The Mitigating Effect of Supply Chain Risk Management in Marginal Field Oil and Gas Companies in Nigeria

Vincent Oyovwevotu Erakpotobo Ph.D. & Justice Oborakpororo Omo OKEI Ph.D.
Department of Management Sciences, Western Delta University. Oghara, Delta State, Nigeria

Abstract: **Historically, oil and gas was discovered in Nigeria in 1956 by Shell petroleum at Oloibiri now Bayelsa state. The oil and gas industry is divided into upstream, downstream and mid-stream respectively in Nigeria. Each of the petroleum sectors performs different functions in terms of exploration, refining and distributions and with respective supply chains. In course of the supply chain distribution, distractions in form of turbulence and disruption can occur which could have serious effects on operations and performance. Hence this study focused on the mitigating effect of supply chain risk management in marginal field oil and gas companies in Nigeria. It is field survey and case type of research. A total of 687 Management and Senior staff of nine marginal filed oil and gas companies constituted that population while 325 formed that sample size. The main instrument was questionnaire administration and analysed using descriptive statistics. The study found that application and proper management of supply, demand, information, transportation and monitoring risk mitigation strategies are critical factors enhancing reduction of risks in marginal field oil and gas in Nigeria. It therefore recommended that there should proper coordination of information, monitoring, demand and supply chain risk management in order to reduce vulnerability of disruptions and distraction in operations.**

***Keywords*: Supply Chain, Risk Management and Marginal Field Oil and Gas**

I. INTRODUCTION

The issue of oil and gas in Nigeria is traced to the year 1956 when Shell petroleum discovered oil in large quantity at Oloibiri in Bayelsa state. As at today, Nigeria is among the first five largest producer of oil in Africa such the country is seen as a mono-culture nation. The petroleum industry supply chain focus in Nigeria consists of the upstream sector, the midstream sector, and the downstream sector (Aminu & Olawore, 2014; Amor & Ghorbel, 2018). Each of the sectors performs important role in the oil and gas industry. The Marginal field oil and gas is part of the upstream sector majorly of maritime firms charged with exploration, exploitation, and production of crude oil. The oil and gas industry is prone to high risk and any occurrence of risk can equally disturb operational performance of the supply chain (Bhatti & Ali, 2019). Supply chain risk could take form of disruption or turbulence risks like natural disasters, labor strike, political unrest, lockdown during pandemic outbreak, and, related trade bans, droughts, port disruptions, cargo theft, and industrial fires (Jaclyn, 2019). Supply chain risk management is advantageous for the firm in order to reduce cases of disturbances in the supply chain and as well reduce possible operational unforeseen losses (Shou Hu, Kang & Park, 2018). This is because disruptions could have negative impact on the performance of firms. Nevertheless, extra investment in form of added inventories, alternative transport, additional suppliers, and further competencies is essential and needed to implement supply chain risk management (Bhatti & Ali, 2019; Shou et al., 2018) and thus it may have a strong impact on the financial performance. Supply chain risk management has become increasingly challenging due to two factors, like the dynamic and prone to disaster nature of the environments in which supply chains operate; and top three disruptions such as information technology (IT) outages, natural disasters and supplier service issues (Glendon & Bird, 2013). In Nigeria, Sunflag Textile Manufacturing Company in Lagos supply experienced fire outbreak which later disrupted their operation in 2013. Several disruptions like oil pipeline vandalism by Niger Delta militants, Oil workers 'union strike in 2016, major fire disaster engulfing oil tankers, tank farms and gas depots and other acts of nature in Nigeria. However, between December, 2019 and November, 2020, companies all over the world lost Billions of US Dollars due to disruption from Covid 19 lockdown which affected supply chain (Helper & Evan, 2021; Meyer, 2021).

Most studies on supply chain risk management were conducted in developed countries like US, Uk, while scant studies were from developing countries like Nigeria. For instance, Agorzie, Unam, and Aderemi (2017) examined supply chain risk factors' assessment in the Nigerian pharmaceutical industry while Ireoegbu, Ogbo and Kifordu (2018) examined the effect of supply chain management on managerial performance of the Private Manufacturing Enterprises (PMEs) In South-East, Nigeria, while Nsikan, Ekeins-Wilson, Ayandike, and Ortencia (2019) examined petroleum supply chain disruption in Nigeria oil and gas industry by identifying the drivers of disruption and determining mitigation strategies. To the best of researchers' knowledge, studies from Nigeria have not really dwelled much on the mitigating effect of supply chain risk management using case of marginal field oil companies in Nigeria. The specific objectives are to determine the influence

of transportation, information, demand, monitoring risk mitigation in supply chain of business operation using case of Marginal Field oil companies in Nigeria.

II. CONCEPTUAL REVIEW

Supply Chain Risk Management

Risks are unforeseen circumstances that can occur in course of doing business or activity. Supply chain risks relate to unforeseen circumstances that can disrupt business activities. Risk is divided into two, namely "macro risks and micro risks (catastrophic and operational" (Sodhi, Son & Tang (2012). Macro risks are external in nature and have adverse negative effects on companies operation. Macro risks include natural disasters (earthquakes, Tornado, drought) and man-made risks (e.g., war and terrorism, and political instability). Micro risks are risks associated with internal operation of the company or relationships within partners in the supply chain. Between the two risks, macro risk has more negative effect on firms compare to micro risks. However, micro risks are into four sub-categories: demand, manufacturing, supply, and infrastructural risk(Wu, Blackhurst & Chidambaram., 2006).

Supply chain risk management is defined in different ways but the various definitions are channelled towards the same direction. Supply chain risk management is the identification and management of risks for the supply chain, through a co-ordinated approach amongst supply chain members, to reduce supply chain vulnerability as a whole (Juttner, 2005). "To collaborate with partners in a supply chain apply risk management process tools to deal with risks and uncertainties caused by, or impacting on, logistics related activities or resources" (Norrman & Jansson, 2004, p. 436). The management of supply chain risks through coordination or collaboration among the supply chain partners is essential in order to ensure profitability and continuity (Tang, 2006a). "The identification and management of risks within the supply network and externally through a co-ordinated approach amongst supply chain members are necessary in reduction of supply chain vulnerability as a whole" (Goh, Lim & Meng, 2007, p. 164-165).

Supply Chain Risk Mitigation Strategies

A supply chain design has to involve sufficient inherent risks consideration within, otherwise it will face a high probability of failure (Faisal, Banwet & Shankar, 2006). Many supply chain risks are based on realization effects in business and its environment (Harland, Brenchley & Walker, 2003). To achieve success and overcome unforeseen risks, firms are expected to identify and develop incident plans for already existing risks associated with the organization's internal and external operation (Zolkos, 2003). Proper understanding of supply chain risks give advantages for decisions and reduce risks (Hallikas, Karvonen, Pulkkinen, Virolainen & Tuominen, 2004). Weaver (2011) suggested C3 framework like: coordination, cooperation and collaboration to outline firm's supply chain strategy to address external partners. Helper and Evan (2021) identified seven key points to consider while creating a strategy for managing supply chain disruptions to include: (i)create a supply chain emergency plan; (ii)build up inventory; (iii)conduct a supply chain vulnerability audit; (iv) identify backup suppliers; (v) diversify supply base; (vi)partner with a logistics expert; and, (vii) adopt risk evaluation tools. Zhang., Chai., Yang & Weng (2011) showed that risk monitoring is essential to mitigate disruption.Helper and Evan (2021) pointed out the following steps to take when a Disruption Has Occurred in supply chain: (1) Communicate with customers; (2) Evaluate all critical components of the supply chain; (3) Estimate available inventory (4) Assess buyer behaviors; (5) Optimize production and distribution capacity for safety; (6) Identify logistics flexibilities; (7) evaluate cash flow impact. **C**ombination of factors make supply chain networks more vulnerable to disruptions (Blackhurst, Dunn, & Craighead, 2011; Kim, Chen, & Linderman, 2015). This not only increases exposure to risk but propagation or spread once a disruption occurs (Ponomarov & Holcomb, 2009). Majority of these studies focused on two SCRM processes, such as risk identification and assessment (Cheng & Kam, 2008), risk identification and mitigation (Oke & Gopalakrishnan, 2009), and risk assessment and mitigation (Kumar & Havey, 2013). Kern, Moser, Hartmann and Moder, (2012) found that superior risk identification supports the subsequent risk assessment and this in turn leads to better risk mitigation.

III. EMPIRICAL STUDIES

Plethora of studies were conducted in different perspectives on supply chain risk management and risk mitigation. These include.

Andreas (2014) investigated the frequency, impact and severity of supply chain risks experienced by companies in India. The methodology is a quantitative, empirical study, using a survey instrument in the form of a questionnaire distributed electronically to thousands of members of four prominent trade associations in India. The main research instrument used was questionnaire administration and found that chronic risks such as inadequate transportation, logistics and utilities infrastructure, supplier and labor problems, and bureaucracy/red tape are more severe than highly publicized and visible risks such as natural disasters, terrorism and crime.

Prakash, Soni and Rathore (2017:69) examined "Supply Chain Risk Management (SCRM) by employing content analysis of 343 articles across 85 journals by way of systematic literature review (SLR) published over a period of 11 years (2004-2014). Review of extant related literature showed that there is a marked rise in research in the SCRM area and that not only risk but also different forms of uncertainties pose as challenges to supply chain (SC) operations difficult to manage".

Simba, Niemann, Kotze and Agigi (2017:1) examined whether the "Supply Chain Risk Management (SCRM) process enables supply chain resilience among

grocery manufacturers in South Africa. The study was conducted using a descriptive qualitative research design. Data were collected by means of 12 semi-structured interviews with senior supply chain practitioners within the South African grocery manufacturing industry. The study found that most firms informally implement SCRM processes of risk identification, assessment, mitigation and monitoring to mitigate disruptions. Furthermore, the findings indicate that the SCRM processes facilitate resilience among grocery manufacturers in South Africa".

Shqairat and Sundarakani (2018: 3541) investigated "the agility of oil and gas value chains in the United Arab Emirates and to understand the impact of implementing supply disruption strategies, outsourcing strategies and management strategies on oil and gas value chain agility. The research instrument was questionnaire administration to 106 participants. The result showed that oil and gas value chain in the UAE have a good combination of supply disruption and outsourcing strategies in place that are synchronized with the overall management strategies".

Khadem, Piya and Shamsuzzoha (2018: 637) examined a "quantitative risk management in gas injection project within a case company in Oman. The study employed the use of interviews. The simulation result predicted a delay of about 2 years as a worse case with no chance of meeting the project's on stream date. Also, it has predicted 8% chance of exceeding the total estimated budget".

Ireoegbu, et al., (2018:1) examined the "effect of supply chain management on organizational performance focusing on Private manufacturing enterprises (PMEs) in South-East. It employed questionnaire and interview in generating data from sample size of 553. The statistical tools used include Pearson product moment correlation and Regression analysis. The finding revealed that training, technological know-how and security of investments enhance the development of innovative skills; also, opportunity identification positively promotes research and development significantly. The study concluded that firms need to ensure that their entrepreneurial abilities are developed consistently so that their survival will be ensured also that indigenous firm should engage in employment of qualified staff, though within their budget capacity".

Baryannis, Validi, Dani and Antoniou (2019:2179) carried out "comprehensive review of supply chain literature that addresses problems relevant to SCRM using approaches that fall within the Artificial Intellengence (AI) spectrum. The study employed, a mapping to categorise existing literature according to the AI methodology used, ranging from mathematical programming to Machine Learning and Big Data Analytics, and the specific SCRM task they address (identification, assessment or response). Finally, a comprehensive analysis of each category is provided to identify missing aspects and unexplored areas and propose directions for future research at the confluence of SCRM and AI".

Nsikan, Ekeins-Wilson, Ayandike, and Ortencia (2019:92) examined "petroleum supply chain disruption in Nigeria oil and gas industry by identifying the drivers of disruption and determining mitigation strategies. It employed the use of questionnaire administration and descriptive statistics. Results show the top five drivers/causes of supply chain disruption relates to: poor quality of supply chain information, inaccurate product demand forecast, third party logistics outsourcing firms, inadequacy of critical storage infrastructure and components, and poor visibility of inventory position. From the study, major strategies for handling disruption challenges in the downstream petroleum supply chain includes: flexible supply chain, collaborative outsourcing, efficient management of petroleum products inventory, and supply chain relationship coordination".

Wachyudi, Daryanto, Machfud and Arkeman (2020:179) examined "biofuel supply chain characteristics and risk mitigation strategy framework in Indonesia. It employed expert interview-based approach as a qualitative approach with a multi-perspectives view. Outcome showed that business strategies of collaborative, coordinative, and cooperative arise as alternative strategies were necessary to minimize the impact of supply chain risk on a company's business activities and performance".

Wanjala, M. M & Muli, S (2021:1) examined **"s**upply chain practices on the performance of food and beverages manufacturing firms in Kenya. It is a cross-sectional survey design and has a population of 102 and sample size of 50 Food and Beverages Manufacturing. Questionnaires administration was employed for generating data. Descriptive statistics and Inferential statistics using linear regression and correlation analysis were employed. The result showed that supply chain risk management, agility, supply chain collaboration and supply chain integration significantly influence the performance of Food and Beverages Manufacturing Firms in Kenya".

IV. METHODOLOGY

This study is an expost-facto and descriptive type of research. It focuses on Marginal Field oil and gas companies. The Marginal Field Oil Companies were conceived following the "Marginal Field Concession by the Federal Government of Nigeria. The Federal Government (FG), in furtherance of its Nigerian Content agenda, encourages marginal Oil Contracts (MOCs) to surrender their marginal fields for assignment to indigenous concession holders. To provide special incentives to Marginal Field Operators, the Federal Government (FG) promulgated the Petroleum (Amendment) Act No. 23 and the Marginal Field Operations (Fiscal Regime) Regulations 2005 on the development of marginal fields. Generally, a Marginal Field is defined as any field that has reserves booked and reported annually to the Department of Petroleum Resources (DPR) and has remained unproduced for a period of over 10

years. Marginal Fields companies in Nigeria include Midwestern, Energia Ltd, Oriental Energy, Niger Delta Petroleum, Platform Petroleum, Inaltersmith, Pillar, Britannia and Prime Exploration".

A total of 687 management and senior staff constituted the population from the nine Marginal Field Oil Companies, while 325 formed that sample size. Combination of convenience and purposive sampling techniques were used in selection of sample in course of questionnaire administration.

V. RESULTS AND DISCUSSION

A total of three hundred and eleven (311) copies of questionnaires were successfully retrieved and used in the analysis.

Table 4.3: Extent of Risk Mitigation:

	Statement /Question	N	Respondents					Pooled Result	
			Strongly Agreed %	Agreed %	Neutral %	Disagreed %	Strongly Disagreed %	Mean	Standard Deviation
1	Transportation risk mitigation: Appropriate mode of transportation of materials considering ordering, quantity, lead time, optimal and buffer level can assist in mitigation of risk.	311	196 63.0%	91 29.3%	7 2.3%	2 0.6%	15 4.8%	4.45	0.955
2	Information risk mitigation: Information sharing, and collaboration without leaking information to rivals can assists in risk mitigation.	311	95 30.5%	165 52.1%	8 2.6%	9 2.9%	37 11.9%	3.86	1.226
3	Demand risk mitigation: The level of order and placement has implication on demand risk mitigation.	311	75 24.1%	196 63.0%	32 10.3%	1 0.3%	7 2.3%	4.06	0.746
4	Monitoring risk mitigation: Proper monitoring of disruption in form of warning signals can enhance risk mitigation.	311	100 32.2%	167 53.7%	21 6.8%	13 4.2%	10 3.2%	4.07	0.918
5	Supply risk mitigation: Proper implementation of management technique like supplier relationship, involvement, reducing supply complexity and continuity risk management strategy can enhance mitigation of risk.	311	73 23.5%	199 64.0%	20 6.4%	10 3.2%	9 2.9%	4.02	0.831

Source: Researchers' field survey (2021) Highly utilized bench mark mean=3.0

Table 4.3 observes respondents' perception on statement question relating to transportation risk mitigation. It is affirmed that a total of 287(92.3%) respondents were of the agreed opinion, 7(2.3%) respondents were neutral, while 17(5.4%) of the respondents disagreed with this view. The calculated mean value of 4.45 was above standard deviation of 0.955 and bench mean of 3.0 suggesting that greater proportion of the respondents were of the agreed opinion that appropriate mode of transportation of materials considering ordering quantity, lead time, optimal and buffer level cannot assist in mitigation in Marginal Field Oil and Gas firms in Nigeria. The finding support the view of Andreas (2014) who observed that chronic risks such as inadequate transportation, logistics and utilities infrastructure, supplier and labor problems, and bureaucracy/red tape are more severe than highly publicized and visible risks such as natural disasters, terrorism and crime.

It is deduced that from statement question relating to information risk mitigation, that a total of 260(82.6%) respondents were of the agreed view, 8(2.6%) were neutral, while 46(14.8%) respondents were of the disagreed view. The result of calculated mean value of 3.86 is higher than standard deviation and bench mark of 1.226 and 3.0 respectively suggesting that greater proportion of the respondents were of the agreed perception that information sharing, and collaboration without leaking information to rivals can assists in risk mitigation. The result supported Tang and Musa (2011) who suggested more proactively managing Supply Chain Risk from system perspectives.

Moreover, on the statement question relating to demand risk mitigation. It was observed that a total of 271(87.1%) respondents agreed, 32(10.3%) respondents were neutral, while a total of 8(2.6%) respondent were of the disagreed opinion. The computed mean value of 4.06 was higher than standard deviation of 0.746 and bench mean value of 3.0 respectively indicating that most proportion of the retrieved administered questionnaire respondents were of the agreed opinion that thelevel of order and placement has implication on demand risk mitigation. The observation is in line with Shqairat and Sundarakani (2018) who showed that

supply chain is expected to have a good combination of supply disruption and outsourcing strategies in place that are synchronized with the overall management strategies. The implementation of these strategies has a positive and significant effect on the agility of the value chain and therefore the company's competitive position.

Furthermore, on the statement question relating to monitoring risk mitigation. A total of 267(85.9%) respondents were of the agreed view, 21(6.8%) respondents were neutral, while the remaining 23(7.4%) of the respondents disagreed to this view. The calculated high mean value of 4.07 implied that most of the respondents were of the agreed perceptions that proper monitoring of disruption in form of warning signals can enhance risk mitigation in marginal field oil and gas firms in Nigeria. The finding is in agreement with Simba, etal., (2017) who revealed that most firms informally implement SCRM processes of risk identification, assessment, mitigation and monitoring to mitigate disruptions.

Lastly, on the statement question relating to supply risk mitigation, it revealed that a total of 272(87.5%) respondents were of the agreed perception, 20(6.4%) respondents were neutral, while the remaining 19(6.1%) disagreed to this view. The calculated mean value of 4.02 was higher than standard deviation of 0.831 and bench mean value of 3.0 respectively indicating that most proportion of the retrieved administered questionnaire, respondents were of the opinion that proper implementation of management technique like supplier relationship, involvement, reducing supply complexity and continuity risk management strategy can enhance mitigation of risk in marginal field oil and gas firms in Nigeria. The finding is in tandem with Kumar, etal., (2018) who indicated that in manufacturing context supply risk and manufacturing risk management are both vital for business performance. While, the overall mean index of 3.65 compares to standard deviation of 0.99 and bench mean of 3.0 indicated that most of the respondents were of the agreed opinion that the extent of risk management strategy can enhance mitigation of risk in marginal field oil and gas firms in Nigeria.

VI. CONCLUSION AND RECOMMENDATIONS

The thrust of this study is to investigate mitigating effect of Supply Chain Risk Management in Marginal Field Oil and Gas Companies in Nigeria. The issue of supply chain risk management has attracted considerable attention from developed and developing countries. Having reviewed related literature and analysed questionnaires administered, it was found that with cooperative and coordinative supply chain risk management by application of strategies like supply risk, demand risk, information risk and risk monitoring are critical in mitigating risks in operations. In conclusion, the mitigating effect of supply chain risk management could bring about smooth operation and performance in terms of efficiency and effectiveness in Marginal Field oil and gas companies in Nigeria.

This study recommended as follows:

(1) There should be proper coordination of supply and demand risk management in the organization. Supply chain partnership should be more coordinative, cooperative or collaborative in nature and behavior. Preferably, oil and gas companies should outsource functional areas while they focus on core activities.
(2) There should be regular flow of information in terms of sharing and collaboration that can help mitigate disruption in operation and enhance performance.
(3) There should be an organized transportation risk management strategy considering various features of the stock.
(4) There should be monitoring of risk before disruption or distractions take the organization unnoticed.
(5) There should be out sourcing of the mitigation strategy to a third party and under writers of some of the perceived risks,

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