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GREEN MANAGEMENT STRATEGIES AND ENVIRONMENTAL SUSTAINABILITY OF MANUFACTURING FIRMS IN RIVERS STATE

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ABSTRACT

This study examined the relationship between Green Management Strategies and Environmental Sustainability of Manufacturing Firms in Rivers State. Three objectives and three corresponding null hypotheses guided the study. Correlational survey design was adopted for this study. The population of this study consisted of 170 managers of steel manufacturing firms in Rivers State. The study adopted the census sampling technique. The instrument for collection of data was a self-structured questionnaire titled "Green Management Strategies and Environment Sustainability Questionnaire (GMSESQ)". Cronbach's alpha reliability coefficient of 0.82 was ascertained. PPMC (person product moment correlation) was used to test hypotheses on SPSS version 25. There is a significant relationship between green product design and resource efficiency of manufacturing firms in Rivers State. There is a significant relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State. There is a significant relationship between green procurement and product lifecycle of manufacturing firms in Rivers State. The study concluded that the adoption of green strategies such as green product design, green manufacturing, green procurement, and sustainable supply chain practices plays a pivotal role in enhancing the environmental sustainability of manufacturing firms in Rivers State. The study recommended that Manufacturing firms should adopt green manufacturing technologies and practices, such as energy-efficient machinery, waste minimization systems, and cleaner production techniques, to enhance supply chain sustainability.

INTRODUCTION

Environmental sustainability in today's dynamic and constantly evolving global economy has become a core priority for business operations, especially in sectors with significant ecological footprints like manufacturing (Dyllick & Hockerts, 2002; Bansal & Roth, 2000). As the world faces increasing pressure from climate change, resource scarcity, and environmental degradation, firms are expected to play a proactive role in minimizing their environmental impact while maintaining profitability (Porter & van der Linde, 1995). In economies experiencing constant business flux characterized by rapid industrial growth, technological advancement, and shifting regulatory demands, the importance of aligning corporate strategies with sustainable environmental practices becomes even more critical (Hart, 1995). Environmental sustainability, in this context, refers to the responsible management of resources, waste, and emissions in a way that supports the ecological balance and meets the needs of both current and future generations (UNEP, 2011).

One of the emerging strategic approaches for achieving environmental sustainability is the adoption of green strategies, which include green product design, green manufacturing, green procurement, and sustainable supply chain management (Seuring & Müller, 2008; Jayal et al., 2010). These strategies not only reduce environmental harm but also drive innovation, operational efficiency, and long-term cost savings (Luttropp & Lagerstedt, 2006). In manufacturing sectors, especially in developing economies like Nigeria, green strategies are gaining momentum as firms respond to global sustainability trends, regulatory pressures, and consumer expectations (Testa et al., 2012).

However, the successful implementation of these strategies requires organizational commitment, investment in green technologies, and a shift in operational mindsets (Walker & Brammer, 2009).
In Rivers State, an industrial hub dominated by oil, gas, and heavy manufacturing, the challenges of environmental sustainability are particularly severe (Igbokwe & Nwankwo, 2021). The region faces widespread environmental degradation due to decades of industrial pollution, inefficient resource use, and poor waste management practices (Adebayo & Folarin, 2022). Despite the potential benefits of green strategies, many manufacturing firms in the state are yet to fully integrate them into their operations. Issues such as limited awareness, high costs of green technology adoption, inadequate policy enforcement, and weak supply chain coordination continue to hinder progress (Brezet & van Hemel, 1997). Furthermore, resource inefficiency, poor product lifecycle management, and unsustainable supply chain practices exacerbate the environmental problems faced in the region (Allwood et al., 2011).
Therefore, this study investigates the relationship between green strategies and environmental sustainability among manufacturing firms in Rivers State. It aims to explore how the implementation of green product design, green manufacturing, and green procurement influences key dimensions of environmental sustainability, including resource efficiency, supply chain management, and product lifecycle. By examining these relationships, the study seeks to provide insights that can guide policy, management practices, and future research in fostering a more sustainable manufacturing sector in the region.

Statement of the Problem

Despite the increasing global emphasis on sustainable development, many manufacturing firms in Rivers State continue to face significant challenges in achieving environmental sustainability. Industrial activities in the region, particularly those linked to oil, gas, and heavy manufacturing, have contributed to environmental degradation through excessive resource consumption, poor waste management, and high emissions. While green strategies such as green product design, green manufacturing, green procurement, and sustainable supply chain practices offer promising solutions, their adoption among manufacturing firms in Rivers State remains limited and inconsistent. This raises concerns about the firms' capacity to meet both local and international environmental standards and to operate within ecological limits.
A key area of concern is resource efficiency, which remains suboptimal in many manufacturing operations across Rivers State. Firms often rely on outdated production technologies and linear consumption models that prioritize throughput over sustainability, leading to high levels of material waste, energy inefficiency, and increased production costs. The lack of integration of green product design principles further hampers efforts to conserve resources throughout the product lifecycle. Inadequate investment in eco-innovation and poor staff training on sustainability also limit firms' ability to transition toward more resource-efficient models.
Additionally, s
upply chain management poses another major challenge. Most manufacturing firms in the region operate within fragmented and poorly regulated supply chains, where environmental considerations are rarely prioritized. Suppliers often lack environmental certifications, and green logistics practices—such as low-emission transport, waste reduction along the supply chain, and reverse logistics are seldom implemented. This undermines the effectiveness of green manufacturing strategies and prevents firms from achieving sustainability across their supply networks.
Furthermore, the product lifecycle is poorly managed in many cases, with limited emphasis on end-of-life product recovery, recycling, or sustainable disposal. Most products are not designed with durability, recyclability, or environmental impact in mind. As a result, firms fail to address the environmental consequences of their products beyond the point of sale. This not only affects corporate sustainability goals but also contributes to broader environmental issues such as pollution, landfill overflow, and natural resource depletion in the region. In light of these problems, there is a pressing need to explore how green strategies can be effectively applied to improve environmental

sustainability outcomes in the manufacturing sector of Rivers State. It is against this downturn that the green management strategies and environmental sustainability of manufacturing firms in Rivers State.

Conceptual Framework

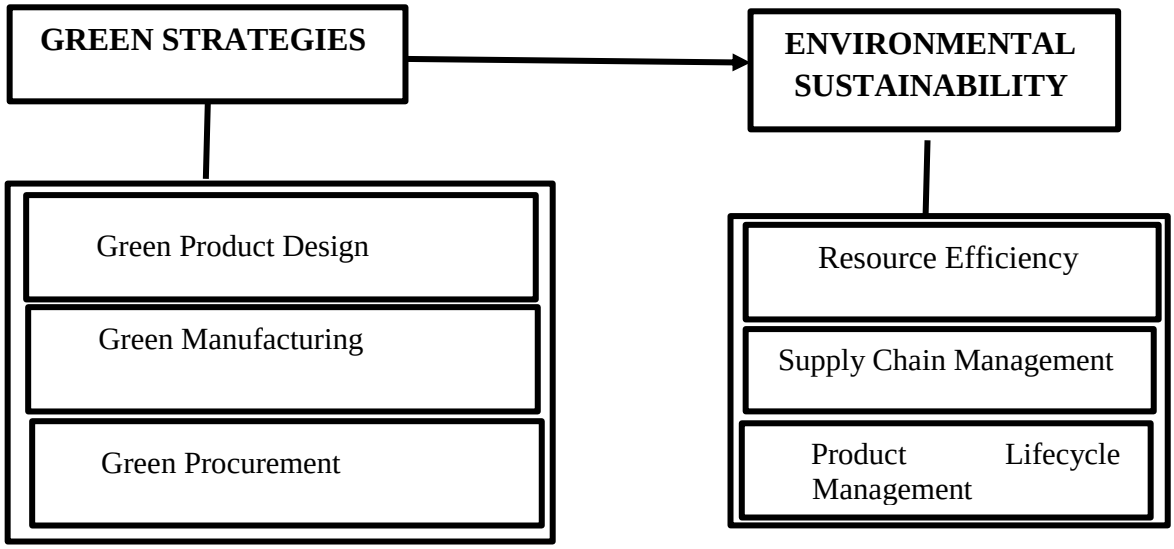

Figure 1: Conceptual framework on Green Management Strategies and Environmental Sustainability of Manufacturing Firms in Rivers State

Source: Adopted from Aguilar (1967); Drucker (1954) and King & Lenox (2001), Conceptualize by Desk Researcher (2025)

Aims & Objectives of the Study

The aim of this study is to determine the relationship between Green Management Strategies and Environmental Sustainability of Manufacturing Firms in Rivers State. The specific objectives are:

1. To determine the relationship between green product design and resource efficiency of manufacturing firms in Rivers State.
2. To determine the relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State.
3. To determine the relationship between green procurement and product life cycle of manufacturing firms in Rivers State.

Research Questions

The following research questions were raised to guide the study.

1) What is the relationship between green product design and resource efficiency of manufacturing firms in Rivers State?
2) What is the relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State?
3) What is the relationship between green procurement and product life cycle of manufacturing firms in Rivers State?

Hypothesis

The following null hypotheses were formulated and was tested at a significant level of 0.05.

H_{O1}: There is no significant relationship between green product design and resource efficiency of manufacturing firms in Rivers State.

H_{O2}: There is no significant relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State.

H_{O3}: There is no significant relationship between green procurement and product life cycle of manufacturing firms in Rivers State.

REVIEW OF RELATED LITERATURE

This section reviews extant literatures under the headings of conceptual review, theoretical review and empirical review.

Conceptual Review

Green Management Strategic

Green Management Strategy refers to an organizational approach that incorporates environmental considerations into business strategies and operations. It involves the integration of eco-friendly practices such as resource conservation, pollution reduction, and sustainable product design into corporate policies and decision-making processes. The goal of green management is to achieve long-term business sustainability while minimizing negative environmental impacts. According to Daily and Huang (2001), green management enhances environmental performance through proactive initiatives, such as environmental audits, eco-friendly procurement, and stakeholder engagement. By aligning business objectives with environmental responsibilities, firms not only improve their ecological footprint but also enhance brand reputation and stakeholder trust.

Green management strategies are often guided by regulatory frameworks, consumer expectations, and industry standards. By adopting green strategies, companies can reduce operational costs, avoid legal sanctions, and access environmentally conscious markets. In sectors such as manufacturing and energy, green management has become central to achieving regulatory compliance and operational efficiency. Green management strategy is increasingly viewed as a driver of innovation and long-term competitiveness. Companies that embed sustainability into their core operations are more likely to adapt to global trends like climate change mitigation and carbon footprint reduction. Porter and van der Linde (1995) argue that properly designed environmental standards can trigger innovation that may offset the costs of environmental compliance and improve competitiveness. Thus, green management is not merely about environmental protection—it is also a forward-looking business strategy that supports resilience, market differentiation, and stakeholder value creation.

Dimensions of Green Management Strategies

Green Product Design

Green product design, also known as environmentally conscious design or eco-design, is a strategic approach in product development that prioritizes environmental considerations throughout the product lifecycle from raw material selection to end-of-life disposal. The core aim is to minimize the environmental impact of products without compromising their quality or performance. This strategy incorporates principles such as reducing material usage, selecting non-toxic or biodegradable substances, enhancing energy efficiency, and designing for recyclability or reuse. According to Luttropp and Lagerstedt (2006), eco-design promotes sustainability by integrating environmental requirements early in the product design phase, thereby reducing negative ecological consequences downstream in production and disposal.

Green product design is becoming a key differentiator in competitive markets, especially where consumers are increasingly environmentally conscious. Companies embracing eco-design not only reduce their environmental footprint but also appeal to a growing market segment that values sustainability. Brezet and van Hemel (1997) emphasized that green product innovation can lead to long-term cost savings, enhanced brand image, and compliance with environmental regulations. Additionally, international standards such as ISO 14006 guide organizations in integrating environmental thinking into product design and development processes, thereby aligning corporate sustainability goals with environmental best practices.

Green Manufacturing

Green manufacturing refers to the creation of products through processes that reduce negative environmental impacts, conserve energy and natural resources, and are safe for employees, communities, and consumers. It involves the adoption of cleaner production techniques, waste minimization strategies, and energy-efficient technologies. According to Jayal et al. (2010), green manufacturing enhances resource efficiency and reduces emissions by reengineering production systems to be environmentally friendly. It also includes practices such as the reuse of materials, reduction in hazardous waste, and energy optimization.

Green manufacturing supports economic and regulatory advantages. It helps companies comply with environmental laws and regulations, avoid penalties, and gain tax incentives or eco-certifications. Moreover, it can lead to cost savings through reduced material consumption and energy use. Zhu and Sarkis (2004) found that implementing green manufacturing practices positively influences corporate performance, including customer satisfaction and market access. As global emphasis on sustainability grows, green manufacturing is transitioning from a compliance obligation to a core element of strategic corporate responsibility.

Green Procurement

Green procurement, also known as sustainable or environmentally preferable purchasing, is the process of acquiring goods and services that have a reduced environmental impact throughout their life cycle. It emphasizes selecting suppliers and products based on environmental criteria such as recyclability, energy efficiency, non-toxicity, and minimal packaging. As per Walker and Brammer (2009), green procurement enables organizations to influence environmental outcomes not only within their operations but across their supply chains by encouraging suppliers to adopt sustainable practices.

Green procurement also plays a strategic role in organizational sustainability efforts by aligning purchasing decisions with environmental goals and corporate social responsibility (CSR) standards. It is especially significant in public procurement, where governments can drive large-scale environmental change through their purchasing power. Testa et al. (2012) highlighted that green procurement practices can improve organizational image, foster innovation, and create long-term value.

Concept of Environmental Sustainability

Environmental sustainability refers to the responsible interaction with the environment to avoid depletion or degradation of natural resources, thereby ensuring long-term ecological balance and the well-being of future generations. It involves adopting practices and policies that minimize environmental harm, such as reducing carbon emissions, conserving biodiversity, managing waste responsibly, and using renewable energy sources. According to Dyllick and Hockerts (2002), environmental sustainability is one of the three pillars of sustainable development—alongside economic and social sustainability—and it emphasizes the need for maintaining the natural capital that supports human life and economic activity. This concept encourages organizations, governments, and individuals to operate within the planet's ecological limits to prevent irreversible environmental damage.

Growing worldwide worries about resource shortages, deforestation, and climate change have made environmental sustainability a strategic necessity for businesses and policymakers. Companies who include environmental sustainability into their fundamental strategy, according to Bansal and Roth (2020), not only help to preserve the environment but also obtain a competitive edge through increased efficiency, innovation, and improved company image. Green technology, sustainable resource management, environmental impact assessments, and compliance with global accords like the Paris Climate Accord are some of the instruments used to operationalize environmental

sustainability. Achieving environmental sustainability is now necessary for the continuation of life and responsible economic development as a result of growing worldwide awareness.

Measures of Environmental Sustainability

Resource Efficiency

Resource efficiency refers to the strategic use of natural resources—such as water, energy, raw materials, and land—in a way that maximizes productivity while minimizing environmental impact. It emphasizes doing more with less by reducing waste, improving process efficiency, and promoting the circular use of materials. According to UNEP (2011), resource efficiency is crucial for achieving sustainable development, as it decouples economic growth from environmental degradation. Techniques such as energy audits, material flow analysis, and lean manufacturing are commonly employed to identify and reduce inefficiencies in operations.

Beyond environmental benefits, resource efficiency also enhances economic competitiveness. Companies that optimize resource use often experience cost savings, improved regulatory compliance, and enhanced brand reputation. Allwood, Ashby, Gutowski, and Worrell (2011) emphasized that improving resource efficiency can significantly reduce global carbon emissions and help businesses transition toward a low-carbon economy. It also plays a pivotal role in sustainable production and consumption patterns, enabling organizations to meet stakeholder demands for environmentally responsible practices.

Supply Chain Management (SCM)

Supply Chain Management (SCM) involves the coordination and integration of all activities across the supply chain, from raw material procurement to final product delivery, to create value efficiently and sustainably. In the context of sustainability, SCM focuses on reducing environmental and social risks within the supply chain while improving operational performance. According to Christopher (2016), effective SCM ensures that goods and services are produced and distributed in the right quantities, to the right locations, and at the right time, all while minimizing waste and resource use. Sustainable supply chain management integrates environmental, social, and economic considerations into procurement, production, logistics, and disposal. Companies are increasingly adopting green supply chain practices to comply with environmental regulations, meet consumer expectations, and improve their overall sustainability profile. As Seuring and Müller (2008) noted, sustainable SCM not only helps in managing upstream and downstream relationships but also enables companies to monitor their environmental footprint across the supply chain. This approach has become vital for organizations aiming to reduce risk exposure and build long-term resilience.

Product Lifecycle

The product lifecycle refers to the stages a product goes through from its conception and design, through production and use, to its eventual disposal or recycling. These stages typically include design and development, raw material extraction, manufacturing, distribution, use, and end-of-life management. The concept is central to sustainability because it provides a holistic view of a product's environmental impact across its entire lifespan. As explained by Finnveden et al. (2009), lifecycle thinking helps identify environmental "hot spots" where improvements can lead to significant ecological and economic benefits.

Lifecycle Assessment (LCA) is a common tool used to evaluate the environmental effects associated with all stages of a product's life. It allows companies to make data-driven decisions about materials, energy consumption, and waste management, thereby promoting sustainable design and responsible consumption. According to Baumann and Tillman (2004), incorporating lifecycle thinking into business strategies enables firms to innovate for sustainability, reduce regulatory risks, and appeal to eco-conscious consumers. As global pressures for sustainability increase, understanding and managing the product lifecycle is critical for organizations seeking long-term environmental responsibility.

Theoretical Review

Natural-Resource-Based View (NRBV)

Natural-Resource-Based View (NRBV) of the firm, introduced by Stuart L. Hart (1995)**.** This theory extends the traditional Resource-Based View (RBV) by incorporating ecological concerns into strategic management. It posits that firms can achieve sustainable competitive advantage by developing capabilities that respond to environmental challenges. These include pollution prevention, product stewardship, and sustainable development. NRBV argues that environmental sustainability is not a constraint but a source of innovation, efficiency, and market differentiation.

The Natural-Resource-Based View (NRBV) is highly relevant to the adoption of Green Management Strategies and the promotion of Environmental Sustainability among manufacturing firms in Rivers State**,** as it provides a strategic framework for leveraging environmental capabilities as sources of competitive advantage. In a region facing significant environmental challenges due to industrial activities, the NRBV emphasizes the need for firms to develop core competencies in pollution prevention, eco-efficient production, and sustainable innovation to reduce their environmental footprint while enhancing operational efficiency. By embedding green practices such as resource conservation, waste minimization, and sustainable product design into their business models, manufacturing firms in Rivers State cannot only comply with environmental regulations but also build long-term resilience and gain legitimacy among increasingly environmentally conscious stakeholders. The NRBV thus encourages these firms to view environmental sustainability not as a constraint, but as a strategic opportunity to innovate, reduce costs, and differentiate themselves in the local and global markets.

Empirical Review

Igbokwe and Nwankwon (2021) examined Green Supply Chain Management Practices and Environmental Sustainability of Manufacturing Firms in Anambra State, Nigeria. The study adopted a descriptive survey design. The population comprised 320 management staff across selected manufacturing firms in Anambra State. Using Taro Yamane's formula, a sample size of 178 respondents was drawn through stratified random sampling. Data were collected via a structured questionnaire developed by the researchers. The instrument's validity was ensured through expert review in environmental and operations management, while its reliability was confirmed using Cronbach's alpha coefficient of 0.87. The instrument was self-administered to the respondents. Data were analyzed using descriptive statistics and regression analysis. The results showed that green supply chain practices particularly eco-friendly purchasing, waste reduction, and reverse logistics had a significant positive effect on environmental sustainability. The study concluded that incorporating green strategies within the supply chain contributes to environmental quality and firm sustainability. It recommended that manufacturing firms should strengthen their green procurement policies, adopt cleaner production technologies, and engage in continuous training of staff on environmental practices.

METHODOLOGY

The survey designed used was a correlational survey design. A target population of 170 managers of steel manufacturing firms in Rivers State was used for the study. The study adopted a census sampling technique to ascertain a sample size which ensures that all respondents were captured. A self-administered structured questionnaire titled "Green Management Strategies and Environment Sustainability Questionnaire (GMSESQ)" was subjected to face and content validity for scrutiny by the two experts in the Department of Management, Faculty of Management Sciences, Ignatius Ajuru University of Education, Port Harcourt. The corrections and suggestions of the validators were affected on the finale copy of the instrument which was used to collect primary data and the data obtained were accordingly analyzed. Cronbach's alpha reliability coefficient below the 0.75 was used ascertained.

Table 1: Reliability Statistics

Cronbach's Alpha	N of Items
. 85	3

Source: Researcher Computation via SPSS Version 25

The result of the Cronbach's Alpha reliability test indicates .782 which is above .70 which implies that the items are reliable. PPMC (person product moment correlation) was used to test hypotheses on SPSS version 25.

ANALYSIS OF DATA

H_{o1}: There is no significant relationship between green product design and resource efficiency of manufacturing firms in Rivers State.

Table 2: **Correlation of Green Product Design and Resource Efficiency**

			Green Product Design	Resource Efficiency
Spearman's rho	Green Product Design	Correlation Coefficient	1.000	**.565****
		Sig. (2-tailed)	.	.000
		N	170	170
	Resource Efficiency	Correlation Coefficient	**.565****	1.000
		Sig. (2-tailed)	.000	.
		N	170	170

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

Source: Field Survey, 2025

Table 2 above reveals r value of 0.653 at a significance level of 0.00 which is less than the chosen alpha level of 0.05 for the hypothesis relating green product design and resource efficiency of manufacturing firms in Rivers State. Since the significance value 0.00 is less than the alpha level of 0.05, the null hypothesis (Ho_1) which states that there is no significant relationship between green product design and resource efficiency of manufacturing firms in Rivers State was rejected and the alternate hypothesis (Ha_1) was accepted. This implies that there is a positive relationship green product design and resource efficiency of manufacturing firms in Rivers State.

Ho_2: There is no significant relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State.

Table 3: Correlations of Green Manufacturing and Supply Chain Management

			Green Manufacturing	Supply Chain Management
Spearman's rho	Green Manufacturing	Correlation Coefficient	1.000	**.674****
		Sig. (2-tailed)	.	.000
		N	170	170
	Supply Chain Management	Correlation Coefficient	**.674****	1.000
		Sig. (2-tailed)	.000	.
		N	170	170

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

Source: Field Survey, 2025

Table 3 above reveals r value of 0.670 at a significance level of 0.00 which is less than the chosen alpha level of 0.05 for the hypothesis relating green manufacturing and supply chain management of manufacturing firms in Rivers State. Since the significance value 0.00 is less than the alpha level of 0.05, the null hypothesis (Ho_2) which states that there is no significant relationship between

green manufacturing and supply chain management of manufacturing firms in Rivers State was rejected and the alternative hypothesis (Ha_2) was accepted. This implies that there is a positive relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State.

Ho_3: There is no significant relationship between green procurement and product lifecycle of manufacturing firms in Rivers State

Table 4: Correlations of Green Procurement and Product Lifecycle

			Green Procurement	Product Lifecycle
Spearman's rho	Green Procurement	Correlation Coefficient	1.000	**.675****
		Sig. (2-tailed)	.	.000
		N	170	170
	Product Lifecycle	Correlation Coefficient	**.675****	1.000
		Sig. (2-tailed)	.000	.
		N	170	170

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

Source: Field Survey, 2025

Table 4.26 above reveals r value of 0.675 at a significance level of 0.00 which is less than the chosen alpha level of 0.05 for the hypothesis relating green procurement and product lifecycle of manufacturing firms in Rivers State. Since the significance value 0.00 is less than the alpha level of 0.05, the null hypothesis (Ho_3) which states that there is no significant relationship between green procurement and product lifecycle of manufacturing firms in Rivers State was rejected and the alternate hypothesis (Ha_3) was accepted. This implies that there is a positive relationship between green procurement and product lifecycle of manufacturing firms in Rivers State.

Discussion of Findings

With respect to research question one; the correlations on strategic green product design and resource efficiency of manufacturing firms in Rivers State revealed that there is a significant relationship between green product design and resource efficiency of manufacturing firms in Rivers State (where P. 565 = sig, .000) thus leading to acceptance of alternate hypothesis: there is a significant relationship between green product design and resource efficiency of manufacturing firms in Rivers State. This result is in line with the findings of Brezet and van Hemel (1997)**,** who found that firms implementing eco-design reported long-term cost savings, reduced material use, and increased customer satisfaction. These findings suggest that green product design not only fulfills environmental responsibilities but also enhances competitive advantage through product differentiation and regulatory compliance.

With respect to research question and hypothesis two; correlations on green manufacturing and supply chain management of manufacturing firms in Rivers State revealed that there is a significant relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State (where P. 674 = sig, .000) thus leading to acceptance of alternate hypothesis: there is a significant relationship between green manufacturing and supply chain management of manufacturing firms in Rivers State. This result is line with the study of Jayal et al. (2010) who emphasized that integrating environmental considerations into manufacturing processes can lead to innovation, lower production costs, and compliance with environmental regulations. Furthermore, green manufacturing fosters corporate responsibility and improves a firm's image among environmentally conscious stakeholders.

With respect to research question and hypotheses 3; correlations on green procurement and product lifecycle of manufacturing firms in Rivers State revealed that there is a significant relationship between green procurement and product lifecycle of manufacturing firms in Rivers State (where P. .675 = sig, .000) thus leading to acceptance of alternate hypothesis: there is a

significant relationship between green procurement and product lifecycle of manufacturing firms in Rivers State. This finding is in line with Walker and Brammer (2009)**,** whose findings showed that organizational culture, top management support, and supplier engagement were key factors influencing the success of green procurement. The study revealed that green procurement helped reduce environmental risks, encouraged innovation among suppliers, and created positive public perceptions.

CONCLUSION

The adoption of green strategies such as green product design, green manufacturing, green procurement, and sustainable supply chain practices plays a pivotal role in enhancing the environmental sustainability of manufacturing firms in Rivers State. These strategies enable firms to minimize their ecological footprint, comply with environmental regulations, and foster innovation while improving operational efficiency and competitiveness. Empirical evidence suggests that integrating environmental considerations into core business functions not only addresses the region's pressing ecological challenges but also contributes to long-term corporate resilience and stakeholder trust. Therefore, a strategic commitment to green management is essential for manufacturing firms seeking sustainable growth in an increasingly eco-conscious and regulated business environment.

RECOMMENDATIONS

Based on the study objectives, the following three recommendations are made:

1. Manufacturing firms in Rivers State should integrate environmental considerations into product design from the early stages of development**,** including the use of recyclable materials, modular components, and energy-efficient designs which can enhance resource efficiency by reducing waste.
2. Manufacturing firms should adopt green manufacturing technologies and practices**,** such as energy-efficient machinery, waste minimization systems, and cleaner production techniques, to enhance supply chain sustainability.
3. Manufacturing firms should institutionalize green procurement policies that prioritize suppliers offering sustainable raw materials and environmentally friendly products, as this improves product lifecycle outcomes and environmental performance.

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