



Gusau Journal of Accounting and Finance (GUJAF)

Vol. 2 Issue 2 April, 2021 ISSN: 2756-665X

A Publication of
Department of Accounting and Finance,
Faculty of Management and Social Sciences,
Federal University Gusau, Zamfara State –Nigeria

GREEN SUPPLY CHAIN MANAGEMENT AND PERFORMANCE OF LISTED OIL AND GAS FIRMS IN NIGERIA: A MODERATING ROLE OF INTERNET OF THING

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Abstract

Integration of Internet of Things (IoT) into an eco-innovation system in Green Supply Chain Management Practices (GSCM) and Firms Performance (OP) is an important and desired direction with sufficient and necessary potentials to improve supply chain especially in the oil and gas industry. Conversely, the complexity nature of oil and gas supply is capable of influencing oil and gas prices and ecosystem, owing to low environmental standards in the petroleum downstream sector (PDS) in Nigeria. Previous researches displayed a limited role played by GSCM practices on the OP. Therefore, this study investigates the moderating role of IoT on the relationship between GSCM practices and OP in Nigeria's PDS. A quantitative research approach was employed using a cross-sectional survey design. The participants were 365 which is a representative sample of senior staff from 7 companies operating in PDS selected using a stratified random sampling technique. The instrument of data collection was a developed and validated questionnaire designed to elicit responses on a 5-point scale. The data collected were analyzed using SmartPLS 3 by conducting the Partial Least Square Structural Equation Modelling (PLS-SEM) analyses. The results revealed that, GSCM practices has a significant relationship with OP ($\beta=0.91$, $t=5.07$; $p < 0.05$). Similarly, IoT has a significant moderating effect on the relationship between GSCM Practice and OP ($\beta=-0.051$, $t=2.44$; $p < 0.05$). The findings of this study have provided empirical evidence on the effect of GSCM practices on OP and thus, IoT moderates the relationships thereby, supporting the hypothesized relationship. Given that integration of IoT into GSCM practice is relatively new, the integrated IoT application/GSCM framework proposed in this study needs to be further strengthened through refinement and validation across different economy.

Keywords: internet of things, industry 4.0, organization performance, green supply chain management

1. Introduction

The Internet of Things (IoT) is an emerging term that consists of different approaches on technologies, based on the connection between physical things and the Internet (Gökalp et al., 2017). The IoT defined as an integrated system where devices communicate through a broad network such as the internet (Fatorachian & Kazemi, 2018; Saarikko et al., 2017). According to Fatorachian and Kazemi, (2018), IoT is a means of connecting devices through the Internet with physical world objects, which are equipped with sensors, actuators and communication technologies (Fatorachian & Kazemi, 2018), furthermore, IoT can have multiple application domains, such as manufacturing, health, transport, energy, etc. and to improving existing ones in used (Bonilla et al., 2018; Lu, 2017).

Nevertheless, the IoT is a developing term, which combines different devices of technology and methods for connecting between the Internet and physical devices in an organisation set by the support of internet connections (Bonilla et al., 2018). In production environments, this enables manufacturing lines and machinery to communicate and share information in real-time, creating a more collaborative and effective system (Tiwari, 2017). Cloud systems or cloud computing enable firms to store big amounts of data that can be accessed from any part of the world (Rahmani et al., 2018). These types of application could be useful for Nigerian PDS to improve organisational sustainability and can make PDS to closed its communication gap between its clients, logistic system and connect with external environment.

Nigeria's PDS can transform it business operations to calm new trend toward digital business system, and these engagements could enable technological operation in SC functionalities in a co-creating value through new value chain (Ambituuni et al., 2014). These operations could also transform the composition of the PDS and provides with a competitive environment, for instance, SC in PDS being previously done traditional one, as depicted in Figure 1.1, i.e., Oil still being conveyed by tankers to some part in Nigeria through road system, which is so risk for both human and environmental factors and this requires PDS to integrate it business activities through digital system to avoid potential risk (Michael & James, 2015). Digitalisation of operation has potential advantages on time efficiency, delivery as well as cost reduction in operations (Parviainen et al., 2017). This application can enable Nigeria's PDS to respond quickly to the customers' demand and deal with real-time to avoid the shortest in SC process (Clauss, 2017; Tseng et al., 2019).

Likewise, the Nigerian government make moved in collaboration with Chinese government to actualised digital business operations within the Information Technology System (ITS) purposely to provides with a conducive environment for business (Edomah, 2016). Although, most international companies operating within PDS have engaged in digital operation, whether small or big operating especially in the Oil and Gas sector (He et al., 2018). Similarly, Vianova is a governmental organisation that administers state subsidies for Research and Development (R & D), was instructed by the Swedish Government to encourage Swedish production to become innovative in a production system and to make it competitive among business operation (He et al., 2018). Furthermore, Vianova carried out research on "Digitising industry", the study's primary aim is to highlight fields of technology that

are of great significance for the Swedish Oil and Gas industry's digitisation to enhance technological operation (Boenzi et al., 2015).

Consequently, the digital operation is vital for the industry with high demand like Energy sector for customer's satisfaction as well as operational performance (Nasrollahi, 2018). Therefore, digitalising Nigeria's PDS will provide opportunities for innovative operations, smooth supply, services delivery, working and more opportunity for business (Murray et al., 2017). Research commissioned by the European Commission and carried out by the German industry Association of BDI demonstrated that approximately EUR 600 billion worth losing every year as a result of ineffective digitalised system within European Industries (Oghazi et al., 2018). This could also prevent Europe from realising its objective of raising the Petroleum Sectors from 15 to 20 per cent by 2020 (Oghazi et al., 2018).

The integration of Industry 4.0 application with the GSCM practices in an eco-innovation system, can ensure, ECP, EP, and OPP. It is expected that this study can contribute in helping practitioners, stakeholders and governments to answer issues related and the results developed through the huge adoption of those environmental practice, technological aspects, as well as supporting the anticipated positive impacts through policies and green initiatives (Bag et al., 2018). Based on the above statement, stakeholders' concerns call for technology driven green activities within business enterprises (Daniele, 2016; Zahraee et al., 2018), the pressure on re-modernising business operations in PDS is higher than that of other sectors like non-energy companies because of the hazard caused by PDS activities (Zhu, Sarkis, & Lai, 2008; 2013). However, the study is set to achieve objectives through posited phenomenon as follows:

The study examines the Effect of Green Supply Chain Management on the performance of listed Oil and Gas firms in Nigeria. Specifically, the study intends to;

- i. Investigate the impact of Green Supply Chain Management practices on the performance of listed Oil and Gas firms in Nigeria.
- ii. Investigate the impact of the Internet of Things (IoT) as a Moderator on the performance of listed Oil and Gas firms in Nigeria.

In line with the above objectives, the following hypotheses were generated and tested at 0.05 level of significance in this study.

H₀₁: There is a significant relationship between GSCM practices on the performance of listed Oil and Gas firms in Nigeria.

H₀₂: Internet of Thing moderate the relationship between GSCM practice on the performance of listed Oil and Gas firms in Nigeria.

This research provides an understanding that Green Supply Chain Management practice can benefit Nigeria's Petroleum Downstream Sector in developing its operational performance. By doing so, it has inspired Petroleum Downstream Sector and other business competitors to combined Industry 4.0 applications and environmentally concerned rather than green supply chain management practice which will improve all aspects of their sustainable performance, i.e., ECP, EP, and OPP (Mumtaz et al., 2018). In terms of theoretical contribution, this work in line with the contribution of Resource-Based-View (RBV), to access important of Industry 4.0 (CPS and IoT) application that assumed to be filled in the existing gap

in the literature reviewed to obtained relationship between Green Supply Chain Management practice and Sustainable Performance.

The remaining parts of this paper are section two; review of relater literature, section three; methodology, section four, results and discussion and the conclusion and recommendation make section five.

2. Review of related studies

Over the years, the office setting has changed dramatically, the workplace set up is probably one of the environments most affected by technological advancements (Abbott et al., 2018; Hermann et al., 2016; Schallock et al., 2018). However, the office's equipment and tools are getting smarter by days, as time goes the workplace experiencing a major transformation into what is now being referred to a smart office (Sanders et al., 2016). Given the fact that office equipment and services are getting smarter by days, the workplaces are experiencing a significant transformation into what is now called a smart office (Schallock et al., 2018). Also, companies now find themselves trapped between a rock and a hard spot due to changes got from digital era (Schallock et al., 2018).

Yet, due to industry 4.0 application things are getting much easier than what they used to before; the move from the conventional workplace to smart system can be described in three stages: Stage one (1996–2006), that is when it all started, when industries incorporated the use of tablets, cell phones and the Internet to increase efficiency. Stage 2 (2006–2016), Innovative technology became advanced (Mikulecky, 2011); the advent of smartphones and other fast electronics into the market contributed to the development of software, and cloud computing applications. Stage 3 (as of 2017 to date), Intelligent offices are now phenomenon organizations that have a greater understanding and incorporate automated systems that make their offices super-efficient, cut operational costs, creates an effective and well-connected working environment (Mikulecky, 2011). According to a report by Allied Market Research, the global smart building market is projected to expand at a compound annual growth rate of 29.5 per cent between 2018 to 2025. A smart office is a place of work where technology makes it possible for firms to work more comfortable, quicker; yet, Beacons, sensors and mobile devices also help workers to perform significant tasks easily so that company's operations can be smarter (Tjahjono et al., 2017).

Besides, technology also helps firms to communicate better in a smart office (Wang et al., 2016; Weyer et al., 2016). Sensors can tell if a staff is in the industry, exactly where the staff are at any given time, or even cars doing companies logistics and services for the industry can be track and know where they are and for how long does it take them to reach to the particular place (Zakuri, 2019; Zawadzki & Zywicki, 2016). The smart office could be what lies between clients and the industry's sustainable growth. Smart offices are also referred to as future offices (Weyer et al., 2016). One might wonder what Smart office can do for PDS: Here's what PDS Smart office can do: No wonder the workplaces of the future are sometimes called smart office.

Let's take a look closer at what smart office would be bringing to the PDS in term of operation! Therefore, it would boost productivity; companies using an approach to smart offices are better positioned to perform well than those using the traditional approach (Wang et al., 2016). The idea fosters innovation and creativity (Weyer et

al., 2016). This will affect the way company activities are done, and a smart workplace also has several ways to store, track, and handle information within the organization (Hermann et al., 2016). This information can be used to establish strategic trends that improve workplace engagement and communication (Hermann et al., 2016). This will provide Nigeria's PDS with conducive environment and empowers them with the right tools to be creative and achieve the PDS's objectives.

The structure of Smart SC in two ways self-organizing and self-optimizing (Nowicka, 2014). The simple example of incorporating the Smart SC into a business model is the retail giant gap, which uses integrated inventory control and focuses on making the best items available in the right quantity at the right time (Allam & Dhunny, 2019). Smart supply chains are about the use of machines system to coordinate activities and develop various modes of inference to solve challenges in decision-making where optimal solutions are either too costly or difficult to deliver (Hermann et al., 2016; Navickas et al., 2018; Wan & Qie, 2020). Smart supply creates a virtual experience which plays a key role in the process of decision making (de Giovanni, 2019). Using machine learning methods and case-based reasoning to compare past experiences with similar situations could save time, energy, and workforce across the process of the SC, because Machine learning and other big data technologies in the coming decade could save the Oil and Gas industry as much as \$50 billion per year (Cioffi et al., 2020).

The PDS SC is a dynamic operation, with many complex dimensions, such as crude Oil procurement, purchase price, transportation to the refinery, refining operations, and retail sales of end products (Singh et al., 2020). When crude Oil develops by steps, it also increases the difficulty in the production dimension making (Chaopaisarn & Woschank, 2019). There are many paths that PDS companies are applying in terms of pursuing smart operations to their SC processes (Singh et al., 2020). Those areas are: Smart SC operation can guaranty firms by predicting the market situation products demand this also allows to make purchasing decisions optimization for consumers' satisfaction (Philip Chen & Zhang, 2014) (Weyer et al., 2016), warehouse and storage, inventories control, shipping operations, therefore, these can help to ensure, the appropriate Oil supply correctly managed (K Grzybowska et al., 2020; Li, 2020).

Risk hedging sufficient investment to offset the risks due to supply demand adjustments as well as monitoring vessels because monitoring deliveries is a quicker way to tackle end-customer need (Oh & Jeong, 2019). Planning and scheduling enable the company to make better use of its assets, time and inventories to comply with orders within the shortest time by the deployment of Robotic automation operations has a significant effect on industry success, performance and accuracy in the business processes (Dash et al., 2019). The Oil and Gas industry has great ability to incorporate smart operation into its SC processes because smart supply increases network flexibility and predictive demand efficiencies by enabling companies to become more strategic in SC process capabilities and aid demand forecasting particularly when demand inventory lags, businesses will experience losses. Smart supply has a handling capacity of 80 per cent of its consumers' engagement and optimizes the interaction between consumers and SC processes (Dash et al., 2019). Nevertheless, Smart industries are more efficient, because smart logistics are fully automated where an automated system performs much of the works, and logistics may arrange deliveries with no targets missed (Dash et al., 2019).

Smart operation improves delivery times and reduce costs of every mile and minute in the logistics business; firms can use a navigation app to map optimal delivery routes. Example of Smart supply involvement in leading Oil and Gas Industries is British Petroleum (BP) (Alreshidi, 2019). Furthermore, BP launched its exclusive compass network, which is vital part of its procurement change beyond Global Business Services (GBS) division (Alreshidi, 2019). Some of the Smart supply benefits are: designed to allow automated, end-to-end, digitized procurement processes with changed and flexibility system (Alreshidi, 2019). It provides availability of intelligent systems, and automated source for Procure to Pay (P2P) functions to external clients perhaps this will be the crucial solution on suppliers' and consumers' interaction challenges in Nigeria's PDS. According to the research, the Smart market operations in Oil and Gas was estimated at USD 2 billion in 2019, and is projected to reach USD 3.81 billion by 2025, at a Compound Annual Growth Rate (CAGR) of 10.96 per cent over the 2020-2025 base on forecast report (Chen et al., 2020).

So, adoption of smart SC driven by drones is useful for efficiency, quality assurance and operational purposes to inspect railroads, power lines or Oil pipelines (Chandan, 2016). The industry may also plan the drone's exact routes, then follow the path for surveillance to produce an actionable report based on their observations processing capacities (Allam & Dhunny, 2019; de Giovanni, 2019; Wan & Qie, 2020). The adoption of industry 4.0 application in the PDS industries has accelerated research spending and increased investment power (Singh et al., 2020).

Digitalization described as integrating technology operations into the daily activities by digitizing all that can be computerized in the process of the production system (Sung, 2018), in the era of Industry 4.0 application, firms are progressively investing in technology instruments to have sound solutions, which enable their processes, in term of machines employees and even products into a single integrated system for business operation as well as performance improvement (Rosell, 2018; Sener & Yuksel, 2017). Industry 4.0 application can be described as increased in digitalisation and automation of the production process for value chain, and enable the communication between clients to their suppliers (Oesterreich & Teuteberg, 2016; Sung, 2018). The Nigerian PDS facing a lot of SC issues while using roads to distributes Oil and Gas product this has caused many environmental hazards to immediate communities.

Therefore, this awareness of digitalisation application has to be reviewed in the PDS to deal with customers' request through digital devices. According to, Bianchi and Labory, (2018), digitisation merely relates to the automation of industries' operations, and the most exciting part of the digital era is information produced by many emerging companies at zero storage and zero transport cost (Kulauzovic, 2018). For example, some leading technology firms and social media managers, such as Instagram or WhatsApp, produce and received information with a low capital commitment with maximum satisfaction (Parviainen et al., 2017). However, Baumers et al. (2016) stated that, digital processes raised as a results of networking entire production system and services that lead to an entirely digitized environment with a combination of the new technologies such as smart business or smart environment (Baumers et al., 2016; Rosell, 2018).

3. Methodology and Models

This study employed a quantitative research approach with a planned data collection and analysis using a cross-sectional survey design to assess the relationships between GSCM practice and Firms Performance in this study. The study also evaluates the moderating role of Internet of Things in the relationship between GSCM and Firms Performance. In a cross-section survey design, the researcher measures the outcome and the exposures in a survey participants' at the same time (Levin, 2006; Setia, 2016). The study been a cross-sectional survey research was carried out using 365 staff of the seven (7) established subsidiaries of Nigerian National Petroleum Corporation (NNPC) operating in the Petroleum Downstream Sector (PDS) in Nigeria. The participants were selected using simple random sampling technique. This method was selected because the population is large and that problem at hand affect each and every member of the city (Creswell & Creswell, 2017). The questionnaire was distributed directly to the respondents in a face-to-face encounter during some selected open days. It is, therefore, the best selection strategy for study involving large group in a cross-sectional approach (Levin, 2006). The distribution of the participants based on the organization in Nigeria's PDS is provided in Table 1.

Table 1 Study's Participants

SN	Firms level	Population	Sample
1	NIDAS Marine Ltd	03	01
2	NIKORMA Transport Ltd	03	01
3	Pipelines and Product Marketing Company	04	02
4	Warri Refining and Petrochemical Company Ltd	15	07
5	Kaduna Refining and Petrochemical Company Ltd	15	07
6	Port Harcourt Refining Company Ltd	15	07
7	NNPC Retail Ltd	774	340
Total		829	365

The instrument of data collection is a developed and validated questionnaire on GSCM practice, FP and Internet of Things which is a strong component of the Industry 4.0. The instrument was designed to elicit responses based on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly disagree). Prior to the data collection the instrument was content validated by experts in management sciences, information system and professional in the field of measurement and evaluation. After the content validation process, the experts made some recommendations to modify the instrument. After few modifications suggested by the experts, the instrument was pilot tested with a sample of 30 respondents. The results from the pilot test were used to conduct the test for construct and internal consistency reliability. The reliability coefficient generated using Cronbach's Alpha was 0.83 for the instrument. The value of 0.83 was considered adequate for the utilization of this scale to collect relevant data in this study (Cowan et al., 1994; Joseph F Hair Jr et al., 2017).

The data obtained from the respondents were coded, scores and entered into MS-Excel file. After cleaning, the data were prepared into two different formats appropriate for the software used to analyzed relevant data to address the research objectives. The descriptive statistics were carried out to summarized data. Additionally, Partial Least Square Structural Equation Modeling (PLS-SEM) was

used to analyze the data and test the hypotheses. It has been recounted that the PLS-SEM can account for measurement errors and present more accurate calculation and realistic mediation test (Chin et al., 2003). In PLS-SEM it is necessary to conduct the analysis in two main stages validating (i) Measurement Model and (ii) Structural Model (Joseph F Hair Jr et al., 2017).

3.1 Validity and reliability diagnosis

Assessment of Measurement Model

The Measurement models of the constructs in this study were assessed by items factor loadings, a composite reliability and average variance extracted (FL, CR and AVE). An item loading of at least 0.7 displayed acceptable indicator reliability for the measurement model (Joseph F Hair Jr et al., 2017). At initial stage, majority of the items measuring the four constructs showed loadings 0.7. However, few items displayed low loading, thus, the model require modification to remove the 8 items to obtain modified and valid measurement model. Based on the analysis results of the second order constructs, all the items measuring the 3 constructs showed loadings 0.7 and above (See Table 2). Similarly, all the 3 constructs achieved a satisfactory reliability CR and AVE. This exhibits that the proposed measurement model had satisfactory convergent validity.

Discriminant Validity

In line with the Fornell and Lacker's (1981) principle, the discriminant validity of the measurement model in this study was employed. A proposed measurement model of a study is regarded to have obtained considerable discriminant validity if the square roots of the AVE are higher than, the correlations that exist between the identified measure and all other measures in the model. The outcomes specified that, all the AVE square roots were greater than the off-diagonal elements within them within their corresponding column and row. The values highlighted in bold in Table 3 demonstrates Fornell-Larker criteria assessment. As presented it indicate that, the AVE's square roots and other values signify the intercorrelation value existing between the constructs. This indicates that Fornell and Lacker's criterion are met. In this situation the discriminant validity is accomplished as the correlation among different constructs were found low. Thus, with the satisfaction of discriminant validity, all the modifications of measurement model have been completed and can be used to run the structural model and test the hypotheses in this study.

Assessment of Structural Model

To test the study hypotheses, the structural model should successfully be evaluated. (Joseph F Hair Jr et al., 2017) recommended to observe the R^2 , path coefficients or beta (β), corresponding t-values and P-values via bootstrapping procedure. In addition, (Ringle et al., 2015) stated that researchers should also report the effect sizes (R^2) in order to take decision. The β value needs to account for a certain impact within the model at least at the significance level of 0.05 and t-value should be greater than 1.96.

Table 2 Modified Measurement Models of the Research Variables

SN	Construct	Sub-constructs	Item	Loadings	CR	AVE	Alpha
1	Green Supply Chain	Cooperation with Customers	GSC1	0.914	0.947	0.818	0.926
			GSC2	0.916			
			GSC3	0.921			
			GSC4	0.866			
		Eco-Design	GSE1	0.957	0.911	0.775	0.862
			GSE2	0.951			
			GSE3	0.711			
		Green Purchasing	GSG1	0.905	0.972	0.875	0.962
			GSG2	0.926			
			GSG3	0.951			
			GSG4	0.949			
			GSG5	0.944			
		Internal Environment Management	GS11	0.855	0.928	0.720	0.902
			GS12	0.861			
			GS13	0.806			
			GS14	0.824			
			GS15	0.894			
		Investment Recovery	GSIR1	0.665	0.953	0.838	0.968
			GSIR2	0.985			
			GSIR3	0.986			
GSIR4	0.984						
2	Firms Performance	Economic Performance	OECP1	0.891	0.964	0.900	0.944
			OECP2	0.976			
			OECP3	0.977			
		Environmental Performance	OEP1	0.962	0.983	0.922	0.978
			OEP2	0.967			
			OEP3	0.988			
			OEP4	0.988			
			OEP5	0.892			
		Operational Performance	OOP1	0.773	0.841	0.570	0.747
			OOP2	0.708			
			OOP3	0.847			
			OOP4	0.683			

3	Internet of Thing	Digital System	IOTD1	0.999	0.999	0.996	0.999
			IOTD2	1.000			
			IOTD3	0.996			
			IOTD4	0.998			
		Smart Office	IOTSO1	0.793	0.940	0.764	0.921
			IOTSO3	0.642			
			IOTSO4	0.935			
			IOTSO5	0.974			
			IOTSO6	0.976			
		Smart Supply	IOTSS1	0.999	0.999	0.993	0.998
			IOTSS2	0.999			
			IOTSS3	0.996			
			IOTSS4	0.995			
			IOTSS5	0.992			

Table 3: Final Discriminant Validity

Sub-Constructs	CC	DS	ECP	ECO	EP	GP	IEM	IR	OPP	SO	SS
Cooperation with Customers	0.905										
Digital System	-0.037	0.998									
Economic Performance	0.047	0.015	0.949								
Eco-Design	0.003	0.116	0.047	0.881							
Environmental Performance	0.053	0.049	0.116	0.099	0.960						
Green Purchasing	0.403	0.030	-0.038	0.139	0.037	0.935					
Internal Environment Management	-0.035	0.073	0.386	0.124	0.022	-0.135	0.848				
Investment Recovery	0.038	0.021	0.036	0.028	0.556	0.065	0.010	0.915			
Operational Performance	-0.042	0.084	0.494	0.021	0.097	-0.126	0.410	0.066	0.755		
Smart Office	0.033	0.043	-0.028	0.003	0.013	0.109	-0.10	0.043	0.015	0.874	
Smart Supply	-0.023	0.991	0.021	0.105	0.044	-0.039	0.101	0.017	0.089	0.043	0.996

4. Results and discussion

The results of this study were obtained using the procedure described in the preceding section of Methodology. The results of the structural modeling analysis obtained using SmartPLS was presented in the following order to address the research objectives. Thus;

4.1 Test of Normality

In order to conduct the structural equation modelling analysis to determine the influence of study variables, it is recommended that one of the most important requirements is to test the initial data for normality or normal distribution status of the data. Yet, to apply the structural equation modelling with AMOS data should be normally distributed. Where the data violate the normality assumption, a partial least square Structural Equation Modelling with SmartPLS should be applied to analyse the data. Similarly, an essential means of determining the normality of data is to conduct two main non-parametric tests (Shapiro-Wilk test and Kolmogorov-Smirnov test). Thus, the test of normality conducted in this study is presented in Table 4.

Table 4 Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Green Supply Chain Magnet	.073	365	.000	.986	365	.001
Firms Performance	.079	365	.000	.988	365	.003
Internet of Thing	.044	365	.082	.993	365	.008

a. Lilliefors Significance Correction

As presented in Table 4, two normality tests were run. However, in this study, Shapiro-Wilk test statistics has been considered in determining the normality. Shapiro-Wilk test was used because the requirement for a data set smaller than 2000 elements for normality can use it and for the dataset of 2000 elements and above can use Kolmogorov-Smirnov test. In the case of this study, there are only 365 elements; thus, the Shapiro-Wilk test was used (George & Mallery, 2010). The test results showed that p-value for the entire Green Supply Chain, Firms Performance and Internet of Thing are generally less than 0.05 (0.001, 0.003 and 0.008 for Green Supply Chain, Firms Performance and Internet of Thing respectively). Thus, it can be concluded that the data comes from the non-normal distribution. Therefore, the data is not normally distributed, and Partial Least Square SEM is more appropriate to be used in addressing the hypotheses.

4.2 Assessment of Structural Model

To test the study hypotheses, the structural model should successfully assess; Hair Jr. et al. (2017) recommended that, looking at the R², path coefficients or beta (β) and corresponding t-values via bootstrapping procedure. It is also recommended that, in addition to these necessary measures, according to Ringle, Wende, and Will (2015), researchers should also report the effect sizes (R²). The structural model (Path PLS Algorithm) of this study is presented in Figure 1.

In consideration with Hair et al. (2017) recommendations, the results obtained from the structural model were used to address the study's hypotheses. To accept or reject the hypotheses, a researcher should consider, reporting the path coefficients (β), corresponding t-values, P-values and effect sizes (R²) in order to decide. The β value

needs to account for a certain impact within the model at least at the significance level of 0.05, and t-value should be greater than 1.96.

4.3 Hypotheses Testing (Direct Relationship)

The structural model assessment in PLS-SEM reveals the evaluation of the hypothesised relationships. Emphasis is placed on the bootstrap procedure because it produces the relevant statistics for estimating the statistical significance of the path coefficients (Hair et al., 2017). The bootstrapping procedure involves a re-sampling process, from the original sample with replacement; in this study, 5000 re-sampling was used in executing the bootstrapping (Ramayah et al., 2017).

Hypothesis 1: *There is a significant relationship between GSCM practice on the performance of listed Oil and Gas firms in Nigeria.*

As presented in Figure 1 Green Supply Chain Management (GSCM) practices has a significant relationship with Organisational Performance in Nigeria's Petroleum Downstream Sector ($\beta=0.914$, $t=5.072$; $p < 0.05$; $R= 0.835$). Thus, the results shown that the hypothesis was supported because the relationship is significant. Accordingly, there is a significant relationship between Green Supply Chain Management practices and Organisational Performance in Nigeria's Petroleum Downstream Sector.

Table 4 Structural estimates (Direct Effect/GSCM -> OP)

No .	Path	Beta (β)	t-Value	p-value	R ²	Decision
H ₁	GSCM -> OP	0.914	5.072	0.000	0.835	Supported

1. Notes: Critical t-values. *1.96 (P < 0.05).

Hypotheses Testing (Moderating Effect)

To test the hypothesis and assess the moderating role of Internet of Things on the relationship between GSCM practice and Firms Performance in Nigeria's Petroleum Downstream Sector. The moderating analysis was conducted using the SmartPLS 3 with bootstrapping with 5000 sub-samples. The results are presented in the following order:

Hypothesis 2: *Internet of Things moderate the relationship between GSCM practice on the performance of listed Oil and Gas firms in Nigeria.*

The results obtained from the structural model in Figure 2 and Table 5 were used in line with the (Hair et al., 2017). The path coefficients or beta (β), corresponding t-values, P-values are reported to take the decision on the hypothesis. The β value needs to account for a certain impact within the model at least at the significance level of 0.05, and t value should be greater than 1.96 (Hair et al., 2017).

Table 5: Moderation effect of IoT (GSCM -> OP)

Path	Beta (β)	T-Values	P-Values
IoT -> OP	-0.025	0.936	0.350
GSCM -> OP	0.924	42.176	0.000
Moderating Effect 1 -> OP	-0.051	2.499	0.013

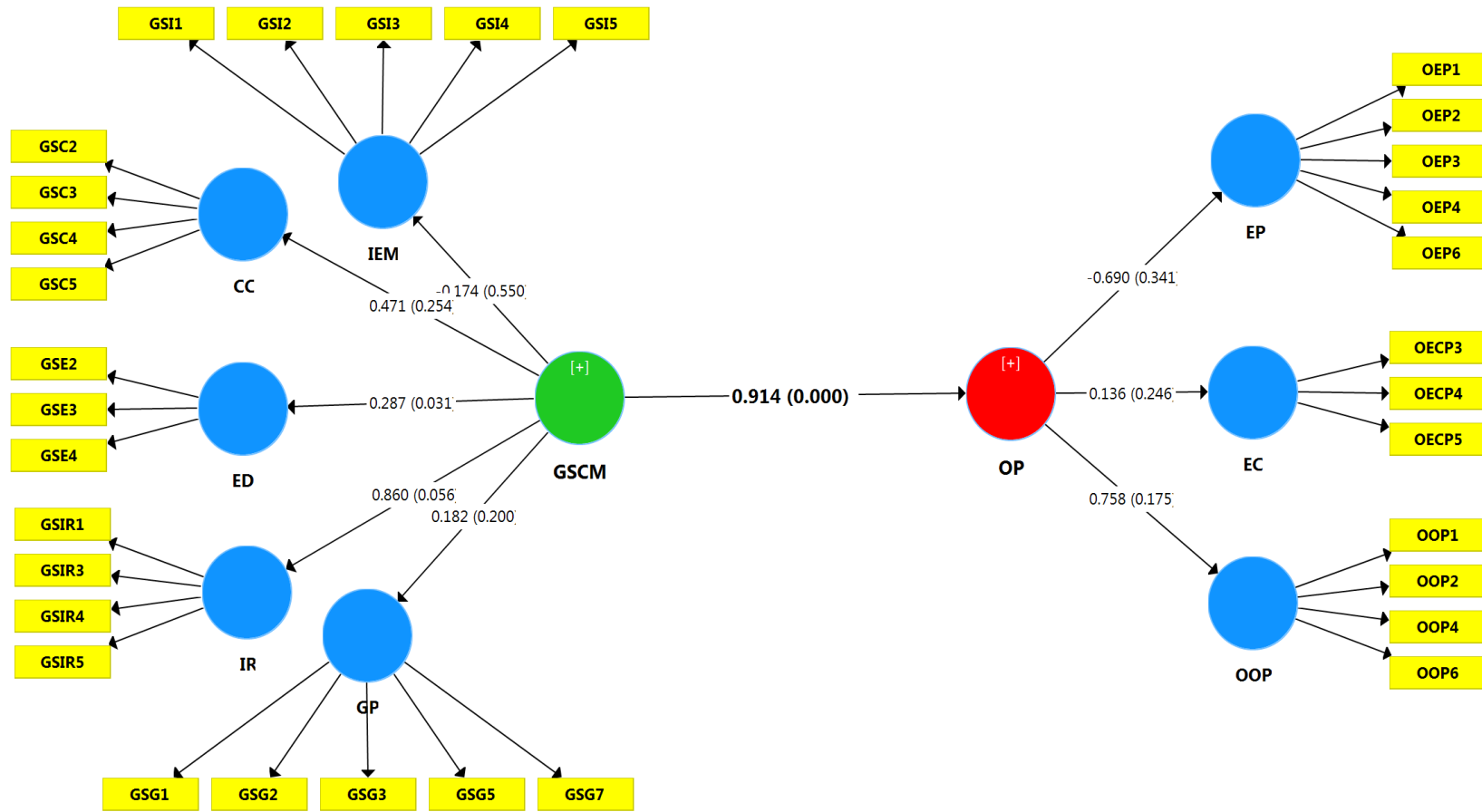


Figure 1 Structural Model (GSCM & OP)

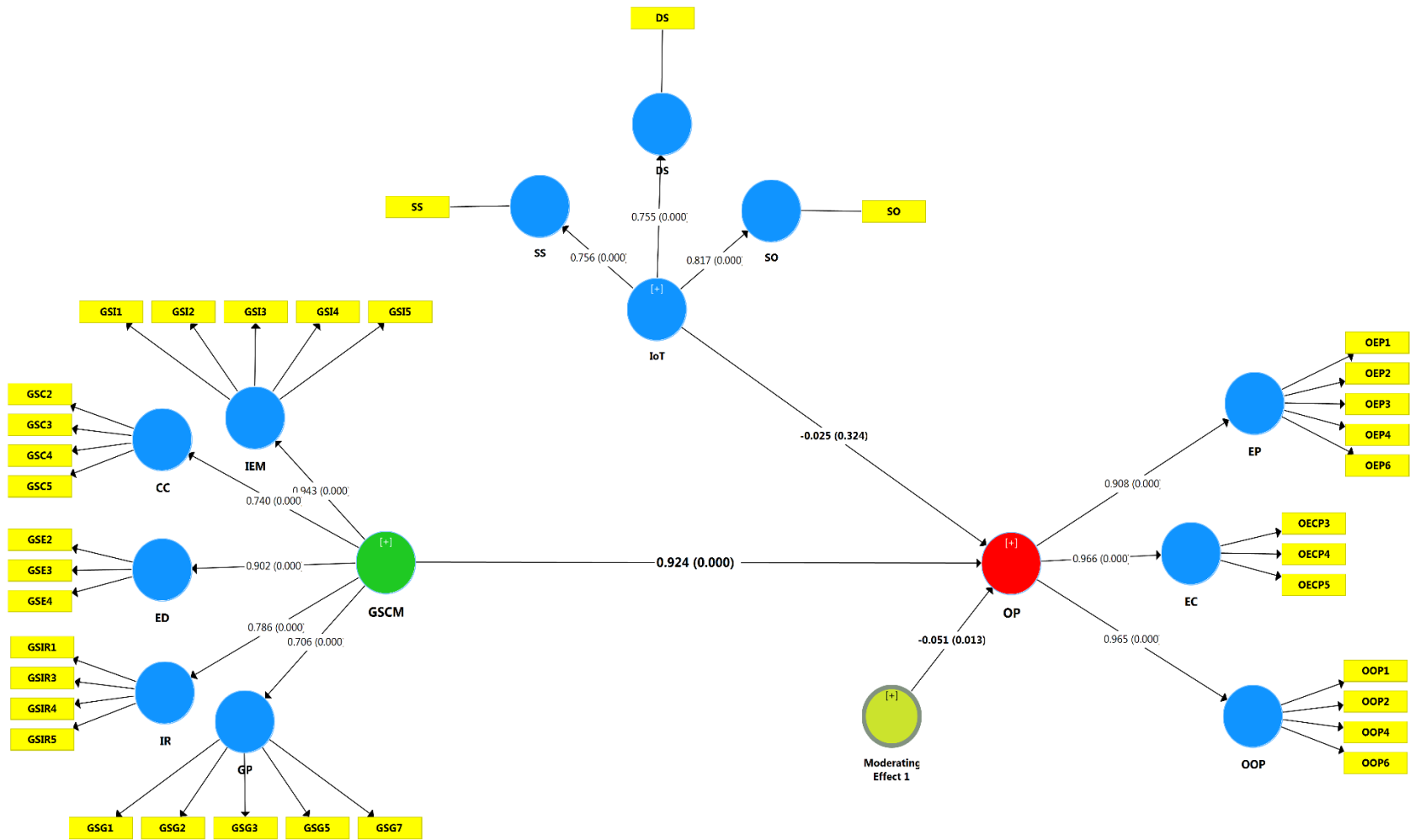


Figure 2 Moderating Role of IoT

As presented in Figure 2 and Table 5, Internet of Things has a significant moderating effect on the relationship between GSCM Practice and Firms Performance in Nigeria's Petroleum Downstream Sector ($\beta=-0.051$, $t= 2.438$; $p < 0.05$). Similarly, this moderating effect means that with the highest level of Internet of Things application, the relationship between GSCM practice and Organisational Performance will be affected. Thus, this finding supports the hypothesis, which says that Internet of Things significantly moderates the relationship between GSCM practice practices and Organisational Performance.

4.4 Discussion of Finding

Finding on the moderating role of IoT on the relationship between Green Supply Chain Management practice and Firms Performance in Nigeria's Petroleum Downstream Sector, based on the structural model of the PLS-SEM, showed that, IoT have significant moderating effect on the relationship between Green Supply Chain Management practice and Firms Performance in Nigeria's Petroleum Downstream Sector. This finding means that, although relationship exist between Green Supply Chain Management practice and Firms Performance in Nigeria's Petroleum Downstream Sector, application of IoT help in strengthening the relationship between the two established constructs in the present study. Thus, implementation of IoT in Nigeria's Petroleum Downstream Sector helps to improve Firms Performance which implied that, improved ECP, EP and OPP can be facilitated by application of IoT in the sector.

This finding supported the other research discovery among which Muñuzuri et al. (2020) affirmed that, main benefits of the system correspond to supply chain, including manufacturers and distributors, the IoT system effectively divides the transport chain into segments, which allows shippers to redesign the movement of goods inside the chain, also with the contribution of real-time information regarding the location and condition of the related services. These capabilities improve the decision-making process, increase reliability and security, and reduce costs and uncertainties. This provides added value in promoting firms Performance resulting in higher revenues and market share.

Similarly, according to several other opinions, with respect to supply chain execution applications, the introduction of IoT and dynamic optimization enables the real-time management of intermodal chain segments (Manavalan & Jayakrishna, 2019). Also, authors like Banerjee and Mishra, (2017) Prajogo and Olhager, (2012) have investigated the relation between IoT and supply chain performance, concluding that the integration of materials flow needs to be supported by a parallel integration of information flow, whereas in the area of field force automation many optimization techniques have been reported over the recent years to improve intermodal transport efficiency (Muñuzuri et al., 2020). Furthermore, Venter and Joubert Venter and Joubert, (2012) demonstrate the applicability of multi-source GPS to characterize driving patterns, and Wong et al. (2016) and Tao et al. (2014) apply IoT principles and techniques in their various studies and thus, proved effective in improving performances.

In consideration of the previous researches related to application of IoT for improved organizational efficiency, analyses revealed that, implementation of certain technologies, that connotes IoT into the production, manufacturing and distribution environment results in providing adequate advantages for improved Firms Performance in any sector of the economy

(El-Kassar & Singh, 2019; Tjahjono et al., 2017). In another similar outcome, IoT application is possible in providing lots of opportunities that, could also be threats to some organizations. The fact that, application of IoT to some sector at some reasonable terms could result in threats and opportunities that is, all the different components are interconnected with no clear limits among them. It all depends on where and how it was applied, but application of IoT could have positive implication to Petroleum Downstream Sector in Nigeria (Manavalan & Jayakrishna, 2019; Tjahjono et al., 2017).

In the specific terms, IoT usually play the role of intermediaries between inter modal processes and supply chain actors in an industry. IoT solutions are in general recognized as a critical success factor for the future organizational contribution which improved high value-added services, and increasing the efficiency and competitiveness of logistics and other systems (Manavalan & Jayakrishna, 2019). On the basis of several research discoveries which are related to the above statement, stakeholders' concerns call for technology drive green activities within business enterprises (Intravaia, 2016; Zahraee et al., 2018), in this regard, the pressure on re-modernizing business operation in Nigeria's Petroleum Downstream Sector is higher than that of other sectors like non-energy or retail companies because of the hazard caused by Petroleum Downstream Sector activities (Groening et al., 2018; Zhu et al., 2017). More specifically, IoT provides organization with a way to generate additional revenue by introducing advanced communications services to other operational services (Ruiz-Rosero et al., 2017).

Looking at the substantial and growing significance of IoT in advancing organizational sustainability, the application of IoT in Nigeria's Petroleum Downstream Sector would lead to improved efficiency of the sector as well as proving sufficient connections that, could support Green Supply Chain Management practice as positively affecting EP, OPP and ECP of Petroleum Downstream Sector in Nigeria. Furthermore, IoT can have a significant impact on the Green Supply Chain Management practice aspect of the organisational operation, that would result in positive increased in Firms Performance (El-Kassar & Singh, 2019; Liew, 2018).

5. Implications, Conclusion and Recommendations

The finding of this study significantly fills the gap in the literature on the lack of GSCM practice with advanced technology in PDS of the economy. Nevertheless, given that integration of Internet of Things into GSCM practice framework is relatively new and promising domain in several sectors especially PDS, the integrated Internet of Things application/GSCM framework proposed in this study needs to be further strengthened through refinement and validation across different economy. This study established that, integration of IoT component with the GSCM practice in an eco-innovation system, that can ensure, ECP, OPP, and EP. Thus, the study contributes in helping practitioners, stakeholders and governments to address issues related to huge adoption of those environmental and technological aspects, as well as supporting the anticipated positive impacts through policies and green initiatives.

The issue linked to effective role of Internet of Things application and PDS activities, furthermore, this research synthesizing some Industry 4.0 applications (Internet of Things) and Green practices, in an attempt to provides new way for the implementation of Industry 4.0 application sand proper utilization of innovative way for the firms Performance. Moreover, Internet of Things/GSCM practice framework proposed in this study can be used to evaluate the role of GSCM practice in improving the Firms Performance and other related

variables/programmes for PDS as well as other sectors of the economy such as manufacturing that are involved in GSCM practice.

Thus, it is therefore recommended that, more research into application or integration of Industry 4.0 application with GSCM practice, and Firms Performances in PDS could support the development of more innovative ways of delivering GSCM practice to meet the needs of the sector and global PDS market. The findings from this study have become part of the discourse about PDS and the increasing thinking about the integration of Internet of Things application into GSCM practice as an innovative way of improving capacity utilization of the sector and achieving improved performances. Stakeholders should provide a clear, substantive purpose for and stated value of integration of Internet of Things application into GSCM practice, emphasizing the significant component of IoT as identified in this study. To do this, the authorities should offer resources and information about relevant component of Internet of Things application. Professional development should be provided for managers at senior and intermediate level with adequate information technology training to boost their knowledge on Internet of Things and other components with their applicability with standard IT security and policies to guide their implementation.

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