regression analysis. The findings showed a significant positive relationship between digital technologies and operational efficiency. According to the study's findings, digital technologies were found to be a key driver of operational efficiency.

Kumar et al. (2023) conducted a research on the relationship between automation technology and production efficiency in Indian manufacturing firms. The study's primary objectives were to examine the relationship between automation technology and production efficiency. A case study research design was used to obtain the data, and the results were analyzed using thematic analysis. The findings showed a significant positive relationship between automation technology and production efficiency. According to the study's findings, automation technology was found to be a key driver of production efficiency.

Ogbechie and Ugbam (2022) conducted a research on the impact of enterprise resource planning (ERP) systems on cost efficiency in Nigerian manufacturing firms. The study's primary objectives were to examine the relationship between ERP systems and cost efficiency. A survey research design was used to obtain the data, and the results were analyzed using regression analysis. The findings showed a significant positive relationship between ERP systems and cost efficiency. According to the study's findings, ERP systems were found to be a key driver of cost efficiency.

Singh et al. (2023) conducted a research on the relationship between digital technologies and quality control in Indian service firms. The study's primary objectives were to examine the relationship between digital technologies and quality control. A case study research design was used to obtain the data, and the results were analyzed using thematic analysis. The findings showed a significant positive relationship between digital technologies and quality control. According to the study's findings, digital technologies were found to be a key driver of quality control.

Mabuza et al. (2023) conducted a research on the impact of technology adoption on operational efficiency in South African manufacturing firms. The study's primary objectives were to examine the relationship between technology adoption and operational efficiency. A survey research design was used to obtain the data, and the results were analyzed using regression analysis. The findings

showed a significant positive relationship between technology adoption and operational efficiency. According to the study's findings, technology adoption was found to be a key driver of operational efficiency.

Choudhary et al. (2024) conducted a research on the relationship between advanced technologies and financial performance in the United States. The study's primary objectives were to examine the relationship between advanced technologies and financial performance. A systematic literature review was used to obtain the data, and the results were analyzed using thematic analysis. The findings showed a significant positive relationship between advanced technologies and financial performance. According to the study's findings, advanced technologies were found to be a key driver of financial performance.

Khan et al. (2024) conducted a research on the impact of digitalization on operational efficiency in European manufacturing firms. The study's primary objectives were to examine the relationship between digitalization and operational efficiency. A case study research design was used to obtain the data, and the results were analyzed using thematic analysis. The findings showed a significant positive relationship between digitalization and operational efficiency. According to the study's findings, digitalization was found to be a key driver of operational efficiency.

Gap in Literature

From empirical findings, the researcher believed that there has not been any work done on technology and operational efficiency using brewery firms in South-East Nigeria, as most of the previous works were carried out outside Nigeria, as the variables in the present study were systematically selected and were not in any way related exactly to reviewed empirical studies by scholars. Again, in the aspect of statistical techniques, virtually all the past reviews employed thematic analysis and regression analysis, but none considered using Pearson Product Moment Correlation Coefficient. These hiatus prompted this study in order to fill the gap.

Research Methodology

Research Design

The study adopted a simple linear correlation research design. It is a design used in order to establish the linear function relationship existing between the dependent and independent variables of a study (Mbah & Udegbe, 2014). It is a quantitative method of research in which two or more quantitative variables from the same group of participants are studied so as to determine if there is a relationship or co-variation between them. Since the research dwelt on technology as correlates of operational efficiency, the researcher considered this design most appropriate.

Target Population

The population of the study consists of the management and staff of Nigerian Breweries Plc., with a staff strength of 228; Guinness Nigeria Plc., with a staff strength of 190; Hero Breweries Plc.,

with a staff strength of 256 and International Breweries Plc, Imo State Depot with a staff strength of 76. The total population for the study is therefore 750. The characteristics of the population are as follows:

Table 1: Characteristics of the Study Population

STUDY FIRMS	STAFF POPULATION
Nigerian Breweries Plc, Enugu (NBPE).	228
Guinness Nigeria Plc brewed at Dubic Breweries, Aba (GNPBA)	190
Hero Breweries Plc, Onitsha (HBPO)	256
International Breweries Plc, Imo State Depot (IBPI)	76
Total	750

Source: From the Study Firms (2024).

Sample Size and Sampling Technique

Sampling is the act of selecting components from the study's target population in such a way that they accurately reflect the population as a whole (Creswell, 2013). Because it is frequently impossible to interview every person of the target group, sampling is used in a research. The study used Slovin's formula (Maragia & Kemboi, 2021) for calculating a sample of a finite to obtain the representative sample. The formula is given below as;

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = Sample size
N = Population size (750)
e = Margin of error or error tolerance (0.05)

$$n = \frac{750}{1 + 750(0.05)^2} = \frac{750}{2.875} = 260.8696$$

The study followed Singh & Masuku's (2014) advice and used an error margin of 5%. With a target population of 750 employees, the sample size for the employees is 261 when the error margin is 5%.

Stratification procedures were employed to ensure subjects are drawn from the 4 targeted manufacturing firms. Proportionate sampling was employed when determining the number of employees from each firm. This was computed using Bowley's formula as shown below and the results obtained were NBPE (79), GNPBA (66), HBPO (89) and IBPI (27):

$$n_h = \frac{nN_h}{N}$$

where

$$\begin{aligned} N_h &= \text{number allotted to each stratum (firm)} \\ n &= \text{Sample size} \\ N &= \text{Population} \end{aligned}$$

Research Instruments and Reliability of Instrument

As the main tool for gathering data, the researchers created their own questionnaires (Yeasmin & Rahman, 2012). According to Kothari and Garg (2014), a questionnaire is a tool that consists of a number of questions printed or typed in a specific order on a form or set of forms and distributed to the individuals involved. The instrument was constructed using a 4 point likert scale of Strongly Agree (SA) 4; Agree (A) 3; Disagree (D) 2; and Strongly Disagree (SD) 1. To ensure the validity of the instruments for this study, the content and face validity was adopted in ascertaining the extent to which the instrument could be said to be accurate and precise in the measurement of the variables under investigation. The instruments were administered to the group outside the study area and the scores were collated. Their responses (scores) were analyzed using Cronbach alpha which yielded an index coefficient of 0.889, 0.887, 0.735 for the dependent variables and 0.769, 0.865, 0.852 for the independent variables. The researcher therefore considered the instrument suitable and adequate for the study.

Method of Data Analysis

The data analysis techniques applied in this study were the descriptive statistics such as mean, inferential statistics such as Pearson Product Moment Correlation Coefficient (r). The mean was used to analyze the responses received to the questionnaire items on the study variables. Before the analysis, a criterion mean of 2.50 was set for any item to be accepted. This implies that any item that scores 2.50 or above was accepted while those that score a mean value of less than 2.50 was rejected. The research questions and hypotheses formulated in this study were tested using Pearson Product Moment Correlation Coefficient (r). Pearson Product Moment Correlation Coefficient (r)

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

Where X = Independent Variable

Y = Dependent Variable

$\sum XY$ = Summation of X and Y

The Pearson Product Moment Correlation Coefficient (r) was used for the bivariate analysis. Here, the direction and strength of relationship between the two variables in each of the hypothesis was determined using the Pearson Correlation Coefficient (r). Bhandari (2021) stated that the direction of a relationship can be positive or negative. Additionally, according to Ogbeibu et al. (2022), the strength of relationship between two variables can vary. A positive relationship indicates that both variables move in the same direction, while a negative relationship implies that both variables move in opposite directions (Ogbeibu et al., 2022). Zero relationship implies that no relationship exists between the two tested variables. The strength of relationship between two variables is interpreted by Ogbeibu et al. (2022) as follows: 0.00– 0.20 = very low extent relationship, 0.21– 0.40 = low extent relationship, 0.41–0. 60 = moderate extent relationship, 0.61–0.80 = high extent relationship and 0.81–1.00 = very high extent relationship.

The Pearson Correlation Coefficient (r) was computed using a computer software program known as IBM SPSS version 25.0, and the rejection of the null hypothesis was achieved if the calculated p-value is less than the level of significance (0.05); otherwise the null hypothesis is not rejected.

Result

Univariate Analysis

The responses received to the questionnaire items on each of the study variables were analyzed. The mean score was used to analyze the responses received to the questionnaire items on the study variables. Here, the frequency of responses received to each item was determined and the mean score for each item on the study variables were computed.

Table 1: Mean Responses of Adoption of Automation Technology and Production Efficiency

S/N	Items	SA 4	A 3	D 2	SD 1	Grand Total	\bar{X}	Crit. Mean	Decision
1.	Our organization has adopted automation technology such as robotic process automation	140	80	15	5	240	3.48	2.50	Accepted
2.	The adoption of automation technology has improved our production efficiency	130	90	15	5	240	3.44	2.50	Accepted
3.	Automation technology has enabled us to reduce production costs and increase productivity	150	85	4	1	240	3.60	2.50	Accepted
4.	The adoption of automation technology has enabled us to improve our product quality	120	110	7	3	240	3.45	2.50	Accepted
5.	Automation technology has enabled us to gain a	140	95	4	1	240	3.56	2.50	Accepted

competitive advantage in the market	
Cluster Mean	3.51

Source: Field Survey, 2024.

The Table 1 presents the results of a survey on the adoption of automation technology and its impact on production efficiency. The survey had 240 respondents, and the results are presented in terms of mean scores. The results show that: a majority of the respondents (140) strongly agree that their organization has adopted automation technology, with a mean score of 3.48, which suggests that automation technology is widely adopted in the industry; the adoption of automation technology has improved production efficiency, with a mean score of 3.44, which suggests that automation technology has a positive impact on production efficiency; automation technology has enabled organizations to reduce production costs and increase productivity, with a mean score of 3.60, which suggests that automation technology is effective in reducing costs and improving productivity; the adoption of automation technology has enabled organizations to improve product quality, with a mean score of 3.45, which suggests that automation technology has a positive impact on product quality; and automation technology has enabled organizations to gain a competitive advantage in the market, with a mean score of 3.56, which suggests that automation technology is effective in providing a competitive advantage.

The cluster mean of 3.51 suggests that, overall, the respondents are positive about the adoption of automation technology and its impact on production efficiency. All the statements have a mean score above 2.50, which suggests that they are all accepted by the respondents. This implies that the adoption of automation technology is widely accepted and has a positive impact on production efficiency, cost reduction, productivity improvement, product quality, and competitive advantage.

Table 2: Mean Responses of Digital Technologies and Quality Control

S/N	Items	SA 4	A 3	D 2	SD 1	Grand Total	\bar{X}	Crit. Mean	Decision
1.	Our organization uses digital technologies such as AI and IoT to monitor and control quality	150	80	5	5	240	3.56	2.50	Accepted
2.	The use of digital technologies has improved our ability to detect and prevent quality defects	135	100	4	1	240	3.54	2.50	Accepted
3.	Digital technologies have enabled us to improve our quality control processes and reduce waste	150	86	3	1	240	3.60	2.50	Accepted
4.	The use of digital technologies has enabled us to improve our product quality and reduce customer complaints	122	113	4	1	240	3.48	2.50	Accepted
5.	Digital technologies have enabled us to gain real-time insights into our quality control processes and make data-driven decisions	142	97	1	0	240	3.59	2.50	Accepted
Cluster Mean							3.55		

Source: Field Survey, 2024.

The results of Table 2 indicate that the respondents overwhelmingly agree that digital technologies have a positive impact on quality control. The mean scores for all five statements are above 3.48, indicating a strong agreement. The cluster mean of 3.55 suggests that, overall, the respondents are very positive about the use of digital technologies for quality control. The results indicate that

digital technologies have enabled organizations to improve their quality control processes, detect and prevent quality defects, reduce waste, and improve product quality.

The high mean scores also suggest that digital technologies have provided organizations with real-time insights into their quality control processes, enabling them to make data-driven decisions. The results provide strong evidence that digital technologies are effective in improving quality control and should be adopted by organizations seeking to improve their quality control processes. Overall, the results suggest that digital technologies are a key driver of quality control, and their adoption is essential for organizations seeking to improve their quality control processes and gain a competitive advantage in the market.

Table 3: Mean Responses of Enterprise Resource Planning and Cost Efficiency

S/N	Items	SA 4	A 3	D 2	S D 1	Grand Total	\bar{X}	Crit. Mean	Decision
1.	Our organization uses an ERP system to manage and coordinate our business processes	151	84	3	2	240	3.60	2.50	Accepted
2.	The use of an ERP system has enabled us to reduce our operational costs	136	101	2	1	240	3.55	2.50	Accepted
3.	The ERP system has enabled us to improve our inventory management and reduce waste	151	87	2	0	240	3.62	2.50	Accepted
4.	The use of an ERP system has enabled us to improve our supply chain management and reduce costs	123	115	2	0	240	3.50	2.50	Accepted
5.	The ERP system has provided us with real-time insights into our business processes and enabled us to make data-driven decisions	144	95	1	0	240	3.60	2.50	Accepted
Cluster Mean							3.57		

Source: Field Survey, 2024.

The results of Table 3 indicate that the respondents strongly agree that Enterprise Resource Planning (ERP) systems have a positive impact on cost efficiency. The mean scores for all five

statements are above 3.50, indicating a strong agreement. The cluster mean of 3.57 suggests that, overall, the respondents are very positive about the use of ERP systems for cost efficiency. The results indicate that ERP systems have enabled organizations to reduce operational costs, improve inventory management, reduce waste, improve supply chain management, and make data-driven decisions.

The high mean scores suggest that ERP systems are effective in improving cost efficiency and providing real-time insights into business processes. The results provide strong evidence that ERP systems are a key driver of cost efficiency, and their adoption is essential for organizations seeking to improve their cost efficiency and gain a competitive advantage in the market. Overall, the results suggest that ERP systems are a valuable tool for organizations seeking to improve their cost efficiency, and their adoption should be considered a key strategic initiative.

Bivariate Analysis

The bivariate analysis was carried out to determine the relationship between independent and dependent variables in each of the hypotheses. The Pearson Product Moment Correlation (r) was used to test and determine the relationship between the two variables in each of the hypotheses formulated in this study. The r value was computed using the IBM SPSS version 25.0 and the results are presented below according to the research questions and hypotheses, since both of them fall under bivariate analysis.

Research Questions and Hypotheses

Research Question 1

To what extent does the adoption of automation technology (AAT) impact production efficiency (PE) in brewery firms in South-East Nigeria?

Table 4: Summary of Analyses Concerning Research Question One

Variables	n	\bar{X}	SD	r
AAT	240	17.9754	2.1132	0.781
PE	240	17.8786	2.0032	
High Relationship				

Table 4 shows the result obtained in respect of research question one. The result reveals that the correlation coefficient is 0.781, which is high. This implies that adoption of automation technology (AAT) has high impact production efficiency (PE) in brewery firms in South-East Nigeria.

Research Hypothesis 1

H₀₁: There is no significant relationship between the adoption of automation technology and production efficiency in brewery firms in South-East Nigeria

Table 5: Result of Bivariate Analysis between Adoption of Automation Technology (AAT) and Production Efficiency (PE)

			AAT	PE
Pearson (r)	AAT	Correlation	1.000	0.781*
		Coefficient	.	0.000
		Sig. (2 tailed)	240	240
		N		
	PE	Correlation	0.781*	1.000
		Coefficient	0.000	.
		Sig. (2 tailed)	240	240
		N		

*Correlation is significant at 0.05 levels (2 tailed)

Table 5 presents the result of the bivariate analysis performed between adoption of automation technologies and production efficiency. The p-value is 0.00, which is less than the level of significance (0.05), hence, the null hypothesis which stated that there is no significant relationship between the adoption of automation technology and production efficiency in brewery firms in South-East Nigeria is rejected. With a correlation of 0.781, it implies that adoption of automation technology is strongly and positively correlated to production efficiency. Thus, the conclusion is that there is high significant relationship between the adoption of automation technology and production efficiency in brewery firms in South-East Nigeria.

Research Question 2

How does the use of digital technologies (DT) influence quality control (QC) in brewery firms in South-East Nigeria?

Table 6: Summary of Analyses Concerning Research Question Two

Variables	n	\bar{X}	SD	r
DT	240	17.8754	2.4963	
QC	240	17.0787	2.0232	0.854
Very High Relationship				

Table 6 shows the result obtained in respect of research question two. The result reveals that the correlation coefficient is 0.854, which is very high. This implies that the use of digital technologies (DT) influence quality control (QC) in brewery firms in South-East Nigeria is to a very high extent.

Research Hypothesis 2

H₀₂: The use of digital technologies has no significant impact on quality control in brewery firms in South-East Nigeria

Table 7: Result of Bivariate Analysis between Digital Technologies (DT) and Quality Control (QC)

			DT	QC
Pearson (r)	DT	Correlation	1.000	0.854*
		Coefficient	.	0.000
		Sig. (2 tailed)	240	240
		N		
	QC	Correlation	0.854*	1.000
		Coefficient	0.000	.
		Sig. (2 tailed)	240	240
		N		

*Correlation is significant at 0.05 levels (2 tailed)

Table 7 presents the result of the bivariate analysis performed between digital technologies and quality control. The p-value is 0.00, which is less than the level of significance (0.05), hence, the null hypothesis which stated that the use of digital technologies has no significant impact on quality control in brewery firms in South-East Nigeria is rejected. With a correlation of 0.854, it implies that a digital technology is very strongly and positively correlated to quality control. Thus, the conclusion is that the use of digital technologies has a very significant impact on quality control in brewery firms in South-East Nigeria.

Research Question 3

What is the relationship between the implementation of Enterprise resource planning (ERP) systems and cost efficiency (CE) in brewery firms in South-East Nigeria?

Table 8: Summary of Analyses Concerning Research Question Three

Variables	n	\bar{X}	SD	r
ERP	240	17.3432	2.4756	0.889
CE	240	17.8454	1.9632	
Very High Relationship				

Table 8 shows the result obtained in respect of research question three. The result reveals that the correlation coefficient is 0.889, which is very high. This implies that the relationship between the implementation of Enterprise resource planning (ERP) systems and cost efficiency (CE) in brewery firms in South-East Nigeria is to a very high extent.

Research Hypothesis 3

H03: There is no significant relationship between the implementation of ERP systems and cost efficiency in brewery firms in South-East Nigeria.

Table 9: Result of Bivariate Analysis between Enterprise Resource Planning (ERP) Systems and Cost Efficiency (CE)

			ERP	CE
Pearson (r)	ERP	Correlation	1.000	0.889*
		Coefficient	.	0.000
		Sig. (2 tailed)	240	240
		N		
	CE	Correlation	0.889*	1.000
		Coefficient	0.000	.
		Sig. (2 tailed)	240	240
		N		

*Correlation is significant at 0.05 levels (2 tailed)

Table 9 presents the result of the bivariate analysis performed between cost efficiency and cost efficiency. The p-value is 0.00, which is less than the level of significance (0.05), hence, the null hypothesis which stated that there is no significant relationship between the implementation of ERP systems and cost efficiency in brewery firms in South-East Nigeria is rejected. With a correlation of 0.889, it implies that Enterprise resource planning is very strongly and positively correlated to cost efficiency. Thus, the conclusion is that there is a very high significant relationship between the implementation of ERP systems and cost efficiency in brewery firms in South-East Nigeria.

Discussion of Findings

The result of research question one and hypothesis one revealed that with a correlation of 0.781, it implies that adoption of automation technology is strongly and positively correlated to production efficiency. Thus, the conclusion is that there is high significant relationship between the adoption of automation technology and production efficiency in brewery firms in South-East Nigeria, since the p-value is 0.00, which is less than the level of significance (0.05). The results of this study are consistent with previous research that suggests a positive relationship between the adoption of technology and operational efficiency (Kumar et al., 2020; Singh et al., 2019). Specifically, the finding that there is a strong positive correlation between the adoption of automation technology and production efficiency is in line with the results of previous studies that have investigated the relationship between technology adoption and operational efficiency in various industries (Chukwu and Igwe, 2012). However, the results of this investigation contradict those of Oyedijo (2017), who found a negative correlation between technology adoption and financial performance in Nigerian manufacturing firms.

The result of research question two and hypothesis two revealed that with a correlation of 0.854, it implies that a digital technology is very strongly and positively correlated to quality control. Thus, the conclusion is that the use of digital technologies has a very significant impact on quality control in brewery firms in South-East Nigeria, since the p-value is 0.00, which is less than the

level of significance (0.05). Specifically, the findings of this study are in line with those of Singh et al. (2019), who found a positive correlation between digital technologies and quality control in Indian service firms. Similarly, the results of this study are consistent with those of Kumar et al. (2020), who found that the adoption of automation technology was positively related to quality control in Indian manufacturing firms. However, the results of this study contradict those of Oyedijo (2017), who found a negative correlation between technology adoption and quality control in Nigerian manufacturing firms. The discrepancy between the findings of this study and those of Oyedijo (2017) may be due to differences in the research context, methodology, or sample characteristics.

The result of research question three and hypothesis three revealed that with a correlation of 0.889, it implies that Enterprise resource planning is very strongly and positively correlated to cost efficiency. Thus, the conclusion is that there is a very high significant relationship between the implementation of ERP systems and cost efficiency in brewery firms in South-East Nigeria, since the p-value is 0.00, which is less than the level of significance (0.05). Specifically, the findings of this study are in line with those of Kumar et al. (2020), who found a positive correlation between ERP adoption and cost efficiency in Indian manufacturing firms. Similarly, the results of this study are consistent with those of Singh et al. (2019), who found that the implementation of ERP systems was positively related to cost efficiency in Indian service firms. Additionally, the results of this study are also consistent with the findings of Chukwu and Igwe (2012), who found a positive correlation between technology adoption, including ERP systems, and organizational performance, including cost efficiency, in the Brewery Industry of Southern Nigeria. However, the results of this study contradict those of Oyedijo (2017), who found a negative correlation between ERP adoption and cost efficiency in Nigerian manufacturing firms. The discrepancy between the findings of this study and those of Oyedijo (2017) may be due to differences in the research context, methodology, or sample characteristics.

Conclusion

The study investigated the relationship between automation technology, digital technologies, and Enterprise Resource Planning (ERP) systems on production efficiency, quality control, and cost efficiency in brewery firms in South-East Nigeria. The results of the study revealed a strong positive correlation between automation technology and production efficiency, digital technologies and quality control, and ERP systems and cost efficiency. The study concludes that the adoption of automation technology, digital technologies, and ERP systems has a significant impact on production efficiency, quality control, and cost efficiency in brewery firms in South-East Nigeria.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Brewery firms in South-East Nigeria should adopt automation technology to improve their production efficiency.
2. Digital technologies should be adopted by brewery firms in South-East Nigeria to improve their quality control processes.
3. ERP systems should be implemented by brewery firms in South-East Nigeria to improve their cost efficiency.
4. The government and regulatory bodies should provide incentives and support for brewery firms in South-East Nigeria to adopt automation technology, digital technologies, and ERP systems.
5. Brewery firms in South-East Nigeria should invest in training and development programs to enhance the skills and knowledge of their employees in the use of automation technology, digital technologies, and ERP systems.

Suggestion for Further Research

Some potential areas for further research include:

1. Future studies should investigate the impact of automation technology, digital technologies, and ERP systems on other performance metrics such as customer satisfaction, employee productivity, and environmental sustainability.
2. The study should be replicated in other industries and countries to determine the generalizability of the findings.
3. Future studies should investigate the challenges and barriers to the adoption of automation technology, digital technologies, and ERP systems in brewery firms in South-East Nigeria.
4. The study should investigate the role of leadership and organizational culture in the successful implementation of automation technology, digital technologies, and ERP systems in brewery firms in South-East Nigeria.
5. Future studies should investigate the impact of emerging technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT) on the performance of brewery firms in South-East Nigeria.

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