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Corporate social responsibility and the resilience of the Nigerian oil and gas industry: Insight from crude oil spill data

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Abstract:
Background*: The aim of this study is to provide further insight into the impact of corporate social responsibility (CSR) on the resilience (OR) of the oil and gas industry in the Niger Delta region of Nigeria. In this study, CSR is investigated through the company's environmental and social programs, while OR is investigated by the continuous growth of the company's business in the host community through long-term growth and financial volatility.*
Materials and Methods*: The study was conducted using secondary datasets of crude oil spill incident from January 2011 to December 2012 in the Niger Delta. By adopting a quantitative research approach based on both positivist and relativist philosophy, descriptive and regression statistics, and structural equation modelling techniques were used to simulate the conceptual/theoretical framework to select the best-fit model that explains the impact of CSR on OR in the industry.*
Results*: The main proposition from the study is that the long-term growth (LTG) of the oil and gas industry in Nigeria is dependent on the combinational effect of environmental responsiveness (ER) and social reputation (SR) of oil exploitation and exploration companies operating within the host communities in the Niger Delta.*
Conclusion: *It was recommended that existing government policies on ER and SR be strengthened to ensure compliance by the international oil companies (IOCs) and all other operators in the industry.*
Key Word*: Crude oil spill; Oil and Gas industry, Nigeria, Corporate Social Responsibility, Organizational resilience; Structural Equation Model.*

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I. Introduction

The Nigerian oil and gas industry operates in the Niger Delta region of Nigeria. Oil was first discovered in economically viable volume in Oloibiri in 1958 [1]. The production of oil from the Niger Delta is averaged at 1858.63bbls/day since 1973 [2]. Overtime, the industry has become the major economic source for the nation providing over 90% of the GDP [1,3], hence the recovery of the economy is hugely dependent on the price and the volume of crude oil available for the international market. Though the nation has experienced growth in infrastructure and development, the Niger Delta region can be said to have been neglected in the scheme of things. Most importantly, is the effect of oil pollution on the environment. This has led to loss of farmland and coastal rivers [4,5]; thus, impoverishing the local communities depending solely on the farmlands and rivers for their survival. The Niger Delta land mass of 70,900 square metres is home to over 40 million people [3,6]. Also, mega oil and gas industries, like the Dangote refinery with crude oil processing capacity of 650,000bbls/day [7], for instance, have been situated outside the Niger Delta which can lead to increased poverty and poor infrastructural development. Implying that this population will be left impoverished without intervention from the oil and gas companies, and the government that can improve the socioeconomic life of the people. The frustration of the people over continuous neglect by the responsible parties has led to restiveness and insecurity in the region [8,9]. In some cases, the companies have been shut down and stopped from further oil and gas exploration and production activities. A case in hand is the Ogoni oil spill which has spanned over two decades, with the responsible company still not allowed to operate within the community, leading to loss of millions of dollars in monetary terms [10,11]. As at 2020, the initial recommendation by the United Nations Environment Programme (UNEP) of $1billion in 2011 for oil pollution damages is yet to be paid to the people of Ogoni by the indicted IOCs [12]. Consequently, the reason for the continuous litigation, militancy and agitations has been blamed on poor performance in corporate social responsibility (CSR) [10]. The Federal Ministry of Environment (FMENV) was established in 1999 with the statutory empowerment to protect the Nigerian land mass from

environmental pollution [13]. Environmental pollution has significant negative effect on global warming and influence on climate change [14].

The growth of the oil and gas industry as a viable energy sector is driven by economics, where cost-benefit analysis plays significant role [15]. Hence, to enhance profitability, the Nigerian oil and gas industry must conduct its extractive and exploitation business with minimal risk to the community and environment in the Niger Delta. The business risk in the industry is mainly driven by the unstable oil price in the global market [16]. Implying that the loss of crude oil due to theft/sabotage will increase financial volatility, especially on the cost of remediation and litigations on environmental damage. Already, a case in hand is the claim of $111.6 million by the Ogoni people of the Niger Delta as compensation from 3 decades old oil spill [17,18]. References to oil thefts from the oil pipeline that traverses the Ogoni land was also made by a former managing director of Shell in Nigeria, as responsible for loss in revenue to the industry [19].

The Nigerian crude oil production projections for 2023 and 2024 using econometric models are 1420bbls/day and 1850bbls/day [2]. The realisation of these economic projections is heavily dependent on the performance of the industry in meeting the CSR needs of host communities in the Niger Delta. In the past, the international oil companies (IOCs) have engaged in improving the socio-economic life of the communities through empowerment skills and scholarships [4,20], while minimising gas flaring through various gas-to-revenue projects such as the Nigerian Liquified Natural Gas (NLNG) plant in Bonny. Evidence of the performance of the industry in CSR include contributions to the development of education through award of scholarships and sponsorship of professorial chairs, and the provision of IT centres and laboratory equipment [9,21–23]. The outcome of this study can lead to the development of policies that can enhance CSR obligations by the petroleum industry. By conducting the study with secondary datasets on historical incidents of oil spill in the Niger Delta, the study can reveal further insights into the growth of the industry. Furthermore, this study will close the gap of the absence of a study that investigates the specific dimensions of CSR and OR in a single research construct that is related to the Nigerian oil and gas industry.

Research Hypotheses: A quantitative research approach based on both positivist and relativist philosophy is adopted by using crude oil spill secondary datasets obtained from the website of Shell [24] as data for the study. This study was conducted underpinned by the following theories: (i) Stakeholder theory [25] explains how the relationships between the organisation and those directly or indirectly affected by the operations of the organisations develops overtime[26]. This theory has been applied in studying organisational effectiveness by satisfying the expectations of key stakeholders through the integration of the goals of the stakeholder into that of the organisation [27]; (ii) Organisational performance theory, which relates organisational effectiveness to the actualisation of goals [28]. Implying, an organisation that consistently fail to meet operational goals due to shutdown of operations caused by poor performance in CSR is likely to experience ineffective performance and low resilience; and (iii) Resource-Based theory asserts that organisational growth through the exploitation of opportunities is based on internal resources [29]. However, evidence in the Niger Delta suggest that the exploitation of opportunities for long-term growth is equally dependent on the performance level of oil and gas companies in CSR. The measured variables of CSR and OR are as adopted from the literature [30]. Therefore, the theoretical framework in Figure 1, is developed and explained as follows.

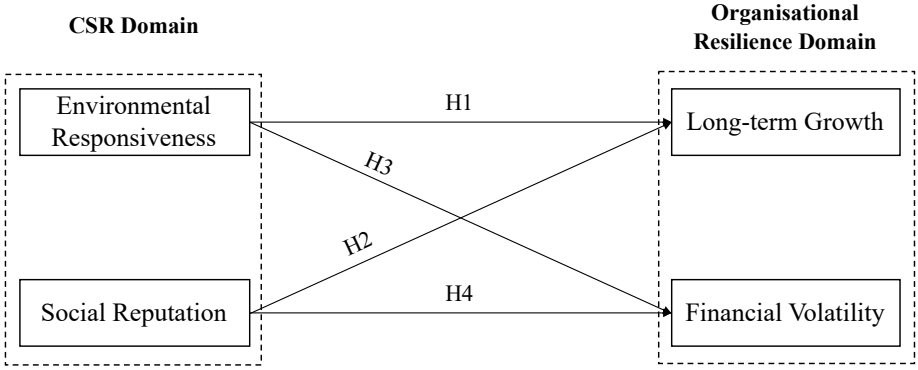


Figure no 1. Conceptual/Theoretical Framework

From the theoretical framework in Figure no ***1***, four hypotheses will be tested based on the CSR theory and OR theory discussed above.

H1: Environmental responsiveness is positively and significantly related to the growth of the oil and gas industry
H2: Social reputation is positively and significantly related to the growth of the oil and gas industry
H3: Environmental responsiveness is negatively and significantly related to the financial volatility of the oil and gas industry
H4: Social reputation is Negatively and significantly related to the financial volatility of the oil and gas industry.

The dimensions are understood in this study as follows:
Environmental responsiveness (ER): Implies the period of delay in crude oil spill remediation to restore the environment to the original state before the site was polluted by crude oil, achieve a fully certified environmental standard and be able to support the flourishing of flora and fauna.
Social reputation (SR): This dimension underscores the relationship between the delay in joint inspection team visit (JIV) to spill site and the social relationship between the industry and host communities. Hence, an oil and gas company obtain its social reputation by providing infrastructures to improve the socio-economic life of the host community. Delayed access to spill sites is implied as indication of a poor social relationship.
Financial volatility (FV): As a financial related dimension, it is defined as the total spill volume in barrels of oil in a particular site before intervention by the company. Cost of remediation was not included because it was not accessible at the time of this study.
Long-term growth (LTG): The propensity for long-term growth is implied in this study as dependent on the other three dimensions. Hence, an averaging technique is adopted in deciding the implied outlook of LTG of the company. A previous study reported that LTG is positively related to both ER and SR and negatively related to FV.

Research Aim: The aim of this study is to provide further insight into the impact of CSR (independent variable - IV) on the resilience of the oil and gas industry (dependent variable - DV) in the Niger Delta region of Nigeria. In this study, CSR is investigated through the company's environmental and social programs, while OR of the company's business in the community is investigated through long-term growth and financial volatility. This study was conducted in the Niger Delta because of the visible presence of multinational oil and gas exploration and production companies.

Research Objectives: To achieve the aim of this study the specific objectives are stated below:
1. Conduct an extensive literature review to select the measurable variables of CSR and OR.
2. Develop a structural equation model (SEM) to investigate the causal relationship between CSR and OR at the sub-unit level.
3. Investigate the correlation among the measured variables of each concept in the construct.
4. Recommend policies for action to improve CSR practices based on the investigated relationship between CSR on the resilience of the Nigerian oil and gas industry.

The first and second objective is related to the positivist and relativist philosophy adopted, to provide a means to explain the influence of CSR on OR. Objective 3 is important in extending the benefits of this study for fiscal policy development or enhancement of existing policies because the oil and gas industry is the mainstay of the Nigerian economy

II. Material And Methods

A descriptive quantitative approach is adopted in this study based on both positivist and relativist epistemological philosophy. The questionnaire incorporates the two concepts in the research construct. Data analysis is by descriptive statistics and structural equation modelling (SEM), to determine both causal relationship between CSR and OR, and correlational interaction among the dimensions of both concepts. This study is epistemologically positioned midway between positivism and relativism. Positivism is adopted to explain the causal relationships between CSR and OR [31], while relativism is adopted to explain the association between the measured dimensions in the study [32]. A purely deductive approach is adopted in this study because of the limited time frame for this study.

Study Design: This study involves a minimum of 85 datasets selected from non-probabilistic sampling because of the specific inclusion criteria. Consequently, this study adopts a cross-sectional time horizon, and relied on the report in the datasets that the oil polluted sites have been adequately remediated.
Study Location: This study was conducted in the Nigerian oil and gas industry, with secondary data of crude oil spills recorded in the Niger Delta.
Study Duration: January 2022 to March 2022.
Sample size: 90 data sets from crude oil spill events.

Sample size calculation: This study utilised secondary data in the public domain, no participants were recruited. The data source is from the website of Shell Petroleum Development Company (SPDC) Limited. The sample size is from recorded incidents of oil spillage in various communities where they occurred [24]. Two errors can arise from choosing a wrong sample frame and size which are Type I and Type II errors. The sampling frame and size is calculated using G* power software with a mean effect size(f^2) of 0.15 and a total of 4 measured variables. The effect size was reduced to estimate the minimum datasets required for the statistical data analysis as explained in Cohen (1988)[34] because of the exploratory nature of the study with the aim of establishing a relationship between the significance of the variables at alpha value of 0.05 and to correctly eliminate Type 1 error. A statistical power size of 0.8 was adopted as suitable for exploratory studies [35] to correctly reject the null hypothesis and eliminate Type II error. The minimum sample size estimated from this approach is 85 datasets.

Secondary data selection method: The approaches to data collection in quantitative methods include time-dependent count of the effect of the independent variable (IV) on the dependent variable (DV) in experiments; observing the behaviour of participants in a structured workplace setting; the use of secondary; and survey instrument, which can be administered for collecting data from large number of participants. Consequently, secondary data sources have been adopted in this study to provide 90 datasets. *Likert 5 Scale* measurement is adopted for all variables, as presented in section III.

Inclusion criteria: The datasets with oil spill caused by sabotage or theft and oil volume of 50bbls and above were selected.

Exclusion criteria: Crude oil spills from mechanical failure and internal or external corrosion were excluded because of the specific need of the study on influence of crude oil spills from CSR related causes.

Procedure methodology

The selected data sets are from the Shell Petroleum Development Company Limited, as the largest operating oil and gas multinational firm in Nigeria in terms of size and exposure.The dimensions studied were reported to be significantly correlated in another study elsewhere [30] and the measured variables are defined in Table no1, as follows.

Table no1. Operationalization of the measurement variables

Latent Variable	Dimensions	Operationalization	Likert Scale				
			1	2	3	4	5
CSR	Environmental Responsiveness (CSR-ER)	Days of delay in crude oil spill clean up	>120days	up to 120 days	up to 90 days	up to 60 days	<30 days
	Social Reputation (CSR-SR)	Delay in joint inspection team visit (JIV) to spill site	>28 days	up to 28 days	up to 21 days	up to 14 days	<=7days
OR	Financial Volatilty (OR-FV)	Total spill volume in barrels of oil before intervention	<=50bbls	up to 100bbls	up to 150bbls	up to 200bbls	>200bbls
	Long-Term Growth (OR-LTG)	Propensity for business growth as a funtion of CSR-ER, CSR-SR and OR-FV	Lower	Low	Medium	High	Higher

As seen from Table no1, the required datasets must contain the date of crude oil spill in a locality, the days before initial site visit by a joint investigation team visit (JIV) to the oil pollution site comprising of the company, government and community personnel, the data of final approval of completed environmental remediation work, and a record of the total volume of crude oil spilled into the environment. The social reputation of the company was measured by the days of delay in approval of JIV presence by the community; environmental responsiveness was inferred from the data as the period between when the spill was reported to when the site of pollution was certified as fully remediated; financial volatility was inferred from the volume of crude oil that was spilled into the environment as this reflects loss of revenue from volume spilled and relative cost of remediation; and long-term growth was estimated using an averaging mathematical relationship in Eq.(1), based on the suggestion in Lv et al. (2019)[30] that OR-LTG was positively associated with both CSR-ER and CSR-SR, and negatively associated with OR-FV.

$$LTG = \frac{1}{3}\left(\frac{5}{FV} + ER + SR\right) \quad (1)$$

where LTG, FV, ER, and SR represent long-term growth, financial volatility, environmental responsiveness, and social reputation, respectively. The required datasets are the crude oil spill incidents from January 2011 to December 2012, and was retrieved from the website of Shell Petroleum Development Company (SPDC) on the 11th of February, 2022 [24]. The SPDC crude oil spill incident database was chosen for its credibility and accessibility by the public, and because the company controls 50% of the oil and gas business with oil pipelines spanning over 6000km in the Niger Delta [36]. Before the increased theft of oil from these pipelines, the company produced 899,000 barrels of oil per day as at 1997 from over 80 oil fields [36]. This spread of business interest in the Niger Delta, makes SPDC more vulnerable to oil theft than other IOCs. As the operator of the joint venture (JV) business agreement comprising of the government owned company (NNPC) holding 55% share, Shell-30% share, Total.SA-10% share and Agip-5% share, SPDC's huge stake in the Nigerian oil and gas industry is obvious. The suitability of the crude oil spill incident datasets [24], used in this study will be evaluated in the sub-sections that follows.

Structure of the Dataset: Secondary data is existing data including interviews and company records and archives. The literature review section is the most visible form secondary data in research, especially when references are made to empirical outcomes of any study in the subject area which usually provides a supporting role for the conceptualization of the research construct(s) [37,38]. As a disadvantage, secondary data are usually collected for another purpose and the researcher must be sure that the data can accurately fit into the new study [38,39]. The advantage of using secondary data for research is driven by timeliness and low cost [38,40], especially when the source of data is difficult to access due to insecurity or other restrictions due to delays in obtaining approvals from gatekeepers as in this study. The secondary datasets for this study were originally intended by the company to enhance the reporting of crude oil related environmental pollution from operational and third-party activities. Each line of the database contains an oil spill event that has been jointly approved by all stakeholders, including the company, the government, and the host community where the incident occurred. The main headings on the data table are the dates the spill incident was reported, incident site, JIV date, terrain (land/swamp/water), estimated oil volume in barrels, clean-up status, comments, and links to site photo and the full inspection report. The nature of the secondary data and its value – timeliness, accuracy and the relevance of the data was critically evaluated before it is used in research [40].

Suitability of secondary data: The evaluation of suitability the dataset for current study is based on the need described in the two main research questions: (1) How has CSR affected OR in the oil and gas industry in Nigeria? (2) What are the approaches taken by the oil and gas industry to enhance both environmental and social context of CSR? Since the focus of this study is environmental responsiveness, the use of oil spill data informs the need to address social issues in the communities of operation too. the overall and precise suitability of the datasets to this study will be discussed below.

Overall Suitability: The validity of the measurement is based on the jointly approved document that records the estimated volume of crude oil spilled into the environment, and the dates of spill and final certification of remediated sites, and the public accessibility of the measured data. The operationalization of the measured variables in Table no1 was guided by the definition of the variables in the literature [30], the theoretical underpinnings provided by the stakeholders theory [25,27], resource-based view theory [41] and organisational performance theory [28,42], and have considered financial, social, and environmental aspects of oil spills, and the influence on the propensity for long-term growth of the industry. The only unmeasured variable is long-term growth, which was estimated based on the understanding posited in the literature of the correlation among the variables. Thus, the available oil spill dataset meets the need of current study, and the coverage of the field measurements for both years considered can provide 90 oil spill datasets with minimum crude oil spill volume of 50 barrels needed for partial least square (PLS) structural equation modelling (SEM).

Precise Suitability*:* The reliability and validity of datasets is based on the credibility of the company and the website from where the datasets was retrieved. The accuracy of the measurements is also attested to by the fact that the document is in the public domain and there are no mentions of anyone contesting the authenticity of the datasets 10 years after publication. As stated earlier, the onsite oil spill measurements were carried out using volume measurement equipment, while dates were recorded and approved by the JIV. For the same reasons given above, measurement bias is also ruled out.

Statistical analysis

The secondary data retrieved for this study are numeric and the statistical approach is adopted in the analyses of the data. A descriptive statistical method is used to provide insight into the spread of the data across the dimensions measured. The hypotheses will be tested using structural equation modelling (SEM) for multivariate regression and correlation statistical analysis. Two approaches to SEM: factor-based or composite-based, are adopted based on the purpose of the study. Factor based SEM is used when the model is implemented

as a confirmatory model, while composite based is adopted when the study is exploratory, and the data set is less than 300. IBM AMOS software is available for factor-based SEM and SmartPLS is available for composite-based SEM [43]. This study adopts SmartPLS SEM software as most suitable because of the low sample size and the research evidence in support of this approach as most suitable for exploratory studies [44]. Also, evidence in the literature indicates that the difference in the outcomes with increasing sample size is not extreme [45,46]. High correlational dimensions will be identified from the model to assess which of the CSR dimensions strongly influenced the variances of both dependent variables of organisational resilience. Thus, two models are combined in the SEM model, and this study outcome will recommend which of the models best explain the data of oil spill record retrieved from the industry [24]. The two models of the SEM combine the two dimensions of CSR: environmental responsiveness and social reputation as predictor variables, while the first model has long-term growth (LTG) as independent variable, the second model has financial volatility (FV) as independent variable. The hypotheses were derived from an earlier study in the literature [30], as stated earlier.

III. Result

This study evaluates how corporate social responsibility (CSR) through environmental responsiveness and social reputation can influence the resilience of the industry by investigating the impact of these CSR domains on the long-term growth and financial volatility of the industry. The results are presented first using descriptive statistics and followed by structural equation modelling.

Descriptive Statistics

In quantitative data analysis, the first step is to describe or summarize the sample of interest using descriptive statistics technique to study central tendency, variability and relationship [47]. The measure of central tendency can be studied using the mean, median and mode of the data collected. The mean ($\bar{\bar{X}}$) is adopted in this study because it provides early interpretation of the average response on the measured variable. The standard deviation (SD) explains the variability of each data from the mean. Hence, the mean is usually reported with the SD as $\bar{\bar{X}} \pm SD$. Hypothesis testing involves relationship studies, hence the correlation among the measured variables is studied to understand the direction and strength of the relationship.

Central Tendency and Variability: The measure of central tendency enables the data to be described with a single numeric value, while the variability of the data explains the degree by which the dataset is spread around the mean. Lower value of variability suggests that the representation of the datasets by the value of the mean is better than when the value of variability is higher. The standard deviation (SD) is a stable measure of variability because it takes into account every data in the datasets [47]. From Table no 2, the estimated mean and standard deviation for the datasets are as follows: CSR-ER (1.356$\pm$0.825), CSR-SR (4.644$\pm$0.940), OR-FV (3.456$\pm$1.317), and OR-LTG (2.556$\pm$0.620).

Table no 2. The mean and standard deviation of the datasets

Descriptive Statistics	Environmental Responsiveness (CSR-ER)	Social Reputation (CSR-SR)	Financial Volatilty (OR-FV)	Long-Term Growth (OR-LTG)
Sample Size	90	90	90	90
Mean	1.356	4.644	3.456	2.556
Std. Deviation	0.825	0.940	1.317	0.620
Minimum	1	1	1	1
Maximum	5	5	5	4

Hence, the spread of the data within 1SD suggests delay of about 120 days before the site is certified as fully remediated, delay in accessing the site is within 7 days, an average spill volume up to 200bbls and above, and low to medium propensity for long-term growth.

Bar Chart Representation of Data on the Likert Scale: The bar charts in Figure no *1* represent the percentage of the dataset occupied by each Likert scale number based on the definitions for the measured variables in Table no1. Extreme cases of the measured variables are as follows: 34.44% cases of crude oil spill volume above 200bbls; 52.22% evidence of propensity for long-term growth; 78.89% cases suggests that the polluted site was fully remediated and certified 120 days after the incident was reported; and 83.33% cases shows that the community allowed the JIV team into the site within 7 days from the day the spill was reported.

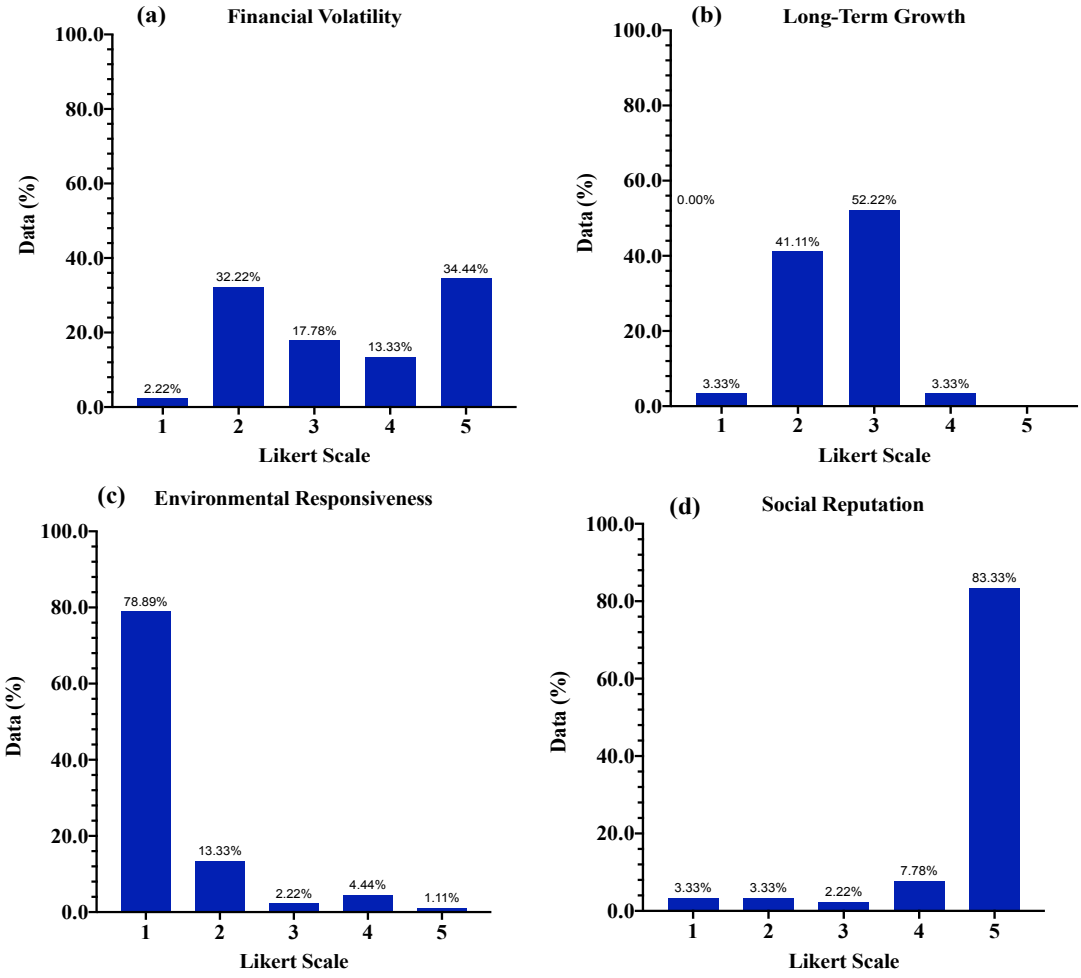


Figure no 1. Bar charts of the data distribution along the Likert scale for each measured variable of CSR and OR

The propensity for LTG is based on the combined effect of crude oil spill volume, days of delay from when the incident was reported to when the JIV was on site, and the delays in days when the site was finally certified as meeting international standard of remediated site. Higher spill volume of oil increases FV but indicates that the pipeline or well head has higher potential to generate revenue. The lower the delay in JIV inspection was inferred as good SR, and lower delay in receiving full environmental remediation certification, the higher the ER rating. Hence, the judgement from Table no1 is that the effect of the other three variables on LTG based on Eq. (1) is low to medium. This implies that the propensity for LTG of the industry is not totally dependent on CSR. The relative effect of CSR on LTG will be assessed later using the SEM approach.

Correlation Analysis: It is assumed that the datasets follow a linear relationship between the measured variables, hence Pearson r coefficient has been estimated for the correlation matrix in Table no 3. The pairwise relationships that are significant at $\boldsymbol{\alpha = 0.05}$, are indicated as defined in the table. All the pairwise associations in Table no 3 are positive except the relationship between OR-LTG and OR-FV, while the significant relationships are with OR-LTG only. Thus, explaining that Eq.(1) developed earlier to measure OR-LTG agrees with the indication in the literature [30]. Based on the relationship established in Table no 3, a regression plot for each pairwise relationship is performed in the next section to investigate the causal coefficient of determination and explain the impact of the CSR on the variance in OR.

Table no 3. Correlation matrix

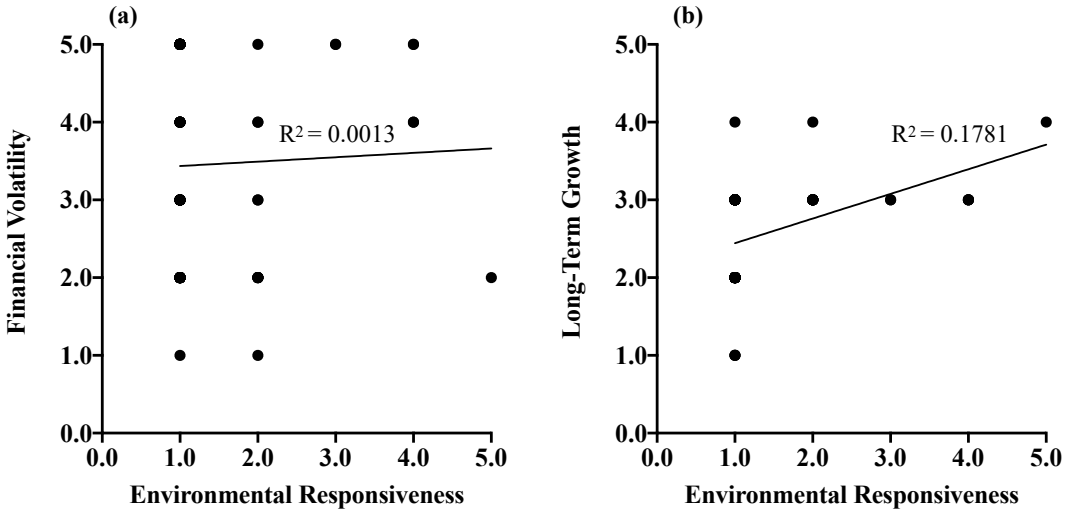
Pearson r	CSR-ER	CSR-SR	OR-FV	OR-LTG
CSR-ER	1			
CSR-SR	0.107	1		
OR-FV	0.035	0.078	1	
OR-LTG	0.422***	0.478***	-0.657***	1

* p < .05, ** p < .01, *** p < .001

Regression Analysis: This section explains the direction and strength of the causal relationship between measured independent variables and the measured dependent variables. Regression analysis is an inferential statistical approach for testing hypotheses through the R-squared (R^2) value. The R^2 takes values from 0 to 1, where higher values suggest that the causal effect of the predictor variable has higher explanatory power on the variance of the outcome variable. The adopted interpretation of the explanatory power of the R^2 values in the literature are: 0.75 (substantial), 0.50 (moderate) and 0.25 (weak) [48,49]. The 90 datasets were measured along the Likert scale of 1 to 5 and scattered around the line of best fit. The significance of each plot with a degree of freedom of 88 is provided in Table no 4, below.

Table no 4. Results of regression analysis

Relationship	Direction	R-Squared	P-Value	Devation from Zero
CSR-ER ---> OR-LTG	Positive	0.1781	<0.0001	Significant
CSR-ER ---> OR-FV	Positive	0.0013	0.7406	Not Significant
CSR-SR ---> OR-LTG	Positive	0.2474	<0.0001	Significant
CSR-SR ---> OR-FV	Positive	0.0035	0.5825	Not Significant



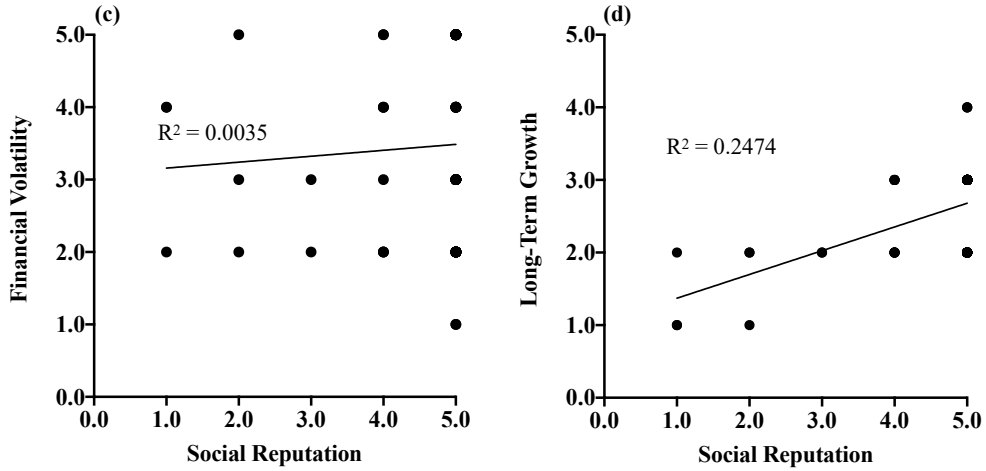


Figure no 2. Pairwise regression plots between the variables of CSR and OR

As indicated from Table no 4, only the relationship of the CSR dimensions with the propensity for the long-term growth of the industry is significant at $\alpha = 0.05$. The R^2 value of 0.1781 is indicated for the causal effect of CSR-ER on OR-LTG. Figure no ***2***b, suggests that 17.81% variance of the propensity for long-term growth of the oil and gas industry in Nigeria is dependent on the environmental responsiveness of the industry in cleaning up and remediating the sites having crude oil spills, and instituting actions that can minimize the frequent occurrences of oil pollution. Also, the R^2 value of 0.2474 for the causal effect of CSR-SR on OR-LTG. Again, Figure no ***2***d, suggests that 24.74% variance of the propensity for long-term growth of the oil and gas industry in Nigeria is dependent on the social reputation the industry has earned from their host communities based on the social intervention activities of the operating oil and gas companies. Both casual predictions of the impact of CSR on financial volatility (Figure no ***2***a and c) are not significant. Hence, suggesting that the explanatory power of the oil spill datasets retrieved from January 2011 to December 2012 is strongly dependent on the impact of CSR on the propensity for the LTG of the industry. A further regression analysis between financial volatility and long-term growth, suggests that the relationship is significant (p<0.0001) and negative with R^2 value of 0.4322, indicating that about 43.22% variance on the propensity for LTG is explained by FV. Therefore, it is advisable that the oil and gas industry focus on enhancing CSR by improvement on both ER and SR to reduce financial volatility.

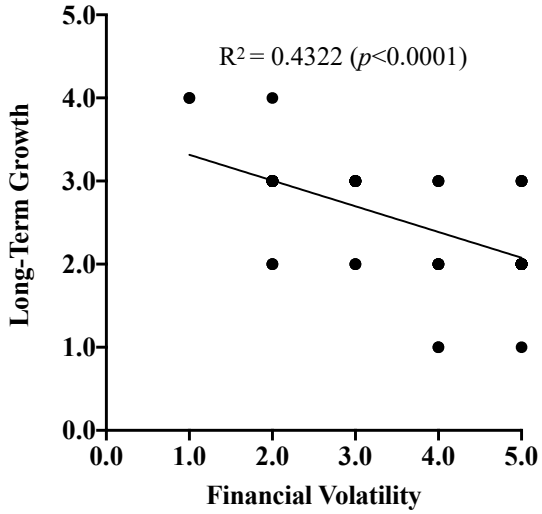


Figure no 3. Regression plot of FV against LTG

A structural equation model was developed to adopt a model that best explain the ability of how oil spill datasets can be used to explain the impact of CSR on OR.

Structural Equation Model

The purpose of the SEM is to describe which model best interprets the data. Two models are combined in the SEM below. Model 1 is combined impact of CSR-ER and CSR-SR on OR-LTG, while Model 2 combines the impact of CSR-ER and CSR-SR on OR-FV. The final SEM model simulation outcome is presented in Figure no ***4***. Bootstrapping was achieved with 1000 subsamples to obtain the *p*-values of the estimated path coefficients and outer predictor loading. In the final adopted model, a formative approach was used to combine the measured variables as regressors on CSR (latent variable).

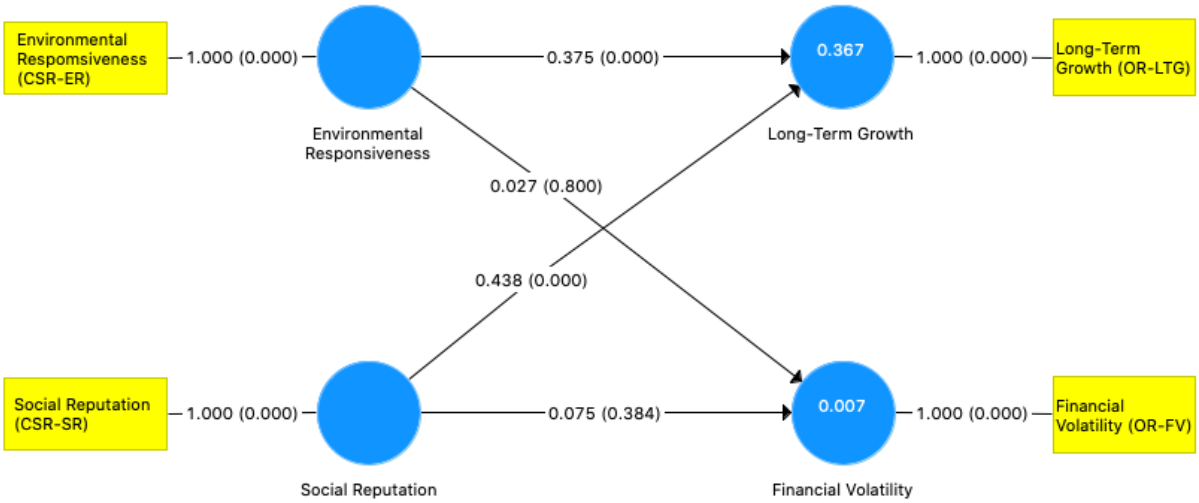


Figure no 4. Structural equation model of the study construct.

Since there is link between the measured independent (predictor) variables and the independent latent variables, the outer loadings are given a value of 1. From the SEM, only the path coefficients for the links between CSR-ER and CSR-SR and OR-LTG are significant at $\alpha = 0.05$. The R^2 are indicated in Figure no ***4*** and Table no ***5*** for LTG and FV as 0.367 ($p<0.0001$) and 0.007 ($p=0.757$), respectively. Since only the R^2 for OR-LTG is significant at $\alpha = 0.05$, it implies that the oil spill datasets can only explain 36.7% variance in OR-LTG. Based on the explanation and classification of effect size in the literature where 0.02, 0.13, and 0.26 represent small, medium and large effect size for the population R^2, respectively [35], model 1 effect size of CSR-ER and CSR-SR on OR-LTG are 0.22 (medium-large) and 0.29 (large), respectively. The effect sizes of CSR-ER and CSR-SR on model 2 are negligible and non-significant at $\alpha = 0.05$. The section that follows will test the four hypotheses developed from the literature review based on the results obtained so far.

Table no 5. R-Squared values for model 1 and model 2

SEM Models	R-Squared	P-Value	Devation from Zero
Model 1 (Long-Term Growth)	0.367	<00001	Significant
Model 2 (Financial Volatility)	0.007	0.757	Not Significant

Table no 6. Effect size of predictor variables

Relationship	Effect Size	P-Value	Devation from Zero
CSR-ER ---> OR-LTG	0.220	<0.0001	Significant
CSR-ER ---> OR-FV	0.001	0.987	Not Significant
CSR-SR ---> OR-LTG	0.299	0.045	Significant
CSR-SR ---> OR-FV	0.006	0.759	Not Significant

Hypotheses Testing and Model Selection

The hypotheses for this study were investigated based on the suggestions from Table no **3**, Figure no ***2*** and Figure no ***4*** as detailed in Table no ***7***, below.

Table no 7. Table of evidence for testing hypotheses H1, H2, H3 and H4

Relationship	Hypothesis on Relationship	Correlation Pearson r	R-Squared	SEM Path Coefficient	Significance at α=0.05
CSR-ER ---> OR-LTG	H1: Positive and significant	0.422***	0.1781***	0.375***	Supported
CSR-SR ---> OR-LTG	H2: Positive and significant	0.478***	0.2474***	0.438***	Supported
CSR-ER ---> OR-FV	H3: Negative and significant	0.035	0.0013	0.027	Not Supported
CSR-SR ---> OR-FV	H4: Negative and significant	0.078	0.0035	0.075	Not Supported

* p < .05, ** p < .01, *** p < .001

From Table no ***7***, only hypotheses H1 and H2 are supported. The Pearson r, R^2 and path coefficient values for H3 and H4 did not give indication of a reversed relationship either, rather these values shows that environmental responsiveness and social reputation as operationalized for this study did not suggest a direct causal effect on financial volatility. The model selection criteria is the combination of R^2 (higher value) and AICc (lower value). The AICc stands for Akaike Information Criterion (AICc), where the small letter "c" indicates that the criterion has been adjusted for small data. The AICc criterion is a more reliable criterion for model selection because it accounts for information loss. Hence, the lower the AICc value, the lesser the information loss [35,50].

Table no 8. Model selection criteria

SEM Models	R-Squared	AICc
Model 1 (Long-Term Growth)	0.367	-33.166
Model 2 (Financial Volatility)	0.007	7.431

Thus, a combination of each criterion suggests that model 1 is more suitable in explaining the oil spill datasets in studying the impact of corporate social responsibility on organisational resilience in the Nigerian oil and gas industry. Hence, the final model is presented in Figure no ***5***, below. A formative model combining the effect of CSR-ER and CSR-SR clearly explained how CSR affects organisational resilience through the long-term growth. Figure no ***5*** suggests that 36.7% of the variance in LTG is determine by CSR in the Nigerian oil and gas industry, with SR contributing the higher loading.

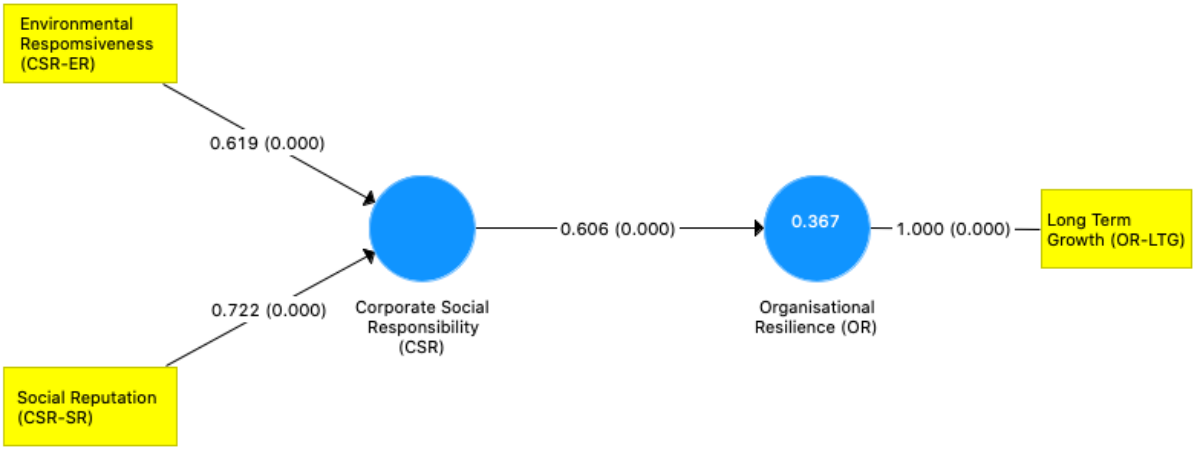


Figure no 5. Best fit model for the oil spill datasets

Discussions

The analysis of the secondary oil spill datasets from the website of Shell Petroleum Development Company Limited was exploited to provide insight into the impact of corporate social responsibility on organisational resilience in the Nigerian oil and gas industry. The hypotheses generated from the literature suggests that CSR can be measured from both environmental and social perspectives, while organisational resilience can be measured using indications of financial volatility and propensity for long-term growth. A detailed descriptive analysis was conducted using bar charts, measure of central tendency and variability, and correlational studies. The indications show an average delay of about 120 days before the site is certified as fully remediated, the site can be accessed within 7 days, average spill volume of 200bbls and evidence of propensity for long-term growth based on the availability of crude oil resource. A further analysis was caried out using both regression and structural equation modelling approach, which led to the selection of the best model that represent the datasets retrieved. The results suggest that long-term growth influences the continuous presence of the industry in the Niger Delta and not financial volatility in the Nigerian oil and gas industry. The potential for growth encourages investors to increase their portfolios, despite the risks and uncertainties in the industry [51,52]. The negative relationship between LTG and FV, indicates that increase in LTG will bring about corresponding reduction in FV. Hence, since both CSR-ER and CSR-SR are positively and significantly associated with LTG, it equally follows that improvement in CSR can reduce FV. The final model selected in Figure no ***5*** suggests that 36.7% of the variance in LTG is determine by CSR in the Nigerian oil and gas industry, with SR contributing the higher loading. This explains why despite increasing oil pollution, the industry LTG initiatives have been mostly supported by the social reputation they have earned in CSR [53]. Again, the regression relationship defined in Figure no ***3*** suggests that the relationship between CSR and financial volatility might be mediated by the drive for long-term growth initiatives in the industry. This will be investigated in future studies. The two main propositions resulting from this study are as follows:

1. The impact of corporate social responsibility on the resilience of the Nigerian oil and gas industry from the perspective of environmental and social activities of the companies can be explained from the crude oil spill datasets.
2. A positive and significant direct causal relationship exist between both environmental and social dimensions of CSR and the long-term growth dimension of organisational resilience in the Nigerian oil and gas industry.

IV. Conclusion

The objectives of the study where three folds - to: (i) develop a structural equation model (SEM) to investigate the causal relationship between corporate social responsibility and organisational resilience at the sub-unit level; (ii) investigate the correlation among the measured variables of each concept in the construct; and (iii) recommend policies for action to improve CSR practices based on the investigated relationship between CSR on the resilience of the Nigerian oil and gas industry. This study was conducted using quantitative research method and the data interpreted from the perspective of both positivist and relativist philosophical assumptions. Existing studies on CSR related activities in this industry did not specifically provide a quantitative justification on the impact of CSR on OR, because of the difficulties in retrieving reliable and relevant data. To overcome this difficulty, this study relied on the crude oil spill datasets available on the website of the Shell Petroleum Development Company Limited [24], which holds about 50% assets of the Nigerian oil and gas business [36]. The spill datasets were intended as proof that the dates and causes of crude oil spills on the environment were

objectively captured and the environment was certified as fully remediated. This was achieved through a joint investigation team comprising of government, community, and company representatives, to avert likely cases of litigation(s). Hence, the approach adopted in this study is unique and provides further insights on using datasets of crude oil spill incidents in quantitative inferential studies on the resilience of the industry. The adopted datasets are credible and reliable, and readily accessible with no need for further permissions from the company, communities in the Niger Delta or government regulatory agencies, hence was adequate for the short time duration of this study. Thus, this study was able to evaluate how corporate social responsibility (CSR) through environmental responsiveness and social reputation can influence the resilience of the industry by investigating the impact of these CSR domains on the long-term growth and financial volatility of the industry. The adopted dimensions of CSR and OR were developed from a previous study by Lv et al. (2019), and have been operationalized by liking CSR and OR to the spill volume, ease of access to the spill site and final date of site restoration. Descriptive and regression statistics and structural equation modelling technique were used to simulate the conceptual/theoretical framework and select the best fit model that explain the impact of CSR on OR. The following main conclusions are derived from the study:

1. Some crude oil spill volumes are more than 200 barrels of crude oil, which negatively affects the Niger Delta flora and fauna and could become the possible cause of future extinction of plants and animals.
2. The impact of corporate social responsibility on the resilience of the Nigerian oil and gas industry from the perspective of environmental and social activities of the companies can be explained from the crude oil spill datasets.
3. A positive and significant direct causal relationship exist between both environmental and social dimensions of CSR and the long-term growth dimension of organisational resilience in the Nigerian oil and gas industry.
4. Financial volatility in the industry is not significantly related to CSR but as a determinant of the industry's long-term growth.

Furthermore, the outcome of this study corroborates the rationale for the CSR related activities conducted by the company in host communities and available from the website of the company [53], as responsible for the continuous existence of the industry. Finally, the publication of this study can encourage researchers in this field to use quantitative statistical techniques to provide more information on the causal relationships among management concepts from available crude oil or other related secondary datasets to enhance the growth of the industry.

Recommendation

The outcome of this study led to the following recommendations:

1. The continuous existence of the Nigerian petroleum industry from CSR perspective is partly dependent on the level of performance of the companies in eliminating or reducing the impact of environmental pollution from crude oil, and partly on improvement in the provision of social projects that can enhance the socio-economic wellbeing of the communities.
2. With regards to environmental responsiveness, the regulatory arms of government in the petroleum industry must ensure that CSR related policies are performed appropriately with special focus on reducing the spill clean-up and remediation timeline, to avert continuous damage to the environment. This is important as the study indicates that most certified remediated spill sites (78.89%) happen after 120 days.
3. From the perspective of social reputation, the government must emphasise the provision of working social structures in all host communities in the Niger Delta. This is needed to mitigate against the continuous restiveness and sabotage of crude oil pipelines by providing scholarships and skills acquisition training to all indigenes of host communities instead of a selected few as is currently practiced.

Future Studies

This study is exploratory in nature because this is the first research that uses secondary crude oil spill datasets to provide insight into the relationship between CSR and OR. The limitation of this study is in the adopted criteria for the measured variables and future studies should improve on the operationalization and the criteria adopted. This effort is needed to accurately measure financial volatility using crude oil spill incident datasets available in the public domain. Also, including the cost of remediation of impacted sites will define the reality of the extent of financial volatility. It is also important to note that the operationalization for the environmental responsiveness suggested a higher rating of 5 when the remediation was achieved within 30 days. However, this rating is not currently feasible because of lack of the technology to achieve this, hence the need for the industry to focus on research efforts to reduce the impact of crude oil pollution on the environment beyond 30 days. Finally, it is equally important for future studies to include spill area as a variable.

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