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Agile logistics challenges of petroleum product distribution in Nigeria

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Abstract

Agile distribution of petroleum product is a strategy towards uninterrupted supply of quality products at affordable prices. Industry and economic productivity as well as transportation in Nigeria is largely driven by petroleum energy due to low investments in other sources of energy, yet the petroleum energy supply and distribution is marred by lingering history of scarcity, high prices, and distribution bottlenecks to end users all over the nation. The study through a descriptive survey following literature view, primary and secondary data collection sought to determine at granular level the limiting factors of agile petroleum product distribution in Nigeria. Petroleum supply, consumption and pricing are significant aspects of the study survey. Study findings shows limiting factors of distribution agility cut across pricing, supply, technology, infrastructure, accessibility and lead time, storage, management, and Human Resource issues. Significantly lack of local refining capacity and poor distribution network are notorious for supply limitations and rising price of products. Addressing the challenges would require strong political will, driven by genuine commitment and focused attention towards economic growth and improvement in the welfare of the citizens.

Keywords: Petroleum; Distribution; Agility; Supply

1. Introduction

The petroleum industry is involved in a global supply-chain that includes domestic and international transportation, ordering and inventory visibility and control, materials handling, and information technology. Logistics is a supply chain function that plays an essential role to ensure a safe, timely and cost-effective delivery. Oil and gas logistics includes typically transportation of crude oil from the production sites to refineries as well as transportation and distribution of oil products to markets and customers. The demand for oil and gas has increased in tandem with the economy of the world as it continued to prosper. From the reference point of 1960, Organization of the Petroleum Exporting Countries (OPEC) projects that oil demand would increase up to five times by 2035 (OPEC, 2014).

The demand for petroleum product is affected by myriad of challenges. Alongside the need to replace depleted wells, old plant, and equipment, and to accommodate ever higher standards and tighter regulations is the need to adopt logistics strategies that ensure consumers continue to receive products in a timely and orderly manner (OPEC, 2014). An effective and efficient logistics process is an industry key for reducing lead times and costs, increase the company's profits and in managing supply chains; demand management, efficient distribution of petroleum products among customers, better transportation scheduling, warehouse management, and quality and timeliness of information (Lisitsa, Levina and Lepekhn, 2019).

In Nigeria, the consumption of petroleum products Onwioduokit and Adenuga (2000) recount has continually been on the increase with most of the demand for products fulfilled over time by importation due to the poor condition of the refineries. Starting from the 1980s the demand for petroleum products they acknowledge have increased tremendously

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reflecting rapid growth in the number of automobiles, industries, households, intensified rural-urban migration, economic and political developments. The bulk of products consumption has been the Premium Motor Spirit (PMS) or petrol, Automotive Gas Oil (AGO) or diesel, dual purpose kerosene and bitumen/asphalt. Together, they account for more than 60.0 per cent of the total consumption of petroleum products. The petroleum product distribution in Nigeria is challenged by short deliveries, high lead time, increased cost of distribution, scarcity of products and high pump prices. Nigeria is an emerging and fast developing market and the demand for petroleum product continues to increase. As such, the need for sufficient and uninterrupted supplies is a major task for national development and economic growth. A sustainable economic development cannot be successfully achieved without an appreciable vibrant supply chain which involves the even distribution of petroleum products to keep alive economic activities such as manufacturing, production distribution and general logistics involving the movement of materials and human resources from one place to the other. In this regard, the study seeks to:

- Examine the limiting factors to agile distribution of petroleum products in Nigeria.
- Evaluate petroleum supply and consumption.
- And analyse product pricing.

2. Literature review

Energy is key to economic productivity and industrial growth and is central to the operation of any modern economy. Energy is one of the most important inputs for economic development and from a physical viewpoint, the use of energy drives economic productivity, consumption, and growth. Many production and consumption activities involve energy as a basic input (Zahid, 2008). In Nigeria the petroleum products and the derivatives constitute the main source of energy for production, manufacturing, distribution and general logistics of goods, passengers, and services. A logistics system which meets the need for timely availability, quality, and affordable products is necessary to drive economic productivity and growth. The components of petroleum and its by-products traded include the following: Premium Motor Spirit (PMS), Automotive Gas Oil (AGO), Household Kerosene (HHK), Dual Purpose Kerosene (DPK), Aviation Turbine Kerosene (ATK), Low Pour Fuel Oil (LPFO), Liquefied Petroleum Gas (LPG), Bitumen, Lubricants and Base Oil. Fuels are extracted from crude petroleum and pass through various processing units by thermal cracking in the refineries.

2.1. Distribution Enterprise Task

A significant aspect of the enterprise logistics function is distribution. Specifically referring to the delivery of the finished products to the customer. Schewe and Smith (1980) define distribution as the physical movement of products to the ultimate consumers. It consists of order processing, warehousing, and transportation. Distribution Straka (2017) identify is responsible for storage and transportation of goods to consumers as well as related information, management, and control activities. It ensures the most appropriate way, selection, and analysis of transport, which is most suitable for transfer of products manufactured by enterprises to achieve failure-free performance of the market. The distribution network comprise of specific nodes which include; factories where products are manufactured or assembled; a depot or deposit relating to standard type of warehouse for storing of merchandise (high level of inventory); distribution centres for order processing and fulfillment (lower level of inventory) and also for receiving returning items from clients, transit points built for cross docking activities, which consist in reassembling cargo units based on deliveries scheduled (only moving merchandise).

2.2. Agility of Petroleum Product Distribution

The petroleum industry is frequently classified into three main sections: upstream, midstream, and downstream operation. Upstream activities refer to the exploration and production of crude oil. This includes searching for potential underground or underwater oil and gas fields, drilling of exploratory wells, and subsequently operating the wells that recover and bring the petroleum crude oil and/or raw natural gas to the surface. Midstream activities refer to the refining, transportation (by pipelines, rail, tankers), storage and wholesale marketing of crude or refined petroleum products. Downstream activities refer to the transportation and marketing of end-user products, e.g. petrol, diesel, and liquefied petroleum gas (LPG).

The agility of petroleum product distribution is a strategy to building an agile supply chain of the same. Agility Tiefenbacher (2020) denotes is a strategy to thrive, improve performance and be competitive in VUCA environments, that is environments that are volatile, uncertain, chaotic, and ambiguous characterized by being unpredictable and thereby necessitating adaptive, flexible approaches and interventions to muster them. Logistics and Supply chains are one of the same ultimately concerned with delivering the right thing to the right place at the right time (LaBotz, 2022).

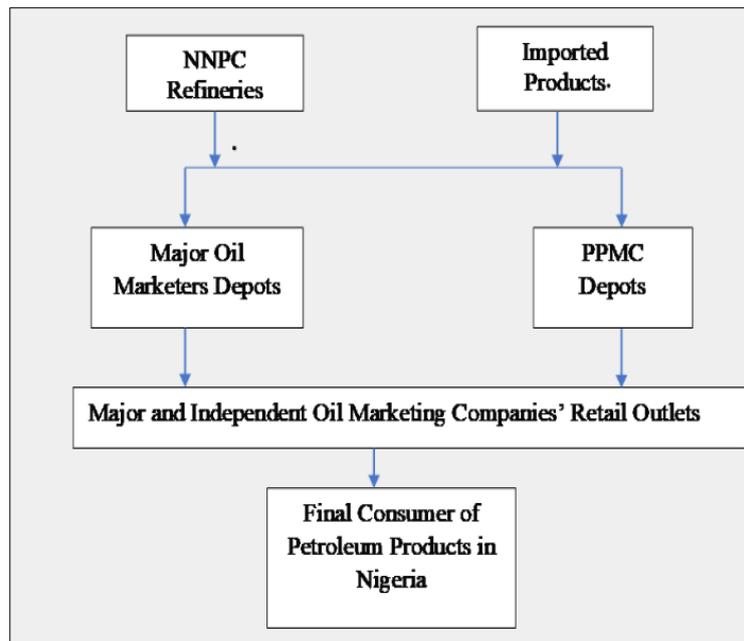
The agile supply chain is a more recent concept which focuses on leveraging responsiveness to customer demand. Here, logistics plays a crucial role in aligning material flow across the supply network with customer demand, and in ensuring execution in a flexible and customized manner (Harrison & Hoek, 2008). The origins of the agility paradigm in logistics and supply chain can be traced back to the theory of lean enterprises, which comprises concepts and methods which aim to minimize waste and consequently maximize efficiency and cost-effectiveness as the company uses fewer resources (capital, financial, human, organisational) and less time to achieve the same goal (Sajdak, 2015).

Agile logistics strategy of petroleum product distribution represents a distribution process which ensures the availability right products to the right customer at the right place, in the right condition and right quantity at the right time, and right (lowest possible) costs. Logistics is the task of managing two key supply chain flows; material flow of the physical goods from suppliers through the distribution centers, stores and flow of Information; demand data from the end-customer back to purchasing and to suppliers, and supply data from suppliers to the retailer, so that material flow can be accurately planned and controlled (Harrison & Hoek, 2008). The agile strategy ensures the adequacy of place (moving refined products to places where there is a demand for them) and time (maintaining the right stocks levels) and proper distribution of the products through procedural alignment, end-to-end accountability, social proximity, and deep integration of suppliers.

2.3. Petroleum Distribution Chain in Nigeria

The actors in the Nigerian industry consist of both private and public organizations. The public actors are the government agents and functionaries such as the Nigerian National Petroleum Corporation (NNPC) and its subsidiaries, the Department of Petroleum Resources (DPR), the petroleum products pricing regulatory authority (PPPRA), the Pipeline and Product Marketing Company (PPMC) among others. The private segment consists of both indigenous and foreign actors. The PPMC is charged with the task of large quantities supply, distribution, and marketing of petroleum products in Nigeria. There exists network of four thousand (4,000) kilometers of pipelines which are interconnected with twenty-one (21) highly dispersed depots.

The products may be obtained from the four local refineries or in the event of a supply short-fall from off-shore refineries by way of imports. Imported refined products are received at PPMC depots at Atlas Cove. From here, products are pumped to nearby depots at Mosimi in Shagamu, from which products are pumped into various other depots through the pipelines; Booster pump stations are provided along the route and between two adjoining depots. This arrangement is necessary to boost the flow of products in the pipelines along the routes. Movement of products from the depots is the responsibility of major oil marketers.



Source: NNPC/PPMC Bulletin, 2010

Figure 1 Channel of Petroleum Product Distribution in Nigeria

2.4. Challenges of Petroleum Product distribution in Nigeria

2.4.1. Lack Local Refinery Capacity

Nigeria is blessed with the abundance of petroleum resource and natural gas, but the country is seriously challenged by local refining capacity which meet the soaring energy need. World Energy 2023 report according to Akintayo (2023) reveal local refineries output of Nigeria has dropped to near zero output in 10 years. According to data the statistical review, output from the nation's four refineries fell from 92,000 barrels per day in 2012 to just 6,000 barrels per day in 2022 representing a 92 per cent drop in production capacity. Similarly, the Organisation of the Petroleum Exporting Countries' Annual Statistical Bulletin (2023), also revealed the country's crude oil refining capacity fell from 33,000 bpd in 2018 to 6,000 bpd in 2022, representing about 81 per cent drop in production output. The drop in refining capacity has made the country to rely solely on the importation of refined petroleum products to meet the local energy consumption needs. NBS report spanning from 1997 up to 2014 presented in table 1 below shows a continued decline in capacity utilization of the refineries and year on year growth in crude oil refining percentage respectively. Adeosun and Oluleye (2017) acknowledge Nigeria despite having a nameplate refining capacity, 445,000 bpd which exceeds demand has over the last four decades consistently struggled to keep its refineries functioning optimally and is ranked as the 3rd highest importer of petroleum products in Africa, importing over 80% of products consumed.

Table 1 Yearly Domestic Crude Oil Refining 1997-2014

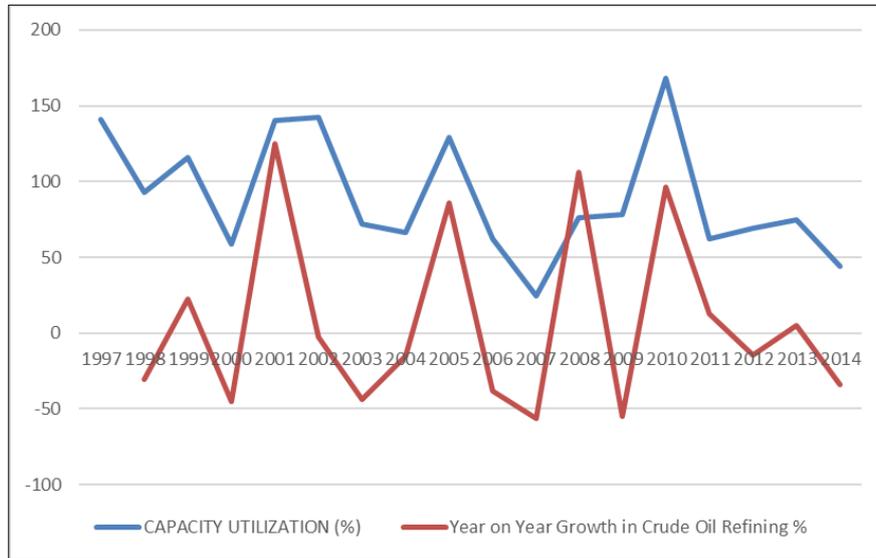
Year	Crude received oil	Crude processed oil	CAPACITY UTILIZATION (%)	Year on Year Growth in Crude Oil Refining %
1997	80,473,488.91	78,001,995.34	140.8	
1998	52,422,070.13	54,304,185.98	93.16	-30.38
1999	65,979,134.80	66,409,253.60	116.18	22.29
2000	36,189,139.39	36,282,789.51	58.64	-45.36
2001	82,578,546.57	81,512,099.57	140.41	124.66
2002	78,160,576.55	79,579,031.26	142.65	-2.37
2003	42,754,815.49	44,811,925.54	72.11	-43.69
2004	38,019,906.64	38,026,965.93	66.14	-15.14
2005	72,360,780.00	70,637,019.00	129.44	85.76
2006	42,471,739.00	43,445,397.00	62.45	-38.49
2007	18,191,136.45	19,059,670.28	24.87	-56.13
2008	45,533,304.84	39,264,519.46	75.92	106.01
2009	19,392,571.25	17,745,656.61	78	-54.80
2010	33,633,907.94	34,871,693.84	167.87	96.51
2011	40,405,605.00	39,408,108.00	61.95	13.01
2012	33,595,260.00	33,628,602.00	68.95	-14.67
2013	36,193,237.20	35,233,125.59	74.5	4.77
2014	25,839,373.09	23,360,372.27	44.42	-33.70

Source: National Bureau of Statistics e-Library, 2014

The scarcity of petroleum products and the rising cost of the petroleum products is an indication that refined product importation is not sustainable for agile distribution of petroleum products. Okereke, Emodi and Diemuodeke, (2022) lament the shortage of refining capacity at existing oil refineries is the main driver of Nigeria's fuel crisis, which hampers the socio-economic development of the country, placing a high subsidy burden on the government and has long made Nigeria dependent on imported petroleum products. Similarly, Ehinomen and Adeleke (2012) decry the low-capacity utilization of government owned refineries and petrochemical plants in Kaduna, Warri and Port Harcourt and inadequate crude oil allocation to the refineries for domestic consumption as well as long turnaround time for the

maintenance of the refineries poses a lot of challenge to NNPC and result into petroleum product shortage and eventual importation of the products a situation that puts a drain on the scarce foreign exchange of the nation.

An attempt by the government at the removal of subsidy without addressing the issues of local refining capacity has compounded the issue of product scarcity and high prices with PMS and AGO pricing reaching 600 NGN and 1300 NGN respectively, the highest prices ever recorded in the history refined product distribution in Nigeria. Because industrial production activity and business operation in Nigeria largely depend on petroleum energy following the epileptic electric power supply and lack of technology to harness the solar power, the increase in the price of the petroleum products have resulted to hyperinflation which has affected the cost of production, local cost of transportation and prices of consumer commodities. Sales and business struggle due to high cost of doing business, low demand, and patronage while many shut down and workers lose their jobs.



Source: Author's Analysis

Figure 2 Capacity Utilization and Year on Year % Growth in Oil Refining

Figure 2 above presents a graphical analysis of the capacity utilization and year on year percentage growth in crude refining with reference table 1. The line graph shows a staggered progression in the refinery capacity utilization and year on year growth in oil refining for the years referenced depicting a very hopeless situation for the industry in Nigeria. There has not been a serious approach in addressing the issues of local refinery capacity in the country since time and the challenges have compounded till date. With growth in population and increasing demand for development which put pressure on energy supply to drive industrial and economic productivity, the reliance on importation of refined products has become highly unsustainable. A significant aspect of agile product distribution is delivering the products available to the end users at affordable cost. This cannot be realized by dependance on importation to feed the local market. No doubt pump price of petroleum products in Nigeria is due to importation is determined by world crude prices, and inflation in the import countries. Interruption in production due political instability, social unrest and natural disaster in the import countries would translate to scarcity of product in Nigeria.

2.4.2. Insecurity, Terrorism and Acts of Sabotage

Agile supply and distribution of petroleum products will remain a mirage in the presence of insecurity and safety concerns which disrupt operation and investment in oil production, refining and distribution. Industrial sabotage, crude oil theft, illegal refining operations, pipeline vandalism and piracy present significant challenges which adversely impact onshore oil and gas production and freight delivery of products to the market. The disruptive activities of the various militant group and instability in the Niger Delta region is acknowledged a major threat to the security of the oil & gas industry. Oturugbum (2021) acknowledge pipeline vandalism and militancy represents a means which the inhabitants of the oil producing areas adopt in pressing their demands to the government and oil companies. Unfortunately, this is due to the prevalence of corruption, poverty, and governments unfulfilled promises, among others. The Petroleum Production Act and other legislation which criminalize the act of tampering and vandalism of crude oil and natural gas pipelines with the death penalty and life imprisonment have not deterred the commission of relevant offences as the challenge continues to escalate. Adeosun and Oluleye (2017) lament Nigeria lost over NGN 50 billion to pipeline vandalism between January and April 2016. Okumagba (2019) reports within a space of 10 years between 2006 – 2016,

Nigeria recorded over over 16,083 cases of “pipeline tampering” and vandalism amounting to a loss of 174.57 billion (or approximately \$484 million) and between 2016 and 2017, a total of 992 cases of pipeline vandalism were recorded across pipelines and depot lines, amounting to a loss of 167 billion (approximately \$464 million). Nigeria Extractive Industries Transparency Initiative (NEITI) records between 2017 and 2021 (in 5 years) Nigeria recorded a total of 7,143 cases of pipeline vandalism. The country recorded in 11 years (2009-2020) a loss of 619.7 million barrels of oil valued at \$46.16 billion to theft, pipeline tampering and vandalism. This is higher than the size of the country’s foreign reserves. In addition, Nigeria lost 4.2 billion litres of petroleum products from refineries, valued at \$1.84 billion at the rate of 1440,000 barrels per day, from 2009 to 2018 (Aduloju, 2023).

2.4.3. Corruption and Mismanagement

Unscrupulous and corrupt practices of government agencies, oil companies and marketers as well as mismanagement of petroleum revenue largely fraught the agility of petroleum product distribution in Nigeria. Subsidy of petroleum products leads to a situation where the pump price of petroleum product is higher in neighbouring countries, Benin, Cameroon, and Chad. The aim of the petroleum subsidy was undermined following large-scale smuggling of petroleum meant for Nigerian consumption and subsidized by the government to the neighbouring countries where they are sold at higher prices making superfluous profits short-changing the government and causing scarcity in Nigeria (Terkimbi, 2015 & Ayanruoh, 2023). Oshunkeye, (2012) alleges the oil subsidy is bedeviled by criminal tendencies of oil importers and sharp practices in the distribution of import allocation, approval of subsidy payments and actual release of subsidy cheques. While the significance of petroleum resources as a substantial source of economic advantages became increasingly obvious, susceptibility of the resource regions to military attacks, regional pressure, and oil-related problems, such as oil spills, crude oil theft, illegal refining of crude oil, accidents involving oil trucks, pipeline vandalism, and explosions will continued to exacerbate and requiring strategic management innovations by government to bring under control (Francis et al., 2022). Mismanagement, lack of proper guidelines and standards for the design, construction, and operation of major oil pipelines result in corrosion and aging pipelines, ruptures, operational error, and mechanical failure which lead to leaks and explosion that disrupt product flow (Akinpelu 2021, Achebe, Nneke, & Anisiji, 2012,).

2.4.4. Dependency on Road Haulage

The supply of refined petroleum products to end users is faced with many challenges. Efficient transportation of petroleum product requires a modal integration of shipping via vessels, pipeline, road trucking and rail tankers. While the pipeline is acknowledged the most efficient single mode due to the benefit of large volume delivery at high speed and constant flow resulting to cheaper cost relative to other modes, zero accidents and limited environmental concerns the case is different in Nigeria where on the contrary road haulage is the dominant mode of petroleum distribution. This is because the pipeline mode is underdeveloped and fraught by the combined force of vandalism by oil bunkering, industrial sabotage, militancy, poor maintenance, and neglect. According to Bataiya, (2018) 98% petroleum products that include fuel components like premium motor spirit, domestic pure kerosene, and automotive gas oil’s lifting from supply sources to all parts of the country is done by road which of itself is in gross disrepair and affecting the distribution of the products. 70% of the federal road which constitute a 70% of the vehicular freight movement is overstretched with 40% and 27% in poor and fair condition respectively requiring rehabilitation and maintenance work and a 3% unpaved. 78% and 87% of state and local government roads respectively are in poor condition. The road transport research acknowledge is not efficient for petroleum distribution over long distances due to lower speed, interrupted flow, limited capacity leading to high cost of transportation per unit volume. Nwolozi et al. (2021) acknowledge the inefficiency of railways and pipeline transportation heavily contribute to total dependency on road transportation in the distribution of petroleum products to various depots and stations located all over the country. Ehinomen and Adeleke (2012) recounts the despair, neglect and repeated vandalization of the state-run petroleum products pipelines and oil movement infrastructure nationwide, coupled with frequent accidents of haulage trucks on the nations heavily used highways pose complex problems managers, and operators in the oil industry. Road haulage of petroleum products is marred by road traffic accidents, theft, and robbery incidence, bad and poor road networks as well as various hindrances such as delays at police, customs check points and many other bottlenecks (Thomas et al., 2014, Nwachukwu & Chike, 2015, Bataiya, 2018, Nwolozi et al., 2021, Ehinomen & Adeleke, 2012).

3. Study Framework and Data

The agile logistics of petroleum product distribution is a concept representing a distribution strategy which ensures uninterrupted supply of right products to the right customer at the right place, in the right condition and right quantity at the right time, and right (lowest possible) costs. The study follows a descriptive survey design based on quantitative and qualitative approach relying on primary and secondary data. While Primary data is gotten by the distribution

structures questionnaire, secondary data is ensued from e-library of National Bureau of Statistics (NBS) and literatures reviews.

3.1. Limiting factors of Agile Distribution

At a very granular level, the study sought to survey the factors which limit the agile distribution of refined petroleum products to end users in Nigeria. Distribution agility based on the review of literature hinges on continuous product availability at affordable prices without quality compromise. Research observation and findings shows the distribution of refined petroleum products in Nigeria is fraught with the challenges of scarcity, product adulteration, and high prices. And efforts by the government to address this have not yielded the desired results. Perceived factors which limit distribution agility were presented to selected staff of six major independent petroleum marketers and NNPC retail as presented in Table 2 below. 30 questionnaires were distributed to the executive staff of each of the study organizations drawn from sales, marketing, admin, HR, imports, finance, business analyst, logistics and transport units via one-on-one interview making a total of 210 questionnaires. 187 questionnaires, which represent 89% of the total questionnaires distributed, were returned valid for the research.

Table 2 Instrument Analysis

Company	Questionnaires Distributed	Returned and Valid	% Returned and Valid
Total Energies	30	28	13
OVH Energy (Oando)	30	27	13
MRS	30	26	12
Conoil Plc	30	27	13
Arдова Plc	30	27	13
11 Plc (Mobil)	30	28	13
NNPC Retail	30	24	11
Total Energies	210	187	89

Source: Authors Field Survey

The questionnaire instrument follows a five-point likert scale ranged 1 to 5 where 1 = strongly disagree, 2 = agree, 3 = undecided, 4 = agree, 5 = strongly agree. The qualitative data is coded with the capability of the SPSS and analysed for data results and discussions. The perceived limiting factors of distribution agility cut across pricing, supply, technology, infrastructure, accessibility and lead time, storage, management, and Human Resource (HR) issues.

Table 3 Descriptive Statistics of limiting factors to agile distribution

	N	Minimum	Maximum	Mean	Std. Deviation
Fluctuation in crude prices and scarce foreign exchange (F ₁)	187	2.00	5.00	4.4813	0.76441
Insecurity, fire incidence, theft, and acts of terrorism ((F ₂)	187	1.00	5.00	4.2193	0.82960
Lack of technology and integrated ICT system (F ₃)	187	3.00	5.00	4.4652	0.67411
Lack of local refinery capacity (F ₄)	187	3.00	5.00	4.5134	0.71360
Access limitations to retail delivery locations (F ₅)	187	3.00	5.00	4.3422	0.74088
Long delivery cycle, transit time and high cost (F ₆)	187	2.00	5.00	4.4118	0.69288
Lack of integrated management system and process (F ₇)	187	3.00	5.00	4.3636	0.76648
Poor transport infrastructure and networks (F ₈)	187	3.00	5.00	4.4332	0.64722
Expertise limitations (F ₉)	187	2.00	5.00	4.1551	0.76377
Valid N (listwise)	187				

Source: Author's SPSS Data Computation Output

Table 3 above presents the analysis of the response of the respondents as per their level of agreement or disagreement to the perceived limiting factors of petroleum distribution agility in Nigeria.

The sampled factors on a five-point likert scale shows a mean response ranged 4 – 4.5 higher than the likert mean value 3 and standard deviation values less the likert scale mean value indicating the respondents largely agree the sampled variables are limiting factors to petroleum product distribution in Nigeria. The sample factor of lack of local refinery capacity has the highest mean response above 4.5 indicating the respondents are very highly concerned about the limitations of product importation to meet local consumption demand. The data is further subjected to K-S Test for more information about the sample and to test the significance of the sample mean to the liket mean value and that the data result is not by random chance.

Table 4 One-Sample Kolmogorov-Smirnov Test

		F ₁	F ₂	F ₃	F ₄	F ₅	F ₆	F ₇	F ₈	F ₉
N		187	187	187	187	187	187	187	187	187
Normal Parameters ^{a,b}	Mean	4.4813	4.2193	4.4652	4.5134	4.3422	4.4118	4.3636	4.4332	4.1551
	Std. Deviation	0.76441	0.82960	0.67411	0.71360	0.74088	0.69288	0.76648	0.64722	.76377
Most Extreme Differences	Absolute	0.377	0.276	0.353	0.383	0.315	0.326	0.337	0.328	.240
	Positive	0.249	0.173	0.214	0.242	0.187	0.200	0.203	0.230	.206
	Negative	-0.377	-0.276	-0.353	-0.383	-0.315	-0.326	-0.337	-0.328	-.240
Test Statistic		.377	0.276	0.353	0.383	0.315	0.326	0.337	0.328	0.240
Asymp. Sig. (2-tailed)		.000 ^c	0.000 ^c							
a. Test distribution is Normal.										
b. Calculated from data.										
c. Lilliefors Significance Correction.										

The K-S Test is presented in table 4. The variables F₁-F₉ represent the perceived limiting factors of agile product distribution presented in table 9. The K-S Test mean values and standard deviation as in descriptive statistics of table 9 are greater and less than the liker mean values respectively. The P value < 0.05, and negative and positive upper and lower bound mean interval for the data parameters are indication that the mean of the data parameters is significantly different from the likert mean value 3. This validates the descriptive result of table 3 and leads to accept that the sample variables are limiting factors to agile distribution of petroleum products.

3.2. Supply Consumption Analysis

Table 5 Product Supply and Consumption

Product	Category	2017	2018	2019	
PMS	Import	17,313,512,018	20,147,419,127	20,892,934,107	
	Consumption	18,335,739,889	19,467,446,039	20,584,964,536	
	Local Refinery Output		1,022,227,871	-679,973,088	-307,969,571
			5.58%	-3.49%	-1.50%
AGO	Import	4,277,630,139	4,236,496,957	5,148,860,318	
	Consumption	4,748,102,354	4,583,290,750	5,158,861,275	
	Local Refinery Output		470,472,215	346,793,793	10,000,957
			9.91%	7.57%	0.19%

HHK	Import	340,333,700	537,605,965	128,110,313
	Consumption	944,390,851	619,859,750	270,215,589
	Local Refinery Output	604,057,151	82,253,785	142,105,276
		63.96%	13.27%	52.59%

Source: NBS E-library

Two sources of product supply import and local refinery are identified. Data is sourced from the NBS e-library and products considered are Premium Motor Spirit (PMS), Automated Gass Oil (AGO) and Household Kerosene (HHK). Data parameter of product category examined are import volume, local consumption, and local refinery output in liters for the period of 2017 – 2019 as available on the NBS e-library data base. With regard to table 5 above, data analysis shows PMS import has increased steadily from 17.3 billion liters in 2017 to 20.8 billion liters in 2019 representing a 17.6% increase. The consumption volume also experienced a steady increase form 18.3 billion liters in 2017 to 20.5 billion liters in 2019 representing a 11% increase. The local refinery capacity decreased from 1 billion liters in 2017 to 307 million liters in 2019 representing a 70% decline in output. The local refinery contribution to PMS consumption nose-dived from 5.58% in 2017 to 0% in 2018 and 2019. There is a gap of 679 and 307 million liters of PMS in the 2018 and 2019 respectively which infers smuggled volume PMS. This is also validated by the recorded supply excess against local consumption for the same years. The imports and local consumption of AGO increased from 4 billion liters in 2017 to 5 billion liters in 2019 representing an increase of 25% respectively. Local refining capacity decreased from 470 million in 2017 to 10 million liters in 2019 which is a 97% decline. Local refinery contribution to total supply decrease from 9.9% in 2017 to 0% in 2019. HHK imports decreased from 340 million litres in 2017 to 128 million litres in 2019 representing a 62% decline. Consumption decreased from 944 million litres in 2017 to 270 million litres in 2019 which is a 73.4% decline in consumption. Contribution of local refinery to consumption decreased from 63% to 52%.

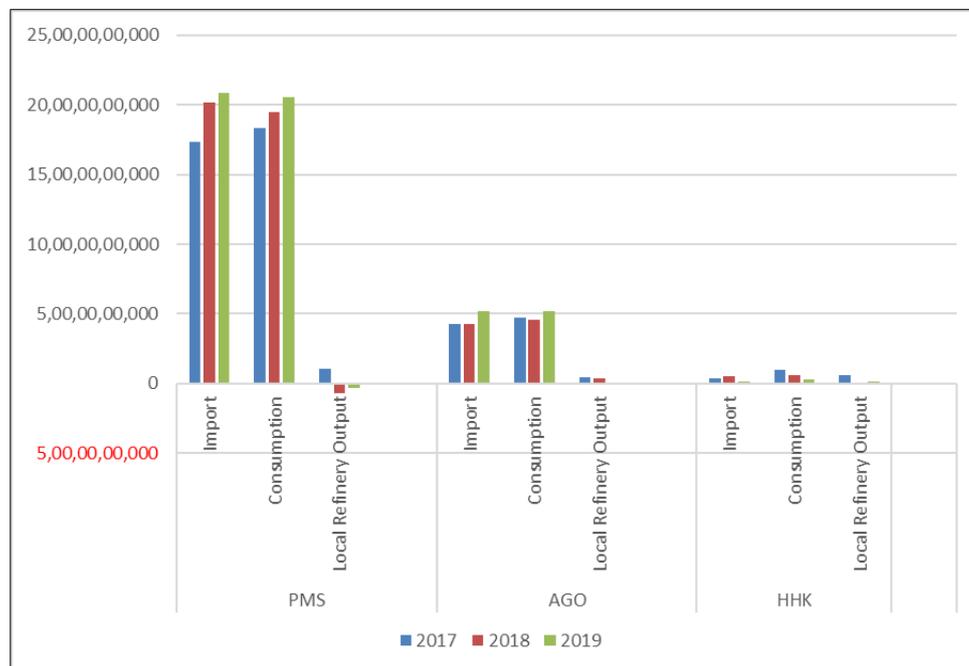


Figure 3 Product Supply and Consumption Analysis

Figure 3 shows local consumption for the years under review increasingly depends on foreign supply of products. Local supply capacity for all product group have declined over the years with PMS reaching negative levels in 2018 and 2019. This explains the reason for low levels of agility in product supply and distribution. There is a limit to which a country will effectively meet her local consumption requirements depending solely on importation.

Dependence on imported refined products is notorious for the high cost of products in the hands of the consumers following rising cost of dollar, cost of production in the exporting countries port clearance and landing costs. It also means Nigeria will not be in control of its supply. Any challenge in production, supply shortage, political unrest or economic concern in the exporting countries will translate to supply shortages in Nigeria. The supply country would

prioritize local consumption and cut short export in the event of production constraints. This will translate to severe shortage to Nigeria, scarcity of product and hike in price as few distributors with products would hoard them to sell at exploitive prices.

3.3. Product Pricing

The study surveys the pump price of AGO, PMS and HHK for the period of 2017 to 2023 to examine how the price of the products have fared over the years. A significant aspect of product agility is continual availability of best quality at affordable prices. But it is unfortunate that the price of the refined petroleum products has continued to increase over the years becoming unaffordable and making life difficult for the people following the attendant hyperinflation bearing in mind that industrial and economic productivity in the country is driven largely by the petroleum energy.

Table 6 Petroleum Pump Price for the period of 2017 to 2023

Product		2017	2018	2019	2020	2021	2022	2023
AGO	Yearly Average	212.73	210.79	227.19	223.69	248.95	664.81	1,152.00
	YOY Difference	0.00	-1%	8%	-2%	11%	167%	73%
PMS	Yearly Average	146.40	154.82	145.45	147.77	166.47	181.01	483.02
	YOY Difference	0.00	6%	-6%	2%	13%	9%	167%
HHK	Yearly Average	297.57	287.70	315.35	340.31	394.02	771.78	1,211.65
	YOY Difference	0.00	-3%	10%	8%	16%	96%	57%

Source: NBS E-Library

Table 6 above presents the yearly average price of AGO, PMS and HHK for the period of 2017 to 2023 alongside with the Year on Year (YOY) percentage increase. The price of the products has increased over the years with YOY percentage increase nearing a 200% for PMS in the year 2023. This is occasioned by the sudden removal of subsidy on the product without plans of local supply. The AGO and HHK reached highest price increase of 167% and 96% respectively in the year 2022. This is also following the removal of subsidy on the products.

4. Study Findings

The agility of petroleum product distribution is a strategy towards uninterrupted supply of refined petroleum products to consumers at affordable prices and best quality. Research observation and finding shows the petroleum supply and distribution in Nigeria have had history of challenges ranging from product scarcity, inconsistent pricing, and quality compromise. At the root of the challenge is festering issues of corruption, mismanagement petroleum resource and infrastructure, lack of local refinery capacity, dependency on importation, poor distribution networks and technology constraints. Lack of local refinery capacity is fuel by corruption, sabotage, and lack of political will. There is no identified radical approach by the government to resuscitate the hitherto moribund refineries and to build new ones. The local refineries currently operate at near zero out levels. Corrupt gains of oil subsidy and importation has engineered the sabotage of any government effort at building local refinery capacity.

Insecurity, pipeline vandalism, theft, and terrorism which disrupt supply are acts of sabotage and militancy that the government must address. Product importation is the reason for increasing cost of petroleum products following rising foreign exchange, devaluation of Naira, rising global oil prices and inflation in the country of import. The product importation itself places foreign exchange burden on the Naira leading to further devaluation of the currency. Also supply disruption in the exporting countries will translate to scarcity in the country of import. Storage capacity constraints, access limitations to retail delivery locations, poor transport infrastructure and networks are transport and distribution challenges which lead to long delivery cycle, high transit time and delivery cost per unit volume. Furthermore, expertise limitations, lack of integrated management system and technology driven process have led to poorly coordinated distribution system.

5. Conclusion

More than 70% of energy requirement in Nigerian for transportation, domestic consumption, economic and industrial productivity depend on petroleum and its derivatives. This is chiefly because of the underdevelopment of electric power

and other sources of energy. Over time, the demand for petroleum products has soared in the following rising population, increasing demand for economic productivity, general logistics and distribution, as well as quest for improved standard of living. While the consumption demand for petroleum product has continued to increase, the issues of scarcity, high prices and corrupt practices which fraught the distribution of petroleum in Nigeria has compounded and successive governments have not shown a political will in addressing them. Significantly lack of local refinery capacity and poor distribution network the study identifies are notorious for supply limitations and rising price of products. Nigeria is blessed with abundance of natural petroleum resource yet depends on importation of refined petroleum products to satisfy her local consumption demand. The reliance on road haulage in distribution is inefficient and possess significant bottleneck and risk to product supply. To ensure the availability of products which meet local demand at affordable prices and even distribution to all regions, the government is tasked to show genuine commitment in addressing the issues identified. Savings from removal of petroleum subsidy as implemented by the current government should be invested in local refinery capacity, revitalization of the pipeline for efficient distribution and development of other sources of energy especially electricity supply to reduce over dependence on petroleum energy.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares that there is no conflict of interest in this manuscript.

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