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## The Relevance of Transport in Gas Logistics in Nigeria

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**Abstract.** Transportation is crucial to effective and efficient logistics. The operation of transportation determines the efficiency of moving products. The progress in techniques and management principles improves the moving load, delivery speed, service quality, operation costs and the usage of facilities. There is a need for a clear framework of logistics and proper transport implements to connect the various nodes of gas supply chain. The objective of the paper is to define the role and relevance of transportation in Gas Supply Chain logistics for the reference of further improvement. This paper is to assist Gas Transporters, Logistics managers, researchers and transportation planners to comprehend the basic views of Gas logistics and its relationship to transportation.

**Key words:** Gas, Logistics, Supply Chain and Transport

### 1. Introduction

Since logistics advanced from 1950s, there were numerous researches focused on the area of logistics in different applications. Due to the trend of globalization in recent decades, the importance of logistics management has been growing in various areas. For industries, logistics helps to optimize the existing production and distribution processes based on the same resources through management techniques for promoting the efficiency and competitiveness of enterprises. The key element in a logistics chain is transport, which connects the separated activities. In gas logistics, transport is required in the whole production procedures, from Gas fields, Processing and treatment, distribution and delivery to the final consumers who are also referred to as off takers. Only a good coordination between each component would bring the benefits to a maximum. The purpose of this paper is to understand the position and relationship between transportation and effective Gas logistics.

This paper introduced the development of the Nigerian Gas sector, logistics and transport. Afterwards it discussed the interrelationships of transportation and logistics, Gas Logistics, Gas transport modes, the relevance of transport in Gas logistics. It expresses the benefits that transportation brings to gas logistics activities.

### 2. Logistics and Supply Chain

Logistics is defined by the Council of Logistics Management as that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers (Ballou 2004). Ayers (2004) views supply chain as a network of resources that supports fulfilment and satisfaction of customers. Christopher (2005) emphasized on the logistics framework upon which supply chain is built which seeks to achieve a linkage and co-ordination between the process of other entities in the pipeline that consist of suppliers, the organisation and customers.

### 3. Transport and Logistics

In describing the modern world, it can be characterised as the development of advanced communication and information technology networks, and the development of transport networks. From being an external

factor, transport has become an integral part of the production and distribution system (Pedersen, 2001) and the restructuring process of the global transport system taking place at present is having profound effect on globalisation, of which Nigeria is not an exception. Christopher (2005) opined that transport plays an important part in the distribution and supply from the place of origin to the place of consumption. Its relevance cannot be underestimated as noted by several author such as Rushton *et al.* (2000); Ballou (2004); Pedersen (2001); Coyle et al, (2003); and Jespersen et al (2004).

According to Coyle (2003), transport is like a physical tread that connects firms that are geographically dispersed. The transportation link allows the flow of goods between the various fixed points from the points of production to the points of consumption. Ballou (2004) on the other hand noted that inexpensive, high quality transportation also encourages an indirect form of competition by making goods available to a market that normally could not withstand the high cost of transportation. This is an important issue especially in determining the affordability of goods and services. In order to develop a good distribution network, transport systems such as modes of transport, delivery operation, types of delivery operation and route scheduling are all important factors that need to be considered (Rushton et al, 2000).

An efficient and effective logistics is a function of how well the transport system is structured considering issues such as precision, just-in-time, frequency, distance and time (Jespersen et al 2004). Therefore, transportation decisions such as mode choice decision are strategically important for a well functioned logistics and supply chain operation.

#### 4. The Nigerian Gas Sector

Nigeria is the largest sub-Saharan country with a population exceeding 140 million people, and has the largest gas reserve in Africa and ranked 7<sup>th</sup> in terms of global gas reserves. Nigeria with a proven reserve of 260 trillion cubic feet of natural gas triples the nation's crude oil resources. [www.energymarketsinternational.org](http://www.energymarketsinternational.org) Hitherto, associated gas encountered during the normal course of oil production has been largely flared. Since the 1980s, there has been increasing utilization of gas in Nigeria, for power generation, industrial heating, fertilizer and petrochemical manufacturing and as feedstock for direct steel reduction. [www.nnpc.org](http://www.nnpc.org) Nigeria exports gas and domestic consumption is now highly encouraged. Hence, the need for effective and efficient transport system.

#### 5. Gas Logistics

The diagram below illustrates a typical gas supply chain, showing the connection and the interaction of the various activities within the chain. Although, the focus of this paper is on outbound logistics, therefore emphasis will be on the various modes of transport to the off takers.

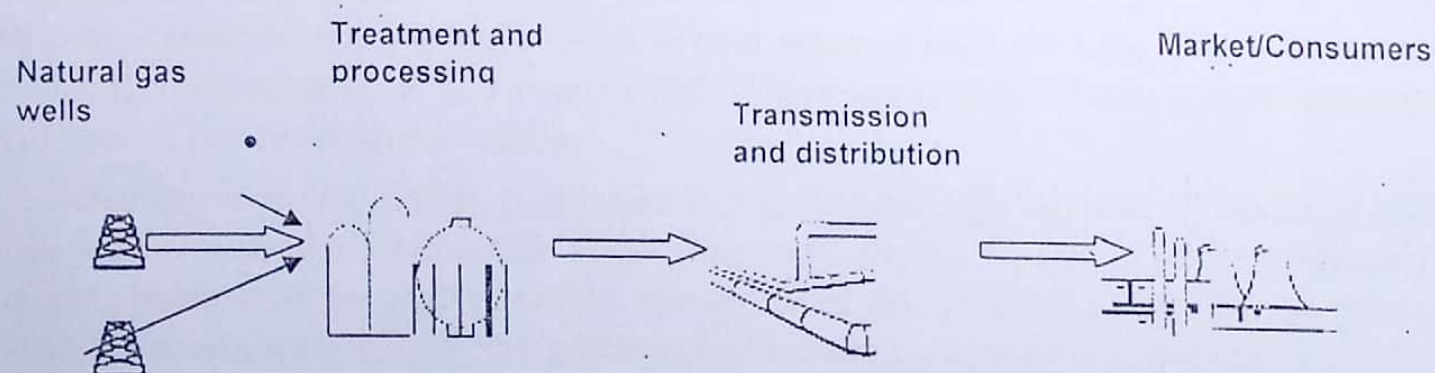


Fig 1.0: Gas supply chain Logistics

Source: Adapted from Ekundayo (2003): Nigeria oil and gas seminar

As illustrated above, the distribution and transmission sector which is made up of the transportation infrastructure and network forms a crucial part of the chain as it connects the upstream and downstream and enable product flow.

#### 6. Gas Transport Modes in Logistics context

Transport modes are the vehicles supporting the mobility of passengers, freight and information, and also act as the infrastructures supporting their movements. In supporting the mobility requirement in logistics context, road, railway, sea and pipeline transport have all proved as effective means of transportation. Both Coyle et al (2003) and Ballou (2004) have analysed the performance rating of these modes in terms of various selection determinants such as transport cost, transit time, reliability, capability, accessibility and security. The table below illustrates these determinants

Table.1.0: Relative ranking of transportation mode by cost and operating performance Characteristics

Performance Characteristics					
Modes of transportation (a)	Cost (b)	Average delivery time (c)	Delivery-time Variability		
			Absolute	Percent (d)	Loss and Damage
	1 = Highest	1 = Fastest	1 = Least	1 = Least	1 = Least
Rail	3	3	4	3	5
Truck	2	2	3	2	4
Water	5	5	5	4	2
Pipeline	4	4	2	1	1
Air	1	1	1	5	3

(a) Service is assumed to be available  
 (b) Cost per ton-mile  
 (c) Door-to-door speed  
 (d) Ratio of absolute variation in delivery time to average delivery time.

Source: Ballou, 2004.

Gas transportation requires a greater amount of care, hence transported in specialised forms of transport. However, the most common forms of gas transport are pipelines and LNG vessels. Gas can also be transported and distributed using road tanker trucks. Okogu, (2002) noted that the main constrain to gas sector development is the costly transportation of delivering gas to the consuming markets.

## 7. Pipeline Transportation

Pipeline transportation has been well known for its limited offer of a range of services and capabilities Ballou (2004). But in the area of oil and gas transportation, it has proved to be an efficient means of transportation. In addition, Milidiu et al (2004) sees pipeline as a unique form of transport having a stationary carrier but moving cargos which in other modes of transport is the reverse. He further stresses that the management of pipelines as a complex task which raises important issues such as logistics and planning, maintenance and environmental safety.

According to Ballou (2004), pipeline service is the most dependable of all modes of transport because there are few interruptions to cause transit time variability as weather is not a significant factor and the pumping equipments are highly reliable. He also noted that product loss and damage for pipeline is low. However, it must also be noted that pipelines are frequently subjected to vandalization especially within the Niger Delta region of Nigeria. Overall, pipelines are seen as an environmentally friendly means of transporting gas.

## 8. LNG Transportation

Ocean transport of natural gas in liquid form has expanded since in the 1960's (Kennedy, 1993). The usage of LNG tankers came purely because the distance to certain markets are far and cannot be reached by pipelines. The most peculiar of LNG transport is that LNG tanker represents only one phase of the movement of liquidity natural gas from producing field to the market. The process also require a liquefaction plant near the port where the LNG is loaded aboard the tanker and at destination, another plant is required to



regasify the LNG for distribution to users as natural gas. Moreover, he also emphasised that while pipeline provides a fixed physical link between buyer and seller, LNG cargoes can be diverted to other buyers and sellers in the event of a contract dispute.

## 9. Road Transportation

In terms of road transportation, gas is transported in dedicated road gas tank-trucks. However, in Africa, bad roads, poor road networks and also various hindrances such as delays at police and customs check points obstructs an effective and efficient logistics. As noted by Pedersen (2001), trucks seldom drive more than 25,000 km per annum due to the nature of the African continent and its road transport network.

Road infrastructures are large consumers of space with the lowest level of physical constraints among transportation modes. However, environmental constraints are significant in road construction. Road transportation has an average operational flexibility as vehicles can serve several purposes but are rarely able to move outside roads. However, due to the poor road infrastructure in Nigeria, the road transport systems have high maintenance costs.

## 10. Conclusions

Gas supply, like any energy distribution cannot be implemented without adequate transport system. An efficient and effective movement of natural gas from the producing regions to the consumption regions require an extensive and elaborate transport system. The role of transport in Logistics and supply chain of natural gas are numerous especially the expectation from firms to delivering value added services by ensuring the movement of goods and services to the right place in the right time and at the right quantity and quality. Also, the increasing nature of supply chains in the global economy introduces an increased spatial gap which results in greater transportation cost in most cases. This is apparently displayed in the gas sector as places of supply are geographically far away from the markets causing the transportation expenditures incurred by gas firms to increase at a significant amount. Hence, this calls for a most efficient and effective mode of transport in order to have control over service level and expenditure of the transport modes in view of reducing cost. As viewed by Ballou (2004), it is performance that a user buys from the transport system

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