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Green Manufacturing and Operational Cost of Selected Fast Moving Consumer Goods Companies in Lagos State, Nigeria

Okunuga, A. M.,[1] Amos-Fidelis, N. B.,[2] and Dogo, E B[3]
School of Management Sciences, Department of Business Administration and Marketing, Babcock University, Ilishan-Remo, Ogun state, Nigeria.

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ABSTRACT: *Manufacturing firms have witnessed an unexpected high operating cost with the attendant reduction in profitability, operating costs are expenses associated with the maintenance and administration of a business on a day to day basis and as such businesses have to keep track of operating costs as well as the costs associated with non-operating activities. However, in recent years, difficulties in adopting green product design, inefficient green processes, unreliable green supply chain, and lack of green recycling have been identified as significant factors affecting the operational cost. Despite various research on green manufacturing and operational cost in developed economies, few studies have been conducted in Nigeria. Hence, this study examined the effect of green manufacturing on operational cost of selected fast-moving consumer goods in Lagos State, Nigeria. Survey research design was adopted. The population for the study was 3512 employees from three of the leading fast-moving consumer goods companies in Lagos State, Nigeria from which a sample of 451 employees was selected using the Cochran formula. Stratified random sampling technique was adopted. A validated questionnaire was used to collect data. Cronbach's alpha reliability coefficients for the constructs ranged from 0.72 to 0.93. The response rate was 80.4%. Data were analyzed using descriptive and inferential statistics. Findings revealed that that Green Efficient Processes ($\beta = 0.234$, $t = 3.554$, $p<0.05$) and Green Recycling ($\beta = 0.391$, $t = 5.869$, $p<0.05$) have significant, positive, and direct effect on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria while Green Product Design ($\beta = 0.071$, $t = 0.980$, $p>0.05$) and Green Supply Chain ($\beta = 0.041$, $t = 0.615$, $p>0.05$) has an insignificant direct effect on operational cost in Lagos State, Nigeria. The study concluded that green manufacturing components have a significant effect on the operational cost of the selected fast-moving consumer goods companies in Lagos State, Nigeria. The study, therefore, recommends that the management of fast-moving consumer goods companies should insist on and practice continued green manufacturing to improve the overall operational cost in their companies.*

KEYWORDS: green manufacturing, green product design, green recycling, green efficient processes, green supply chain and operational cost.

INTRODUCTION

The concept of green manufacturing is increasingly gaining worldwide prominence both in theory and in practice across several sectors with numerous environmental

safety measures being passed as laws by different nations to assist enforce green manufacturing in numerous industries. This concern is seemed to have emerged from cost pressures, changing customer expectations, stronger competitors, and other industry and market disruptions which are collectively causing a tremendous strain on operational capabilities and performance. Hence, the emphasis on green manufacturing is a crucial driver for manufacturing industries to fulfill their operational performance like cost reduction, good corporate image, fewer environmental health hazards, and competitiveness.

Famiyeh, Adaku, Gyampha, Darko, and Teye (2018) established that an organisation's competitive advantage can be attributed to the reduction in production cost, continuous improvement of quality, increased flexibility, and improved delivery time. In order words manufacturing firms should thus employ green manufacturing strategies as this will not only help them gain a competitive advantage but also sustain the competitive advantage in the ever-dynamic global market. Mathiyazhagan, Sengupta, and Mathivathanan (2019) revealed in their study that in Europe there is inadequacy in consideration of sustainability measures by developers; policies, and regulations which has hindered the adoption of the best sustainability practices. According to Geyer and Scapolo (2004), sustainable manufacturing may be significantly affected by industrialists who are more likely to focus on short-term rather than long-term goals.
In Africa, manufacturing currently emits about 440 megatons of carbon dioxide equivalent (MtCO2 e)—about 30 to 40 percent of total African emissions. Furthermore, the bulk of Africa's manufacturing emissions 75 percent comes from just four economies: South Africa (37 percent); Egypt (20 percent); Algeria (10 percent); and Nigeria (7 percent), driven by factors including their level of development, population size, high concentration of high-emitting sectors such as cement and refining, and share of manufacturing in GDP (Mckinsey, 2021). According to Mckinsey (2021) If Africa's manufacturing sector keeps on its current growth path, without any efforts to decarbonize, it is likely to nearly double its emissions by 2050. According to Banjoko, Iwuji, and Bagshaw (2012) since independence, the performance of the Nigerian manufacturing sector has been unimpressive with the scenario that consists of diverse elements of early mild growth and subsequent decline. Despite interventions by the government, the Nigerian manufacturing sector remains challenged and overwhelmed by a weak and frail performance outlook (Guardian, 2020).

Currently, the manufacturing industry is developing rapidly however, it also produces a mass of garbage and resource consumption. The idea of sustainability and green is gaining popularity, and the expanding global economy has brought not only prosperity but also environmental degradation (World Bank, 2012), such as depletion of the ozone layer, climate change, pollution, and the depletion of water, air, minerals and land (United Nations Environment Programme, 2012; World Bank, 2012). Based on the foregoing issues, gaps and problems identified, this study investigated the effect of green manufacturing on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria.

LITERATURE REVIEW

Diverse views and scholarly discourse are embraced in this section along conceptual, empirical, and theoretical lines of green manufacturing components (green product design, green efficient processes, green supply chain, and green recycling) on the operational cost.

Green Manufacturing

The concept of green manufacturing is a relatively new concept that can be viewed as a product of the 1990s, it was first introduced in Germany in the early 1990s to fulfill the market's greener expectations by extending the "waste reduction" idea proposed by lean manufacturing, in the sense of reducing waste and pollution as well as optimizing the use of raw material and energy to minimize the environmental and health risks (Maruthi & Rashmi, 2015; Paul, Bhole, & Chaudhari, 2014). According to Deif, (2011) Green manufacturing can be defined as an efficient approach required in the design and production activities necessary for new product development and production system operations aimed at minimizing environmental impact. Reducing hazardous emissions, eliminating wasteful resource consumption and recycling are examples of green manufacturing activities. Further, Maruthi and Rashmi (2015) opined that green manufacturing is a sustainable approach that makes a special focus on product development and operations to decrease the impact on the environment. In addition, green manufacturing concept draws attention not only to the environment, but also addresses how to minimize potential environmental damages that arise in the cause of manufacturing (Jatmiko & Prestianto, 2022).

The increasing effects of climate change, pollution, as well as the depletion of natural resources of the manufacturing environment calls for a new manufacturing paradigm which green manufacturing seeks to address. Saxena and Srivastava (2022) submits that green manufacturing strategies and techniques makes the manufacturing more efficient through the minimization of waste and pollution. This is achieved through the lowering of the rate of depletion of natural resources as well as the reduction of the amount of wastes produced by the production system. This definition corroborates that of Eshikumo and Odock (2017), who reported that greening of the industry means adopting strategies that would minimize pollution and wastage that is generated during manufacturing, it gives many chances for reducing costs, meeting environmental principles, improving corporate image, and minimizing health risks to reduce, control, avoid and prevent wastage during production. It's a strategy that protects the environment, consumers, and workers and at the same time improves industrial efficiency, profitability, and competitiveness. Green Manufacturing is being measured with proxies of green product design, green efficient processes, green supply chain, and green recycling for this study which is discussed below;

Green product design is defined as a set of project practices whose aim is at the creation of eco-efficient products and processes, it aims to design and develop an environment-friendly product to minimize the environmental impact through product life-cycle analysis (Al-Ghwayeen & Abdallah, 2018). It is a new approach to the product's design

and it involves identifying environmental aspects connected with the product and including them in the design process of product development (Nowosielski, Spilka, & Kania, 2007). Karlsson and Luttropp (2006) state that green design is a sustainable solution of products and services changes that reduce negative sustainability and maximize positive sustainability and impacts economic, environmental, social, and ethical throughout and beyond the life-cycle products. Green product design seeks to solve the increasing negative effects industrial progress has on the environment (Salih & Yahya, 2022).

Green efficient processes are those processes that use green energy, and minimize on wastage of resources with no rejects and rework required on products. The processes generate less undesirable wastes by minimizing the production of solid wastes and reducing the emission of greenhouse gases (Abdul-Rashid, Sakundarini, Raja Ghazilla, & Thurasamy, 2017). According to Amos, Adebola, Asikhia, and Abiodun (2018) one of the most significant areas of gain in performance optimization for companies in the manufacturing sector, and particularly in the Food and Beverage sub-sector would be in the area of operational efficiency, further stating that an overall efficient system requires paying attention to all areas of production, procurement, fabrication, assembly, testing, packaging and distribution, and keeping in check the non-essentials.

Green supply chain refers to a set of managerial practices that integrate environmental issues into supply chain management to ensure environmental compliance and foster the environmental capabilities of the entire supply chain (Caniato, Caridi, Crippa & Moretto, 2012; Paulraj, 2011; Sarkis, Zhu, & Lai, 2011). The benefit of green supply chain according to Eltayeb, Zailani, and Ramayah (2011) is that, unlike the traditional environmental management, the concept of green supply chain assumes full responsibility of a firm towards its products from the extraction or acquisition of raw materials up to final use and disposal of products.

Green recycling is described as the most common product recovery management method because it generates economic value for materials recovered through the restoration of the functional capability allowing re-use thus decreasing the continuous use of new raw materials thus enhancing sustainability (Alvi, 2013; Maruthi & Rashmi, 2015). According to Eltayeb et al. (2011), green recycling aims at sustaining long-term ecological balance through recycling, re-use, and remanufacturing thus safeguarding natural resources from depletion, and the environment is not harmed by the disposal of materials.

Operational cost

Operational cost refers to expenses associated with the maintenance and administration of a business daily. Operational costs are the expenses that are related to the operation of a business, operation of a component, piece of equipment, or facility. They are the cost of resources used by an organisation just to maintain its existence. Common operating cost examples are rent, machinery, payroll services, utilities, uniforms, and office supplies (Nwatu & Idoko, 2020). A business's operating costs are comprised of two components, fixed costs and variable costs, which differ in important ways. John

(2017) defined cost reduction as the process of eliminating waste and improving processes to reduce overhead and or cost of goods sold, hence the need to identify how to measure operating costs because it allows for improving the bottom line.

Manufacturing firms have witnessed an unexpected high operating cost with the attendant reduction in profitability as operating costs are expenses associated with the maintenance and administration of a business on a day to day basis and as such businesses have to keep track of operating costs as well as the costs associated with non-operating activities (Nwatu & Idoko, 2020). Operational cost includes the cost of goods sold, operating expenses as well as overhead expenses. Thomas (2015) indicated that virtually every business has ongoing operating costs. Operating costs generally do not include capital outlays; they can include many components of operating expenses such as sales and marketing costs, office supply costs, rent, repair and maintenance costs, and utility expenses. Operations costs is a good reflection of the operational performance of any firm and is of interest in literature (Khan, Idrees, Rauf, Sami, Ansari & Jamil, 2022).

2.2.2.1 Green Manufacturing Components and Operational cost

It is important for fast-moving consumer goods companies to consider their operational cost while been involved in green practices. While several factors have been considered in the extant literature with regards to operational cost, this study considers green manufacturing component as a plausible determinant. Despite the attention given to the significance of green manufacturing in ensuring green practices gets implemented, only a few empirical studies have considered green manufacturing with respect to factors responsible for its success and scanty empirical evidence of the effect of green manufacturing components on operational cost. Amongst the few that considered the above objective, Shrivastava and Shrivastava (2017), established in their research within Indian cement manufacturing industries that by adopting green processes coupled with efficient use of energy cement manufacturing industries were able to reduce cost while also reducing the negative effects to the environment without losing on quality, reliability and performance.

In a similar study, Khor and Urdin (2013), found that green recycling which is a component of green manufacturing helps in reducing cost through reduction in the consumption of virgin raw materials and reduction in material supply risk thus conserving natural resources and reducing negative impacts to the environment. In another study, Mollenkopf and Closs (2005), affirm that the use of recycled, refurbished, or remanufactured products in the forward supply chain can create additional revenue, reduce operating costs, and minimize the opportunity costs of writing off defective or out-of-date products. In the study of Eshikumo and Odock (2017), it was revealed that green manufacturing component have an effect of reducing operational cost and thus enhancing operational performance. Gbadamosi and Oluwole (2020), in their study found that the result of the lack of adoption of green practices includes cost ineffectiveness, poor customer satisfaction, weak financial performance, poor operational efficiency and poor service delivery. These findings were also similar to previous research (Caiado, Quelhas, Nascimento, Anholon, & Filho, 2019; Gaikwad

& Sunnapwar, 2019; Orji & Wei, 2016). Also, Borchardt, Wendt, Pereira, and Sellitto (2011), found that green design can help firm create competitive advantage and improve the company's public image thereby aiding in cost reduction.

Research Conceptual Model

The study was conceptualized as shown in the model below:

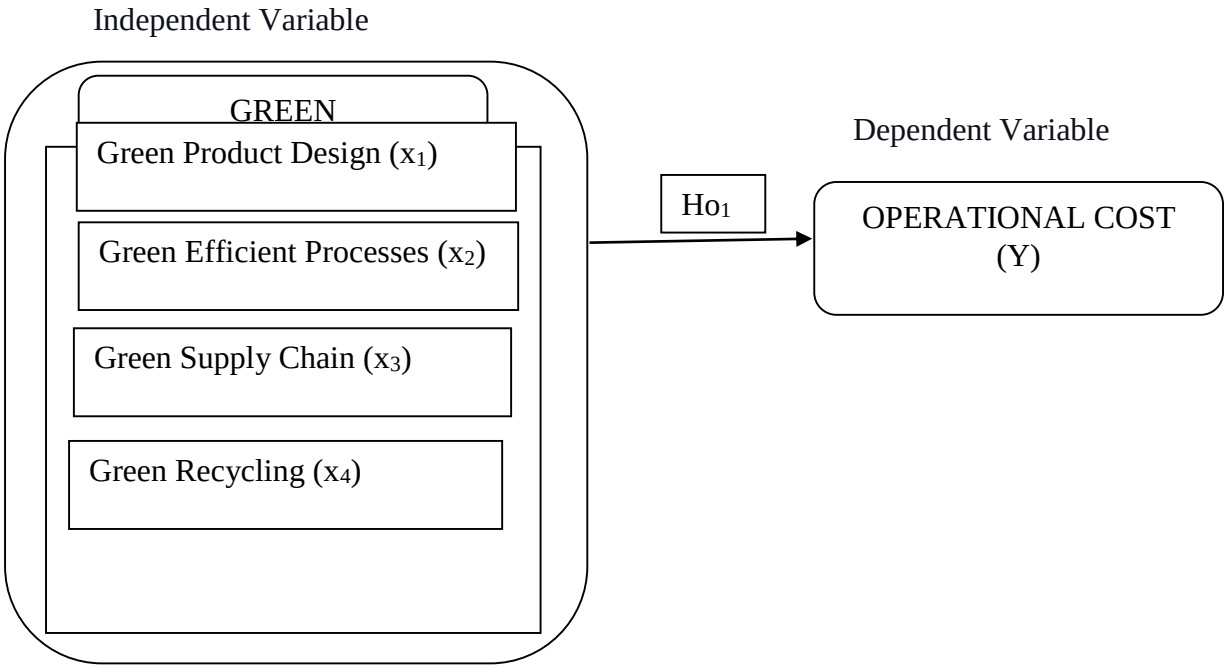

Figure 1: Research Model (2022)

The figure above presents the conceptual model based upon the review of literature and it shows the effect of green manufacturing components (green product design, green efficient processes, green supply chain and green recycling) on operational cost.

Theoretical Review

This study is anchored on institutional theory as baseline theory for this study which was introduced in the late 1970s by John Meyer and Brian Rowan, the theory examines how company operations are influenced by external pressures (Hirsch, 1975). The theory assumes that organisations operate within a social network and a strong motivating force behind firm behavior is socially based and it is embedded within institutions and interconnected organisational networks (Iacobucci & Hopkins, 1992). These social-cultural pressures forced organisations to persuade adoption of green manufacturing practices and structure is emphasized (Scott, 1992). The institutional theory provides a theoretical lens through which manufacturing firms can adopt practices that promote the future of the sector, including factors such as culture, social environment, and legal as well as economic environments.

According to Zhu and Sarkis, (2007) the institutional theory posits that enterprises embrace certain strategies to gain legitimacy or acceptance within society. Hirsch (1975) further supports this view by stating that the theory explores the influence on a firm by external pressures. Zhu and Sarkis (2007) argue that institutional pressures may cause firms to engage in proactive environmental practices such as green manufacturing. Firms that yield to these pressures are perceived to be more legitimate and are likely to gain competitive advantage and hence improve performance (Darnall, Henriques, & Sadorsky, 2008; Zhu & Sarkis, 2007). The institutional theory is a relevant theory to this study in that it explains how changes in social values, technological advancements, and regulations can affect decisions regarding 'green' sustainable activities (Ball & Craig, 2010; Lounsbury, 1997; Rivera, 2004). Such changes can be as a result of three forms of drivers that promote sustainable manufacturing. These drivers are coercive, normative, and mimetic. Coercive isomorphic forces are driven by those in authority like the government and its associated agencies influencing how organisations act by enacting regulations which the firms are expected to adhere to (Rivera, 2004), and as such the fear of repercussions for noncompliance causes firms to engage in proactive environmental practices.

Normative isomorphic forces are important in ensuring conformity to perceived legitimacy concerning green manufacturing and environmental management practices by different firms (Ball & Craig, 2010). Mimetic pressures occur when an organisation mimics the actions of successful competitors in the industry. Mimetic pressures are the main driver for firms to implement green practices. As a consequence of globalization, firms in developing countries can learn through self-regulation, from their foreign competitors in developed countries on how to implement environmental management practices (Christmann & Taylor, 2001).

METHODOLOGY

Survey research design was adopted. The population was 3512 employees of three fast-moving consumer goods companies in Lagos State, Nigeria. A sample size of 451 employees was determined using the Cochran formula. Stratified random sampling technique was adopted. A validated questionnaire was used to collect data. The Cronbach's alpha reliability coefficients for the constructs ranged from 0.72 to 0.93. The response rate was 80.4%. Data were analysed using descriptive and inferential statistics. The hypothesis was tested using Partial least squares structural equation modeling (PLS-SEM). The choice of PLS-SEM (via SmartPLS) is because it is a more advanced multivariate analytical technique which performs multiple regression, factor analysis, and provides a pictorial model of the interactions in a study with the push of one command as against running isolated analysis using SPSS (Hair, Black, Babin, & Anderson, 2018). SEM also provides researchers with the ability to conduct complex and multidimensional precise empirical analysis of data that considers different aspects of the phenomenon, concepts and constructs (Tarka, 2018). In addition, the SmartPLS statistical platform offers stricter and robust analysis compared with the outcomes of SPSS (Ronkko & Evermann, 2013). The principal factors investigated were measured on a six-point scale with anchors ranging from Strongly Agree (SA) to Strongly

Disagree (SD), for the independent variables and dependent variables respectively. Multiple regression equations developed along the dependent and independent. Thus, the models can be represented as follows:

Functional Model

In this study, there are two constructs; independent and dependent variables. The first independent variable is green manufacturing measured by sub-variables such as green product design, green efficient processes, green supply chain, and green recycling, while the dependent variable is the operational cost.

$Y = f(X)$

Y = Dependent Variable (Operational Cost)

X = Independent Variable (Green Manufacturing)

Where:

$X = (x_1, x_2, x_3, x_4)$

Therefore:

x_1 = Green Product Design (GPD)

x_2 = Green Efficient Processes (GEP)

x_3 = Green Supply Chain (GSC)

x_4 = Green Recycling (GR)

Hypothesis One

$Y = f(x_1, x_2, x_3, x_4)$

$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \mu_i$

$OC = \beta_0 + \beta_1 GPD + \beta_2 GEP + \beta_3 GSC + \beta_4 GR + \mu_i$---------- Eqn 1

Where:

β_1 = coefficients of parameters to be estimated

μ_i = error or stochastic term

Data Analysis, Results, and Discussion

A total of 451 copies of questionnaire were administered to employees of the selected fast-moving consumer goods companies. Out of 451 copies of questionnaire that were distributed, 362 were completed and usable. This represents a response rate of 80.4%, which is deemed satisfactory for data analysis and interpretation. The data from three hundred and sixty-two (362) respondents were analysed.

Restatement of Research Objective, Research Question, and Research Hypothesis One

Objective One: Examine how green manufacturing component affects the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria.

Research Question One: What effect do green manufacturing components have on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria?

H_01: Green Manufacturing Components has no significant effect on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria.
In order to test the hypothesis, multiple linear regression through Structural Equation Modelling Partial Least Squares (SEM-PLS) implemented in Smart-PLS version 3.3.6 software was used. In SEM-PLS, R-Square i.e., the coefficient of determination, structural path co-efficient (β-value), T-statistic value, and the degree of the goodness-of-fit model helps to determine the level of influence and relationship between the independent and dependent variables as well as the model fitness. The extent of prediction for each independent variable was determined using bootstrapping procedure. The level of variance explained independent variables by exogenous variables (predictive accuracy of the model) was determined by R-squared (R2) value. The SEM-PLS results are presented in Table 1, Figures 2.1a, Figures 2.1b, and Figures 2.1c present the effect relationship.

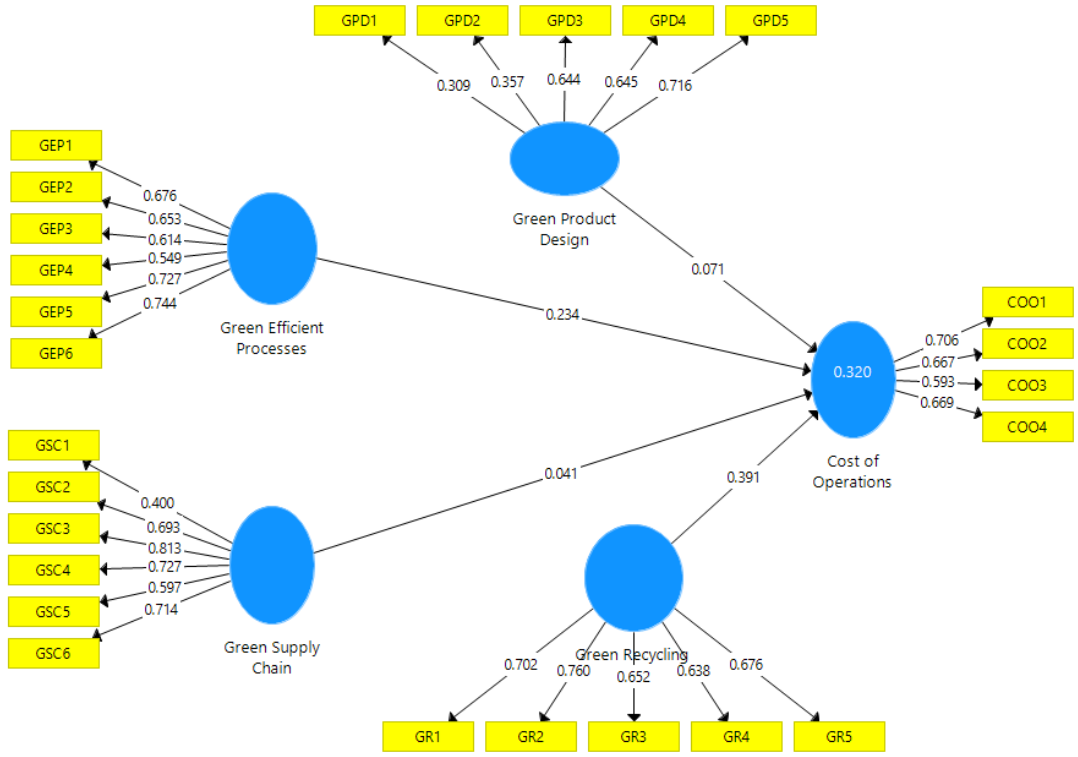

Figure 2.1a: Path Analysis Showing the Measurement and Structural Model Source: Author Data, via Smart PLS 3.3.6

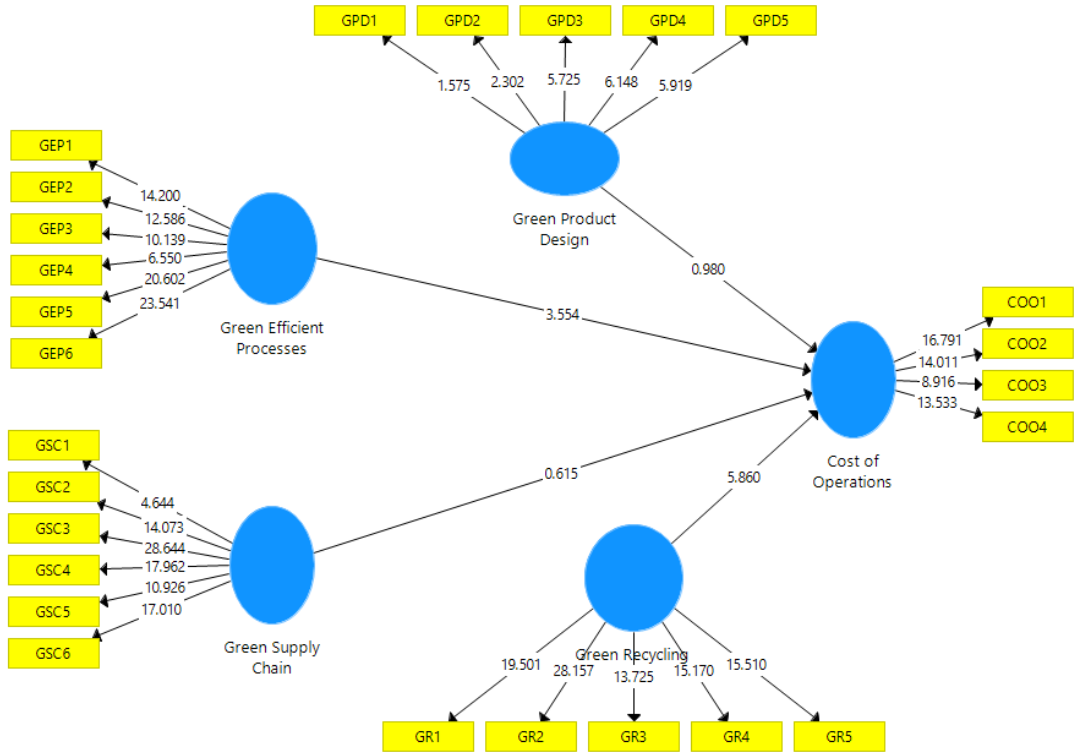

Figure 2.1b: T- Statistics
Source: Author Data, via Smart PLS 3.3.6

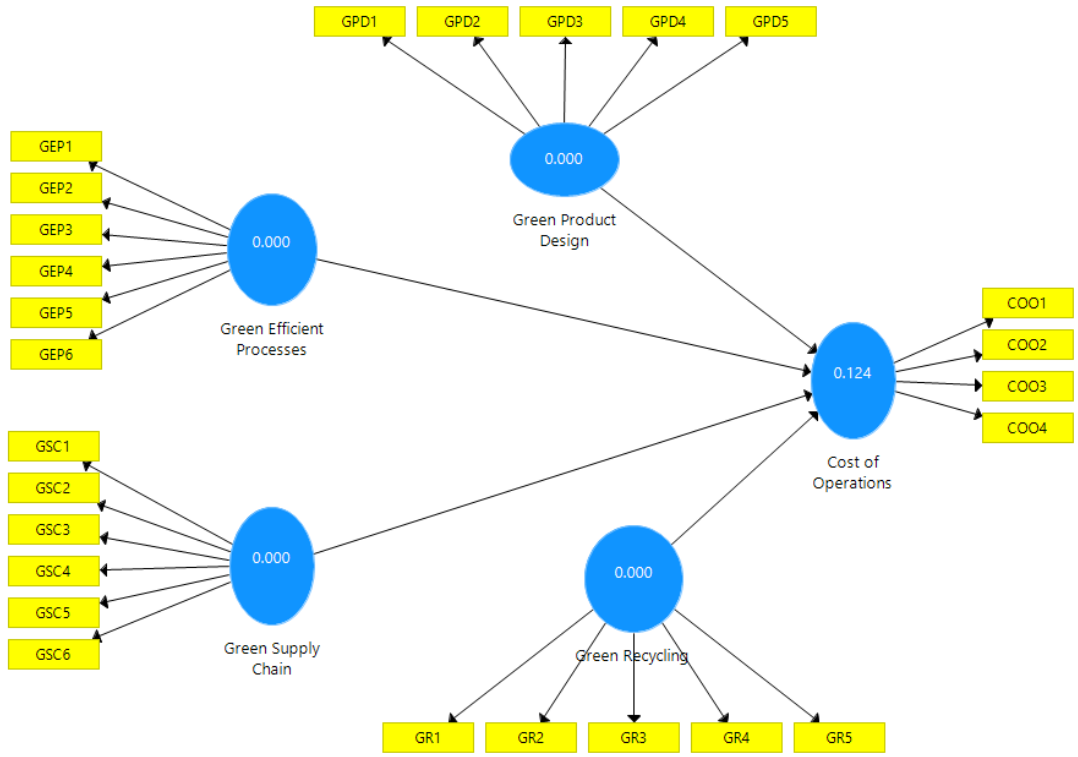

Figure 2.1c: Q^2 Statistics
Source: Author Data, via Smart PLS 3.3.6

Table 1: Summary of the PLS – SEM for the Effect of Green Manufacturing Components on Operational cost of selected FMCGs in Lagos State, Nigeria.

Path Description	Original Sample (o) Unstandardized Beta	T	Sig.	F^2	R^2	Adj. R^2	Q^2
Green Product Design → Operational cost	0.071	0.980	0.327	0.006	0.320	0.313	0.124
Green Efficient Processes → Operational cost	0.234	3.554	0.000	0.063			
Green Supply Chain → Operational cost	0.041	0.615	0.539	0.002			
Green Recycling → Operational cost	0.391	5.860	0.000	0.176			

Source: Researcher's Result via SmartPLS Version 3.3.6 (2022)

Figure 2.1a illustrated and gave the results for both the outer (measurement) model and the inner (structural) model. The measurement model revealed how well the items on each latent variable measure it. The inner model on the other hand shows the relationship between the components of the exogenous variable and the endogenous variable which is summarised thus: Table 1 showed the SEM-PLS results for the effect of green manufacturing components on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria. The results showed that Green Efficient Processes ($\beta = 0.234$, $t = 3.554$, $p<0.05$) and Green Recycling ($\beta = 0.391$, $t = 5.869$, $p<0.05$) have significant, positive, and direct effect on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria while Green Product Design ($\beta = 0.071$, $t = 0.980$, $p>0.05$) and Green Supply Chain ($\beta = 0.041$, $t = 0.615$, $p>0.05$) has an insignificant direct effect on operational cost. The results of the analysis revealed that two of the components of green manufacturing (green efficient processes and green recycling) have a significant and positive effect on the operational cost of the selected fast-moving consumer goods companies in Lagos State, Nigeria. The T- statistics further confirm this result as only green efficient processes ($t=3.554 >1.96$) and green recycling ($t=5.869 >1.96$) have test statistic values greater than 1.96. This implies that green efficient processes and green recycling are important determinants of the operational cost of the selected fast-moving consumer goods companies in Lagos State, Nigeria. The results suggest that improving green efficient processes and green recycling would lead to improving the operational cost in the companies.

The Adjusted R^2 was used to establish the predictive power of the study's model. From the results, the adjusted coefficient of determination ($Adj\ R^2$) of 0.313 showed green manufacturing component explained about 31.3% of the variation in the operational cost of selected fast-moving consumer goods under study while the remaining 68.7%

variation in the operational cost is explained by other exogenous variables different from green manufacturing component considered in this study.

The effect size of the green manufacturing component in relation to R^2 was determined using Cohen's f^2 metric. Cohen (1988) suggested that effect sizes with values that are >0.35, >0.15, and >0.02 could be considered as strong, moderate, and weak, respectively. In view of the threshold, the effect sizes (f^2) of the green manufacturing component revealed that green product design, green efficient processes, and green supply chain had weak effect sizes (0.006, 0.063, and 0.002, respectively) on the operational cost, while green recycling was found to have a moderate effect size (0.176) on the operational cost.

Further analysis was conducted to establish the predictive relevance of the model using the Stone-Gleisser Q^2 value. Scholars posit that Q^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large predictive relevance. Chin (1998) suggested that Q^2 above zero confirms that the structural model specified is relevant. According to Table 1, the Q^2 value of the cost of production of selected fast-moving consumer goods companies in Lagos State Nigeria is 0.124. Hence, green manufacturing has a comparatively moderately high degree of predictive relevance with regard to the cost of production of selected fast-moving consumer goods in Lagos State, Nigeria, thus, for this reason, the structural model specified is relevant and has sufficient predictive quality. The multiple regression model generated from the data in Table 1 is thus expressed as:

$OC_i = \alpha + 0.071GPD + 0.234GEP + 0.041GSC + 0.391GR + \mu_i$ ----------Eqn 1a (Predictive Model)
$OC_i = \alpha + 0.234GEP + 0.391GR + \mu_i$ ----------Eqn 1b (Prescriptive Model)
Where:
OC = Operational cost
GPD = Green Product Design
GEP = Green Efficient Processes
GSC = Green Supply Chain
GR = Green Recycling

In the predictive model, it is seen that of all the variables, only green product design, and green supply chain was insignificant so the management of the selected fast-moving consumer goods companies in Lagos State, Nigeria can downplay that variable which is why it is not in the prescriptive model. The results of the multiple regression analysis as seen in the prescriptive model indicate that when all other variables of green manufacturing components (green efficient processes and green recycling) are improved by one unit, the operational cost would increase by 0.234, and 0.391 units respectively and vice-versa. This implies that an increase in green efficient processes and green recycling on a measurement scale would lead to a corresponding increase in the operational cost and a decrease in green efficient processes and green recycling would lead to a corresponding decrease in the operational cost of the selected fast-moving consumer goods companies in Nigeria. From a relative perspective, green

recycling (β = 0.391, p<0.05) affects more positively and significantly the operational cost for the selected fast-moving consumer goods company than green efficient processes (β = 0.234, p<0.05) as revealed by their respective beta values. This suggests that improved green efficient processes and green recycling would lead to an improved operational cost for the selected fast-moving consumer goods companies in Lagos State, Nigeria. On the strength of the PLS-SEM summarized results in table 1 (*Adj* R^2 =0.313, p<0.05, Q^2 =0.124), this study concluded that green manufacturing components with particular emphasis on green efficient processes and green recycling significantly affect the operational cost of selected FMCGs companies in Lagos State, Nigeria. Therefore, the null hypothesis ($H_0$1) which states Green manufacturing components has no significant effect on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria was rejected.

DISCUSSIONS OF FINDINGS

The test of hypothesis one revealed that green manufacturing components (green efficient processes and green recycling) have a significant effect on the operational cost of selected fast-moving consumer goods in Lagos State, Nigeria. In line with literature, this finding aligns with other studies conceptually and empirically. From the conceptual perspective, Elyateb (2019) provides a key definition of green efficient processes in that it uses minimum resources to create value addition in products manufactured enhancing competitive advantage. The research further explained that green efficient processes are a practice that firms are expected to follow to ensure that operational performance is attained. Similarly, this research corroborated the result of the work conducted by Abdul-Rashid et al. (2017), which also affirmed that green efficient processes generate less undesirable wastes by minimizing the production of solid wastes and reducing the emission of greenhouse gases. The core of the green efficient processes requires the use of green manufacturing technologies which would in turn lead to the substitution of raw materials with alternative raw materials, which are less hazardous, have re-manufacturing, re-use, and recycling capabilities to ensure a minimal operational cost (Ahn, 2014).

Further, the studies of Khor, Udin, Ramayah, and Hazen (2016); Maruthi and Rashmi, (2015) explained in their definition that green recycling involves the reuse of products, components, and materials which has been used in the past, mostly for the cost savings of reusing rather than disposing of the product or item. In other words, suggesting that where there is no adequate provision for green recycling, the cost of operation is adversely affected. The studies further elaborated that green recycling should be seen as a means that generates economic value for materials recovered through the restoration of the functional capability. The studies further elaborated on the characteristics of green recycling in the area of its dual perspective of being a negative or positive view where threats are discouraged and opportunities are encouraged. Empirically, the findings of this study corroborated with Inman and Green (2018), where it was revealed that green manufacturing positively and significantly impacts the operational cost. The study of Yu and Ramakrishnan (2014), established also that there exists a positive and significant relationship between green manufacturing components

and operational cost. The study of Wong, Wong, and Sakun Boon-itt (2020), revealed that green manufacturing components (green efficient processes, green product design, and green recycling) positively affect the operational cost.

The test of hypothesis one also revealed that the green manufacturing component of green product design and green supply chain has an insignificant direct effect on the operational cost of selected fast-moving consumer goods in Lagos State, Nigeria. This is contrary to the finding in the study of Shrivastava and Shrivastava (2017), which revealed that by adopting green manufacturing components such as a green supply chain and green product design coupled with efficient use of energy companies were able to reduce costs while also reducing the negative effects to the environment without losing on quality, reliability, and performance. The finding is also contrary to the finding of Orji and Wei (2016) which revealed that green product design and green supply chain variables of green manufacturing have a positive and significant effect on the operational cost as the total life cycle cost of product in green manufacturing is lower than that of the same product in conventional manufacturing.

From the context of theory, the study corroborates the theoretical underpinning assumptions of the institutional theory and the natural resource-based view theory. In general, the results indicate that green manufacturing components (green efficient processes and green recycling) have a significant effect on the operational cost of selected fast-moving consumer goods in Lagos State, Nigeria. This study's results are in concomitance with these theoretical perspectives. Hence, given the support found in conceptual, empirical, and theoretical submissions in previous literature with this present study's result, the study posits that green manufacturing components have a significant effect on the operational cost of selected fast-moving consumer goods in Lagos State, Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study focused on the effect of green manufacturing on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria. The study further indicated that green manufacturing components of (green efficient processes and green recycling) have a positive and statistically significant effect on the operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria. The result further revealed that the green manufacturing component of green product design and green supply chain has a positive and statistically insignificant effect on selected fast-moving consumer goods companies in Lagos State, Nigeria. Therefore, the researcher concluded that green manufacturing components (green efficient processes and green recycling) have a positive effect on the operational cost of selected fast-moving consumer goods companies and the more accurate green manufacturing components (green efficient processes and green recycling) during manufacturing operations, the lesser the operational cost for fast-moving consumer goods companies in Lagos State Nigeria.

The findings of this study have implications for management, academics, government and policymakers, and the general public. The study contributed to knowledge by developing a new perspective to green manufacturing and their effect on operational cost of selected fast-moving consumer goods companies in Lagos State, Nigeria. The researcher recommends improved efficient processes by eliminating the use of hazardous and toxic materials and also ensuring that adequate effort to continuously adopt processes that reduces on energy wastage is maintained. Adequate attention should be given to green recycling by installing collection points for product recovery and makes a concerted effort to decrease pollution by collecting waste created by the firm. It is further recommended that attention should also be given to cost management, in order to improve the operational cost of the selected fast moving consumer goods company in Lagos State, Nigeria. The study indicated that other green manufacturing components can affect the operational cost aside from the ones used in this study, further research should be conducted to reveal these components and how they affect the operational cost of selected fast-moving consumer goods companies in Nigeria.

References

Abdul-Rashid, S. H., Sakundarini, N., Raja Ghazilla, R. A., & Thurasamy, R. (2017). The impact of sustainable manufacturing practices on sustainability performance. *International Journal of Operations & Production Management*, *37*(2), 182–204.

Ahn, S. (2014). An evaluation of green manufacturing technologies based on research databases. *International Journal of Precision Engineering and Manufacturing-Green Technology*, *1*(1), 5-9.

Al-Ghwayeen, W. S., & Abdallah, A. B. (2018). Green supply chain management and export performance. *Journal of Manufacturing Technology Management, 29*(7), 1233–1252.

Alvi, S. (2013). Approaching green manufacturing in iron and steel industry. *International Journal of Mechanical Engineering and Robotics Research*, *2*(3)

Amos, N., Adebola, S., Asikhia, U., & Abiodun, J. (2018). Lean manufacturing and operational efficiency of nestle Nigeria plc. using data envelopment analysis (DEA). *Journal of Management & Social Sciences*, *1*(1), 01-28

Ball, A., & Craig, R. (2010). Using neo-institutionalism to advance social and environmental accounting. *Critical Perspectives on Accounting*, *21*(4), 283–293.

Banjoko, A., Iwuji, I., & Bagshaw, K. (2012). The Performance of the Nigerian Manufacturing Sector: A 52-Year Analysis of Growth and Retrogression (1960-2012). *Journal of Asian Business Strategy*, *2*(8), 177 -191.

Borchardt, M., Wendt, M., Pereira, G., & Sellitto, M. (2011). Redesign of a component based on Ecodesign practices: environmental impact and cost reduction achievements. *Journal of Cleaner Production*, *19*(1), 49-57.

Caiado, R. G. G., Quelhas, O. L. G., Nascimento, D. L. de M., Anholon, R., & Leal Filho, W. (2019). Towards sustainability by aligning operational programmes and sustainable performance measures. *Production Planning & Control, 30*(5-6), 413–425.

Caniato, F., Caridi, L., Crippa, & Moretto, A. (2012). Environmental sustainability in fashion supply chains: an exploratory case bases research. *International Journal of Production Economics, 135*(2), 659–670.

Chin, W. W. (1998). The partial least squares approach for structural equation modeling. In G. A. Marcoulides (Ed.). *Modern methods for business research*, 295–336. Lawrence Erlbaum Associates Publishers.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences (2nd ed.).* Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Darnall, N., Henriques, I., & Sadorsky, P. (2008). Do environmental management systems improve business performance in an international setting*? Journal of International Management*, *14*(4), 364-376.

Deif, M. (2011). A system model for green manufacturing. *Journal of Cleaner Production, 19* (14), 1553-1559.

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.

Eshikumo, S. M., & Odock, S. O. (2017). Green Manufacturing and Operational Performance of a Firm: Case of Cement Manufacturing in Kenya. *International Journal of Business and Social Science*, *8*(4).

Famiyeh, S., Adaku, E., Gyampha, K., Darko, D., & Teye, C. (2018). Environmental management practices, operational performance and environmental performance. *Journal of Manufacturing Technology Management, 29*(3), 588-607.

Gaikwad, L., & Sunnapwar, V. (2020). An integrated Lean, Green and Six Sigma strategies. *The TQM Journal*, *32*(2), 201–225.

Gbadamosi, K., & Oluwole, A. (2020). Logistics Operational Performance of Relief Organisations in the Management of Internally Displaced Persons (IDPs) in Nigeria. *ATBU Journal of Science, Technology and Education*, *7*(4), 331-337.

Geyer, A., & Scapolo, F. (2004). European manufacturing in transition – The challenge of sustainable development: Four scenarios 2015–2020. *Innovation, 6*(2), 331–343.

Hair, J., Black, W., Babin, B., & Anderson, R. (2018*). Multivariate data analysis* (8th ed.). Andover, Hampshire: Cengage Learning, EMEA.

Hirsch, P. (1975). Organisational effectiveness and the institutional environment. Administrative Science Quarterly, 327-344

Iacobucci, D., & Hopkins, N. (1992). Modeling dyadic interactions and networks in marketing. *Journal of Marketing Research*, 5-17.

Jatmiko, B. A. & Prestianto, B. (2022). Designing green manufacturing with OECD methods on a micro

business Oxx guitarmaker ambarawa. *Journal of Management and Business Environment, 3*(2), 126-139.

John S., (2017). Types of cost reduction. *Simplicable.com*

Karlsson, R., & Luttropp, C. (2006). Eco-design: what's happening? An overview of the subject area of Ecodesign and of the papers in this special issue. *Journal of Cleaner Production*, *14*(15), 1291-1298

Khan, M. T., Idrees, M. D., Rauf, M., Sami, A., Ansari, A. & Jamil, A. (2022). Green supply chain
management practice's' impact on operational performance with the mediation of technological innovation. *Sustainability, 14*, 1-22.

Khor, K. & Udin, M. (2013). Reverse logistics in Malaysia: Investigating the effect of green product design and resource commitment. *Resources Conservation and Recycling Journal*, *81*(2), 78-81.

Khor, K., Udin, Z., Ramayah, T., & Hazen, B. (2016). Reverse logistics in Malaysia: The contingent role of institutional pressure. *International Journal of Production Economics*, *175*, 96-108

Lounsbury, M. (1997). Exploring the Institutional Tool Kit. *American Behavioral Scientist*, *40*(4), 465–477.

Maruthi, G. D., & Rashmi, R. (2015). Green Manufacturing: It's Tools and Techniques that can be implemented in Manufacturing Sectors. *Materials Today: Proceedings, 2*(4-5), 3350–3355.

Mathiyazhagan, K., Sengupta, S., & Mathivathanan, D. (2019). Challenges for implementing green concept in sustainable manufacturing: a systematic review. *OPSEARCH*.

Mollenkopf, D., & Closs, D. (2005). The hidden value in reverse logistics. *Supply Chain Management Review*; *9*(5), 34–43

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

Nwatu, E.C., & Idoko, E. A., (2020). Reducing Operating Costs and Profitability of Manufacturing Firms in South East, Nigeria. *Academic Journal of Current Research, 9* (3244-5621)

Orji, I., & Wei, S. (2016). A detailed calculation model for costing of green manufacturing. *Industrial Management & Data Systems, 116*(1), 65–86.

Paul, I. D., Bhole, G. P., & Chaudhari, J. R. (2014). A Review on Green Manufacturing: It's Important, Methodology and its Application. *Procedia Materials Science, 6*, 1644–1649.

Paulraj, A. (2011). Understanding the Relationships between Internal Resources and Capabilities, Sustainable Supply Management, and Organisational Sustainability. *Journal of Supply Chain Management*, *47*(1), 19–37.

Rivera, J. (2004). Institutional Pressures and Voluntary Environmental Behavior in Developing Countries: Evidence from the Costa Rican Hotel Industry. *Society & Natural Resources, 17*(9), 779–797.

Rönkkö, M., & Evermann, J. (2013). A critical examination of common beliefs about Partial Least Squares Path Modeling. *Organizational Research Methods*, *16*(3), 425–448.

Salih, M. M. & Yahya, R. Q. (2022). Green manufacturing influence on adopting mass customization
pillars: An exploratory study of number of manager's opinions in the state's company for textile and leather industry/the ready-made garments factory (Waladi). *Tikrit Journal of administration and Economics Sciences, 18*(57), 534-556.

Sarkis, J., Zhu, Q., & Lai, K. (2011). An Organisational Theoretic Review of Green Supply Chain Management Literature. *International Journal of Production Economics*, *130*(1), 1–15

Saxena, A. & Srivastava, A. (2022). Industry application of green manufacturing: A critical review. *Journal of Sustainability and Environmental Management (JOSEM), 1*(1), 32-45.

Scott, W. (1992). *Organisations: Rational, Natural, and Open Systems.* Prentice-Hall: Englewood Cliffs, NJ

Shrivastava, S., & Shrivastava, L. (2017). A systematic literature review on green manufacturing concepts in cement industries. *International Journal of Quality & Reliability Management, 34*(1), 68-90.

Tarka, P. (2018). An overview of structural equation modeling: Its beginnings, historical development, usefulness and controversies in the social sciences. *Quality & Quantity, 52*(1), 313–354.

Thomas, C. (2015). Naturalizing Sustainability Discourse: Paradigm, Practices and Pedagogy of Thoreau, Leopold, Carson and Wilson: *Ph.D Thesis: Arizona State University*

Wong, C. Y., Wong, C. W. Y., & Boon-itt, S. (2020). Effects of green supply chain integration and green innovation on environmental and cost performance. *International Journal of Production Research,* 1–21.

Yu, W., & Ramanathan, R. (2014). An empirical examination of stakeholder pressures, green operations practices and environmental performance. *International Journal of Production Research, 53*(21), 6390–6407.

Zhu, Q., & Sarkis, J. (2007). The moderating effects of institutional pressures on emergent green supply chain practices and performance. *International Journal of Production Research, 45*(18-19), 4333-4355.