Innovations

Eco-design practices and the performance of manufacturing firms in Nigeria

Okonkwo Chigozie Christian[1], Ogbo, Anastasia Ifechukwudebelu[2], Obamen Joseph[3], Okoro Nkemdi Collins[4]

University of Nigeria, Enugu Campus[1,2,4], Veritas University Abuja[3]

Corresponding Author: **Okonkwo Chigozie Christian**

Abstract

There has been an expansion in the utilization and disposal of merchandise and product because of the great populace development rate. However, in the manufacturing field, fast innovation cycles rapidly render products outdated, and as outcome buyers discard products all the more seriously. Eco-design, product dismantling, garbage removal, and primary methods are turning into a significant period of the product lifecycle to consider from the ecological and financial impact. Attaining a sustainable environment, manufacturing firms require the implementation of eco-design that make long haul value by accepting opportunities and overseeing hazards got from the economic, environment Therefore, the study examines the eco-design practices and performance of the manufacturing firms in Nigeria. Data collected were analyzed using multinomial regression at a 5% probability level of significance. The findings indicated that product design negatively and significantly affected customer satisfaction and design for distribution positively and significantly influenced customer patronage. The study concluded that eco-design practices significantly and positively affected performance. Therefore, the government should encourage all stakeholders in the manufacturing firms to implement eco-design practices in all product life cycles.

Keywords: 1.Eco-design Practice; 2.Performance; 3.Design for Product

1. Introduction

Governments across the globe, at all points, have perceived that contamination and ecological issues do not just hold back inside their perimeter but also cause an effect on the ecosystem through climate change and depletion of the ozone layers accompanying various disasters witnessed in the globe today. To enhance the cooperation among nations, various internal and international conferences were held to address worldwide environmental problems: United Nations Conference on the Human Environment held at Stockholm, Sweden Conference in 1972, Brazil "Rio Conference" of 1992. Pickering and Owen (1997) emphasized that these conferences offered world leaders the rare chance of building consensus on making out the environment and encouraged eco-practices that will assure and safeguard the world.

Eco-design came into limelight in late 1980 when it became evident that end-of-pipe technologies would not solve environmental problems. Manufacturers, practitioners,and researchers were challenged to determine resolutions that would prevent pollution and preserve resources and the environment. The findings recognized: cleaner production and eco-innovation. Eco-production prompted production advancements working considerably more effectively and assisted with cutting the consumption of assets, in this way bringing down manufacturing costs.Eco-design of the product ended up being a more mind-boggling challenge. In the mid-1990s, interest in eco-design grow through an index of 12 Facts of Ecological Design published by the Industrial Designers Society of America (IDSA) (IDSA, 1992).

Singhal (2013) clarified eco-design practices as an aggregation of structure for utilization of raw materials, the structure of production, that encompass design for distribution, structure for product use, and purpose for the process. The primary ground for eco-design is the decrease in environmental effects during a product's life cycle, which is constructed out of crude materials, production, and distribution (Fiksel, 2006).Globally, manufacturing firms and government agencies have seen the relevance of eco-design to customers' satisfaction, customers patronage, performance, and sustainability of manufacturing firms. Performance is characterized as the capacity to accomplish the preset known principles or goals of an organization that includes customer satisfaction, customer personages, profits, return on resources, product-market performance (Richard et al. 2009).Jesuit and Hauschild (2005) stated that eco-design impacts all the stages of a product life cycle, including raw material extraction, production, software systems, distribution, recuperation, and reusing. Eco-friendly product empowers firms to meet ecological objectives, establish a competitive advantage, and push the future development (Nidumolu, Prahalad, and Rangaswami, 2009). Gheorghe MacDonald and She (2015) stated that anorganisation that has successfully produced eco-design products may reduce cycle time and money needed to establish a new product-linked policy.

Evidence showed that Samsung Electronics Company utilized the eco-design assessment system in 2004. The organisation was designed for product conformity with ecological standards created dependent on asset productivity, energy proficiency, and eco-accommodating fabrics. More specifically, Samsung has upgraded its eco-planmanagement framework to the eco-rating framework for all products created in 2009. Eco-design assists Samsung to achieve its target in taking on a rigid evaluation of eco-rating criteria such as eco-product, good eco-product, or premium eco-ware. To date, Samsung has been evaluating its product in the innovative work stage, upgrading energy effectiveness, and expanding the usage of recyclable and eco-accommodating materials (Samsung, 2015a). Samsung Electronics also made an exertion to develop environment-friendly wares to minimize the negative impact on the environment through the whole procedure of obtaining raw materials, production, and shipping (Samsung, 2015b). The statistics show that Samsung Electronics, between 2005 and 2019, recorded an increase in revenue (Vailshery, 2021).

Although, eco-design practice is relatively new in Nigeria. However, environmental sustainability came into luminance due to public disagreement on the issue of improper dumping of dangerous waste in Koko local government Delta State, South-South, Nigeria by an Italian vessel in 1987. In response to this Nigerian government joined the world to enact different regulations, which aimed at mitigating the impact of environmental problems between 1958 to 1992. Additionally, Nigeria is a signatory to some worldwide multilateral shows, which are associated with environmental factors. A portion of these incorporate the accompanying: Convention on biological diversity, 1992; United National Framework Convention on Climate Change (Climate Change Convention) (1992), Stockholm Convention on Persistent Organic Pollutants (POPs) among others (Aina, 1989).

Manufacturing firms in Nigeria are to create value and maximize profit. In the process of achieving theirobjectives, most production firms in Nigeria, throughout the long term, have been accused of unethical activities such as damaging the environment, social and economic nuisance, complicity in human rights abuses, illegal dumping of waste, and contamination. Onyali, Okafor, and Gloria (2014) stated that the use of apparatus and science has gone to more prominent land use and, subsequently, expanded the deficiency of habitat for animals and plants. Akinbami and Adegbulugbe (1998) stated that the role of natural resources like energy had led to degradation and atmospheric contamination.

Contempt, the attempt by the Nigerian Government and international agencies for manufacturing organisations to go green, and the positive discovering of eco-design, the situation seems different in manufacturing Nigeria. Less attention is put on the following facets of eco-design: eco-distribution, eco-product, eco-process, and eco production.The greenhouse gases from the manufacturing industry have increased because of increased demand for the product (Brueckner, 2000). Choice (2011) supported that many organizations were either considering or just initiating the implementation of eco-design practices as there was a lack of knowledge of eco-design practices in Nigeria.

Interestingly the eco-design literature has few studies on performance, customer satisfaction, and customer patronage. Such asSwalehe, Stephen, Bellah and Nyile (2016), Yudi and Nijo (2017),Habeeb, Marzuki, and Abdullah (2019). The study that discussed the effect of eco-design and performance indicated a positive and significant effect on execution with the most prominent effect being on natural effect decrease and monetary performance. As far as I could know no literature explores the impact of the eco plan on performance from Nigeria using manufacturing in the food beverage industry.

This paper is structured as follows. Segment 2 presents the conceptualization of the eco plan and conversation of the different variable measures for this review. In Segment 3, we surveyed the pertinent related literature, Segment 4 portrays the procedure and information used to gauge eco plan and execution just as understanding of information, Area 5 gives the aftereffects of the review dependent on examination information gathered from production firms in Nigeria, and Segment 6 shows the conversation of the consequence of the finding. At last, Part 7 gives ends, impediments, and a way for future examination. Different researchhas been done on eco-design and performance with Nigeria and abroad, for example, Swalehe, Stephen, Bellah, and Nyile (2016) study examined the impact of eco-design practices on the overall performance in Kenya, Yudi and Nijo (2017) examine the empirical evaluation of eco-layout of digital merchandise on operational overall performance inMalaysia. Habeeb, Marzuki, and Abdullah (2019) study eco-designpractices on green product innovation in Malaysian respectively but none focus on the effect of eco-design on the manufacturing performance in Nigeria.Therefore, this study hypothesizes that; *H_1: Eco-product positively and significantly affect performance; H_2: Eco- distribution positively and significantly influences performance.*

2. Conceptualization of the study

2.1 Eco-Design Practice

The segment on the concept of eco-design practices defines the meaning of eco-design, how eco-design influencesthe performance of manufacturing according to different scholars in different countries, disciples, and sectors. Also, list and explain the various independent and dependent variables that form the basis of this study. The concept of eco-design practices is viewed by different authorities, professionals, or interest perspectives.Eco-design was advanced by the World Business Council for Sustainable Development (WBCSD) in Rio; it is a proactive procedure that varies in detail and involvement.

Nowosielski, Spilka, and Kania (2007) define eco-design as a way to deal with the design of the product and services.The design includes recognising ecological viewpoints related to the item and including them for the planned method of product development.Eltayeb (2011) alludes to eco-design practices as the effort made by manufacturing firms during product development, aimed at limiting product' ecological effects during its entire life cycle from procuring materials to create, use, and to its last removal.This study, therefore,defines eco-design practices as aneco-system and structure approach adopted by the organization throughout a product life cycle that gives environmental safety priority. Deshmukh and Vasudevan (2014) characterise green practices as a planned approach that relates to the life-cycle of goods in which the ecological need is set to high. Eco-green practices should bethe plan and implemented by organisations. Eco-design practices aim to lessen the negative ecological effects that come out of production, distribution, storage, andutilising of the product (Al Khattab et al., 2015). Eco-design practice helps to reduce and avoid the negative effect of a product on the environment and enhance performance. The study was done by Singhal (2013) and Beyene (2015) finds a positive connection between green design and ecological performance. This study decomposes eco-design to include the design for product and design for distribution.

2.2 Design for Product

In an emerging economy like Nigeria, intangible assets become essential for a competitive advantage of organisations. Green product is voluntary introduce by manufacturing orgnisation at the point of purchase of raw materials and through the product life cycle to enhance performance and guarantee sustainability. Eco-product design has been confirmed as a strategy apparatus utilized by manufacturing firms to get a competitive advantage and enhance customer satisfaction (Tseng, Wang, Chiu, Geng, and Lin (2012). The research and development department of the manufacturing firms ought to consistently survey the level of new green

products and comprehend customer needs. This assessment empowers the organizations to render goods and services to their consumers without hurting the business environment.

Chen Lai, and Wen (2006), Kammerer (2009), and Carrillo-Hermosilla del Rio, and Konnola (2010) characterize the green product as the introduction of essentially improved products and services for environmental concerns (for example crude material use, proficiency, energy sparing, reusing, squander minimization), being directed under weights of the abbreviated product lifecycle and expanding rivalry. A green product is a modified product pointed towards lessening the ecological effect (Horbach, Rammer and Rennings, 2012, and Ghisetti, and Renning 2014). Product modification can be done through the improvement of the quality, size, advertainment value, and product content. Amores-Salvadó, Castro, and Navas-lópe (2014) state that eco-product can be improved upon through the utilization of eco-friendly materials or recovered materials. Modification of products reduces environmental impact.

Abdul-Muhmin (2002) and Chen (2006) portray eco-item quality as the parts of an item, which incorporates; item elements, and item plan that is related to energy saving, tainting evasion, squander reusing, and being climate agreeable. Eco-product implies making a product and services that have a positive effect or less unhelpful impact on ecology during their lifecycle (Durif, Bolvin, and Julien, 2010). Green product design alludes to the utilization of various plans, in production, and marketing on a product whose freshness and greenness fundamentally outperform conventionally or contending products (Soylu and Dumville, 2011). Green product configuration additionally implies plan items that significantly affect or less adversely impact the environment during their lifecycle (Durif, Bolvin, and Julien, 2010).

2.3 Design for Distribution

Design for distribution is a basic area of supply chain management, it can add to the most elevated organisational expenses. Okello and Were (2014) posit that the reason for designing the distribution of goods is to have better dissemination arranging frameworks and intelligent systems. Design for distribution signifies the determination of diverts in a way that limits ecological harm. Arseculeratne and Yazdanifard (2014) state that the vast majority of the harm to the environment happens during the transportation of products. Subsequently, firms must execute safety measures for/during the delivery of products. The variable of eco-distribution incorporates physical transportation, storage and warehousing, packages, naming, and labeling, and reverse logistics.To accomplish green distribution, organizations should create arrangements and programmes that require suppliers and distributors to consent to ecologically dependable benchmarks as a component of their marketing jobs. Firms may, moreover, build up "eco-collusions" with channel accomplices to improve the environmental impacts of their joint exercises, for example, rebuilding strategic methodology to expand their natural productivity (e.g., less and more full payloads) (Dahlstrom, 2011).

2.4 Firm Performance

Performance is an instrument and estimation used to assess and survey the achievement of organisations to make and convey an incentive to various stakeholders within and outside the organisations. Remarkable firm performance is similarly at the center of competitive advantages to the organisation. Organizational performance is the capacity of an organisation to satisfy its strategic mission through sound management, good governance, and a tireless rededication to accomplishing results.Richard et al. (2009) state that the overall performance of organizations obliges three explicit spaces of organization results; cash related performance (benefits, return on assets, cost of profit from speculation,); item market execution (deals, market share.);and investor-return overall performance (all-out investor return, and economic value).In any given contract. Folan and Browne (2005) clarify that performance is just thesatisfaction of dedication in a way that discharges the performer from all liabilities beneath the settlement.Given these definitions, the term organisational performance would now be characterized as the capacity to accomplish the preset known principles or goals of an organisation. All business associations have different goals they look to accomplish. The ability of the firm or organisation to meet the preset known standards of each of these multiple objectives describes what ' organizational performance is.

3. Review of the Relevant Literature

A different researcher has carried out a study relating to eco-design and performance of organization Swalehe, Stephen, Bellah, and Nyile (2016) concentrate on the impact of implementationeco-plan on performance in

Mombasa Region, Kenya. The study sample of 65 firms. The study discovered that eco-plan practices have a positive effect on performance with the most noteworthy effect being on ecological effect decrease and monetary performance. The discovering additionally uncovered that eco-plan practices implementation was at the arranging/execution stage as the vast majority of the firms had thought about implementation. Yudi and Nijo (2017) investigated the eco-plan of electronic items on functional performancein Malaysia. The review uncovered that eco configuration helps functional/creation/Research and development to settle on choices identified with eco-cognizant and natural state of hardware items. Habeeb, Marzuki, and Abdullah (2019) study the impact of Eco-Plan Practice on Green Item Advancement in Malaysian. The study utilized a sample of 285 respondents. The review discovers that eco-plan practice can pull the achievement, endurance, and green item development of inside plan organizations in Malaysia. Chukwuka and Eboh (2018) study the impact of green strategic policies on the performance of specifics producing firms in Nigeria. The investigation studies 10 manufacturing firms while 543respondent was the sample. The review discovered that green business drives had critical and constructive outcomes on the chose manufacturing worth or performance.

4. Materials and methods

4.1 Instrument Design

The review used a survey design to determine eco-plan practices and productionfirms'performance in Nigeria. Information for the examination was extricated from every essential source through an organized poll study strategy intended to inspect the expected review. In light of the review of the literature, we planned an organized poll with two essential ideal models: Eco item, distribution, and performance. To guarantee that the survey would be more exact and definitively removed, information was needed for the current examination to acquire a superior comprehension of the feelings, information, desire toward the apparent eco plan, and execution of production firms; interviews were organized 2 h and 20 min. The respondent was asked to painstakingly audit and complete the different inquiries brought up in the review (pretesting) to find out the equivocalness and propose an improvement to the survey. An audit of the input prompted further change and, at last, the last structure.The data used in this assessment was estimated on a 5-point Likert scale.

4.2 Sampling

The studywas meant to explore eco-designpractices and the performance of the production firms in Nigeria. The sample frame of three production firms was purposively chosen from three major regions in Nigeria that produce soft drinks. The justification behind picking the three firms is because these organizations Delivered comparable item, deals of non-alcoholic alcoholic and beers, they have a proper green approach on the ground, has gotten ISO14001 affirmation, have a current design of the management of green practices to ensure performance and are among the best-created and most ecologically cognizant firms in Nigeria. The activitiesof the production firms incorporate creation, packaging, and deals of alcohol and beers. A total of 494 was gotten utilizing Krejcie and Morgan's factual equation. A sum of 169 questionnaires was sent, to Coca-Cola, 248 to 7up Packaging Organization, and 77 to Nigeria Brewery. A sum of 400 and 94 (494) duplicates of the survey wasdistributed. From the 400 and 94 (494) duplicates of the survey distributed to the respondents, an aggregate of 400 and 68 (468) duplicates of the questionnaire addressing (95%) were accurately filled and returned by the respondents.

4.3Method of Data Collection

The pivotal reasonfor this examination is to discover the eco-design practices and overall performance of the producing companies in Nigeria. We despatched the deliberate survey to the production department, marketing, operation and research, and development managers and non-supervisor withinside the manufacturing companies due to the fact the administrators and useful managers are the maximum familiar with the eco-design of the overall performance. The respondents were given the overviews with an envelope that contained a display wherein attestation become for the reason that the statistics given might be handled for this survey. Additionally, we confident all the respondents that the final results of the survey could be despatched again to the organization for exam and exposed appreciation for his or her cooperation. A sum of 494 polls become exceeded for the finish, however, 468 have been crammed and returned, which addresses 95%, whilst 26 have been now no longer returned, which addresses 5%. We were given 345 copies of the underlying time.We further fostered the

respondent return speed of the study by careful advancement through dependable visiting of the company, sending messages to the HR and investigation office, and through flexible calls and an online survey. We arrived at workplaces again to return their review following 2 months, which extended the returned rate to 468. The extraordinary yield rate showed the assurance of the investigation and the authenticity of the collaboration

5. Data Analysis, Interpretation, and Discussion of Findings

Table 1 Multinomial Regression Parameter Estimates

Our design for product positively influences customer satisfaction		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Very High extent	[PRORECYL= 1.00]	7.811	3.430	5.185	1	.023	87.0001	4.876E-7	.337
	[DISPOINCINE=1.00]	4.191	2.029	4.26	1	.039	66.100	1.238	3528.602
High extent	[DISPOINCINE =1.00]	3.966	1.638	5.864	1	.015	52.781	2.130	1307.998
	[DISPOINCINE =3.00]	2.186	1.072	4.160	1	.041	8.897	1.089	1307.998
Moderate extent	[DISPOINCINE =3.00]	2.251	.997	5.095	1	.024	9.496	1.345	67.037
Low extent	[PRORECYL =2.00]	-3.906	1.701	5.271	1	.022	.020	.001	.565
	[PRORECYL =4.00]	-2.967	1.615	3.374	1	.025	.031	.001	.642

: SPSS Results, 2020

Note: Reference category = Undecided

From Table 1 the variables that significantly affected complaints from customers over products of manufacturing companies to choose "not at all" rather than "to a large extent" in the multinomial logit model were that the manufacturing companies' products can be recycled after use (PRORECYL) =1 with a significant value of 0.023 and that the products are environmentally friendly in terms of disposal or incineration (DISPOINCINE) = 1 with significant value of 0.039. In detail, manufacturing companies that were involved in the PRORECYL = 1 category were less likely to be in the group of respondents who declared "undecided" rather than "to a very large extent" for complaints from customers over products of manufacturing companies. While DISPOINCINE =1 category was more likely to be in the group of respondents who declared a "very high extent" rather than "undecided" for complaints from customers over products of manufacturing companies. This is due to the positive regression of PRORECYL (1) = 7.811 and DISPOINCINE (1) = 4.191, in the parameter estimates table. Moreover, the possibility of customers who chose "to a very high moderate extent" in PRORECYL and DISPOINCINE to be involved in "to a very high extent" appears to be 8600% (87.0001-1= 86.0001) and 6510% (66.100-1= 65.100) more than, respectively, the possibility to be involved in "undecided" category.

The variables DISPOINCINE =1 with a significant value of 0.015 and DISPOINCINE = 3 with a major value of 0.041 affecting complaints about products of producing companies in distinguishing respondents' decision to settle on "to a high extent" instead of "undecided" within the multinomial logit model. The managerial and non-managerial cadre who were involved within the DISPOINCINE = 1, and DISPOINCINE =3 categories were more likely to be within the group of respondents who declared "to a high extent" instead of "undecided" for re-

patronage intention. Additionally, the likelihood of the managerial and non-managerial cadre who chose "to an high extent" and "to a moderate extent" in DISPOINCINE to be involved in "high extent" appears to be 5178.1% (52.781-1= 51.781) and 789.7% (8.897-1= 7.897), respectively, quite the chance to be involved in "undecided" category

Also, DISPOINCINE =3 with a significant value of 0.041 influencing complaints from customers over products of manufacturing companies in distinguishing respondents' decision to choose "to a moderate extent" rather than "undecided" in the multinomial Logit model. The managerial and non-managerial cadre who were involved in the DISPOINCINE = 3 categories were more likely to be in the group of respondents who declared "to a moderate extent" rather than "undecided" for complaints from customers over products of manufacturing companies. The possibility of customers who chose "to a moderate extent" in DISPOINCINE to be involved in "to a moderate extent" appears to be 849.6% (9.496 -1= 8.496) more than the possibility to be involved in the "undecided" category. Finally, PRORECYL =2 and PRORECYL =4 with significant values of 0.022 and 0.025 respectively, influence complaints from customers over products in distinguishing respondents' decision to decide on "to an occasional extent" instead of "undecided" within the multinomial logit model. The managerial and non-managerial cadre who were involved within the PRORECYL = 2 and PRORECYL = 4 categories were less likely to be within the group of respondents who declared "to an occasional extent" instead of "undecided" for complaints from customers over products of producing companies. the likelihood of consumers who chose "to a high extent" and "to an occasional extent" in PRORECYL to be involved in "to an occasional extent" appears to be -98% (0.02 -1= -0.98) and -96.9% (0.031 -1= -0.969) respectively, over the likelihood to be involved in "undecided" category

Table 2: Multinomial Regression Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	456.547			
Final	334.783	121.764	64	.000

SPSS Result, 2020

Table 2 demonstrates a probability extent preliminary of the model (Final)model (Final) in opposition to one wherein all of the restriction coefficients are zero (Null). With the chi-rectangular estimations of 121.764 at a 0.000 significant value, we inferred that the remaining version that protected unfastened elements changed into advanced to the only with simply the block. As clean from the "Sig." area, p = 0.000, which infers that the overall model predicts the based variable higher than the seize simply model alone

Table 3: Multinomial Regression Goodness of Fit

	Chi-Square	df	Sig.
Pearson	363.948	368	.550
Deviance	267.870	368	1.000

SPSS Result, 2020

Table 3 The goodness of shape (Table 3) gives assessments with the null speculation that the model acceptably suits the statistics. The important fragment, named "Pearson", offers the Pearson chi-rectangular assessment. Colossal chi-rectangular qualities (found in the "Chi-Square" region) show a susceptible in shape for the version. A without a doubt simple outcome (i.e., p < 0.05) indicates that the version does not shape the statistics well. You can see from the table that the p-figure is 0.550 (i.e., p = 0.550) (from the "Sig." section) and is, in this manner, now no longer tremendous. Considering this action, the model suits the statistics well. The different

line of the table (i.e., the "irregularity" line) offers the deviation Chi-squareassessment. In our model, each Pearson and irregularity regards are greater than 0.05; likewise, we can say that the statistics are honest with the model presumptions.

Table 4: Multinomial Regression Pseudo R- Square

Cox and Snell	.495
Nagelkerke	.519
McFadden	.222

SPSS Result, 2020

The Pseudo R2 (Table 4 estimates the goodness of fit of our model yet is not quite the same as the straight relapse model; it doesn't clarify the variety in the reliant variable because of the variety in the independent variable. Cox and Snell = 0.495, Nagelkerke = **zero**.519 and McFadden= **zero**.222 are all **somewherewithinside thevariety** of **zero** and 1. It is **possibleto mention** that our **modelin thisstudy** is **stated** as an**appropriatemodel** overall.

Table 5: Multinomial Regression Likelihood Ratio Test

Effect	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept	3.348E2[a]	.000	0	.
PRORECYL	-381.815	47.032	16	.000
DISPOINCINE	-359.887	25.104	16	.048

SPSS Result, 2020

This implied that PRORECYL and DISPOINCINE have a negative significant effect on complaints.In Table 5, After describing the authenticity of the model as revealed by the model fitting information, the accompanying point is to take a gander at the effect of each autonomous in the multinomial model. In that capacity, the subsequent period of the investigation is to choose the significance extents of picked independent variables in the Multinomial model. For each effect, the two log-likelihood is used for the diminished model; that is, a model except for sway. The chi-square estimation is the qualification between the - 2 logprobabilities of the diminished life-sized model and the abundance model nitty-gritty in the model transforming into an information table. If the degree of the research is fundamentally under 0.05 then the effect adds to the life-sized model. Table 5 shows which of the free factor that is truly critical.

This suggested that PRORECYL and DISPOINCINE have a negative huge impact on complaints from customers over the results of production organizations while LONGSERVLIF doesn't have a negative any huge impact on objections from clients over results of manufacturing organizations at 0.05 importance level. As displayed in Table 4, the item life cycle (the "item life cycle "line) was huge because p = 0.00 (the "Sig." area). Furthermore, for the item removal or cremation, p = 0.048, which is quantifiably basic. There isn't normally any interest in the model catch (i.e., the "capture" segment). It is hence certain that Table 1.4 above shows that the assembling associations intentionally completed green items, for example, item lifecycle (PRORECYL 0.00), disposal, or a 5-point Likert scale with strongly agree rated as 5, agree = 4, undecided = 3, strongly disagree = 2 and agree = 1 (DISPOINCINE 0.48), that had a critical and positive relationship with a hierarchical presentation at 0.05 importance level. The investigation of results showed that eco-product adversely and altogether influenced consumer loyalty.

Table 6: Multinomial Regression Parameter Estimates

Our design for distribution affect customer patronage		B	Std. Error	Wald	Df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
To a moderate extent	[FONEDISA=2.00]	12.839	.951	182.358	1	.000	3.765E5	58412.522	2426809.502
	[FONEDISA =3.00]	12.724	.745	291.676	1	.039	3.358E5	77963.211	1446286.231
	[STRUTECH=3.00]	2.377	.924	6.623	1	.010	10.776	1.763	65.877
To a low extent	[STRUTECH =3.00]	2.338	.887	6.942	1	.008	10.362	1.820	58.992

: SPSS Results, 2020

Note: Reference category = Undecided

Table 6 reveals the variables of design for distribution that significantly influence customer patronage intention of manufacturing companies to choose "to a moderate extent" rather than "undecided". In the multinomial logit model and that the production organization utilizes folding, nesting, or dismantling to convey items in the conservative state (FONEDISA =2) with a huge worth of 0.000, the production organization utilizes collapsing, nesting or dismantling to circulate items in the smaller state (FONEDISA=3) with a huge worth of 0.039and the production organization applies primary strategies and materials to limit the absolute volume of material (STRUTECH =3) with the huge worth of 0.010. The administrative and non-administrative units who were associated with the FONEDISA=2, FONEDISA =3 and STRUTECH = 3 classes were bound to be in the gathering of respondents who pronounced "to a moderate degree" instead of "unsure" for client support.

The likelihood of customers who chose "to a high extent" and "to a moderate extent" in FONEDISA and STRUTECH to be involved in "to a moderate extent" appears to be 3764900% (37650-1= 37649), 335700% (3358-1= 3357), and 977.6% (10.776-1= 9.776) respectively, more than the possibility to be involved in "undecided" category.

Also, STRUTECH = 3 with a significant value of 0.008 influences customer patronage intention in distinguishing respondents' decision to choose "to a low extent" rather than "undecided" in the multinomial logit model. Clients who were associated with the STRETCH = 3 classifications were bound to be in the gathering of respondents who announced "to a low degree" instead of "unsure" for client support. The chance of administrative and non-administrative framework who picked "to a moderate degree" in STRUTECH to be engaged with "to a low degree" seems, by all accounts, to be 936.2% (10.362 - 1= 9.362) more than the likelihood to be associated with the "unsure" classification.

Table 7: Multinomial Regression Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	358.144			
Final	277.026	81.118	48	.002

Source: SPSS Result, 2020

Table 7shows a likelihood degree primer of the model (Last) against one in opposition to one wherein all of the restriction coefficients are zero (null). With the chi-square exams of 81.118 at a 0.002 significantvalue, we pondered that the final model that protected loose elements becomes higher than the only one with genuinely the

capture. As clean from the "Sig." portion, p = 0.002, which proposes that the entire model thoroughly predicts the reliant variable higher than the capture genuinely model alone.

Table 8: Multinomial Regression Goodness of Fit

	Chi-Square	df	Sig.
Pearson	196.907	184	.244
Deviance	176.396	184	.643

SPSS Result, 2020

The decency of -fit (Table 8) gives checks with the null speculations that the version of this model agreeably suits the records. The major segment, named "Pearson", offers the Pearson chi-square estimation. Enormous chi-square characteristics (found under the "Chi-Square" area) showcase a helpless healthy for the modelversion. A in reality vital results (i.e., $p < 0.05$) indicates that the version would not healthy the records well. You can see from the table that the p-figure is 0.244 (i.e., p = 0.244) (from the "Sig." fragment) and is, thus, now no longer in reality huge. Taking into consideration this activity, the model suits the records well. The different line of the table (i.e., the " deviance " line) offers the aberrance Chi-square estimation. In our version, each Pearson and deviance values are extra than 0.05; in this manner, we will say that the records are reliable with the model assumptions.

Table 9: Multinomial Regression Pseudo R- Square

Cox and Snell	.361
Nagelkerke	.379
McFadden	.146

SPSS Result, 2020

The Pseudo R2 (Table 9) measures the goodness of match of our version however one-of-a-kind from the linear regression version, it does now no longer explain the version withinside the based variable because of the version withinside the unbiased variable. Cox and Snell = zero.351, Nagelkerke = zero.379, and McFadden= zero.146 are all among zero and 1. It is likely to mention that our version of this research is accepted as an appropriate model as a whole. The Pseudo R2 (Table 9) gauges the integrity of attack of our model however not the same as the direct relapse model, it doesn't clarify the variety in the reliant variable because of the variety in the free factor. Cox and Snell = 0.351, Nagelkerke = 0.379 and McFadden= 0.146 are all someplace within the extend of and 1. It is likely to say that what we demonstrate in this investigation is recognized as an appropriate demonstration generally.

Table 10: Multinomial Regression Likelihood Ratio Test

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	2.770E2[a]	.000	0	.
FONEDISA	311.043	34.017	16	.005
STRUTECH	3.005E2[b]	23.429	16	.103

SPSS Result, 2020

In Table 10, After characterizing the legitimacy of the version as exposed with the aid of using the version becoming information, the subsequent factor is to test the effect of each unbiased variable withinside the Multinomial version. influence, the two log-chance is applied for the faded version; that is, a version without influence. The chi-square evaluation is the functionality among the - 2 log possibilities of the faded version and the closing version introduced withinside the version becoming an information table. If the meaning of the test is below 0.05, with the aid of using then, at that point, the effect adds to the version.Table 10 above shows that the manufacturing organization uses nesting or dismantling to scatter items in a minimal state.Folding, nesting, or disassembly (FONEDISA) have a positive (311.04) and significant (0.005 less than 0.05) influence on customer patronage while the manufacturing company applying structural techniques and materials to minimize the total volume of material (STRETCH) do have a positive (0.03) but no significance (0.103 greater than 0.05) influence on customer patronage at 0.05 significance level. The hypothesis result showed that eco-distribution positively and significantly influenced customer patronage.

Table 10 demonstrates that the production firms intentionally did green conveyance like Collapsing, settling, or dismantling (FONEDISA) 0.05), underlying strategies (STRETCH 0.103), that had a critical and positive relationship with the performance of production firms at 0.05 importance level. The examination of results showed that eco-items contrarily and altogether influenced consumer patronage.

6. Discussion of Result

There are detail concentrates on eco-design and performance of firms across the world, the augment in the topic is the eco configuration practices that impact the production firms in Nigeria. The discoveries of the review were to build up that Eco product (eco-product; product reuses and item removal/incineration eco distribution; stricture method product dismantling fundamentally influence the execution of production firms in Nigeria. The Multinomial RegressionLikelihood Ratio Test outcome shows a strong critical and constructive outcome of product reuse on the performance of production firms in Nigeria, while the outcome Multinomial Relapse Probability Proportion likewise shows negative and frail huge impact of productdisposal on the execution of production firms in Nigeria. This outcome further upheld the hypothesis that eco item configuration essentially influences execution. The finding lines up with the accommodation of Zhu (2008) that Reused materials can be changed over into new items that can be consumed- To Blumberg, (2005) the discovery show that item reuse means cost investment funds and new floods of pay to the company which works on the productivity. Kangethe (2013), Ellram (2011), and Gobbi (2008) express that reusing of the item is a huge cutthroat system that might be utilized by a firm to improve performance. concerningproduct disposal on execution, that showsa negative and powerless huge impact on the execution of production firms. The discovering match with Ahmed (2015) that utilizing disposal and fix methodologies improve performance, and proper asset assignment will direct the connection between attitude techniques and performance. Skinner (2008) Skinner (2008) states that maintenance and strategies methodologies straightforwardly affect the degree of execution of production. Khor and Udin (2012) express that maintenance and reusing techniques straightforwardly affect the organization's benefit. In addition, the finding on eco products and performance indicated a significant effect. This is in linewith Ilker's (2012) that green product innovation fundamentally influences both firm performance and competitiveness. Bambang, Widji, and Achmad (2017) agreed that green products absolutely and altogether impact consumer loyalty.Nai-Jen Chang and Cher-Min (2010)affirmed that green product quality is particularly connected with green consumer loyalty and green client steadfastness; This means that the organisation could achieve consumer loyalty and client faithfulness through the green product.Lily (2019) explained that green products and green advertising affect purchase decisions, that the purchase decision impacts customer satisfaction and customer satisfaction impacts client reliability.

The finding of Product disassemblyshowed a significant and positive influence on customer patronage. This result matches the findings of European Comission, (2015) that Logical strategies that address the simplicity of dismantling can be valuable backings for the improvement of global principles, such guidelines can be useful to assess the aptitude of an item towards a fix, reuse, or reuse, and can be helpful for recyclers. Claudio and Michele (2014) express that product dismantling has turned into a significant period of the product lifecycle to

consider from the natural and monetary perspective. It happens to limit the support time and portray the Finish of-Life (EoL) methodologies, for instance, part reuse/reusing. To stimulate life expansion and further develop reusing proficiency of EEE, the Joint European Exploration Community (JRC) of the European Commission has examined the incorporation of greatest limits for dismantling seasons of key parts of electronic showcases in European item strategies (Mathieux et al., 2014).

The discovering of structural technique andperformance showed a huge impact. This is following Mwauraet al (2016) that innovation has extraordinarily impacted dispersion methods with more firms utilizing the web as an appropriation channel. Betterpackaging alongside improving stacking models can lessen materials use, increase space utilization both in the stockroom and trailer and decline the proportion of managing required. A part of the green distribution practicesisthe green arrangement which is the use of environmentally cognizant plan (ECD) and life cycle evaluation assessment (PIC) the goal of creating and seeing how to plan decisions mean for the thing biological similarity (Glantsching, 1994). Ecological naming/Eco marking is one more act of green distribution.

Lastly, the hypothesis showed that eco- distribution positively and significantly influenced customer patronage. This result is in tandem with Lameck and David (2016) that green logistics practices fundamentally impact the performance of supply chains, the appropriation of eco-plan practices, green buying, turn around logistics, and the up-take of responsive bundling emphatically influence performance. Francis and Allan (2018) concluded that green distribution impactedenvironmental performance. Anne, Nicholas, Gicuru, and Bula (2016) stated that the adoption of green distribution practices emphatically and altogether impacts food-produce firms. Felix (2016) observed that green distribution is the key determinant of business performance. This implies that manufacturing firms that put resources into the process, item advancement, and green production, decline ecological impact, and in this way assist with monetary increases and competitive advantages.

7. Conclusion and recommendations

All over the world, eco practices have brought obvious improvement to the sustainability ofthe environment. Focus has shifted from contaminant control during the production process and end-of-pipe treatment to the prevention or reduction of negative environmental impact in all the stages of the product life-cycle. The study, therefore, presented and discussed the current eco-design and performance of manufacturing firms in Nigeria. An explanation of the ideas driving the eco-design has been embraced by looking out the potential meaning of eco-design, eco-product, eco distribution;Product disassembly, structural technique, product recycles, and product disposal/incineration.Two performancemeasurementscustomer patronage and customer satisfaction have been considered. The previous literature looked into and thought about thinking about their strategy, sample, and geographical area findings conclusion recommendations, and limitations for further study. Overall, this study established a significant and positive on of eco-design, eco-product, eco distribution, Product disassembly, structural technique, product recycles and product disposal/incineration on the performance of manufacturing firms.

The findings have further implications for manufacturing firms, stakeholders, operational/managers, customers, government, and institutionsin enhancing performance without compromising further. The managerial consequences are that the manufacturing manager and stakeholders ought to understand that eco-design practices influenced performance. Due to increasingair population, water pollution, and other environmental issues, production firms and all stakeholders are challenged with the expanding strain of ecological security by stakeholders and the government.

The production firms' case for eco-design practices proposes that manufacturing firms, assembly firms, and every shareholder should consider the provisions that havea less environmental impact that stimulates reception and performance. This will improve the sustainable performance of production orgnisation in Nigeria, being the regional economic hub. However, the results of this study led to the conclusion that product design positively and significantly affects customer satisfaction, design for distribution positively and significantly influences customer patronage, design for the process does not positively and significantly affect employee productivity, and production design positively and significantly affects quality. Moreover, the examination's revelations have

a positive suggestion for states, stakeholders, and clients that have since needed and strived for eco-design measures. Toimprove sustainability in our nation's environment, the task by manufacturing firms on eco-design is a beneficial thought. This provides Government and regulators the basis for designing environmental rules and regulations for manufacturing firms. Firms can reduce cycle time and money required to institute a new product-related policy, Eco-design is a cornerstone in building sustainable products and distribution that takes into considerations performance and environmental impacts. The finding showed that both customer satisfaction and customer patronage are obtained through the eco-design. Thus, the Manufacturing Industries are switching on to develop the green product to boost their product and increase performance.

The scholars can also use the measurements of eco-design to foresee the organizational outcomes. The practitioners can use the measurement items of eco-design as a checklist to design the organizational products. The operations manager can discuss with his marketing team to deeply understand customers' needs and design products which have aesthetic values and are environmentally friendly. This will assist operational/production/R&D managers to make decisions related to eco-conscious and the shape of manufacturing products. The discussion has assisted with showing that the production firms should execute the eco planto enhance performance sustainable environment.

8. Limitations and further research

This review recognizes a few limitations that call for pressing consideration. The current review is with regards to Nigeria and utilized the main blended strategy that favors quantitative methods. The examination was essentially done through non-probability inspecting methods. In that limit, the representativeness of the example is jeopardized. Thusly, the results ought to be reproduced in various regions to prove the discoveries in this assessment. Furthermore, the example utilized in this examination was from three (3) regions in Nigeria out of six (6) including FCT Abuja, inferring that the results can't be summarized to whatever survives from the region in Nigeria.

Therefore, future researchers must examine the factors that enhance the usage of eco-design in Nigeria. Further, this current study examines the eco-design and performance of the assemblyindustry in Nigeria, future researchers need to evaluate the same variables using qualitative or experimental design. Moreover, it would be important if the comparative analysis is done between the old method of sustaining the environment and eco-sustainability in Nigeria by future researchers. The current study used to design for a product and design for distribution as an eco-design variable. Future researchers could make use of a related variable to measure eco-design and how it affects performance.

9. Reference

1. Abdul-Muhmin AG (2002). Effects of suppliers' marketing program variables on industrial buyers' relationship satisfaction and commitment. J. Bus. Ind. Mark., 17(7): 637-651
2. Ahmed A (2015) The Impact of Returned Product Disposition Strategies on Organizational Performance Applied to the Egyptian Household Appliance Industry. International Journal of Business and Management; 10 (9) 143-155
3. Aina EOA (1992). Halting industrial pollution in Nigeria which way FEPA. In: Towards industrial pollution abatement in Nigeria. Aina EOA and Adedipe NO (Eds), pp: 13-19.
4. Akinbami A. O. & Adegbulugbe J. F. K. (1998) Exploitation of Energy Resources and Environmental Degradation in Nigeria. A Paper Presentation at the Two-Day National Seminar on The Management of Nigerian Resources for National Development under the auspices of NIIA.and Sons Inc., New York
5. Al Khattab, S., Abu Rumman, A. & Massad, M. (2015). The Impact of the Green Supply Chain Management on Environmental-Based Marketing Performance. Journal of Service Science and Management, 8, 588-597.
6. Anne W, M, Nicholas L, Gicuru I & Bula, H O (2016). Green distribution practices and competitiveness of food manufacturing firms in Kenya. International Journal of Economics, Commerce and Management, 6(3), 189 -196.
7. Arseculeratne, D., & Yazdanifard, R. (2014). How Green Marketing Can Create a Sustainable Competitive Advantage for a Business. International Business Research, 7(1)130-140.

8. *Bambang, Widji & Achmad F. (2017). Green Product and Its Impact on Customer Satisfaction Journal of Business and Management (IOSR-JBM), 19(8) 35-42.*

9. *Beyene, Z. (2015). Green supply chain management practices in the Ethiopian tannery industry. International Research Journal of Engineering and Technology (IRJET), 2(7), 587-598.*

10. *Blumberg, D. F. (2005). Introduction to Management of Reverse Logistics and Closed-Loop Supply Chain Processes, 1 edn, CRC Press.*

11. *Brueckner, J. K. (2000). Urban sprawl: diagnosis and remedies. International Regional Science Review, 23(2),160-171.*

12. *Carrillo-Hermosilla, J., del Río, P., & Könnölä, T. (2010). Diversity of eco-innovations: reflections from selected case studies. Journal of Cleaner Production, 18(6) 1073–1083.*

13. *Chen, Y. S., Lai, S. B., & Wen, C. T. (2006). The influence of green innovation performance on the corporate advantage in Taiwan.Journal of Business Ethics, 81(3), 531–543.*

14. *Chukwuka, E J and Eboh E A (2018) the effect of green business practices on organizational performance of selected manufacturing firms in Nigeria. International Journal of Development and Management Review (INJODEMAR) 13 (1) 1-26*

15. *Claudio F and Michele G (2014) A Design for Disassembly Approach to Analyze and Manage End-of-Life Options for Industrial Products in the Early Design Phase.*

16. *Deshmukh, A. &Vasudevan, H. (2014). Emerging supplier selection criteria in the context of traditional vs. green supply chain management.International Journal of Managing Value and Supply Chains (IJMVSC), 3(4),221-234.*

17. *Durif, F., Boivin, C., & Julien, C. (2010). In search of a green product definition. Innovative Marketing, 6 (1), 25--32.*

18. *Eltayeb, T. K., Zailani, S., & Ramayah, T. (2011). Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes. Resources, conservation, and recycling, 55(5), 495-506.*

19. *Felix K. S (2016). Effect of green packaging on business Performance management. Journal of Operations Management, 29 (6) 577-590*

20. *Fiksel, J. (2006). Sustainability and resilience: Toward a systems approach. Sustainability: Science Practice and Policy, 2(2), 14-21.*

21. *Folan, P. & Browne, J. (2005). A review of performance measurement: Towards performance management. Computers in Industry, 56(7), 663-680.*

22. *Francis K & Allan K (2018). Influence green distribution practices on the environmental performance of chemical manufacturing firms in Kenya. International Journal of Human Resources and Procurement, 7(10), 64-84.*

23. *Gbadeyan R.A & Omolekan O J (2015) Relevance of Green Marketing on Environmental Degradation: An Empirical Study of Consumers of Green Products in Benin- City, Nigeria. University of Mauritius research journal – 21*

24. *Gobbi, C. (2008), "The reverse supply chain: configuration, integration, and profitability", Ph.D. thesis, DTU Management Engineering, Technical University Denmark, Copenhagen.*

25. *Gree Khor, K. S., & Udin, Z. M. (2012). Impact of Reverse Logistics Product Disposition towards Business Performance in Malaysian E & E Companies. Journal of Supply Chain and Customer Relationship Management, 1-19.*

26. *Habeeb A, A T, Marzuki I, & Abdullah S K (2019) The Effects of Eco-Design Practice on Green Product Innovation in Malaysian Interior Design Company. International Journal of Engineering Research and Management (IJERM).6(9) 18-25*

27. *Ilker M.A (2012). The impact of green product innovation on firm performance and competitive capability: The moderating role of managerial environmental concern Procedia. Social and Behavioral Sciences, 62(4),854 – 864*

28. *Jeswiet, J., & Hauschild, M., (2005). EcoDesign and future environmental impacts. Mater. Des. 26(3) 629– 634.*

29. *Kammerer, D. (2009): "The effects of customer benefit and regulation on environmental product innovation. Empirical evidence from appliance manufacturers in Germany". Ecological Economics, 68, (2) 2285-2295*

30. *Lameck M.M &David M. K (2016). Effect of green logistics practices on performance of supply chains in multinational organizations in Kenya.Industrial Engineering Letters, 6(4),40.*

31. *Lily S (2019). Effect of green product and green advertising on satisfaction and loyalty which is mediated by purchase decision. International Journal of Contemporary Applied Researches, 6(1), 44-57.*

32. *Mathieux F., Recchioni M., Ardente F. (2014) Measuring the time for extracting components in end-of-life products: needs for a standardized method and aspects to be considered. Procedia CIRP. **15**(0):245–250.*

33. *Nai-Jen C &Cher-Min F (2010). Green product quality, green corporate image, green customer satisfaction, and green customer loyalty.African Journal of Business Management, 4(13), 2836-2844.*

34. *Nidumolu, R., Prahalad, C.K., & Rangaswami, M.R. (2009). Why sustainability is now the key driver of innovation, Harward Business Review, 87/9, March 20, 57-64.*

35. *Nowosielski, R., Kania, A., & Spilka, M. (2007). Development of eco-materials and materials technologies. Journal of Achievements in Materials and Manufacturing Engineering, 21(1), 27-30.*

36. *Onyali, C.I, Okafor, T.G & Egolum P. (2014). An Assessment of Environmental Information Disclosure Practices of Selected Nigerian Manufacturing Companies, International Journal of Finance and Accounting.*

37. *Richard J. P., (2009). Measuring organizational performance: Towards methodological best practice. Journal of Management, 35(3) 718-804.*

38. *Singhal, P. (2013). Green supply chain and eco-design in the electronic industry. Delhi Business Review, 14(1), 57-78.*

39. *Skinner, L. R., Bryant, P. T., & Richey, R. G. (2008). Examining the Impact of Reverse Logistics Disposition Strategies. International Journal of Physical Distribution & Logistics Management, 38(7), 518-539.*

40. *Soylu, K., &Dumville, J. C. (2011). Design for environment: The greening of product and supply chain. Maritime Economics and Logistics, 13(1), 29-43.*

41. *Swalehe R, W, Stephen O, Bellah C & Nyile E, K (2016) Effect of Eco-design Practices on the Performance of Manufacturing Firms in Mombasa County, Kenya. International Journal of Business and Social Science. 7 (8)108-132*

42. *Tseng ML, Wang R, Chiu A, Geng Y, & Lin Y. (2012). Improving the performance of green innovation practices under uncertainty. Journal of Cleaner Production, 20(5) 71- 22.*

43. *Yudi F, & Uu, N. C. R (2017), An empirical analysis of eco-design of electronic products on operational performance: does environmental performance play role as a mediator? International Journal of Business Innovation and Research, 14(2) 188-205,*

44. *Zhu, Q., J. Sarkis & K. Lai (2008). Confirmation of a Measurement Model for Green Supply Chain Management Practices Implementation: International Journal of Production Economics, 111 (2): 261-273.*

*Corresponding Email: **dominicansventure@gmail.com[1]**,*
obamenjoseph@gmail.com[2],ann.ogbo@unn.edu.ng[3],rnzekwe@yahoo.com[4],okoronkemdi@gmail.com[5]