

## Logistics Performance Measurement in the Upstream Oil and Gas Supply Chain in Nigeria

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### Abstract

Globalisation and increasing demand for energy are putting serious pressure on the supply chain of oil and gas companies. Further, the oil and gas industry continue to see steady fluctuation in oil prices which have plummeted their revenue. Reducing the impact of falling oil prices requires the companies in the oil and gas sector in Nigeria, particularly the upstream oil and gas companies to re-evaluate their logistics operations and that of their partners in order to eliminate the inefficiencies in their supply chain. The purpose of this research is to investigate the role of logistics performance measurement in the supply chain of oil and gas companies in Nigeria. The research is based on the qualitative approach. Data gathering was achieved through a semi-interview method to gather primary data. The research identified the Balance Score Card and Supply Chain Operations Reference (SCOR) models were identified as essential performance measurement systems. Interestingly, not all oil and gas companies in the upstream sector apply a formal framework or models in selecting metrics and KPI's required for measuring logistics performance across the supply chain. Based on this, it was recommended that logistics managers in the oil and gas sector must incorporate agility and leanness into their logistics operations in order to remain competitive in a dynamic business environment. Similarly, they should also go beyond cost and lead time measures in assessing their logistics performance. A comprehensive approach to selecting essential key performance indicator such as Order accuracy rate, Outbound freight cost, inbound freight cost, Inventory carrying cost, third-party storage cost to reap the full benefits of logistics management in the oil and gas sector.

**Keywords:** Oil and gas industry, Oil prices, Logistics operations, Upstream oil and gas companies

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### **Background to the Study**

The depressed global business environment and fluctuations in oil prices have negatively impacted the revenues of oil and gas companies as well as the economy of countries which depends largely on earnings generated from oil and gas in financing developmental projects in the public sector. In the past, companies in the oil and gas sector have experienced a remarkable increase in revenue leading to growth in profit. Consequently, the fluctuations in oil price have greatly reduced this revenue. Measurement of Logistics performance in this sector has been an area that has been given less attention (Keebler & Plank, 2009). This may have been because of the increased growth in revenue experienced in the past. With the fluctuations in oil price, there is no better time than now to give more attention to logistics performance measurement as this will increase the effectiveness and efficiency of logistics operation and hence reduce wastage in a logistics operation. It is within this context that the measurement of the logistics performance of the actors across the supply chain of the oil and gas industry became a crucial and important subject of concern. Companies operating in the petroleum industry are faced with the challenges of exploring resources in harsh and hostile environments coupled with the high transportation cost incurred in getting oil and gas equipment and materials to the production site as well as the transportation of raw crude and finished products into the global market (Mellat-Parast, Adams & Jones, 2011). In addition, they are also faced with fierce competition from other global players and most recently the crash in oil prices. Hence their quest to find ways through which they can gain competitive advantage. Furthermore, due to the high demand for petroleum products globally, there has been significant pressure on the supply chain of companies operating in the petroleum industry to ensure the products gets to the consumers in a timely manner. This has brought about the increase in the volume of operational activities and logistics is playing a critical role in the global supply chain (Keebler & Plank, 2009, Halldórsson & Kovács, 2010, Hilletoft & Hilmola, 2010, Jayaram, 2010, Gligor & Holcomb, 2012).

The assessment and measurement of the performance of logistical operations across the supply chain are critical for the attainment of competitive advantage (Griffis et al., 2007, Keebler & Plank, 2009, Rushton, 2010, Wong & Karia, 2010). An efficient logistics operation will bring about improvement in cost savings and timely delivery of products and services to the actual consumers (Fugate, Mentzer & Stank, 2010). Getting the logistics cost right presents the organisations with the opportunity of gaining more market shares in the global business environment. However, in spite of the criticality and increasing importance of logistics management within the supply chain, most organisations still find the measurement of their logistics performance and those of their partners a big challenge, complicated and costly to implement (José Alfaro Saiz et al., 2007, Keebler & Plank, 2009, Graeml & Peinado, 2011). Moreover, (Chima, 2011) affirmed that organisations have done less in measuring the performance of their logistics operation and that of their suppliers within and across the supply chain. (Dey, LaGuardia & Srinivasan, 2011) also contributed that firms have not done so much in re-evaluating their logistics operations in order to obtain sustainability due to the magnitude of the cost involved. Organisations that fail to measure the performance of their logistics operations are faced with challenges such as steady fluctuations in their distribution channels and low delivery rates, high transportation cost as

well as high damaging cost (Hotrawaisaya et al., 2014). These costs which result from poor logistics performance measurement culture cuts deep into the profit margin of the organisation. This study, therefore, explores the performance measurement systems and key performance indicators in the Nigerian petroleum industry.

### **Statement of the Problem**

The Nigerian economy is largely dependent on revenue generated from the oil and gas sector (Odularu, 2008; Aliyu, 2009), and this makes the petroleum industry to play a significant role in sustaining the economy. Following the fluctuations in oil prices, industries such as producers of consumer's products, the food and transportation companies as well as other consumers who fill their cars with petroleum products and businesses with these products being their main input have benefited greatly from the fall in oil prices. Conversely, the fall in oil prices has not been received as good news by the Nigerian government and the major oil producing companies operating in the petroleum industry. Oil prices which have enjoyed stability for over a period of five years until its recent crash that started towards the third quarter of 2014 from around \$110 per barrel to as low as \$48 per barrel have negatively impacted the revenue of the companies as well as the Nigerian government (Bowler, 2015). This is mainly as a result of the exploration of shale gas in commercial quantities in the United States of America (US) which has made the US become one of the largest producers (Bowler, 2015; The Economist, 2015).

The petroleum industry comprises of various facets which include exploration of the oil, drilling of the oil wells, refining of the crude into its components as well as the distribution of the finished products to the final consumers. Hayes (2015) pointed out that the upstream sector of the petroleum industry is characterised by complex and expensive logistics and production activities. However, in the face of a dwindling revenue due to lower oil prices, the businesses of oil and gas companies in Nigeria are under threats as their production and logistics cost exceeds the market price of their products which is being controlled by the forces of demand and supply. Havenga, (2010) and McCann (2013) submitted that logistics cost forms the major part of an organisation's operational cost. The logistics cost involves the cost incurred in the movement of materials and equipment from the suppliers down to the rig or production site coupled with the cost of inspection and storage (Rantasila & Ojala, 2012; Turkensteen & Klose, 2012; Lang, 2013). This cost varies depending on the location where exploration or production activities are being carried out. With the intentions of designing the logistics network to cater for extra capacity due to the complexity of activities involved in coordinating the flow of both human and material resources, oil and gas producing companies have not done much in measuring the performance of logistics operations of their suppliers and distributors in order to have an efficient and cost-effective supply chain (Griffis et al., 2007). In order to dampen the blow which these oil and gas companies have suffered from the low oil prices and fixed operational cost, it is necessary for them to move swiftly in assessing and re-evaluating their logistics operations and that of their partners across the supply chain.

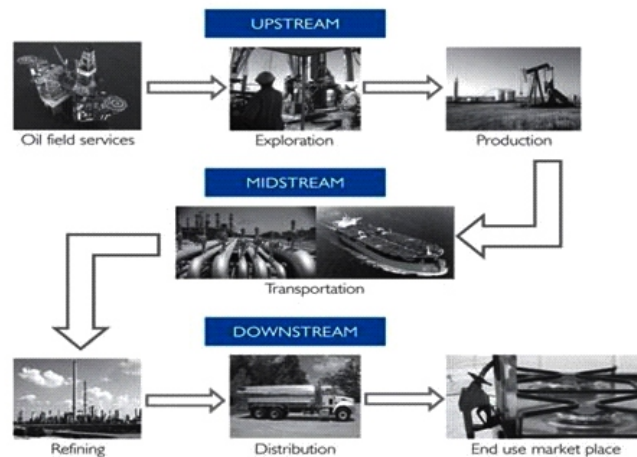
## Objectives of the Study

- i. To identify key performance indicators for logistics operations across the supply chain of oil and gas companies in Nigeria.
- ii. To assess the performance measurement systems for logistics operations across the supply chain of oil and gas companies in Nigeria.

## Review of Related Literature

### Conceptual Review

According to statistics, the oil and gas industry contributes about 90% of the revenue of the Nigerian economy (Elenwo & Akankali, 2014). As a key driver of the Nigerian economy, the oil and gas industry has fostered a strong culture of technical excellence (Nwokeji, 2007; Chima, 2011). However, due to the growth in this sector, the logistics and storage services requirements of this sector has continued to rise and grow in complexity. The petroleum industry is a global supply chain encompassing the exploration and production of crude oil, international and local transportation of oil and gas equipment, end products and materials handling (Bahaidar, 2014). The supply chain structure of the Nigerian petroleum industry is judged to be inflexible and of high complexity compared to other industries in the country (Ikeogu et al., 2013). The management of the logistics operations in the Nigerian petroleum industry is considered to be a daunting challenge because it is characterised by high complexity and inflexibility (Uche, 2015). More so, the extended transportation lead times coupled with the limitations being faced in respect to the different modes of transport in Nigeria and the logistics network in the supply chain have made every stage in the petroleum industry to continually pose various levels of threats (Hussain, Assavapokee & Khumawala, 2006). Additionally, other factors such as cultural orientation of the industry, structure of the organisation, integrated process management and the information sharing frustrate the efforts of overhauling the challenges being posed by inflexibility and complexity.



**Figure 1:** Oil and gas Supply chain (Oladunjoye et al., 2012)

The generally acceptable breakdown of the petroleum industry can be classified into three major operations; the upstream, midstream and the downstream as highlighted in Figure 1.1. Activities in the upstream of the petroleum industry involve the exploration and appraisal as well as production activities (Bahaidar, 2014). In general, upstream operations consist of operations activities from crude oil mining to the oil exportation process. In essence, while it is also known as the Exploration and Production (E&P) sector, it covers oil and gas drilling through the process of fractional distillation of petroleum products that involves the separation of gas and oil crude into refined components.

The downstream sector of the petroleum supply chain entails the conversion of the crude oil into the end products such as diesel and kerosene, and the logistics activities involved in transporting the end products from the refinery down to the customers and other end users. This also involves forecasting, storage and the marketing and distribution activities of getting the end products to petroleum depots (Ikeogu et al., 2013). Logistics activities in the downstream entail prompt and sustainable delivery of finished products from petroleum marketing companies down to the retailers and end users. The viability of the continuity of the supply chain in the major operations from the exploration of petroleum gas products to the distribution is dependent on the availability of the resource across the chain (Pienaar, 2010). A shortage in the supply of the crude oil and gas could directly impact midstream operations and subsequently the distribution and transport of the refined product in the downstream sector. The effectiveness of the downstream operations could also be marred by growing demand for refined products being greater than the available supply from the midstream operations (Ikeogu et al., 2013). Moreover, the effectiveness of the industry could be implanted on the efficiency of the logistics of delivering the crude to the refining units and onwards to the end user (Chima, 2011). This is hinged on the increasing demand for efficient and short delivery times that affects the operations of the sub-components of the industry.

The role of logistics operations in delivering a company's competitive advantage cannot be overemphasised as growing demand for goods and services can only be satiated through an efficient and effective delivery system (Chima, 2011). These operations represent a vital stage in a business. In order to design a transport model scenario for the petroleum industry, it may be imperative to take an integral look at the performance of the 3<sup>rd</sup> party logistics companies servicing the oil companies and the interactions of the downstream, upstream and midstream operations.

### **Empirical Review**

The complexity of business processes coupled with the quest to improve the operational and logistical performance across the value chain through effective integration is driving organisations to embrace performance management of the supply chain. In this regard, performance assessment allows organisations to obtain information on the operational activities that are not meeting established goals so as to identify ways through which they can redirect its course and improve performance. Chan (2003) opined that the overriding purpose of performance measurement is to enable organisations to gather valuable information that is needed in the improvement and fulfilment of customers' requirements

thereby actualizing their strategic business goals. This is hinged on the need to ascertain whether their logistical operations and activities are adding the desired value to the organisation. In the same vein, Fugate, Mentzer & Stank, (2010) mentioned that organisations can only have a window of assessment of their services and logistics operations through the measurement of their performance.

According to Forslund (2011), logistics performance measurement refers to the assessment of service delivery, the cost associated with logistics execution as well as the capital tied up in the supply chain. Forslund (2011) pointed further that the lead time and on-time are elements of service delivery. Many authors agree that primary purpose of logistics performance measurement is to appraise how well organisations have performed in actualizing their set goals (Griffis et al, 2007; Arzu & Erman, 2010; Selviaridis & Norrman, 2015). This relates to the quality of the operations being put in place by an organisation in discharging its functions for the purpose of generating profits (Piriyakul & Kerdpitak, 2011).

In a study by Fugate, Mentzer & Stank (2010) on the relationship that exists between organisational performance and logistics performance, it was observed that logistics performance is dependent on the outlined objectives and the outcome against other competing players. Logistics performance hence takes a multidimensional form which includes effectiveness, efficiency and differentiation. According to (Griffis et al., 2004; Bobbitt, 2004) efficiency refers to how well the allocated resources to the logistics performance was utilised while effectiveness reveals the degree to which the stated objectives were actualized. Efficiency looks at how organisations achieve their results by taking into account the measurement of used resources (Krauth, et al., 2005) submitted that “efficiency is a measure of the ratio between input and output” while “effectiveness is a measure of the capabilities of the organisation to produce results”. Differentiation, on the other hand, has to do with the level of value that is being derived from the elements used for offering services to the customers in relation to other competitors (Lambert, García, Dastugue & Croxton, 2005). Fugate, Mentzer & Stank (2010) stated that a combination of the different dimensions of logistics performance offers organisations the ability to perform excellently well in their logistics operations as opposed to the application of just one dimension in the assessment of logistics performance.

### **Research Methodology**

This research employed the qualitative research approach. The qualitative study is primarily concerned with purposively selected samples and non-statistical methods in the data collection (Lichtman, 2012). The qualitative research method is basically dependent on the collection of qualitative data (Anfara Jr & Mertz, 2014). For the actualization of the purpose of this research, the approach for this study takes the dimension of data gathering from logistics professionals to ascertain their perceptions on the subject matter. This is based on the premise that their wealth of experience in confronting logistics challenges will offer the needed information that would enable the researcher to achieve the objectives of the research and the research question answered (Bogdan & Biklen, 1997). Furthermore, this creates a clear and bigger picture in the mind of the researcher thereby offering the opportunity for the researcher to carry out detailed and constructive analysis from different points of view on the subject matter (Denzin & Lincoln, 2011).

The rationale for selecting the qualitative research method is to enable the researcher to have a concrete and broad understanding of the experience and perceptions of different professionals in logistics operations with regards to; how logistics performance is measured and the appropriate matrix being used in measuring logistics performance across the supply chain. The qualitative approach is considered by the researcher as the most appropriate and effective way to capture the experiences and perceptions of logistics professionals (Bryman, 2006). The ideal target population of this research includes logistics executives and managers. In the qualitative research, participants are selected to be part of the research based on their experience and interest in the subject matter. The selection of the participants who represent the desired population for this research was done through purposive sampling. The researcher used purposive sampling method primarily to choose the right set of participants who would furnish the researcher with relevant information on the factors hindering companies from measuring logistics performance across the supply chain and the logistics performance measurement systems. This research used the inductive approach to analyse the data.

### Research Findings and Discussion

The participants were asked how they measure their logistics performance as well as the framework or system and logistics KPI's they use, if any, in measuring their logistics performance and that of their suppliers. The response gotten from them was quite shocking as most of them were unable to point out a framework they use in selecting performance metrics for measuring their logistics performance. Nevertheless, some key metrics such as time and cost were mentioned by the respondents. Table 4.4 presents the findings under the Metrics/Key Performance Indicators theme category.

**Table 1:** Metrics/KPI code and respondent matrix

Respondent Codes	A	B	C	D
Lead time	✓	✓	✓	✓
Cost	✓	✓	✓	✓

**Lead time:** Lead-time came up during the interview as all the respondent considered it as a major criterion /metric for the evaluation of a supplier's performance as well as their logistics operation. Respondent A mentioned that “we already know the duration it takes for a vessel to cover a certain distance.

In the same light, Respondent B commented: We also make use of the lead time in measuring the logistics performance both within and across the supplier chain. While respondent D went further and pointed out that lead-time as a measure of performance also plays a role in the suppliers' selection process. Hence, the respondent commented: The time for a local supplier will give you a material is definitely not the same time with the foreign supplier. So in the delivery of material, you must consider the time that the local and foreign person is going

to give it to you. Similarly, respondent C also agrees with other respondents that time is a metric used for measuring performance. This shows that there is some general agreement on time as the key performance indicator, hence, it is commonly used to measure logistics and supply chain performance in the oil and gas upstream field to evaluate whether the actual operational time is in conformance with the set goals.

**Cost:** Similarly, to a general agreement on the lead-time. All respondents also mentioned cost as a crucial metric used in the evaluation of their logistic performance and those of their suppliers. Interviewee A was particularly concerned about shipping and terminal charges at the ports. The respondent commented: “We also know the shipping and terminal charges when we provide the clearing agent, that is, the customs broker our documents (bill of lading and commercial invoice, CCVU), and we expect the freight forwarder to meet up with set goals.” Furthermore, while respondent D is also concerned about cost, the respondent was also interested in cost reduction on the part of the suppliers. The respondent explained: there are KPI's we use to measure the performance of our suppliers, they must meet up time, and they must even minimize cost as much as they can. Interviewee B and C also mentioned that cost is an important metric employed in assessing their logistics operations although their submission did not give details. The research has found the cost to be a key metric for evaluating performance measurement. All respondent mentioned cost as an important metric due to the efficacy of cost in measuring the performance of the supply chain.

### **Conclusion and Recommendation**

The two objectives of this research were to identify key performance indicators and assess performance measurement systems for operations across the supply chain of oil and gas companies in Nigeria. Findings revealed that none of the companies whose managers were interviewed instituted formal performance measurement framework or systems. They usually adopt some key logistics metrics such as cost and the lead time. The literature revealed that the key performance measurement models are the balance score card and the Supply Chain Operations Reference (SCOR) model. Additionally, essential key performance indicators identified in the literature include Average materials packing and handling cycle time, Ratio per Customer service cost per sale, Average order processing time, Average delivery cycle time, Damage rate, Ratio of inventory holding cost per sale, Average order cycle time, Order accuracy rate. It was also observed that little was being done in measuring the performance of other supply chain partners.

Based on this, it was recommended that companies within the upstream oil and gas supply chain are encouraged to adopt effective performance measurement systems such as the balance score card and Supply Chain Operation Reference (SCOR) model or develop internal models adopting some of the approaches from BSC and the SCOR-model. These systems help organisations to develop and select metrics, monitor and evaluate logistics measures to improve their operations. They should also go beyond cost and lead time measures in assessing their logistics performance. A comprehensive approach to selecting essential key performance indicator such as Order accuracy rate, Outbound freight cost, Inbound freight cost, Inventory carrying cost, third-party storage cost to reap the full benefits of logistics management in the oil and gas sector.



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