Lean Production Strategies and Environmental Sustainability of Industrial Goods Companies in Nigeria

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Abstract: *The paper examined lean production strategies and environmental sustainability of industrial goods companies in Nigeria. The study adopted a descriptive survey research design. The population of the study comprised of (45) senior management staff of industrial goods companies listed on the Nigeria Business Directory in Southern Nigeria. The study took a census of the population as a sample size making it (12) Management staff from Dangote Petro Chemicals, (19) Management staff from Indorama Eleme Chemicals and (14) Management staff from Nigeria LNG Limited. The study used primary data. The content validity was adopted in the study. The Cronbach Alpha Coefficients method was used to test the reliability of the instruments with a bench mark of 0.7. Descriptive statistics such as frequency and percentage was used to analyze the research questions. The study employed Multiple Regression Coefficients to test the hypotheses. The findings showed that traditional production lean strategies has more predictive influence compare to modern lean production strategies on environmental sustainability in Dangote petro chemicals. Also, the findings showed that modern strategy has more predictive influence compare to traditional strategies on environmental sustainability in Indoroma Eleme Chemicals. Furthermore, modern lean strategy has more predictive influence compare to traditional lean strategy on environmental sustainability in Nigeria LNG Limited. The study recommends that management of industrial goods companies in Nigeria should adopts modern lean production strategies to improve environmental sustainability, air emissions, toxic chemicals use, energy use, solid waste and land use in the operations.*

Keywords: *Lean Production, Lean Production Strategies, Environmental Sustainability, Traditional Lean Production Strategy, Modern Production Strategy*

INTRODUCTION

Responsible Production, Consumption, and Accounting: in the industrial goods industry can be improved by using lean production strategies. Thus, the paper empirically examine lean production strategies and environmental sustainability: specifically, examined the impact of traditional and modern lean production strategies on environmental sustainability: evidence from industrial goods companies in Nigeria. Environmental sustainability requires maintaining natural capital as both a provider of economic inputs (sources) and an absorber (sinks) of economic outputs (wastes) (Basiago, 1999). Thus, at the source site', harvest rates of resources must be kept within regeneration rates; at the 'sink site', waste emissions from industrial activities must be controlled so as to not exceed the capacity of the environment to assimilate them without harm. In practical terms, the theory of environmental sustainability suggests a planning process that allows human society to 'live within the limitations of the biophysical environment. Therefore, environmental sustainability has to do with the preservation and protection of natural resources, reduction of pollution and conservation of the eco-system to ensure a strong and thriving planet for future

generations in terms of providing; renewable energy, waste recycling and reducing consumption, conservation of biodiversity, climate change mitigation, and eco-friendly practices.

Apparently, industrial toxic chemicals and waste recycling are integral to almost all areas of society and are used across all economic sectors. Every year more than 1 billion workers are exposed to hazardous substances in the workplace, including pollutants, dusts, vapours and fumes (ILO 2021). Hamalainen (2017) stated that hazardous substances claimed the lives of almost 1 million workers, with many more subjected to lifelong and debilitating chronic conditions. Anthropogenic chemical pollution has devastated the environment, endangering global ecosystems upon which life depends. There is alarming evidence that important tipping points, leading to irreversible damage may already have been reached or passed (Persson, 2022). Thus, greenhouse gases, climate change and contaminants in the air, water and soil are, to a large extent, caused by toxic industrial activities (Redwell-Emotongha, Hamilton, & Bayo, 2021). Industrial hazardous chemicals, includes heavy metals, plastics and pesticides, have contributed significantly to this burden, which now poses one of the largest environmental threats to humanity (Naidu, 2021). However, the industrial goods and chemical industry is the largest industrial energy consumer and the third biggest industry subsector in terms of direct carbon dioxide emissions (IEA 2022). Air emission and greenhouse gases, such as carbon dioxide, are emitted at every stage of a chemical's lifecycle, including production, use and waste.

Naidu (2021) suggested that chemical pollutants can migrate globally in air and water, in human and animal vectors, in waste materials, and in nanoparticles, such as microplastics. While the environment has a certain capacity to biodegrade some toxic substances, others are resistant to decomposition processes and cause long-term environmental damage, as well as accumulating in food chains. Therefore, chemical emissions have serious and lasting detrimental impacts on the climate, environment and ecosystems. Industries are now facing a problem of broad production in their organizations thus resulting to lots of wastage. This has seen industrial goods companies experience problems of waste along the supply chain and the liability to make the right products for consumers in the market. Keitany (2014) posit that operations managers are bound to embrace the essence of adopting lean production which is a business strategy and philosophy to reduce waste in production process. To this extent therefore, this strategy and philosophy leverage companies to achieve long term competitive advantages by putting in place the proper production systems and technologies particularly with regard to reducing wastage and inventory control system.

Bruce and Larco (1999) stated that lean production is both a concept that can be viewed and implemented at a number of levels and also a commitment process of relentless improvement that can significantly impact upon an organizations health and sustainability. Lean production is a production system that aims to minimize waste and maximize value-added activities in the production process. In other words, lean production is a management philosophy and set of strategies aimed at minimizing waste and maximizing value-added activities in production processes. It emphasizes on creating more value for consumers while using fewer resources. However, the implications of industrial activities on environment (such as greenhouse gas emissions, resource depletion or water pollution) has attract the attention of regulatory and socio-economic pressure on manufacturing firms which the industrial goods sector is not exempted to be more environmentally friendly in order to preserve the environment and the natural resources. Hence, determining how to promote sustainability as a response to such pressure is currently one

of the most important issues being investigated in both theory and practice (Cherrafi, 2018; Baah, Jin & Tang, 2020).

Sartal (2020) claimed that the aim to improve environmental sustainability that is (to minimize the consumption of energy in order to cut CO2 emissions) is difficult to achieve even with current best organizational theory and strategies. Jabbour (2016) found that several barriers, including resistance to change, lack of training, aversion to innovation, limited financial capacity and the difficulty of establishing environmental awareness, has hinder the promotion of lean production strategies and thus affect firms' performance. According to Yu and Chavez (2020), the implementation of lean production can overcome these barriers because lean production is based on the elimination of "waste" (useless consumption of resources); it relies on the engagement of operators and it is made up of tools and strategies such as pull production, 5s method, total productive maintenance (TPM). All these strategies promote lean production and contribute to a better environmental sustainability (Garza-Reyes, 2018; Merli, Preziosi, & Ippolito, 2016). However, a few questions regarding the relationship between lean production and environmental sustainability still need to be clarified. Hence, the paper aims to examine the adoption of traditional and modern lean production strategies and the influence on environmental sustainability of industrial goods companies in Nigeria. Specifically, the objectives are to:
1. Examine the impact of traditional lean production strategy on environmental sustainability of Industrial Goods Companies in Nigeria.
2. Examine the impact of modern lean production strategy on environmental sustainability of Industrial Goods Companies in Nigeria

Research Questions
1. To what extent does traditional lean production strategy affect environmental sustainability in Industrial Goods Companies in Nigeria?
2. To what extent does modern lean production strategy affect environmental sustainability in Industrial Goods Companies in Nigeria?

LITERATURE REVIEW
Lean Production
Lean is defined as a strategy for achieving significant continuous improvement in efficiency through the elimination of all wastes of resources and time in the total business process. Thus, it evolved from (Toyota after World War II) as a business strategy due to the limited resources available in (Japan), in contrast to the vast resources available to manufactures in the (US). Its principles apply to nearly all business operations, from administration and product design to hardware production. Lean production refers to a business strategy or philosophy that emphasizes on meeting responsible production by delivering quality products at the least cost when required. Lean production strategy is about eliminating waste and non value added tasks or activities in the workspace. Furthermore, lean production focuses on the elimination of everything that does not add value to the product and therefore it is considered a "waste" of resources (Chen, 2020) to deliver quality products at low cost with high productivity. The drawing force behind lean production is the essence of creating substantial value with the purpose of utilizing resources to their best advantage. It is imperative to note that lean production can only be realized in an environment which its top level management of the firm/ company invariability support its

adoption. Such abrupt policy changes require a top-down approach to decision making (Emotongha, & Okpimah, 2024).

Lean Production and Waste

According to Shingo (1989) waste is any activity that does not contribute to operations and there with unpacking supplied parts or waiting for lots items to finished. Value adding activities transform materials changing form or quality they turn raw materials into parts or products. Lareau (2003) further identified four groups of office waste such as: people waste (lack of goal alignment, waiting and motion process waste (control the sense of only monitoring, variability lack of standardization and errors), information waste (missing irrelevant and inaccurate information) and asset waste (office inventory buildings and offices that are not fully used and transportation of information). Keitany, (2014) identified eight category of waste such as: motion waste, waiting waste, correction waste, over processing waste, overproduction waste, unnecessary transportation waste, inventory waste and knowledge waste. Lean production typically represents a paradigm shift from conventional 'batch and queue' functionally aligned mass production to one-piece flow, product aligned pull production. Lean production achieves its goals by means of several tools and strategies that help identify, remove and prevent wasteful operations (Cassell, 2016).

Lean Production Strategies

Lean production strategies aim to minimize waste and maximize value-added activities in the workspace. Lean production strategies, originally developed in the automotive industry by Toyota, focus on eliminating waste, improving efficiency, and maximizing value for consumers. Every strategy has its own way of eliminating waste in the production process.

Traditional Strategies such as: Just-in-Time Production (JIT) as a strategy of manufacturing based on production scheduling and planned elimination of all waste to improve efficiency. It reduces the need for large amounts of stored materials and toxic chemicals. This can decrease the energy and resources required for storage and handling. It is a strategy where materials and products are produced and delivered just in time to meet customer demand, minimizing inventory and waste. ABC analysis aim to classify existing inventory based on annual consumption and the annual value of the items. However, A-Item has (very tight control, the items being of high value). B-Item has (moderate control, the items being of moderate value). C-Item being of low value, the control can be exercised at gross root level of authority by managers in various departments (Tomek & Vavrova, 2014). Continuous Improvement Process (CIP): (quality control) was promoted by Edwards Deming (Liker & Hoseus, 2008). The continuous improvement lies on the time line from which the money is collected. The time line is reduced by eliminating the non-value added waste. The above methods are referred in the paper as traditional lean production strategies.

Modern Strategies such as: 5S (Sort, Set in order, Shine, Standardize, Sustain) is a systematic methodology for organizing and managing the workplace to enhance efficiency and effectiveness. Total Productive Maintenance (TPM) focuses on better approach to machine maintenance. The method uses analyses of production system data and sensors to identify possible failures before they occur, using models of dependency (Marik, 2016). Electronic Data Interchange (EDI) makes it possible to improve communication between enterprises through the Electronic Data Interchange (EDI) method. The modern computers have programs to manage individual parts of the production process, even production as a whole. Computerized Management of Production (CAM) often referred to as Computer-Aided Production Management (CAPM), encompasses the use of computer systems to enhance various aspects of production management. This includes

planning, scheduling, and controlling production processes through integrated software solutions. These methods, which have been applied since the 1970s, are referred to as the modern methods and the paper aim to explore their adoption both in relation to traditional methods and in terms of their influence on sustainability of industrial goods industry.

Environmental Sustainability

Environmental sustainability involves ecosystem integrity, carrying capacity and biodiversity emission initiatives. It requires that natural capital be maintained as a source of economic inputs and as a sink for wastes. Resources must be harvested no faster than they can be regenerated. Wastes must be emitted no faster than they can be assimilated by the environment (Kahn, 1995). Environmental sustainability refers to the conservation, management and rational utilization of natural resources in such way to maintain the integrity of ecosystem, support all life, ensure the preservation of biodiversity and prevents environmental degradation (Gbenda, 2012). Environmental sustainability is a responsive interaction with the environment with a view to conserved natural resources through developing alternative sources of power and reducing pollution or any negative impact for the long environmental quality. Environmental sustainability appears to follow three stage in an organization (Jabbour & Santos, 2006). The first stage involves the organization reacting to environmental legislation and product requirements. The second phase focuses on prevention of harm to the environment such as preventing pollution, ensuring proper waste disposal. The third stage is characterized by voluntary proactive actions and change to ensure long term sustainability. Many businesses consequently devote substantial time and resources responding to unforeseen changes in the environment instead of forestalling and getting ready for these changes (Acee-Eke & Ikegwuru, 2020), by means of a suitable lean production. Hence, the notion of responsible lean production, which aims at continuous integration of environmental improvements and products prevent air, water and land pollution and to reduce waste at source; and to minimize risks to humans and other species.

Lean Production and Environmental Sustainability

Martin (2018) examined traditional and modern methods of lean production and quality of manufacturing firms in Czech Republic. The study used a questionnaire survey and research, 90 industrial enterprises were classified by the size, production scope and their ownership. The research results were analyzed by means of statistical methods to determine the differences in the use of lean production methods. The findings revealed that large enterprises tend to use lean production more. It was also proved that some methods of lean production are not completely common in the Czech Republic. Moreover, some methods are quite new to the majority of the enterprises.

Jackson, Ones and Dilchert (2012) conducted a study on managing human resources for environmental sustainability in Kenyan Public Universities. The study was conducted in seven public universities. Designs employed were descriptive survey and Karl Pearson moment Correlation. Target population was 5189 teaching staff from seven Kenyan public universities. Descriptive statistics such as means, percentages and frequency counts were used while inferential statistics involved use of Karl Pearson moment Correlation. The findings show that by ensuring that new employees understand the environmental culture of organizations and share their environmental values, recruitment practices can support environmental management practices in the organizations. Likewise, Organizations which opts to protect their reputation of a green employer, they are effective in attracting new talents, high quality employees with environmental

beliefs. In line with the literature reviewed the following hypotheses were proposed to guide the study:

Ho₁ Traditional lean production strategy has no significant influence on environmental sustainability of Industrial Goods Companies in Nigeria.

Ho₂ Modern lean production strategy has no significant influence on environmental sustainability of Industrial Goods Companies in Nigeria.
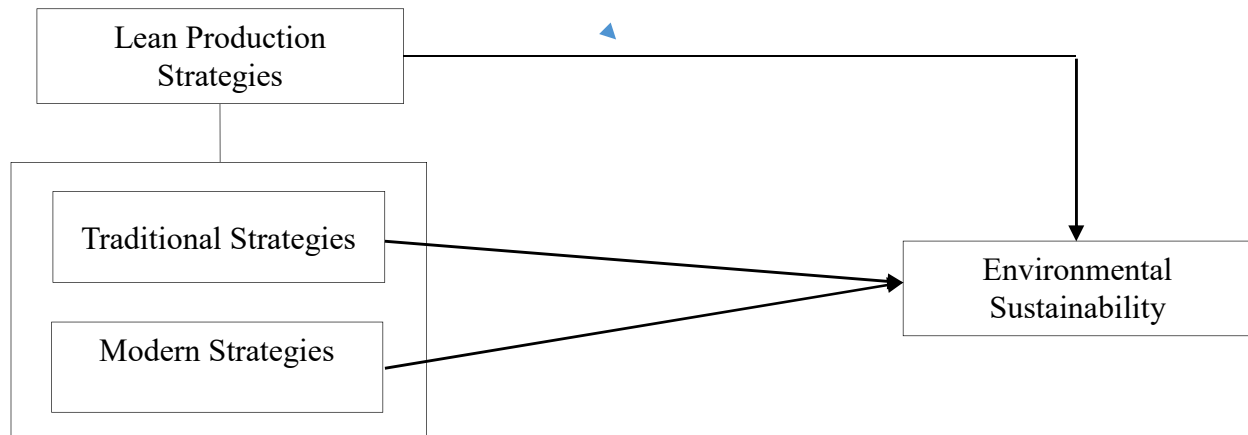
Conceptual Framework

Figure 1: Conceptual Framework of lean production strategies adoption and environmental sustainability

Source: Desk Research, 2024

METHODOLOGY

The paper employed descriptive survey research design. The population comprised of industrial goods companies listed on the Nigeria Business Directory. The accessible population for the study was 45 senior managers in Dangote Petro Chemicals, Indorama Eleme Chemicals and Nigeria LNG Limited that have operational presence in Southern Nigeria. The reason for focusing on industrial goods companies in Southern Nigeria was to allow for a more incisive assessment of the impact of lean production adoption on environmental sustainability within manageable parameters and frameworks. The study took a census as an organizational level unit of analysis; chose (12) management staff from Dangote Petro Chemicals, (19) management staff from Indorama Eleme Chemicals and (14) management staff from Nigeria LNG Limited. This includes Human Resource staff, Safety staff and Operations staff making it (45) respondents. The study used questionnaire to collect primary data through (Google Form) after which they were recorded on the Google Drive App and information was extracted for subsequent analysis. The content validity was adopted in the study. The reliability of the instrument was confirmed through test of internal consistency using Cronbach Alpha. The quantitative data analysis techniques for the study involved both descriptive and inferential analysis. The study used Multiple Regression Analysis to determine the directions and predictive influence of lean production strategies on environmental sustainability.

DATA ANALYSES AND RESULTS

Descriptive Statistics Analyses

Response Rate on Traditional Production Strategies: this section asked respondents on the adoption and the frequently use of traditional lean production strategies such as: Just-In-Time production, ABC Methods and Continuous Improvement Process in Dangote Petro Chemicals, Indorama Eleme Chemicals and Nigeria LNG Limited.
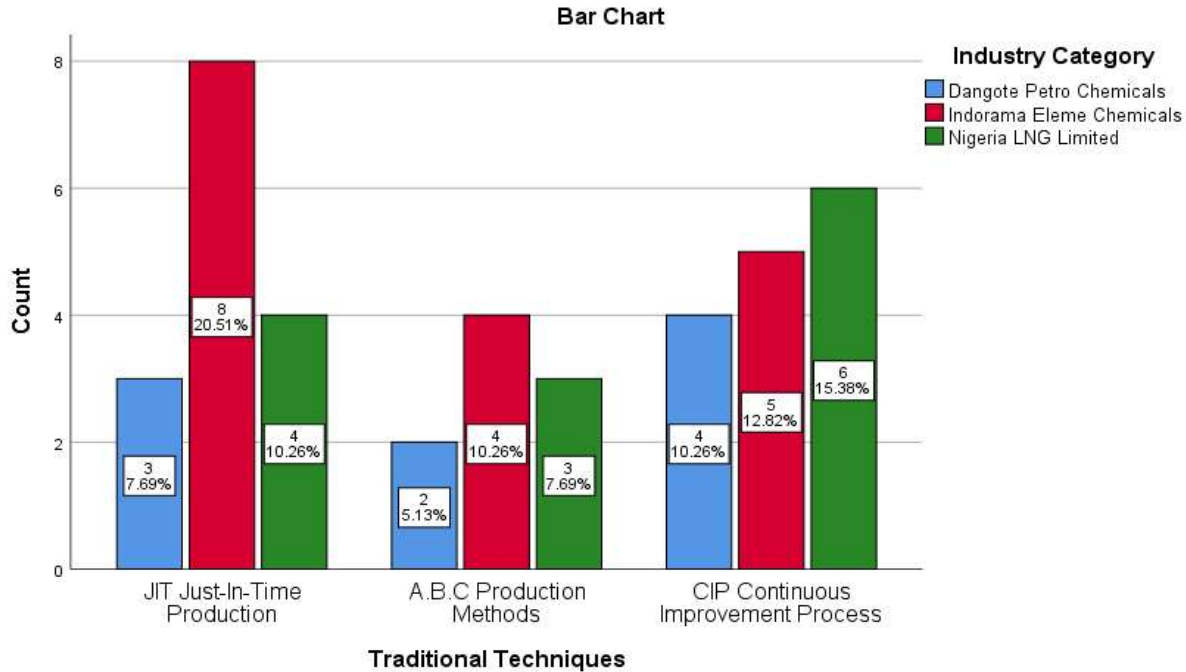

Figure 2: indicate the response rate on traditional production strategies in the three industrial goods companies in Nigeria. Out of the 9 copies of questionnaire retrieved, majority of the respondents 4(10.26%) affirmed that continuous improvement process (CIP) strategy is more in use than JIT and ABC strategies in Dangote Petro Chemicals. Also, Out of the 17 copies return, the majority of respondents 8(20.51%) affirmed that JIT strategy is more in use compare to ABC and CIP strategies in Indorama Eleme Chemicals. Furthermore, Out of the 13 copies return, the majority of respondents 6(15.38%) affirmed that adopts continuous improvement process (CIP) strategy is more in use compare to JIT and ABC strategies in Nigeria LNG Limited.

Response Rate on Modern Production Strategies: this section asked respondents on the adoption and the frequently use of modern lean production strategies such as: 5s (Sort, Set in order, Shine, Standardize, Sustain), (TPM) Total Productive Maintenance, (EDI) Electronic Data Interchange, (CAM) Computerized Management of Production in Dangote Petro Chemicals, Indorama Eleme Chemicals and Nigeria LNG Limited.
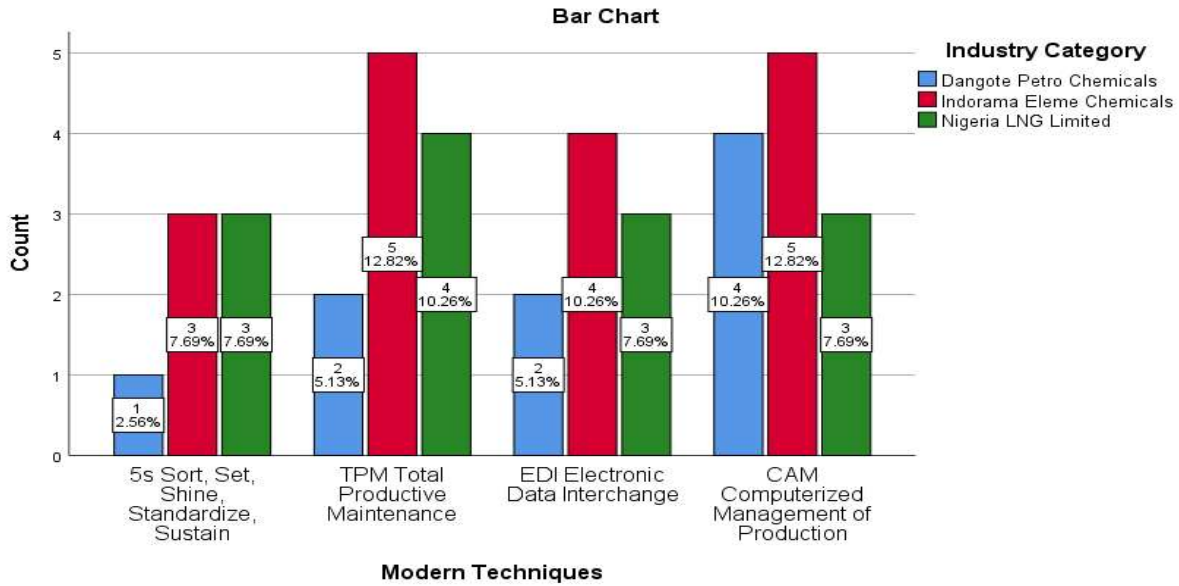
Bar Chart

Figure 3: indicate the response rate on modern production strategies adoption in the three industrial goods companies in Nigeria. Out of the 9 copies of questionnaire retrieved, majority of the respondents 4(10.26%) affirmed that CAM strategy is more in use compare to EDI, TPM and 5s strategies in Dangote Petro Chemicals. Also, Out of the 17 copies return, the majority of respondents 8(20.51%) affirmed that CAM and TPM strategies are more in use compare to EDI and 5s in Indorama Eleme Chemicals. Furthermore, Out of the 13 copies return, the majority of respondents 4(10.26%) affirmed that TPM strategy is more in use compare to 5s, EDI and CAM strategies in Nigeria LNG Limited.

Response Rate on Environmental Sustainability: this section asked respondents on the prevalent of environmental sustainability such as: Air Emissions (causes of climate change), Toxic chemicals use, Energy use, Solid waste and land use in Dangote Petro Chemicals, Indorama Eleme Chemicals and Nigeria LNG Limited.
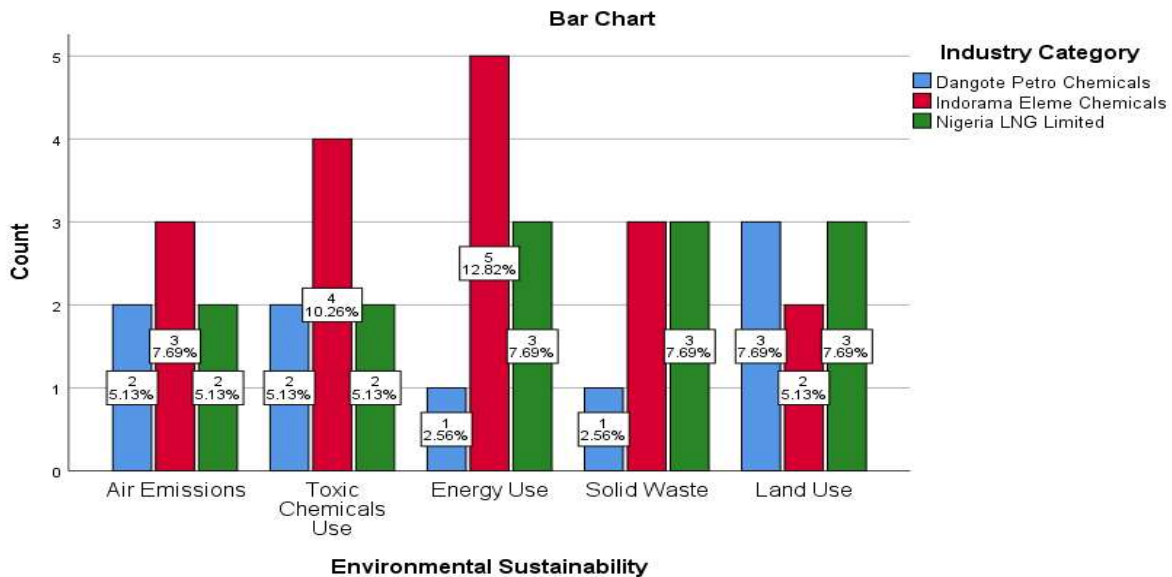

Bar Chart

Figure 4: indicate the response rate on environmental sustainability in the three industrial goods companies in Nigeria. Out of the 9 copies return, the majority of respondents 3(7.69%) affirmed

that land use is more prevalent compare to other factor in Dangote Petro Chemicals. Also, out of the 17 copies return, the majority of respondents 5(12.82%) affirmed that energy use is more prevalent compare to other factors in Indorama Eleme Chemicals. Furthermore, out of the 13 copies return the majority of respondents 3(7.69%) affirmed that energy use, solid waste, land use are more prevalent compare to other factors in Nigeria LNG Limited.

Inferential Statistics Analysis

The multiple regression analysis was used to ascertain the predictive power of lean production strategies on environmental sustainability in Dangote Petro Chemicals, Indorama Eleme Chemicals and Nigeria LNG Limited.

Table 1: Model Summary of Lean Production Strategies on Environmental Sustainability.

Model Summary

Industry Category	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Dangote Petro Chemicals	1	.956ᵃ	.913	.884	.575
Indorama Eleme Chemicals	1	.956ᵃ	.915	.903	.402
Nigeria LNG Limited	1	.980ᵃ	.961	.953	.307

a. Predictors: (Constant), Modern Strategies, Traditional Strategies
Source: SPSS Result, 26.0 (2024)

The coefficient of determination ($R^2 = .913$) in Dangote Petro Chemicals, ($R^2 = .915$) in Indorama Eleme Chemicals and ($R^2 = .961$) in Nigeria LNG Limited establish the predictive power of lean production strategies and the result showed 91.3% change in environmental sustainability of Dangote Petro Chemicals was affected by lean production strategies adoption, 91.5% change in environmental sustainability of Indorama Eleme Chemicals was affected by lean production strategies adoption, 96.1% change in environmental sustainability of Nigeria LNG Limited was affected by lean production strategies adoption.

Table 2: ANOVAᵃ of the Regression of Lean Production Strategies on Environmental Sustainability

ANOVAᵃ

Industry Category	Model		Sum of Squares	df	Mean Square	F	Sig.
Dangote Petro Chemicals	1	Regression	20.902	2	10.451	31.567	.001ᵇ
		Residual	1.986	6	.331		
		Total	22.889	8			
Indorama Eleme Chemicals	1	Regression	24.213	2	12.107	75.092	.000ᵇ
		Residual	2.257	14	.161		
		Total	26.471	16			
Nigeria LNG Limited	1	Regression	23.363	2	11.682	123.688	.000ᵇ
		Residual	.944	10	.094		
		Total	24.308	12			

a. Dependent Variable: Environmental Sustainability
b. Predictors: (Constant), Modern Strategies, Traditional Strategies
Source: SPSS Result, 26.0 (2024)

The ANOVA results in Table 2 show the numerator df (2, 2, 2), which indicates the number of predictor variables in the study (lean production strategies). The value of the F test is F(2, 8) = 31.567, 75.092, 123.688 (p 0.00 < .05) respectively. The F-value indicates that the relationship between the variable in the regression model was fit; hence it has some explanatory value in the studied companies.
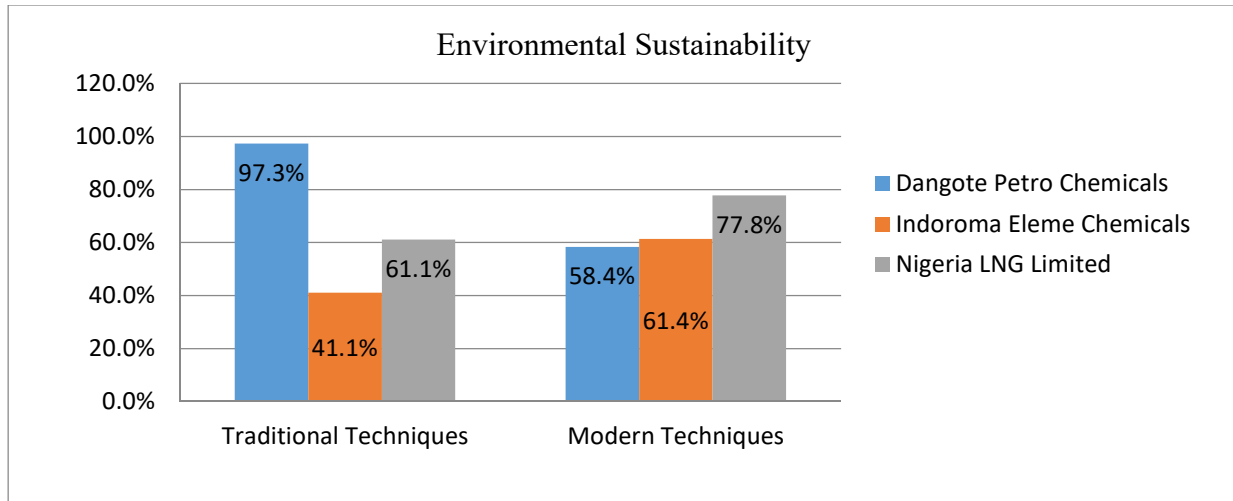
Figure 5 showed the extent of lean production strategies adoption on environmental sustainability in each company.

Figure 5 indicates the predictive power of traditional lean production strategies on environmental sustainability. The results indicates that a unit change (β= 0.973) in traditional lean production strategies explain 97.3% change in environmental sustainability compare to a unit change (β= -0.584) in modern lean production strategies which explain 58.4% change in environmental sustainability in Dangote petrochemicals. Also, the results indicate that a unit change (β= -0.414) in traditional lean production strategies explain 41.4% change in environmental sustainability compare to a unit change (β= 0.614) in modern lean production strategies which explain 61.4% change in environmental sustainability in Indorama Eleme Chemicals. Furthermore, the results indicate that a unit change (β= 0.611) in traditional lean production strategies explain 61.1% change in environmental sustainability compare to a unit change (β= 0.778) in modern lean production strategies which explain 77.8% change in environmental sustainability in Nigeria LNG Limited.

Table 3 showed Correlation of Lean Production Strategies and Environmental Sustainability

Coefficients[a]

Industry Category	Model		Unstandardized Coefficients		Standardized Coefficients		
			B	Std. Error	Beta	T	Sig.
Dangote Petro Chemicals	1	(Constant)	-.203	.587		-.345	.742
		Traditional Strategies	.973	.317	.182	6.218	.001
		Modern Strategies	-.584	.663	-.888	-1.078	.003
Indorama Eleme Chemicals	1	(Constant)	-.100	.264		-.378	.711
		Traditional Strategies	-.414	.360	-.610	-2.040	.009
		Modern Strategies	.614	.285	.966	3.906	.002
Nigeria LNG Limited	1	(Constant)	1.332	.229		.000	1.000
		Traditional Strategies	.611	.240	.386	2.544	.029
		Modern Strategies	.778	.192	.616	4.058	.002

a. Dependent Variable: Environmental Sustainability
Source: SPSS Result, 26.0 (2024)

Ho₁ Traditional lean production strategy has no significant influence on environmental sustainability of Industrial Goods Companies in Nigeria

The empirical findings showed that traditional strategies adoption significantly influence environmental sustainability (standardized β = 0.182, -0.610, 0.386 and P-v =0.001, 0.009, 0.029 < 0.05%) respectively in Dangote Petrochemicals, Indoroma Eleme Chemicals, Nigeria LNG Limited in Nigeria. Therefore, the null hypothesis was rejected and stated that the adoption of traditional lean production strategies has a weak and moderate influence on environmental sustainability in terms of air emission, energy use, land use, solid waste, toxic chemicals use in the industrial goods companies in Nigeria.

Ho₂ Modern lean production strategy has no significant influence on environmental sustainability of Industrial Goods Companies in Nigeria

The empirical findings showed that modern strategies adoption significantly influence environmental sustainability (standardized β = -0.888, 0.966, 0.616 and P-v =0.003, 0.002, 0.002 < 0.05%) respectively in Dangote petrochemicals, Indoroma Eleme Chemicals, Nigeria LNG Limited in Nigeria. Therefore, the null hypothesis was rejected and stated that the adoption of modern strategies has a very strong and moderate influence on environmental sustainability in terms of air emission, energy use, land use, solid waste, toxic chemicals use in the industrial goods companies in Nigeria.

DISCUSSION OF FINDINGS

The study examined traditional and modern lean production strategies adoption and environmental sustainability in Dangote petrochemicals, Indoroma Eleme Chemicals, Nigeria LNG Limited in Nigeria. The findings showed that traditional lean strategy has more predictive influence than modern lean production strategies on environmental sustainability in Dangote petro chemicals. Also, the findings showed that modern strategy has more predictive influence than traditional strategies on environmental sustainability in Indoroma Eleme Chemicals. Furthermore, modern lean strategy has more predictive influence than traditional lean strategy on environmental sustainability in Nigeria LNG Limited. These findings agree with the findings of Ullah (2017) that the implementation of lean and green practice in an organization is likely to result into efficiencies, economical utilization of resources, less wastage, improved job-related attitude, improved work/private life , lower costs, improved worker execution and maintenance which help organization to ensure environmentally sensitive, resource efficient and socially responsible workplace. The results can be compared with the research by Shah and Ward (2003), which divides the lean production into four bundles and stated that the most common lean manufacturing practices are continuous improvement, a cross-functional work force, JIT/continuous flow, reduced batch size, preventive maintenance, pull production/kanban, total quality management. Also the findings corroborate that of Ouma and Ndede (2020) that the habit of going green in an organisation human resource management practices plays a significant role in securing a sustainable development environment through a set target on economic, social and other organisation related goals to their environment.

CONCLUSION AND RECOMMENDATIONS

The study concludes that traditional lean strategy has more predictive power compares to modern strategy on environmental sustainability in Dangote petro chemicals. Also, modern strategy has more predictive power than traditional strategies on environmental sustainability in Indoroma Eleme Chemicals. Similarly, modern strategy has more predictive influence compare to traditional strategy on environmental sustainability in Nigeria LNG Limited. It is shows that the elimination of all forms of waste, including overproduction, waiting times, and defects in the production process leads to a reduction in resource consumption and environmental impact. Therefore, optimizing operations, companies can lower their energy usage, which in turn reduces air emissions, solid wastes and other environmental impacts. Also, by improving process efficiency, companies can reduce their overall environmental footprint, including lower emissions and less waste generation. The study thus recommends that management of industrial goods companies in Nigeria should consider adopts traditional and modern lean production strategies to improve environmental sustainability, air emissions, toxic chemicals use, energy use, solid waste and land use in the operations.

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