



Carbon Reporting and Supply Chain Performance Effectiveness of Oil and Gas Companies in Rivers State

Imo, ThankGod Obutor (PhD)

Department of Accounting, Rivers State University, Port Harcourt, Nigeria | e-mail:

thankgod.imo@ust.edu.ng

Ikegwuru, Mac-Kingsley (PhD)

Department of Marketing, Rivers State University, Port Harcourt, Nigeria | e-mail:

ikegwuru.mac-kingsley@ust.edu.ng

Abstract: *This study focused on carbon reporting and supply chain performance effectiveness of oil and gas companies in Rivers State. The survey research method was employed for the study on a population comprised 295 oil and gas companies resident in Rivers. Afterward, the Taro Yamane's formula was used to turn up 170 oil and gas companies as the sample size for the study. A 5-point likert-scale questionnaire was administered to respondents, of which out of the 510 copies of the questionnaire distributed, 405 were returned and after data cleaning, 286 (71%) were useful for analysis. The study adopted descriptive statistics and simple regressions method for data analysis. The results disclosed that carbon reporting has a positive and significant influence on cost containment and performance reliability. The study therefore, concludes that, carbon reporting significantly influences supply chain performance effectiveness of oil and gas companies in Rivers State, and recommends that, to reduce carbon emission to a low extent, the government should institute an accounting regulatory body to issue a precise benchmark on carbon reporting in order to attract optimistic supply chain performance effectiveness.*

Keywords: *Carbon reporting, Cost containment, Performance reliability, Supply chain performance effectiveness.*

Introduction

Collaboration is necessary for firms in a supply chain. A much-increased necessity for collaboration between partnering firms in sustainable supply chain management ought to be timely in examining an extended fraction of the supply chain (Seuring & Müller, 2008). If emissions are such a huge fraction of a firm's supply-chain carbon footprint, it becomes important to be aware of the degree to which firms are evaluating those emissions. Bostrom *et al.* (2015) highlight that one of the major challenges in improving sustainable supply chain control is information breaches concerning the sustainability influences of products and processes all the way through a supply chain.

Information regarding supplier vulnerability to climate change and greenhouse gas guideline permits firms to make healthier decisions and condense risks linked with carbon emissions (Jira & Toffel, 2013). Devoid of an understanding of upstream emissions, firms may fail to notice the most gainful carbon alleviation strategies, chiefly specified that such a huge piece of emissions emanate from the supply chain. Quantifying carbon emissions contained by the supply chain has considerable advantages, save for espousal has been sluggish. Working in partnership with suppliers to curtail pollution has a major impact on manufacturing and environmental performance as well (Vachon & Klassen, 2008). Suppliers are more prone to disclose carbon emissions if they face more demands from buyers and if buyers

become visibly more steadfast to using it (Jira & Toffel, 2013). Companies' encounter growing demands to quantify supply chain emissions (Jira & Toffel, 2013; Reid & Toffel, 2009).

Companies face numerous confrontations in bringing together carbon emissions further than company thresholds as it was established that merely a modest more than half of all suppliers that are requested to share climate change information respond (Jira & Toffel, 2013). Even when carbon emissions data is accessible, it may still be challenging to evaluate the quality of the data (Kolk, Levy & Pinkse, 2008; Melville & Whisnant, 2014). The use of carbon emissions as a performance metric has also led to many discussions on how far upstream should carbon emissions be measured and how to evaluate its fullness (Busch, 2010, 2011; Murray, Wiedmann & Dey, 2011; Hoffmann & Busch, 2008). The category and scope of carbon emissions data composed will for the most part be driven by what will influence stakeholders (Marland, Buchholz & Kowalczyk, 2013). However, devoid of a yardstick, it is hard to evaluate how all-inclusive and flourishing companies are in accumulating information.

As the carbon emissions could have a considerable effect on business activity and behavior (Saka & Oshika, 2014), companies need to regulate and limit CO₂ emissions and take into justification the climate facets in their business strategy (Gallego-Álvarez, Rodríguez-Domínguez & García-Sánchez, 2011). It is clear as crystal that carbon emissions are grave mechanisms of sustainability, accordingly reporting activities can be related to carbon matters (Lodhia & Martin, 2012). Carbon reporting perhaps will be a fundamental tool to exert demands on firms to lower their emissions, hence may well have a task in realizing climate mitigation intents (Ennis, Kottwitz, Lin & Markusson, 2012). The Department for Environment, Food and Rural Affairs projected that in 2021 four million tonnes of CO₂ emissions could be saved by disclosing CO₂ emissions information (Carbon Trust, 2012). On average, businesses report ten out of 19 indicators that have been made in the disclosure directory and established that the volume of carbon information are dissimilar between companies, sectors and countries (Prado-Lorenzo *et al.*, 2009).

The literature on carbon emission disclosure also categorizes a changeability of reasons why firms may act to disclose carbon information. Relative to corporate characteristic and general contextual factors, internal organizational factors have been less researched in the literature on voluntary corporate behavior (Howard-Grenville, Nash & Coglianesi, 2007) and corporate disclosure (Adams, 2002). Therefore, it is imperative to think about the influence of carbon reporting, since the link between carbon reporting practices and firm performance remains inadequate (Ennis *et al.*, 2012). We need to acknowledge the fact that, mounting greenhouse gases (GHG), obviously carbon dioxide in atmospheres (CO₂) show the way to global warming, presenting emissions as enormous portions of a firm's supply-chain carbon footprint. This raises the question whether carbon reporting influences supply chain performance effectiveness. This study therefore, investigates the influence of carbon reporting on supply chain performance of oil and gas companies in Rivers State of Nigeria?

Objectives of the Study

The broad objective of this study is to evaluate the effect of carbon reporting on supply chain performance effectiveness of firms in Nigeria using the oil and gas industry. The specific objectives are to:

- i. Investigate the effect of carbon accounting on cost containment of oil and gas companies in Rivers State.

ii. Examine the effect of carbon accounting on performance reliability of oil and gas companies in Rivers State.

Literature Review and Hypotheses

Theoretical Foundation

This study is anchored on the stakeholders theory and signaling theory.

Stakeholders Theory

Stakeholder theory speculates that the firm's accomplishment is dependent upon the successful management of all the interactions that a company has with its stakeholders (Ullman, 1985). Businesses that put up relationships with stakeholders founded by mutual trust and cooperation can show the way to a competitive advantage (Jones, 1995) and be a basis of better-quality performance (Barney, 1991). Conversely, if a little or every one of these stakeholders become discontented, the business will be unable to carry on as a going concern (Clarkson, 1995). In environmental management point of view, "stakeholder theory envisages that if businesses attempt to lower their embedded costs by performing environmentally negligent they will in point of fact sustain advanced unequivocal costs, which can result in a competitive drawback (Galbreath, 2006).

Signaling Theory

Signaling theory enables companies disclose value relevant information to satisfy investors' demands for information (Wang & Hussainey, 2013). Signaling theory assumes that managers have superior information as compared to outside investors on company's expected future performance, even with the assumption of an efficient capital market, and managers may enhance the quality of their financial reporting by voluntarily providing additional disclosures (Healy & Palepu, 2001).

Carbon Reporting

Carbon reporting is principally a novel concept which has cropped up in the last few years. Najah (2012:7) delineated carbon reporting as a "set of quantitative and qualitative information that relates to a firm's past and forecasted carbon emissions levels; its exposure to and financial implications of climate change associated risk and opportunities; and its past and future actions to manage these risks and opportunities". Carbon reporting was primarily premeditated as a detachment of environmental reporting and the majority of the reporting is arranged on a voluntary basis (Andrew & Cortese, 2011). Carbon-related disclosures have increased significantly in the last five years and many of these disclosures remain voluntary (Andrew & Cortese, 2011). Many researchers have revealed that a company that voluntarily provide carbon emission in the annual reports or sustainability reports can enhance its reputation for environmental responsibility and lead to economic benefits. However, detailed review in this area reports incompatible results, since the empirical results of this association have been inconclusive and even at variance.

Supply Chain Performance Effectiveness

Supply chain performance effectiveness according to Chen and Schmit, (1993) characterized supply chain performance effectiveness as the resource getting capability, and passes on as unconditional altitude of outcome achievement. It is delineated as the portion flanked by the actual output and normal or expected output (Fugate, Mentzer & Stank, 2010; Tan, Lyman & Wisner, 2002). This study defined it as the facility to realize pre-defined purposes. Basically, there are two underlying approaches to the concept of effectiveness in organization theory, namely external and internal approaches (Bin, 2007).

External organizational effectiveness is the most extensively used effectiveness decisive factor of a goal-attainment model, defines organizational effectiveness as the achievement of a deposit of organizational goals and objectives (Bin, 2007). Internal organizational effectiveness, on the other hand, is anchored on a well managed system and proficient internal processes. A business has a well managed system if its constituents are extremely integrated, information flows effortlessly, and employees attain good performance, take pleasure in job satisfaction and are loyal to the company. Two well-known indicators of supply chain performance effectiveness are cost-containment and performance reliability constructs:

Cost-containment: cost containment is defined as lower total spending or payer expenses compared to a regulated group, together with before-after assessments inside identical population and assessments to an analogous population (OECD/WHO/Eurostat, 2011). Cost containment indicator embraces such activities as cost in and outbound activities, warehousing costs, and inventory-holding cost, and increasing asset turnover.

Performance Reliability: indicator concentrates on such area as order fulfillment rate, inventory turns, safety stocks, inventory obsolesces, and number of product warranty claims (Won, Kwom & Severance, 2007).

Empirical Review

Dubisz and Golinska-Dawson (2021) examined the carbon footprint in an apparel industry supply chain with by means of a case study. A comparative study of the outcomes of two accessible CO₂ measuring standards are offered for the same supply chain. The study applied the US EPA and UK DEFRA carbon footprint calculation methods and it was found that, the level of the CO₂ emissions relied on the logistics parameters, such as distance, load factor and transshipment schedule. The techniques used for measuring of

the carbon footprint do not entirely echo the real life requirements. The reported level of CO2 emissions rely on the used method for calculation.

Dragomir (2012) investigated GHG accounting procedures and disclosures of the top five oil and gas companies selected from the STOXX Europe Total Market Index Oil and Gas Producers index in the European Union (EU). The study evaluated the reliability of methodologies employed for emissions data gathering and aggregation of GHG emissions. The information enclosed in sustainability reports available by these companies was standardized against the Greenhouse Gas Protocol Standard. The result demonstrates that these five industry leaders have released reports enclosing inexplicable figures and methodological discrepancies.

Ennis, Kottwitz, Lin and Markusson (2012) disclosed that emissions levels do not influence the stock prices. The results imply that the market participants are not yet quick to respond to the carbon performance of companies. Furthermore, there is likelihood that the information accessible is not sufficient to supply obvious indications to make a distinction between the companies' performance.

Andrew and Cortese (2011) focused on carbon related data produced by Australasian mining companies in conformity with the Information Request sent to them by the CDP over a three year period. The outcome exposed that CDP information is not comparable in view of the fact that the companies employed a mixture of techniques for their disclosures and thus restricted in its effectiveness.

Ziegler, Busch and Hoffmann. (2011) and Griffin and Sun (2012) established a positive association between the disclosure of carbon reduction measure and climate change information with stock performance.

Jacobs, Singhal and Subramanian (2010) confirmed that improved environmental performance can also offer admission to new markets, hence will result in enhanced revenue. Improved environmental performance can also affect costs, leading to improved performance.

Al-Tuwaijiri *et al.* (2004) found a significant positive relationship between environmental performances and economic performance, suggesting that good environmental performance results in enhanced economic performance.

Conversely, the study of Sarkis and Cordeiro (2001) disclosed a negative association between pollution prevention and end-of-pipe efficiencies with the return on sales, Prado-Lorenzo *et al.* (2009) found a negative association between GHG disclosure and return on equity whereas Stanny and Ely (2008) discovered no relationship between carbon disclosure and investment, additionally suggesting that carbon disclosure does not power a firm's performance.

From the review of literature, the following conceptual framework was designed for the study

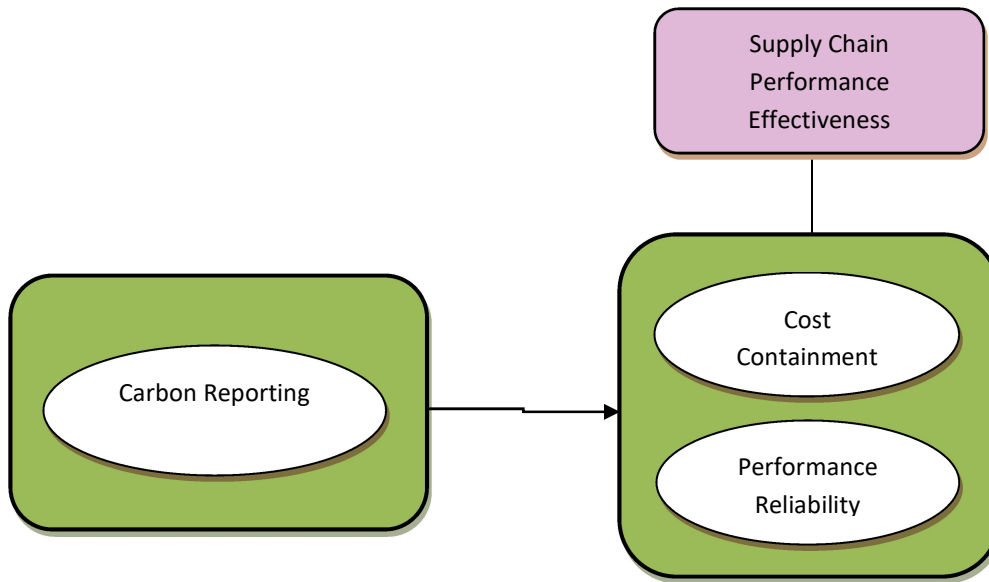


Figure 1: Conceptual Framework of Carbon Reporting and Supply Chain Performance Effectiveness

Source: *Designed by the Researchers (2022)*

From the review of conceptual framework, the following hypotheses were formulated:

Ho₁: Carbon reporting does not significantly influence cost containment of oil and gas companies in Rivers State.

Ho₂: Carbon reporting does not significantly influence performance reliability of oil and gas companies in Rivers State.

RESEARCH METHODOLOGY

The aim of the study is to pinpoint the direction and strength of the effect of carbon reporting on the supply chain performance effectiveness. For this purpose the oil and gas sector of Nigeria has been taken into account. A framework for data collection and analysis was used based on quantitative approach and non probability convenience. The population of the study was two hundred and ninety-five (295) oil and gas companies registered in Rivers State Ministry of Commerce and Industry, Port Harcourt, while the sample size of one hundred and seventy (170) was obtained through the Taro Yamane's formulae (1973) formula for estimating sample size. The data were collected through questionnaires sent to top-level executives in one hundred and seventy (170) oil and gas companies. The questionnaire consisted of three main sections, explicitly the profile of the company and implementation of carbon reporting and specific questions designed to measure the supply chain performance effectiveness constructs. All items of were measured using Five-point Likertscales ranging from "very low extent" to "very high extent. The questionnaires were hand delivered to respondents

who were mainly in Operations. Out of the 510 copies of the questionnaire distributed, 405 were returned and after data cleaning, 286 (71%) were useful for analysis. The study adopted descriptive statistics and simple regressions method for data analysis. The data acquired through the questionnaire were analyzed and interpreted with simple frequency and percentage. Analysis of the effect of “carbon reporting” on “supply chain performance effectiveness” was done using regression analysis in respect of the two research objectives and hypotheses. Regression analysis tends to show the size of contributions of the predictor to variations in the dependent variables.

RESULTS

Regression analysis tends to show the size of contributions of the predictor to variations in the dependent variables.

Test of Hypotheses

Influence of Carbon Reporting on Cost Containment

Table 1: Influence of Carbon Reporting on Cost Containment (n=286).

Model	R	R Square	Adjusted R Square	Std. Error of the estimate
1	.654 ^a	.428	.419	4.06454

a. Predictors: (Constant), Carbon Reporting

b. Dependent Variable: Cost Containment

Source: Authors Computation based on SPSS Window Output, 2022

The table shows the model summary. It shows how much of the variance in the dependent variable (cost containment) is explained by the independent variable (Carbon Reporting). In this model, the value of R square is 0.428. When expressed as a percentage, it shows that Carbon Reporting accounts for 42.8% of variances in cost containment. The remaining 57.2% is due to other variables that will affect cost containment but are not present in the model.

Table 2: ANOVA of the influence of Carbon Reporting on Cost Containment

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2447.670	1	2447.670	49.386	.000 ^b
Within Groups	3271.063	285	.000		
Total	5718.733	286			

a. Criterion: Cost Containment

b. Predictor: Carbon Reporting

Source: Author’s Computation based on SPSS Window Output, 2022.

The results of the findings above revealed that the level of significance was 0.00 which is less than 0.05. This implies that the null hypothesis is rejected and the regression model is significant in predicting the effect of Carbon Reporting on Cost Containment.

Table 3: Coefficients of influence of Carbon Reporting on Cost Containment

Model	Unstandardized Coefficients		Standardized Coefficients		T	Sig.
	B	Std. error	Beta			
1	(constant)	1.5763	.151	400	19.362	.000
	Carbon Reporting	1.586	.136	.654	11.636	.000

Dependent Variable: Cost Containment

Source: Author’s Computation based on SPSS Window Output, 2022.

The table above shows how carbon reporting contributes to the prediction of cost containment. The beta is 0.654 and p-value of 0.00 lesser than 0.05% which is the critical value. This implies that Carbon Reporting is accumulated to 65.4% of cost containment and since the p-value which is 0.00 is lesser than 0.05, this reveals that the null hypothesis is rejected and we can therefore conclude that Carbon Reporting has a positive impact on cost containment. The Coefficients value for Carbon Reporting which is 1.586 also reveals that Carbon reporting has a positive impact on cost containmentsince a unit increase in the Carbon reporting will bring about a 1.586 increase in cost containment..

Influence of Carbon Reporting on Performance Reliability

Table 4: Influence of Carbon Reporting on Performance Reliability (n=286).

Model	R	R Square	Adjusted R Square	Std. Error of the estimate
1	.690 ^a	.552	.550	4.92483

a. Predictors: (Constant), Carbon Reporting

b. Dependent Variable: Performance Reliability

Source: Authors Computation based on SPSS Window Output, 2022

The table shows the model summary. It shows how much of the variance in the dependent variable (Performance reliability) is explained by the independent variable (Carbon Reporting). In this model, the value of R square is 0.552. When expressed as a percentage, it shows that Carbon Reporting accounts for 55.2% of variances in performance reliability. The remaining 44.8% is due to other variables that will affect performance reliability but are not present in the model.

Table 5: ANOVA of the influence of Carbon Reporting on Performance Reliability

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	867.944	1	867.944	35.786	.000 ^b
Within Groups	4850.789	285	24.254		
Total	5718.733	286			

a. Criterion: Performance Reliability

b. Predictor: Carbon Reporting

Source: Author’s Computation based on SPSS Window Output, 2022.

The results of the findings above revealed that the level of significance was 0.00 which is less than 0.05. This implies that the null hypothesis is rejected and the regression model is significant in predicting the effect of Carbon Reporting on Performance Reliability.

Table 6: Coefficients of influence of Carbon Reporting on Performance Reliability

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. error	Beta	T	
1 (constant)	131	.057		2311	.000
Carbon Reporting	.604	.004	.690	141521	.000

Dependent Variable: Performance Reliability

Source: Author’s Computation based on SPSS Window Output, 2022.

The table above shows how carbon reporting contributes to the prediction of performance reliability. The beta is 0.690 and p-value of 0.00 lesser than 0.05% which is the critical value. This implies that Carbon Reporting is accumulated to 87.7 % of performance reliability and since the p-value which is .000 is lesser than 0.05, this reveals that the null hypothesis is rejected and we can therefore conclude that carbon Reporting has a positive impact on performance reliability. The Coefficients value for Carbon reporting which is 0.604 also reveals that Carbon reporting has a positive impact on performance

reliability because a unit increase in the Carbon Reporting will bring about a 0.604 increase in performance reliability.

DISCUSSION

H01: Carbon reporting has no significant influence on cost containment. The results reveal that 42.8% of the variations in cost containment is explained by carbon reporting, with accuracy of 99%, nearly 57.2% is explained by other factors. The effect of carbon reporting, though significant, has low explanatory power on cost containment. This means that hypothesis one did not accurately predict the outcome of the study, leading to rejecting the null hypothesis. This result is in line with Ziegler *et al.* (2011) and Griffin and Sun (2012) who found a positive association between the disclosure of carbon reduction measure and climate change information with stock performance

H02: Carbon reporting has no significant influence on performance reliability. The results indicate that 55.2% of the variations in performance reliability is explained by carbon reporting with an accuracy of 99%, nearly 44.8% is explained by other factors. In view of this, the effect of carbon reporting, though significant, have low explanatory power on performance reliability which implies that hypothesis two did not accurately predict the outcome of the study, leading to rejecting the null hypothesis. This finding does not collaborate the findings of Stanny and Ely (2008) that revealed no relationship between carbon disclosure and investment. Additionally, the findings of the study is not in line with that of Sarkis and Cordeiro (2001) who revealed a negative relationship between pollution prevention and end-of-pipe efficiencies with the return on sales, and Prado-Lorenzo *et al.* (2009) who found a negative association between GHG disclosure and return on equity. Their findings suggest that carbon disclosure does not influence a firm's performance.

This study has provided empirical justification for a framework that identifies carbon reporting and describes its relationship with supply chain performance effectiveness within the context of Nigerian oil and gas sector. Previous studies supporting the importance of carbon reporting used and relate carbon reporting to firm's performance, stock performance, environmental performance and economic performance and not with supply chain performance effectiveness. The major contribution of the present study is the development of carbon reporting through inclusive viewpoints and, hence, exploring its influence on supply chain performance effectiveness. Based on a survey data of 334 oil and gas companies, this study transmits extra weightiness, noting specifically that, operative carbon reporting has significant insinuations for supply chain performance effectiveness.

CONCLUSION AND RECOMMENDATION

This study examined the influence of carbon reporting on supply chain performance effectiveness of oil and gas companies in Rivers State. Research evidence confirmed that cost containment and performance reliability are influenced by the carbon reporting provided by a company. This implies that companies realize their supply chain performance effectiveness tendencies through cost containment and performance reliability, when they adequately implement carbon reporting in their organizations. The study therefore, concludes that, there is a significant influence of carbon reporting on supply chain performance effectiveness of oil and gas companies in Rivers State, and recommends that, to reduce carbon emission to a low extent, the government should institute an accounting regulatory body to issue a precise benchmark on carbon reporting in order to attract optimistic supply chain performance effectiveness.

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About the Authors



Dr. Imo, ThankGod Obutor (Ph.D.) is a Senior Lecturer in the Department of Accounting, Rivers State University, Port Harcourt, Nigeria. He holds BSc and MSc degrees in Accounting from Jackson State University, Mississippi in the USA and a PhD in Accounting from the Ignatius Ajuru University, Port Harcourt, Nigeria. Dr. Imo, ThankGod Obutor is an Associate Member of American Institute of Certified Public accountants (AICPA) and a member of New York State Society of Certified Public Accountants (NYSSCPA). He currently conducts research on Auditing, Financial Accounting, Cost, Strategic and Management Accounting. He has authored or co-authored several articles in referred Journals. Dr. Imo, ThankGod Obutor can be contacted thankgod.imo@ust.edu.ng



Dr. Ikegwuru, Mac-Kingsley is a Lecturer in the Department of Marketing, Rivers State University, Port Harcourt, Nigeria. He holds BSc, MSc and Ph.D (Supply Chain Option) in Marketing, a Post Graduate Diploma in Education (PGDE) and a Professional Post Graduate Diploma in Supply

Chain and Warehousing. Dr. Ikegwuru, Mac-Kingsley currently conducts research in supply chain and warehousing management, entrepreneurial marketing and branding with heavy bias on the use of innovative technologies in supply chain and entrepreneurial marketing processes. He has authored or co-authored several articles in referred Journals. He is a Fellow Africa Supply Chain and Warehousing Institute (FASCWI) Namibia, Fellow Africa Institute of Chartered Marketers (FAICM) Namibia, and Member Teachers Registration Council of Nigeria (MTRCN). Ikegwuru, Mac-kingsley can be contacted at ikegwuru.mac-kingsley@ust.edu.ng