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MATERIAL RECOVERY AND OPERATIONAL EFFICIENCY OF POLYMER FIRMS IN RIVERS STATE.

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Abstract

The focus of this study was to investigate the relationship between material recovery and operational efficiency in polymer firms in Rivers State. Nigeria. Material Recovery was used as the independent variable. It was treated as a uni-dimensional variable. While, operational efficiency was used as the dependent variable which was measured by customer satisfaction and quality control. Two null hypotheses were formulated for the study, meanwhile, the study adopted the survey research design. The population of the study comprised of 8 polymer manufacturing firms in Port Harcourt as listed by Nigeria Business Directory 2023. The entire population was studied hence 3 copies of the research instrument was sent to each of the 8 polymer firms. Thus, the total respondents were 24, but only 20 instruments were returned usable. The hypotheses were tested using the Pearson Moment Correlation Coefficient. The findings revealed that material recovery had a significant and positive relationship with customer satisfaction (an antecedent of operational efficiency) also, the findings revealed that material recovery had a significant and positive relationship with quality control (an antecedent of operational efficiency). The study therefore, concludes that material recovery has a positive and strong relationship with operational efficiency. Hence the study recommends that management of polymer firms should devote more effort to material recovery strategy for it was found to ensure customer satisfaction and aid in maintaining the quality of the product.

Keywords: Material Recovery, Operational Efficiency, Customer Satisfaction, Quality Control

Introduction

In the past few years, there has been an increase in the production of plastic products. This increase can be attributed to the beneficial properties such as longevity, lightweight, water resistant, high elasticity, strength, durability, resistant to corrosion, easy to transport and economical, plastics are otherwise highly useful materials Lamba, *et al*. 2022). We agree with this assertion that there is an increase

in production and use of plastic, Rivers State is no exception as our drainages are clogged with this waste and have resulted in some environmental issues in the state. Operational efficiency as described by Neil (2019) is the several techniques and strategies adopted by an organization to accomplish its basic goal of delivering quality goods and services to its client in the most cost-effective and timely manner. The characteristics of an operational efficient firm are optimal resource utilization, seamless production, efficient and effective distribution system.

Akinrinmola (2019) used customer satisfaction, quality control and business process as measures of operational efficiency. Also, Barian-Espino (2017) used product quality, policies, people, process and productivity as measures for operational efficiency. Chia-Yen *et al*. (2012) used redundancy, waste minimization and streamlining production as measures of operational efficiency. Ahmad and Zabri (2016) used product quality, efficiency, customer satisfaction, and corporate social responsibility as their measures for operational efficiency. Chia-Yen *et al*. (2012) used redundancy reduction, waste minimization and streamlining production as measures of operational efficiency. To the best of our knowledge there appears to be a dearth of extant literature on material recovery and operational efficiency in the polymer industry in Rivers State. The bulk of the study we came across where on material recycling/reuse for example, Tsai *et al*. (2021) examined reuse of material recycled from renewable resources in the civil engineering in Taiwan in the light of this gap in literature this study is deemed necessary.

Given the right circumstances, every polymer manufacturing firm would strive to ensure that they adopt techniques, and strategies that would guarantee that they deliver quality goods and services to their client in the most cost-effective and timely manner. This implies that these firms would strive to minimize redundancy and waste while they ensure that they leverage their resources that contribute mostly

to their success; and also utilizing the best of their workforce, technology and business to achieve operational efficiency. The bulk of the polymer firms are still not able to achieve the level of operational efficiency that they would love to have. This is seen in the scramble by these firms to strategies for effective material recovery strategies towards eco-friendly production. We are proposing that should the polymer firms adopt material recovery as a key strategy in their operations, they would be able to achieve the level of operational efficiency that they desire. Thus, this current study investigates the relationship between material recovery and operational efficiency of polymer firms in Rivers State.

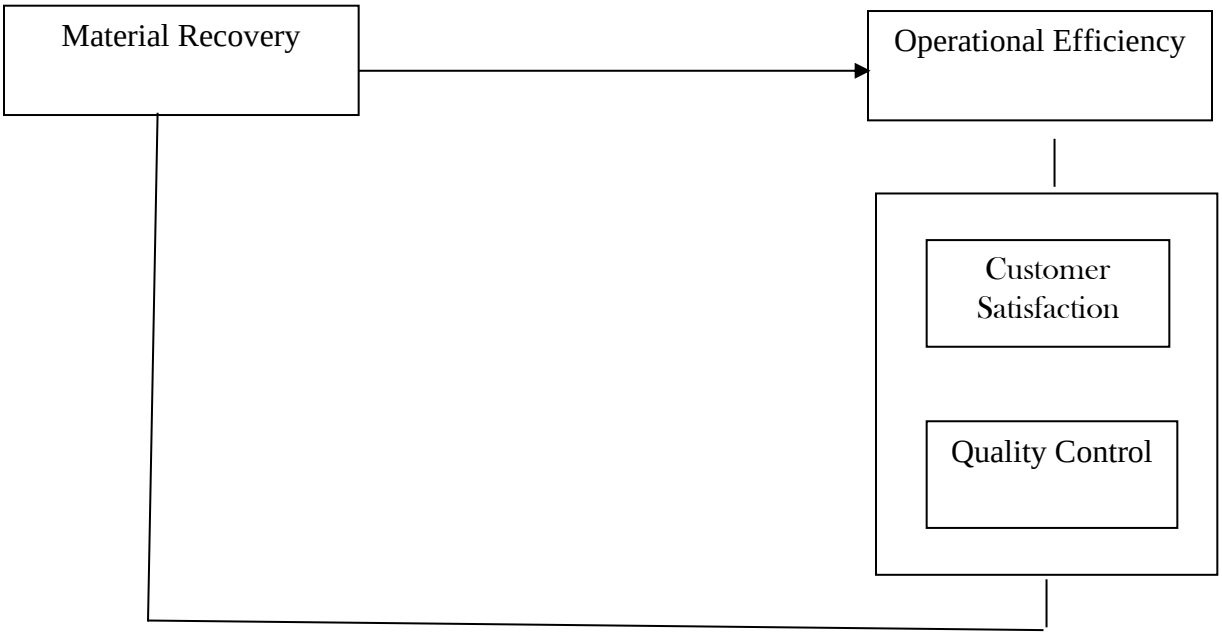

Figure1: Conceptual Framework of Material Recovery and Operational Efficiency. Source: (Desk Research, 2024)

The following null hypotheses were formulated to guide the study:

$H0_1$: There is no significant relationship between material recovery and customer satisfaction.

$H0_2$: There is no significant relationship between material recovery and quality control.

Concept of Material Recovery

The key element in material recovery is the identification of recyclable materials, their separation from other waste streams, and subsequent processing to prepare them for reuse in the production of new goods. According to the European Environmental Agency (2020), material recovery entails the process of reclaiming and reusing material from products that have reached the end of their life cycle. It involves the collection, sorting and processing of discarded materials to extract valuable components for recycling or re-manufacturing. Paulsen (2013) assert that virtually 100% of materials that once comprised industrial waste, such as metals, paper, plastics, various chemicals, and food production residues, are now recovered before they even enter the waste stream. Furthermore, Paulsen (2013) argued that the process for recovering the majority of materials (paper, plastic, glass, metal and biodegradable waste, such as food waste) is relatively simple, well-developed, economically competitive, and applicable in practice.

Operational Efficiency

Operational efficiency is a vital strategic initiative that can ensure the sustainability of an organization or dwindle the fortune of a business organization if not properly addressed. Operational efficiency minimizes waste and improves the ability of a business to provide products of good quality and render services of high standards to their clients. Tekin *et al*. (2020) averred that operational efficiency is the capability of a business to produce goods and services of high quality and deliver them in the most cost-effective manner. Operational efficiency is concerned with the identification of process waste that drains resources and impacts negatively on the bottom line of the organization. Cost reduction is a must for organizations that want to reduce wastage and this can be achieved either by ensuring the same production level with smaller resources or increasing production level with less proportionate

increase in cost, thus reducing average production cost. Production in this sense can be service or intangible goods (Akinrinola 2019).

Measures of Operational Efficiency

Several constructs have been used by scholars to measure operational efficiency for example, Akinrinmola (2019) used customer satisfaction, quality control, and business process as measures for operational efficiency. While, Barian-Espino (20170 used product quality, policies, processes and productivity as measures for operational efficiency. Ahmad and Zabri (2016) used product quality, efficiency, customer satisfaction, and corporate social responsibility as their measures for operational efficiency. Chia-Yen *et al*. (2012) used redundancy reduction, waste minimization and streamlining production as measures of operational efficiency. However, in this study we adopting customer satisfaction and quality control as measures for operational efficiency.

Customer Satisfaction

Every business organization`s success depends on the satisfaction of the customers. customers are those people who buy goods and services from the market or business that meet their needs and wants. Customers purchase products to meet their expectations in terms of money. Rajeshkumar *et al*. (2017) averred that customer satisfaction is the measure of satisfaction level of the customers. Rajeshkumar *et al*. 2017) further stated that today's business entities know that customer satisfaction is the key component for the success of the business and at the same time it plays a vital role in expanding the market value. Khadka *et al*. (2017) noticed that companies that are succeeding to satisfy the customers fully will remain in the top position in a market because the made the customers their priority before profit.

Quality Control

Quality control and improvement is one of the most important factors in every organization. Successful enterprises understand the dominant influence customer-defined quality can have on business. Quality control deals with sampling, specifications, testing, organization, and release procedure which ensure that the necessary and relevant tests are conducted, and materials and products are not released for use. The International Standard Organization (ISO) defines quality control as part of quality management focused on fulfilling quality requirements.

Material Recovery and Operational Efficiency

Material recovery characterization is a seemingly simple task to determine if a given waste is fit or unfit for recycling. This empirical review explores the nexus between material recovery and operational efficiency. Dunchin *et al*. (2019) investigated recovery of products and material for reuse. The findings showed that most successful in recovering value from used products do so in the present framework by reducing total factor requirements to deliver a given bill of goods. Nwanza *et al*. (2018) investigated the strategies for recovery and recycling solid waste: A function of plastic manufacturing companies. The purpose of the study was to assess the strategies for the recovery and recycling of plastic waste. A total of 15 plastic manufacturing and recycling companies were investigated in Zambia and the results showed favourable responses towards the recovery and recycling of plastic waste. The result has an economic, social and environmental impact on the plastic manufacturing and recycling companies as well as on the relevant decision-makers in the waste management sector.

Methods

The study adopted the survey research design. This type of research design is appropriate because it is an accessible and efficient way for respondents to share

their perspectives. By leveraging survey design, we are of the view that we can gauge public opinion, understand trends within the study population. The population comprised of 8 polymer manufacturing firms in Port Harcourt as listed by Nigeria Business Directory 2023. The entire population was studied hence 3 copies of the research instrument was sent to each of the 8 polymer firms. Thus, the total respondents were 24, but only 20 instruments were returned usable. The hypotheses were tested using the Pearson Moment Correlation Coefficient. With the aid of Statistical Package for Social Sciences (SPSS) version 25.

Analysis and Results.

Table 1. Description of the Degree of Association between Variables

Correlation Coefficient (r)	Description/Interpretation
± 0.80 - 1.0	Very Strong
± 0.60 - 0.79	Strong
± 0.40 - 0.59	Moderate
± 0.20 - 0.39	Weak
± 0.00 - 0.19	Very Weak

Source: Magnificio (2016).

The positive ($_{+}$) sign in the value of r indicates a direct/positive relationship while negative (-) sign in value of r indicates an indirect/negative or inverse relationship. Therefore, the sign of the r value explains the direction of association or nature of relationship between the variables. This section continues by testing of the hypotheses raised in chapter one of this study with the aim of determining the strength and direction of the relationship (if any) amongst the independent variables and the dependent variables.

Decision Rule:

Reject the null hypothesis (H0) if PV < 0.05 for 2-tailed test and conclude that significant relationship exists between both variables. Accept the null hypotheses (HO) if PV > 0.05 for 2 tailed test and conclude that there is no significant relationship existing between both variables.

Test of Hypothesis One

$H0_1$: There is no significant relationship between material recovery and customer satisfaction

Table 2. Pearson Correlations Coefficient Depicting the Relationship between Material Recovery and Customer Satisfaction

		Material Recovery	Customer Satisfaction
Material Recovery	Pearson Correlation	1	.963**
	Sig. (2-tailed)		.000
	N	20	20
Customer Satisfaction	Pearson Correlation	.963**	1
	Sig. (2-tailed)	.000	
	N	20	20

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

From the result in Table 2, above the Pearson correlation coefficient shows that there is a positive relationship between material recovery and customer satisfaction. The correlation coefficient .963** confirms the magnitude and strength of this relationship and it is statistically significant at p 0.000< 0.05. The correlation coefficient represents a very high correlation between the variables. Thus, based on the statistical findings the null hypothesis is hereby rejected and the alternate hypothesis accepted. Indicating that there is a significant relationship between material recovery and customer satisfaction.

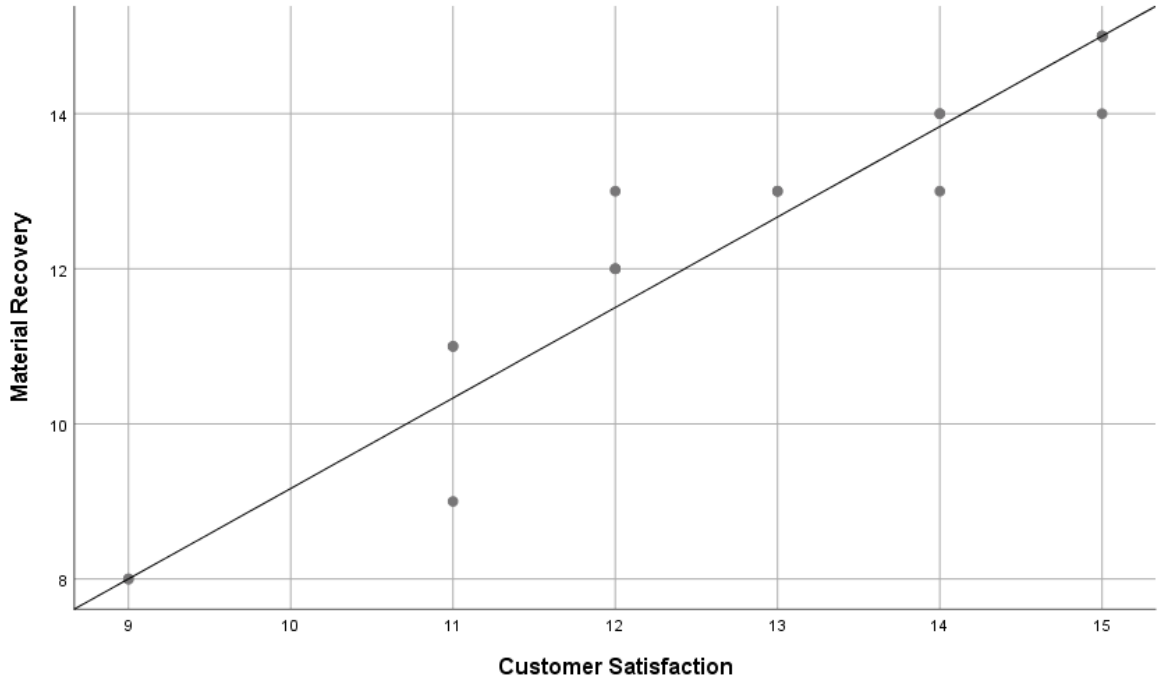

Figure 1 Showing the Linear Relationship between Material Recovery and Customer Satisfaction

The figure 1 illustrates the significance of the relationship between material recovery and customer satisfaction of polymer manufacturing firms in Rivers State. From the diagram, it is evident that material recycling significantly and positively accounts for the approximately 96.3% of the change in outcomes expressed in customer satisfaction of the polymer manufacturing firms. The diagram suggests that where there is an increase in material recovery practices in eco-friendly material management practices in these firms. The greater the propensity for customer to be satisfied with the firm because the perceive that the firms engage actively in reusing its waste material to reduce waste generated that would otherwise be an environmental issue, such enhances their perception of the organization, leading to increased satisfaction

Test of Hypothesis Two

$H0_2$: There is no significant relationship between material recovery and Quality control

Table 2. Pearson Correlations Coefficient Depicting the Relationship between Material Recovery and Quality Control

		Material Recovery	Quality Control
Material Recovery	Pearson Correlation	1	.868**
	Sig. (2-tailed)		.000
	N	20	20
Quality Control	Pearson Correlation	.868**	1
	Sig. (2-tailed)	.000	
	N	20	20

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

From the result in Table 2, above the Pearson correlation coefficient shows that there is a positive relationship between material recovery and quality control. The correlation coefficient .868** confirms the magnitude and strength of this relationship and it is statistically significant at p 0.000< 0.05. The correlation coefficient represents a very high correlation between the variables. Thus, based on the statistical findings the null hypothesis is hereby rejected and the alternate hypothesis accepted. Indicating that there is a significant relationship between material recovery and customer satisfaction

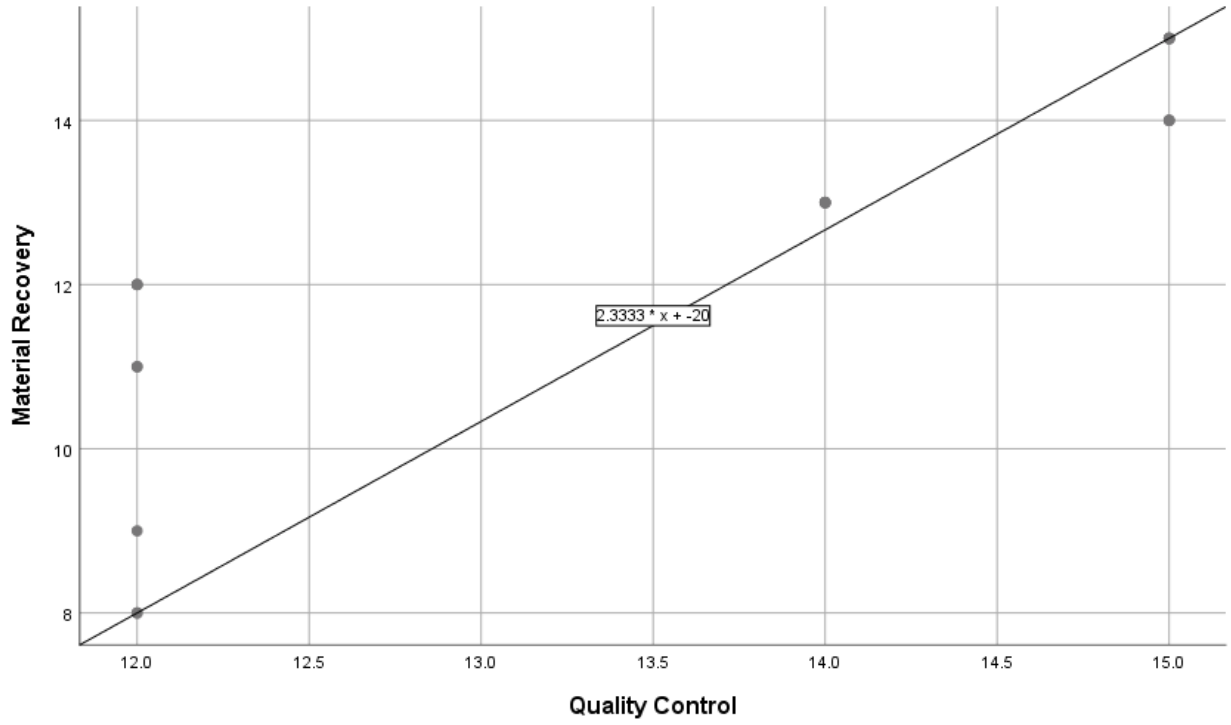

Figure 2 Showing the Liner relationship between material recovery and quality control

The figure 2 illustrates the significance of the relationship between material recovery and quality control of polymer manufacturing firms in Rivers State. From the diagram, it is evident that material recycling significantly and positively accounts for the approximately 86.6% of the change in outcomes expressed in quality control of the polymer manufacturing firms. The diagram suggests that where there is an increase in material recovery practices in eco-friendly material management practices in these firms. The diagram suggests that where there is an increase in material recovery practices in eco-friendly material management practices in these firms. The greater the quality standards that may be assured from the production of the products. An element of operational efficiency.

Discussion

The findings of this study showed that value material recovery has a strong and significant relationship with customer satisfaction. This is indicated by the

Pearson Correlation Coefficient of .963, at a significant level of probability value (PV) = 0.000 < 0.05 (2-tailed). This implies that that material recovery significantly and positively accounts for the approximately 96.3% of the change in outcomes expressed in customer satisfaction of the polymer manufacturing firms. This is in agreement with the research conducted by Dunchin *et al*. (2019) where they submitted that successes in material in recovering increase the value of used products such that they can be further recycled. A practice that when customers see that the firm actively engages in recovery of materials can leads to an improved reputation and brand image which in turn can lead to increased customer satisfaction.

The second result from the analysis of the study showed that material recovery has a strong link with quality control. This is indicated by the Pearson Correlation Coefficient of .868, at a significant level of probability value (PV) = 0.000 < 0.05 (2-tailed). This implies that that material recovery significantly and positively accounts for the approximately 86.8% of the change in outcomes expressed in quality control of the polymer manufacturing firms. This position is consistent with Nwanza (2018) when he averred that plastic wastes can be recovered and recycled for sustainable manufacturing and resource management. Also, facilities effectively ensure that the quality of the newly produce paper are not compromised. Similarly, Chen *et al*. (2018) reported that the effectiveness of the quality control measures adopted ensures the durability of the plastic material recovered.

Conclusion

Based on the findings of this study and the consistency with results of similar studies, we conclude that material recovery is an important driver of operational efficiency of polymer manufacturing firms in Rivers State.

Recommendations

The study therefore recommends that the management of polymer manufacturing firms should strive to maintain their material recovery strategies and constantly find new approaches to recovered material. This practice reduces the waste generated and the recovered materials are recycled into the production process. of course, this sits well with the customer.

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