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Investigating the challenges of refinery construction in Nigeria: A snapshot across two-timeframes over the past 55 years

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ABSTRACT

The sub-optimal performance of state-owned refineries in Nigeria has led to a significant gap in the supply of refined petroleum products (RPPs) in the country. More so, the growing demand for these products has further widened the gap to the range of 500,000 – 600,000 barrels per day (bpd). Consequently, most of the imports for RPPs in Nigeria are being filled from the United States and North-Western Europe at the expense of the Nigerian economy. However, given the abundance of petroleum resources in Nigeria and its long history in the production of oil, it is unfortunate that the local refineries are hardly maintained to meet the needs of the local population. In addition, the inability of the Nigerian state to build additional refining capacity to cushion its domestic supply gap for RPPs has become a major concern. With more than 40 licenses issued to private companies since 2002, only two companies (Niger Delta Petroleum Resources Refinery and Dangote Oil Refinery) have made noticeable progress in new refinery construction. This paper is focused on investigating the current challenges of refinery construction in Nigeria. This is done with a view of comparing the drivers and enablers of productivity in construction in this sector during the period of 1965 – 1989 and how they differ from the current period of 2000 - 2019 in Nigeria. A systematic literature review within the academic journals, source documents from the industry, relevant interviews from published news media and consulting organisations were used to identify and categorise these challenges. The findings of this study were validated by interviews from experts across key industries in this sector. The study reveals that change of ownership structures from the government sector to the private sector between the two eras, present additional challenges. These challenges cut across availability of capital, inconsistent government priorities and access to land for construction. Others include cronyism and corruption, weak political will, unstructured refinery licensing scheme, security challenges and economic factors regarding the regulated downstream market in Nigeria. Key recommendations proffered to help solve these problems include a private sector-led partnership with the government in the form of public private partnerships (PPPs), a review of existing methods for licensing refineries for private organisations, the development of local manpower with relevant technical skills to help lower the cost of expatriate labour and the establishment of more designated clusters as free trade zones within the oil-producing Niger Delta. These recommendations will help lower the entry barriers for private organisations in this sector.

KEYWORDS: Construction, Government Licensing, Performance, Private Refinery, Nigeria

INTRODUCTION

For more than two decades, the performance of state-owned refineries in Nigeria has been sub-optimal, giving rise to significant imports of refined petroleum products (RPPs) into the country (PWC, 2017; Sa'ad & Isah, 2016; Wapner, 2017). Sadly, this development has continued to pose serious challenges to the Nigerian economy as evidenced by the frequent

shortages in the supply of petroleum products (Abila, 2015; Mbunwe, 2014; Odularu, 2008; Sanni, 2014). There are four state-owned refineries with a combined capacity of 445,000 barrels per day (bpd) in Nigeria. This capacity is enough to support at least 70 percent of the country's 630,000 to 700,000 bpd domestic need for refined petroleum products (RPPs). Unfortunately, Nigeria still imports more than 80 percent of its refined oil from North Western Europe and the United States (PWC, 2017; Siddig, 2014). The imported products mainly include petrol (PMS), diesel (AGO), and kerosene (DPK). Researchers opine that this development is hardly expected from a country that has been the largest exporter of crude oil in Africa for many years and has at various times occupied between the 6th and 8th positions amongst the world's largest producers of crude oil (Akpan, 2009; Kadafa *et al.*, 2012). The aim of this paper is to investigate the inability of Nigeria to build additional refining capacity and fully maintain its existing refineries for more than two decades despite incentives.

Since 2002, shortly after Nigeria's transition to democracy, more than 40 licenses have been issued by the government through the Department for Petroleum Resources (DPR). This was to encourage the participation of indigenous private companies in Nigeria's oil and gas sector in order to achieve a more sustainable growth (DPR, 2017). However, the repetitive failures of intending companies bidding to enter the refining sector on a private platform calls for concerns (Angela *et al.*, 2019; DPR, 2017; Nkaginieme, 2005).

According to Industry analysts, PwC (2017), the productivity and performance of Nigeria's refining sector can be improved considerably through policies geared towards the construction of scalable or modular refineries as well as the effective refurbishment of existing ones. After the construction of Nigeria's premier oil refinery in 1965 by a consortium of Shell-BP, the government took up the challenge to build more refineries when it became clear the first refinery was inadequate to cater for the country's growing domestic fuel demands (Turner, 1977). Hence, within eleven years from 1978 to 1989, three refineries with capacities ranging from 100,000 - 150,000 barrels per day (bpd) were completed (Turner, 1977 and Wapner, 2017). Unfortunately, the current trend of increasing demand for RPPs which far outstrips local supply has failed to produce a similar drive for refinery construction to that of the 1970s and 1980s.

It is, therefore, necessary to understand what has changed over the years in the petrochemical construction industry in Nigeria. With all the opportunities for RPPs present in the Nigerian market, it would be rational to ask why it has been difficult to build additional refining capacity for the past 20 years. Similarly, it would be reasonable to uncover the drivers for the success of construction in this sector in the period 1965 – 1989 and understand what has changed since then.

It is these questions that this study seeks to answer as well as provide insights on how the challenges can be overcome in order to enhance productivity in the sector.

LITERATURE REVIEW

The discovery and subsequent export of crude oil from Nigeria launched the country amongst the world's oil-producing countries and essentially changed the dynamics of the country's economic situation (Badejo & Nwilo, 2004). However, reaping the benefits of the petrodollar has not brought much expected gains to the economic situation of Nigeria. Ross (2013) and Eti *et al.* (2004) observed that Nigeria has failed to fully maximise its revenue from petroleum resources to address poverty and unemployment amongst its citizens.

Clearly, as huge quantities of crude oil are exported from Nigeria and refined petroleum products (RPPs) imported back into the country, Nigeria is in effect short-changed in this sort of economic transaction. While some countries in the Middle East and South America such as Kuwait, Saudi Arabia, and Brazil (or even Venezuela) equally endowed with abundant petroleum resources, have historically made important gains from the refining of their petroleum resources; Nigeria still grapples with the imbalances of its foreign-fuel-dominated economy (Bacon & Kojima, 2006; Crystal, 2016; O'Rourke & Connolly, 2003). The result of this is the chronic erosion of its capital budget in the form of fuel subsidies, loss in employment opportunities, missed opportunities for overseas investments and broader economic gains (Balouga, 2012).

Nigeria has four state-owned refineries operated by its national oil company – Nigerian National Petroleum Corporation (NNPC). These refineries have a total installed capacity of 445,000 barrels per day (BPD) and are strategically located across the country with various installed capacities as shown in Table 1.

Table 1: Nigerian refineries with their capacities, locations and year of commissioning (NNPC, 2018)

Refinery Name	Location	Capacity (Bpsd)	Year of Commission
Port Harcourt Refining Company I (PHRC I)	Rivers State	60,000	1965
Warri Refining and Petrochemical Company (WRPC)	Delta State	125,000	1978
Kaduna Refining and Petrochemical Company (KRPC)	Kaduna State	110,000	1980
Port Harcourt Refining Company II (PHRC II)	Rivers State	150,000	1989
Total		445,000	

The first Port Harcourt refinery, built in 1965 was constructed by a consortium of International Oil Companies (IOCs) - Shell-BP (Turner, 1977). It was taken over by the government in 1973 in a bid to gain complete control of its downstream sector (New York Times, 1979 and Wapner, 2017). Subsequently, the government embarked on a series of refinery construction projects engaging different international contractors in order to respond to growing domestic fuel needs. Hence, from 1978 to 1989, three new refineries were completed for the Federal Government as project owners (Ogbuigwe, 2018; Wapner, 2017). Since the completion of these projects, the country has only enjoyed a brief period of self-sufficiency and exports of RPPs (Atumah, 2016; Ogbuigwe, 2018). Despite generating more than 90% of its foreign exchange earnings from crude oil, the supply of refined petroleum to the Nigerian market has been a major struggle for more than two decades (Watts, 2004; Wapner 2017).

Expectedly, this development has received much attention over the years from different government administrations in Nigeria, although without a lasting solution. It is, therefore, necessary to review what the government has done towards mitigating this problem.

Previous Government Efforts to Address Nigeria's Refining Problems

Nigeria's transition to democracy in 1999 witnessed the introduction of certain regulatory changes to help reposition the oil and gas industry for a more sustainable growth. This was a move to encourage local participation in the downstream sector in order to create more prosperity via local content development (Ross, 2013).

Some researchers (Balouga, 2012; Eme & Onwuka, 2011; Nkaginieme, 2005; Ogbuigwe, 2018) have articulated certain measures previously undertaken by the government to achieve these objectives. There is evidence from these studies that government policy over the years towards addressing the petroleum supply gap in Nigeria has taken a multilayer approach. Commencing with the partial deregulation of the downstream petroleum sector in the first term of President Olusegun Obasanjo's democratic administration (1999 - 2003), the government strategy further incorporated policies that would be implemented over time, some by other administrations. These policies were mainly: the issuance of licenses or permits for the construction of private refineries, the award of contracts for the refurbishment and maintenance of government refineries, the attempted sale of the government refineries to private companies, and the withdrawal of the petroleum subsidy on imported RPPs for domestic consumption. Figure 1 shows the timeline of these initiatives.

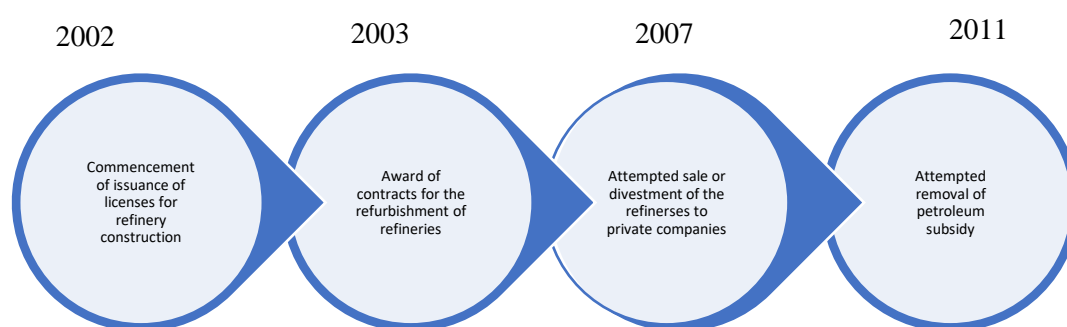


Figure 1: Timeline for Nigeria's downstream sector interventions.

Source: Synthesised from DPR (2017) and Nkaginieme (2005)

Although the first two initiatives were introduced, they have been mostly unsuccessful given the inability of almost all the refinery license holders (except Niger Delta Petroleum Resources and Dangote Oil Refinery) to complete their projects. This is a failure which calls for serious review of the licensing process about the difficulties experienced by the private sector.

Licensing for private refineries

Nigeria's Department of Petroleum Resources (DPR) is mandated with the authority to issue licenses or permits to private investors for the establishment of hydrocarbon processing plants (DPR, 2017). The agency mainly commenced the issuance of these licenses around 2002 without any structured guidelines at the time (Nkaginieme, 2005). However, in 2007, the agency reviewed its policies and made some changes producing an updated guide for the award of licenses. In its current form, DPR (2017) provides three tiers of licensing for private refineries and they include:

License to Establish (LTE)

This is the first stage of the licensing ladder and carries a validity of 2 years. It involves the investor presenting a conclusive feasibility study of the project site including marketing plans,

product specifications, health and safety standards, infrastructural support plans and proposed crude oil (feedstock) supply plans. The LTE application carries a statutory fee of US \$50,000 as well as a service charge of 500,000 Nigerian Naira (about US \$1,400). Putting aside the issue of the fees, the requirements seem quite reasonable except that for feedstock arrangements and that of infrastructure support. Clearly the decision to let investors arrange their own feedstock supply in Nigeria can present some difficulties for the companies. This is because of potential complications that could arise from interfering with existing agreements tying oil producing companies to Joint Ventures (JVs) and Production Sharing Contracts (PSCs) with other parties (Elmaci, 2019). The Nigerian government cannot abdicate this responsibility to private companies alone and must rise to the challenge by making guarantees for the availability of feedstock supplies. One way of doing this could be by demanding that a certain proportion of crude oil produced must be locally refined. In this way, government can partner with producers and refiners to set up special purpose vehicles (SPVs) in which profits can be shared by the partners. Such arrangements must be fair and robust. An alternate practice similar to this has been adopted by China, a crude oil importing nation, as it now guarantees its private refiners certain quotas for crude oil imports (Downs, 2017).

The requirement for infrastructural support plans could also present additional challenges. It is worth noting that there is an absence of good road networks to most of the suitable site locations. Hence, these companies are required to build their own high-grade roads to support the movement of heavy equipment and machinery to and from the project sites. This is an additional financial burden on these companies, which further raises the entry barrier in this industry (Nkaginieme, 2005; Mo Ibrahim Foundation, 2019). The development of designated clusters near seaports with good roads and jetties as free trade zones could help reduce this burden for new entrants. The location of Dangote refinery near the Lagos seaport provides such benefits. However, this will be elusive to other refinery sites located further down the Niger Delta, where the seaports are barely functional. Therefore, more of such infrastructure should be made available in the Niger Delta as well. The second stage of the licensing ladder is the approval to construct (ATC).

Approval to Construct (ATC)

In this stage, the investor is required to submit a detailed engineering plan of the plant, to be reviewed by DPR's engineering team and approved upon satisfaction of certain provisions of their technical guidelines. This stage also carries a validity of two years, within which the investor is required to complete at least 50% of the mechanical erection of the plant as provided in the submitted engineering design plan. The failure to attain this level of completion would necessitate the revalidation of the licence fees. However, it is not clear from the published guidelines if the ATC licensing stage requires additional payment or is attained upon satisfying the requirements of the LTE stage. Also, it is not clear how long a company can remain in the ATC stage as the provision only states that revalidated ATCs cannot be renewed. What support can an organisation receive, which invested much but ran into circumstances outside their control, for any delay to their project beyond the approved date? A detailed clarification of this provision, including how long a revalidated ATC should last, needs to be communicated clearly. DPR also needs to have a strategy for supporting the more progressive companies to reach the final licensing stage and eventually kick-start their operations. Tanaka (2014) chronicles several accounts of state support to mega project development in the oil and gas industry, particularly by Russia, China and France. The use of import waivers for critical equipment can be helpful at this construction stage for the companies. The last stage of the licensing is the license to operate (LTO).

License to Operate (LTO)

This is the final stage in the licensing ladder and requires the completion of the refinery plant manned by well-trained staff and the provision of necessary documentation, including operating manuals. This stage clearly carries a statutory payment of US \$100,000 and another service charge of 500,000 Nigerian Naira (about US \$1,400). After this stage, the DPR begins to monitor the compliance of the refinery to certain standards, including its periodic maintenance programmes. These standards seem quite robust and compares well to that of some of the developed economies and would work if DPR effectively administers it without compromise (EPA, 2018; Gary *et al.*, 2007). Figure 2 (below) shows refinery licensing progression through the three stages, their relative difficulties as well as the number of companies on each stage (DPR 2017).

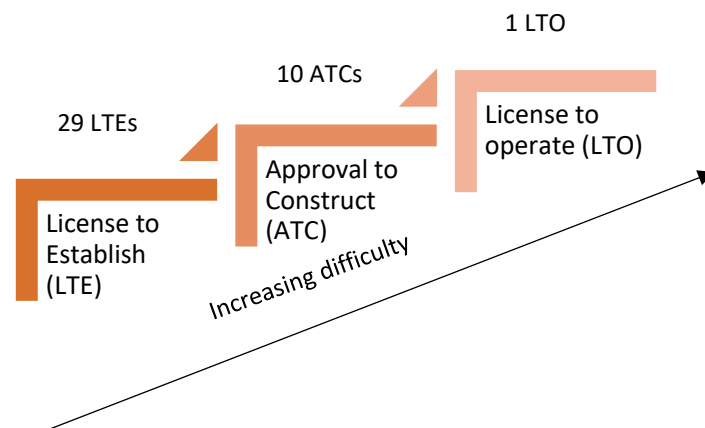


Figure 2: The licensing hierarchy and difficulty levels (Source: adapted from DPR, 2017)

The details of these licenses are provided in Table 2. It is also worth mentioning that there is another kind of license known as approval to relocate (ATR). This is created specifically for plants which may be located outside the country or within the country but whose owners intend to relocate to Nigeria or to another part of Nigeria to continue its operations. A typical example of this license is that of the planned relocation of the 100,000 bpd previously BP-owned African Refinery Port Harcourt Limited (ARPHL) from Turkey to Port Harcourt, Nigeria. This plant is planned to be collocated with the Port Harcourt refineries upon transfer (Egbejule, 2019).

Table 2: Status of licensed refineries by DPR (DPR, 2017)

Licensing Stage	Number of Refineries	Refinery Type	Status
License to Establish (LTEs)	29	22 Modular, 6 conversions and 1 conventional	17 expired and 12 active licenses
Approval to Construct (ATCs)	10	10 modular units	7 active and 3 xpired licenses
License to Operate (LTOs)	1	1 modular unit	1 active license

Conventional and Modular Refineries

A conventional refinery is a standard refinery facility built to fully process variable crude slate into several different product yields. These types of refineries are usually built onsite and takes substantial resources and time (usually from 3 years) to be completed (Gary *et al.*, 2007 and Cross *et al.*, 2013). They also have higher profit margins as they can process multiple range of products. Conventional refineries usually have high capacities in the range of 100,000 to more than 1 million bpd and tend to take longer time to break even as their development costs usually run into billions of dollars (PWC, 2017).

On the other hand, a modular refinery is a crude oil processing plant that has been constructed entirely on skid mounted structures. Each structure contains a portion of the entire process plant, and through interstitial piping the components link together to form an easily manageable process (Cenam Energy, 2012). They normally provide a quick fix solution to economies that have a need to adapt rapidly to local demand. This is because they can be built offsite in modules and transported to the site where they can be assembled. The speed and ease of their construction, including their relatively lower capital cost requirements are their key advantages. A typical 20,000 - 30,000 bpd modular refinery may cost between \$180 – 250 Million and may take between 12 - 18 months to build (PWC, 2017).

Refinery Refurbishment Programmes

On the effectiveness of the refurbishment of existing refineries, Figures 3 and 4 show the capacity utilisation of the refineries for a period of eighteen years from 2001 to 2018 and a comparison of Nigeria's refineries' utilisation rates with that from similar economies in Africa (top 3 African economies).

This figure shows a fluctuating performance and gradual decline of the refineries' production rates to below 30%. This does not compare well with the performance of refineries from other countries with a similar economy to Nigeria, which have maintained the performance of their refineries up to, at least, 65% between the years 2013 – 2018. Clearly, the steady decline in performance of NNPC refineries demonstrates the ineffectiveness of any maintenance programmes in the last two decades.

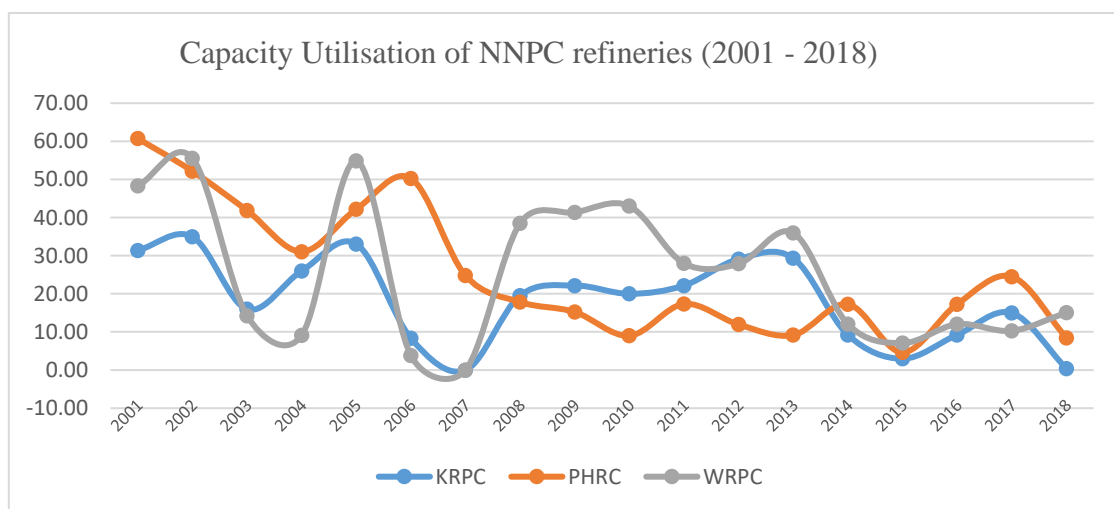


Figure 3: Capacity Utilisation of NNPC refineries (2001 - 2018).
Source: Adapted from NNPC Annual Statistical Bulletin, 2001 – 2018

Figure 4 highlights how ineffective Nigeria's refinery asset management system has been compared to its similar economies in Africa.

However, as at the time of this write up, all the refineries have been inoperative for more than a year due to ongoing assessment for a major turnaround maintenance. In addition, there has been discussions between the Nigerian government and some foreign technical partners such as Saipem, General Electric, Eni and commodity traders such as Vitol and Trafigura on special arrangements to refurbish and operate the refineries. Meanwhile, no developments have resulted from these discussions yet (Reuters, 2018).

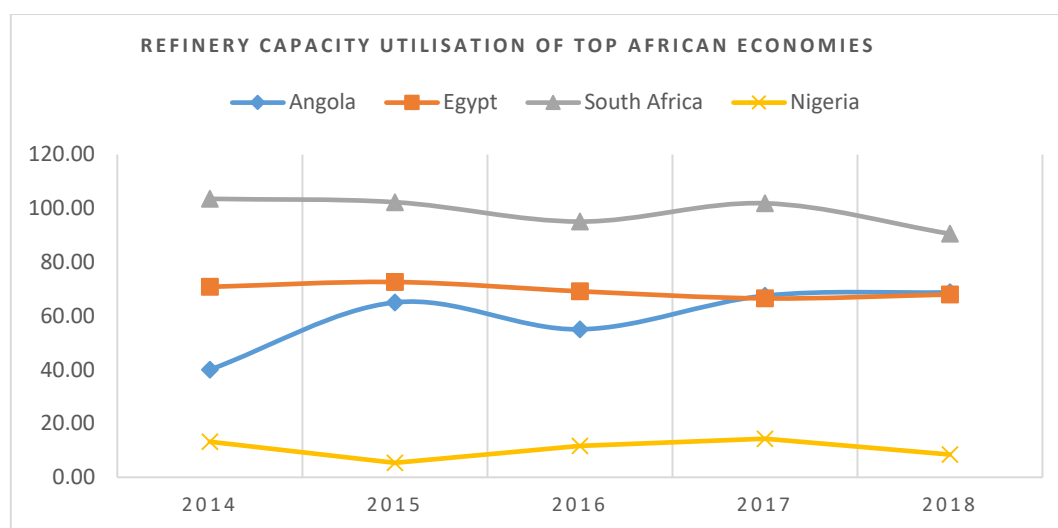


Figure 4: Refinery capacity utilisation of top African economies
Source: Adapted from OPEC annual statistical bulletin 2017

The need for public private partnership (PPP)

Public Private Partnership (PPP) has been suggested by experts and scholars as a viable means of building Nigeria's infrastructure, including the downstream assets such as refineries (PWC, 2017; Unya, 2015). PPPs are partnership arrangements between a public sector entity and a private sector entity, which are created for the development and management of public infrastructure or assets for a specified period based on agreed commercial terms (Vining *et al.*, 2008; Yescombe, 2011). Essentially, PPPs represent a form of shared service delivery between the public and private sector in which the private sector supports a public sector project through financing, construction or management of the asset in return for a stream of income from the government or indirectly from the users (Boardman *et al.*, 2005; Vining *et al.*, 2008).

Although there has been concerns over sustainable use of PPPs in Nigeria mainly due to a lack of trust for government's contribution and possible expropriation by future administrations (Akanfe *et al.*, 2014; PWC, 2017). However, studies have shown that PPPs when carefully designed can yield better economic growth by helping Nigeria develop its critical infrastructure, including the refineries (Akanfe *et al.*, 2014).

METHOD

This paper adopted a systematic literature review to investigate the difficulties of refinery construction in Nigeria across two different time horizons: 1965 – 1989 and 1999 – 2019. According to Grant and Booth (2009), a systematic literature review seeks to systematically search, appraise and synthesize research evidence into a conclusive whole. For this study, relevant publications covering academic journals, books, conference papers, government

publications, and consultancy papers were used to compare the productivity drivers and challenges in building Nigeria's refinery infrastructure across the two time-horizons.

In their study of government-owned refineries in Nigeria, Badmus *et al.* (2012) and Jesuleye *et al.* (2007), observed that there is a scarcity of journals within the academic literature precisely dealing with the overall assessment of Nigeria's refineries. Also, more recent studies on Nigeria's refinery problems deal mostly with issues of policy and economics rather than that of construction and infrastructure challenges (Ogbuigwe, 2018). While this study is focused on construction drivers and impediments for the refining industry in Nigeria, very few articles were found to focus precisely on this topic (Nkaginieme, 2005). Instead, most research in this sector tend to focus on specialised fields or disciplines ranging from Engineering (Eti, Ogaji & Probert, 2004; Jesuleye *et al.*, 2007; Mbunwe, 2014), Economics (Musa, Hounsou & Adeyele, 2014), Business Administration (Sanni, 2014), Management, Social and Political Sciences (Baghebo & Beauty, 2015; Iwayemi, 2008; Ngwu, 2014; Wapner, 2017). Although these studies focused on specialised areas, a few were relevant to this study as they discussed some of the key underlying issues.

To this effect, literature for this study was searched across databases such as Elsevier, SpringerLink, OnePetrol and Google Scholar; all of which have a good reputation of quality publications across disciplines that cover construction projects as well as those for the oil and gas sector. Keywords used for the search includes refinery construction, Nigeria's refineries, licensing refineries, private refineries, performance of refineries, and government refineries; used in various combinations.

Inclusion and exclusion criteria

A total of 320 articles were produced from the initial search across the databases. However, this included a wide range of unrelated topics, including biorefineries, sustainable energy, flare gas refineries, gas-to-liquids technology, petrochemical supply chain, oil subsidy reforms and cybersecurity of petrochemical attacks in Nigeria. When all the non-related items, including duplications across the platforms, were filtered out, only 11 academic journals were identified with reference to the initial keywords. It is important to state that the exclusion criteria were based on relevance of the papers to the context of the study after checking the abstracts, introductions, and conclusions of the articles for relevance to the topic. Some fee articles were also dropped as their full copies could not be accessed.

Then the list was expanded using a single-step forward and reverse snowballing approach to look at some of the references within the 11 articles, including suggested contemporary issues, which focused more on factors limiting refinery construction in Nigeria. This is because a snowballing approach can be useful for obtaining more research samples where data or participants can be hard to reach and makes it easier for studies to take place where they otherwise would have been impossible due to a lack of sufficient data (Sadler *et al.*, 2010). Following this approach, additional 8 articles were identified comprising policy documents, government records, consultancy reports and excerpts of interviews from national dailies pertaining to developments and challenges of Nigeria's refining assets. Consultancy papers from organisations such as PwC that hold substantial information on Nigeria's oil and gas development were particularly useful due to the quality of data they possess as a result of their years of experience in Nigeria.

These materials provided relevant information for the research topic. A total of 19 articles were finally reviewed. Among the materials selected, the oldest publication dates to 1977 and provided a rich and foundational basis for this study. Figure 5 shows the schematic of the research process employed for this study.

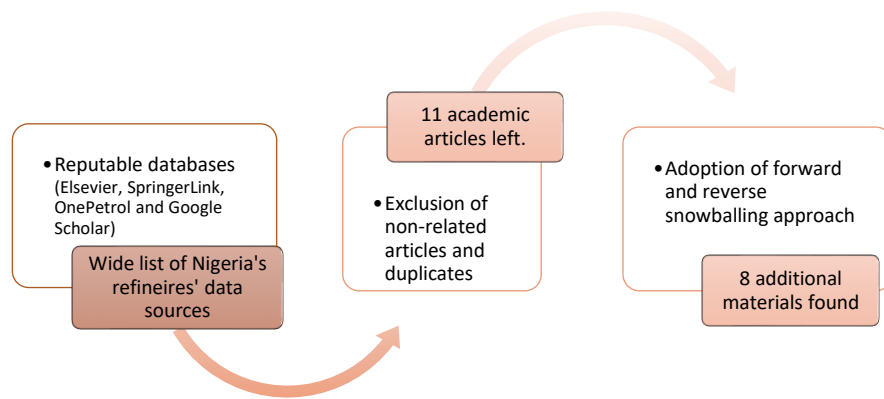


Figure 5: Literature search process

After carefully reviewing the selected literature, some data were extracted from the publications, which include the author(s) and year of publication, research title, summaries of major findings, research method adopted and publication sources. The summaries of these findings are presented in Table 3.

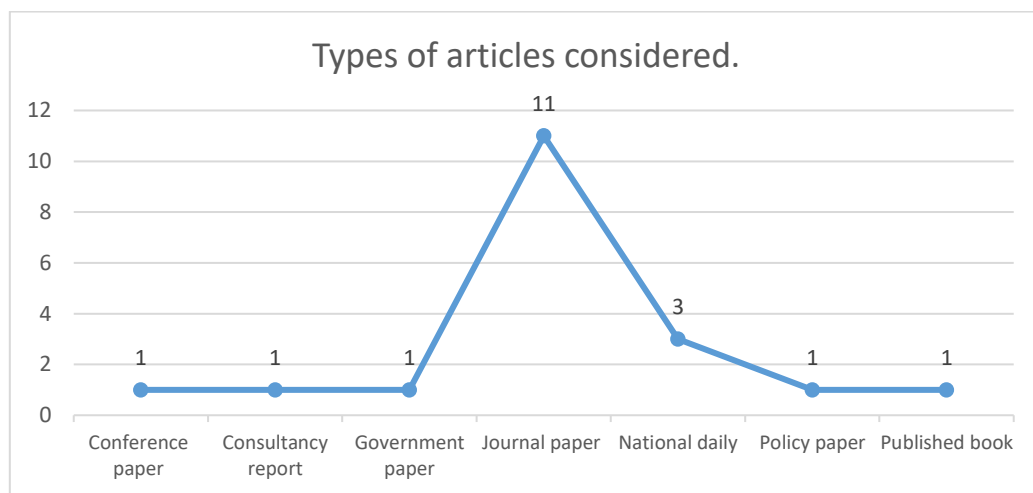


Figure 6: Types of articles considered

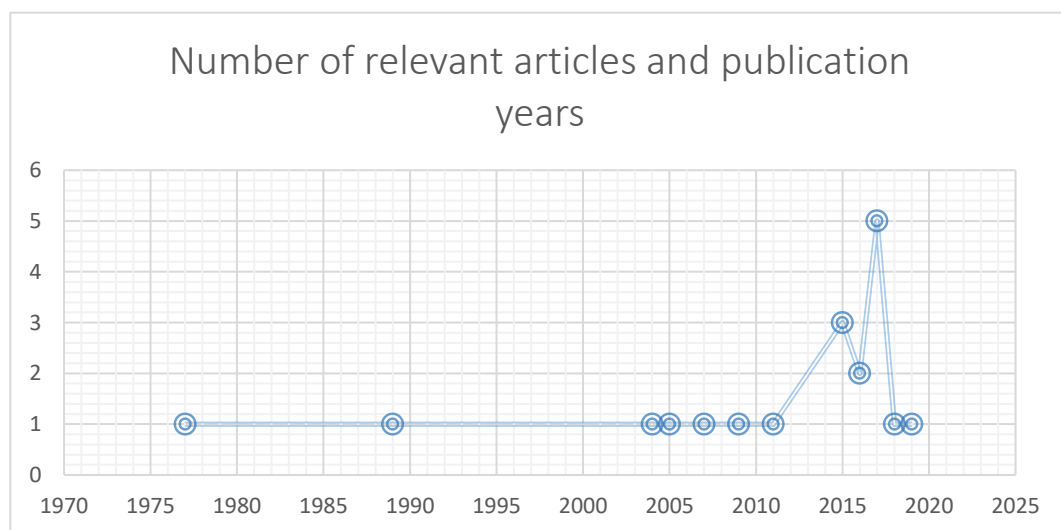


Figure 7: A chart showing the number of articles selected and their year of publications

From Table 3 (on page 67), an excel spreadsheet was used to conduct a simple descriptive analysis of the selected publications used for the study. It can be observed that journal articles constituted most of the selected sources with 11 articles as shown in Figure 6.

Similarly, it can be observed from Figure 7 that most of the publications were dated from 2015 to 2019.

The study identifies nine categories of factors from the findings of Table 3. These factors have been categorised as shown in Table 4 (on page 71) as a comparison for developments across the two eras regarding the construction of Nigeria's refinery infrastructure.

DISCUSSIONS AND ANALYSIS

From the Table 4, there were nine main categories of factors, which can be deduced from the findings of the selected literature. These can be summarily disused as follow:

Project Ownership

Nigeria's transition to democracy from 1999 brought about the introduction of certain policy directions to devolve the downstream petroleum sector for a more sustainable growth (Nkaginieme, 2005; Ross, 2013). As such, there was a shift in focus in the ownership structure of oil and gas infrastructure mostly from government to private sector. This development led to a more structured approach for the issuance of permits and licenses to private investors for refinery construction. Hence, rather than build more refineries by itself, the government decided to allow the private sector to drive the initiative, while it regulates and monitors the activities. (DPR, 2017; Ogbuigwe, 2018).

This change of ownership structure also brought some associated challenges with it, especially with the manner resources are accessed for such projects.

Availability of capital and inconsistent government priorities.

The injection of petrodollar from the oil windfall of the 1970s coupled with the boom for oil and gas infrastructure development at the time, fuelled developments of built assets and facilities in the industry (Strassmann, 1989). Although the current period (1999 – 2019) has equally enjoyed some important gains from oil, especially in the period of 2007 to 2014; however, government attention has focused less on oil infrastructure developments compared to public capital projects. Also, the prolonged delay with the passage of the Petroleum Industry Bill (PIB), including the uncertainties surrounding its implementation have deterred investors from such undertakings (Gary *et al.*, 2007; Osunmuyiwa & Kalfagianni, 2017; Ogbuigwe, 2018; Speight 2010). In addition, the long regulated downstream market for RPPs has made development projects in the sector economically unviable (Nwachukwu, 2015).

Access to land for construction

With government as project sponsors in the 1970s, project financing was much easier buoyed by the influx of petrodollar from the oil windfall of the 1970s (Cole, *et al.* 2015; Osunmuyiwa and Kalfagianni, 2017). Land capital was also much easier for the government to obtain given the promulgation of Land Use Act in 1978, which allowed the federal government unrestricted access to large parcels of land without due compensation to the community stakeholders (Ako 2009; Pedersen & Kweka, 2017). Conversely, the process of land acquisition in the current era for the private sector requires more participation of community stakeholders, hence more challenging for the organisations (Pedersen & Kweka, 2017). This places a certain financial burden not necessarily experienced by the government in the previous era (DPR, 2017; Nkaginieme, 2005).

Cronyism and corruption

During the previous era of 1965 – 1989, the issue of cronyism and corruption, especially regarding the diversion of RPPs to neighbouring countries were near absent. Presently, there is a highly connected import cartel who benefit from import subsidy payments and thereby frustrate govt. policies towards refinery establishment (Chikwem, 2014). The government itself has either shown incompetence or little regard to punish the culprits and stem the tide of corruption in this sector (Boyo, 2015; Chikwem, 2014/2016; Nkaginieme, 2005; Ogbuigwe, 2018).

Political will

The high political will of the previous era was buoyed by government's desire to build and own its own refining infrastructure as this was considered signs of development (Turner, 1977). Unfortunately, in the current era, government has displayed moderate to low political will towards this issue compared to the previous era. This is because government communicates willingness to get the sector working but does little to turn around the situation (Chikwem, 2016; Eti *et al*, 2003; Nwachukwu, 2015, Ogbuigwe, 2018; Wapner, 2017)

Licensing scheme

The Petroleum Act of 1969 drafted by the federal government provided the guidance for the establishment of hydrocarbon processing plants in the previous era. As such, it was much easier for the government to operate by their own agreement. Current licensing scheme by the DPR designed for the private sector has proved ineffectual and have been considered by private investors to contain requirements presenting high entry/exit barriers (Nkaginieme 2005; Nwachukwu, 2015).

Security Issues

Oil and gas infrastructure in Nigeria were hardly the target of any violent attacks in the previous era except for the brief period of Nigeria's civil war from 1967 to 1970 (Turner, 1977). As such, the previous era witnessed none of the challenges of the current period, whereby hostilities in the Niger Delta has mainly targeted oil and gas infrastructure (Ogbuigwe, 2018; Wapner, 2017). Particularly hit are the oil pipelines conveying crude oil to and from oil terminals, flow stations and refineries. The preponderance of such occurrences deters investors from embarking on multimillion-dollar infrastructure projects in Nigeria such as refineries. This incidence also increases the operational costs of doing business in Nigeria. Such is reflected in the form of additional cost for the procurement of security for the built assets and personnel as well as repairs and replacement of damaged equipment. Hence, making such projects even costlier than importing refined oil.

Economic factors and regulated downstream market

Given that the construction of refineries requires the importation of specialised equipment and expatriate labour, the constantly fluctuating Nigerian currency makes access for foreign exchange more difficult (Ogbuigwe, 2018). In addition, the regulated downstream market makes it impossible for private organisations to profit from any investment in the Nigerian environment (Wapner, 2017). This contrasts with the practice, whereby the government absorbs the shortfall in selling RPPs to the public by paying subsidies on the products. This condition cannot be applied to the private sector which needs a free market to thrive based on profits.

LIMITATIONS OF THE STUDY

The articles for this study were sourced by a single researcher but the process was supervised by two independent senior researchers. Hence, the potential for omission of some important articles remain. A further limitation arises from the use of only materials available via online sources. The exclusion of fee articles, which cannot be fully accessed as well as the reliance on some non-academic materials such as consultancy papers and government publications, which contain relevant information not available in academic journals may place a limit on academic quality of publications used. This may be explained by the fact that the studies focusing on refinery construction challenges in Nigeria as a context is yet to attract as much academic discourse as those written for its technical and social science perspectives. Finally, the study may be limited to the search parameters used for material selection. The expansion of search keywords and databases in the future could yield additional materials, which can be more systematically analysed to further enrich this study.

VALIDATION

The validation of some of these findings is done using data from interviews conducted with five professionals who work in two different organisations in the Nigerian oil and gas sector.

Table 5 represents the major findings from these interviews on why private organisations are finding it difficult to build refineries in Nigeria. The codes in Table 5 represents the roles and organisations of the interviewees. MNGR1 and 2 represents Manager 1 and 2 and ENG1, 2 3 represents Engineers 1, 2 and 3 and ORG1 and 2 represents organisations 1 and 2 respectively.

From the interviews, it can be observed that the first manager from the first organisation (MNGR1), raised issues such as regulated downstream market, corruption in the sector, and a lack of trust for sustainable government policies. This echoes the findings of many of the researchers including: Chikwem (2014/2016), Nkaginieme (2005) and Ogbuigwe (2018).

Similarly, ENG1 echoes same sentiments about lack of seriousness on the part of government, especially with the delay in the passage and implementation of the PIB, fixed pump price and challenges of foreign supplies of materials. This echoes the findings of, Nwachukwu (2015), Ogbuigwe (2018) and Wapner (2017).

Also, ENG2 observes that refinery construction is a highly capital-intensive project with seemingly little returns. He also identifies more problems with insecurity and difficulties in raising funds, including weak government policies and inability to tame corruption. These observations reflect the views of Chikwem (2014/2016), Eti *et al.* (2003), Nwachukwu (2015), and.

Furthermore, according to the second manager from the second organisation (MNGR2), building refineries in Nigeria is presently hardly economically attractive. With much reliance on foreign expertise and very little supporting infrastructure, the project becomes even costlier. In addition, there is usually some lengthy and difficult trouble to navigate around getting land and settling with communities. Also, the fixed pump price or regulated downstream market is hardly able to justify all the cost. This view reflects the submissions of Pederson and Kweka (2017), Nkaginieme (2005), Ogbuigwe (2018) and Osunmuyiwa & Kalfagianni (2017).

Lastly, the ENG3 respondent observes that the current licensing schemes is not accompanied with strong vetting systems. There is hardly any government policy that looks into this. There is need for capital, a free unregulated downstream market and waivers for importing equipment to enable some companies to scale through some of the challenges. This is mostly in line with the observed loopholes in DPR's licensing scheme (DPR, 2017; Eti *et al.*, 2003).

Table 5: Findings from interviews

ROLES	ORGANISATION	MAIN FINDINGS
MNGR1	ORG1	The regulated downstream petroleum sector in the country makes investing in refineries uneconomical.... there are many other challenges the private sectors face in building refineries...the corruption in the system makes it very difficult to trust the government. If a company receives crude oil allocation from the government on certain terms, what is the guarantee that future administrations will continue to honour the terms of the agreement. Again, with the pump price of oil fixed, how can the companies make profit? Will the government also continue to pay us subsidies? Is it sustainable?
ENG1	ORG1	I don't think that the government is serious in pursuing that initiative. If they had passed the PIB since these years and made certain enforcements, most companies would have found a way....although raising the capital requires assurances that there will be a good return on that investment...you see, fixed pump price must be removed for the companies to thrive on a free market...the equipment and labour are mostly foreign and our poor exchange rates does not make matters any easier...certain partnerships may be required to achieve this more smoothly and the companies under such agreements must have something to complement each other. Under the right business environment, this can be done more easily but not so much here...
ENG2	ORG1	It's a very capital-intensive venture with potentially very little returns given the current environment. The insecurity in the country makes it even riskier and more costly. Raising billions of dollars for such projects may not interest most lenders for a country like Nigeria...government support will be paramount to realise that objective. There must be strong policies followed by actions...and government must be willing to tame corruption and allow a conducive environment...
MNGR2	ORG2	Days are gone when refineries are considered to be economically very attractive. It is very capital intensive to embark on such projects. We rely a lot on foreign equipment and expertise for such complex facilities and it costs a lot of money. Even the infrastructure to support such investments is lacking and as such everything will need to be built from scratch. After going through the trouble of finding a suitable location for the project, the community must be settled. Sometimes it is a very lengthy process requiring meeting a lot of unreasonable demands. Putting all that issue aside, what rate of return can a company expect from a fixed pump price? The economics has to justify all the trouble...
ENG3	ORG2	The reason why most companies appear to fail here is because government issues license to almost anybody that comes to them and say they want to build refineries without properly checking them out. If a company is willing to pay the initial capital for a license, they usually get it but unfortunately most of those companies lack the experience and wherewithal to complete such projects. If there is a strong criterion backed by policy, it will become a more serious business... Can't you see how far Dangote has gone? If we have four to five more serious people like that, with government support, there can be serious progress with private refineries in Nigeria... Though a lot of challenges must be overcome. Capital, free market, supporting infrastructure and waivers for the import of equipment must all be thoughtfully considered...

CONCLUSIONS

The objective of this study was to investigate the difficulties of building refineries in Nigeria during the period of 1999 – 2019 as opposed to the ease of constructing same in the era of 1965 – 1989. This is because despite numerous efforts to change the status of the sector through the construction of new refineries, the situation has remained unchanged. This study was conducted using a systematic literature review comparing drivers and enablers of the previous era with the situation of the present. Findings from selected sources were categorised and later validated with interviews with five professionals across two notable organisations.

The current study contributes much to academic literature by helping to fill the gap in knowledge through the identification of some challenges with the construction of refineries in Nigeria since 1999 to present. The synthesis of findings from academic studies, consultancy and government papers in this study further enriches the academic knowledge on the subject. According to this study, there are nine main areas in which the current period of 1999 – 2019 has witnessed remarkable challenges, which differ from those of 1965 - 1989. They include changes in factors such as project ownership, availability of capital and inconsistent government priorities. Others are issues with access to land for construction, cronyism and corruption, political will, refinery licensing scheme, security challenges and economic factors regarding regulated downstream market in Nigeria. Suggestions proffered are as summarised as below.

It would be beneficial for the Nigerian government to investigate several models of partnering with the private sector using a suitable form of PPP/PFI to build and operate new refineries on their behalf. This model can also be used to refurbish and operate the existing refineries. For example, the model currently operated by the Nigerian Liquefied Natural Gas (NLNG), whereby the stakeholders (government and the private IOCs) set up an independent private entity with the authority to run its operations with minimal interference, could be borrowed. This way, the government could (through partnership) leverage financing from the private sector, such as the IOCs, with expertise in such fields to build, refurbish and run a functional refining asset. The total deregulation of the downstream sector will be crucial for the realisation of this objective as the entity would thrive better in a free market environment.

Also, a review of the existing licensing framework for refinery construction by the indigenous players is necessary to incorporate modalities that will ensure that only capable organisations are licensed and supported to achieve their objectives. This will imply the inclusion of strong vetting systems that will ensure only companies with reasonable experience and strong links with qualified foreign technical partners and financial integrity are licensed.

The training and development of local skills and manpower will contribute towards lowering the cost of hiring personnel and material from foreign countries in building Nigeria's refinery infrastructure. In addition, the establishment of more designated economic zones within the oil-producing Niger Delta where land can be allocated to the licensed companies at affordable rates will help lower the entry barriers for indigenous players.

The impact of this study for refinery construction in Nigeria lies in understanding the implications of the identified challenges for organisations. As such, there is need for government's cooperation with the private sector to overcome these challenges in order to realise the objectives. The Nigerian government can achieve this by adopting the recommendations of the findings of this study. This must also be backed by a clear commitment through policies that will support and encourage the local organisations.

In the future, further studies can be carried out on the Dangote Oil, Niger Delta Petroleum Resources and other private refineries, to investigate how these organisations managed to scale through some of these challenges, including their experience in building the current Nigeria's refining infrastructure.

Glossary

Abbreviations	Full Meanings
BPD	Barrels per day
IOC	International Oil Company
KRPC	Kaduna Refining and Petrochemical Company
NNPC	Nigerian National Petroleum Corporation
PFI	Public Finance Initiative
PHRC	Port Harcourt Refining Company
PPP	Public Private Partnership
RPPs	Refined Petroleum Products
WRPC	Warri Refining and Petrochemical Company

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Table 3: Selected literature and main findings

AUTHORS	RESEARCH TITLE	MAJOR FINDINGS /FACTORS	RESEARCH METHOD	PUBLICATION SOURCE
Strassmann (1989)	Rise, fall and the transformation of overseas construction contracting.	There was a global construction boom in the 1970s and 1980s with developed countries exporting construction jobs and earning huge sums. This was later followed by less developed Countries (LDCs) like South Korea, India, Pakistan and recently China joining to make their fair share in the booming construction market. Nigeria and other African countries were recipients of this boom	Content analysis	Journal paper
Andrews <i>et al.</i> (2015)	Education and Training for the Oil and Gas Industry: The Evolution of Four Energy Nations: Mexico, Nigeria, Brazil, and Iraq.	Oil windfall of the 1970s fuelled massive government investment on infrastructure in the oil and sector. In addition, the long political stasis by the national assembly in passing the PIB contributed to high levels of uncertainties in investment in the industry. Also, govt policy for the oil and gas sector has been unsustainable, unreliable and lacking in effectiveness. Too much focus given to the upstream sector and disregard for the development of the downstream sector	Content analysis	Journal paper
Speight (2011)	Chapter 10: Refinery of the future. The refinery of the future, William Andrew Publishing, Boston. 315-340.	Global refining technology is changing with the need for more complex plants able to process heavier and more diverse crude slate favouring more profits than the simpler plants. Current requirements to adhere to stricter environmental standards implies more expensive technology to meet current refining challenges.	Quantitative analysis	Journal Paper
Ogbuigwe (2018)	Refining in Nigeria: history, challenges and prospects.	Attacks on pipelines and regulated petroleum product prices by govt. present challenges to investors. The continual management and maintenance of pipeline infrastructure raises project lifecycle cost.	Content analysis	Journal paper
Eti <i>et al.</i> (2004)	Petrochemical industry in Nigeria: a performance appraisal.	Construction of refinery assets in Nigeria is highly dependent on expatriate labour and know-how, as well as imported equipment. There is need for Nigeria to break away from traditional and outmoded indigenous and industrial procurement models and embrace changes that	Content analysis	Journal paper

		will make development and maintenance of refinery infrastructure more viable and sustainable.		
Osunmuyiwa & Kalfagianni (2017)	The Oil Climax: Can Nigeria's fuel subsidy reforms propel energy transitions? <i>Energy Research & Social Science</i> , 27, 96-105.	There is huge opportunity for investment in Nigeria's refinery infrastructure given the high demand for energy, which is driven by population growth. Oil boom in the 1970s fuelled initial construction in the Nigerian refining sector.	Content analysis	Journal paper
Pedersen & Kweka (2017)	The political economy of petroleum investments and land acquisition standards in Africa: The case of Tanzania. <i>Resources Policy</i> , 52, 217-225.	Land acquisition for oil and gas infrastructure development can be complex and difficult for private companies not only in Nigeria but across Africa. The private sector provides a more participatory route for land acquisition with the host communities whereas the government has a more forceful policy for taking up land with little or no participation from stakeholders.	Case study	Journal paper
Turner (1977)	Two refineries: A comparative study of technology transfer to the Nigerian refining industry. <i>World Development</i> , 5(3), 235-256.	Political will was very high in Nigerian government to own its own refinery asset as this was considered a major sign of development at the time. Also, the possibility of self-sufficiency for RPPs promised certain guarantees of security for oil at the time. In addition, the competition amongst oil majors to supply downstream technology such as refinery infrastructure to oil-rich countries was done partly in exchange for stable crude oil supplies.	Case study	Journal paper
Chikwem (2016)	The Political Economy of Fuel Importation Probes and Development of Refineries in Nigeria.	The interplay of class interest and power relations aids and abets corruption amongst cabals benefiting from petroleum subsidies in Nigeria. This cabal is determined to frustrate Nigeria's efforts to attain self-sufficiency for RPPs via the development of refining assets. The inability of Nigerian government to punish and deter the culprits inspires little investor confidence.	Qualitative analysis	Journal Paper
Ako (2009)	"Nigeria's Land Use Act: An Anti-Thesis to Environmental Justice"	The promulgation of land use act by the Nigerian military government in 1978 gave the government unrestricted access to vast amounts of land in	Qualitative analysis	Journal paper

		the Niger delta for oil and gas projects without due compensations for the communities.		
Nkaginieme (2005)	The challenges of building a new refinery in Nigeria with limited energy infrastructure & regulated petroleum products market	Initial licenses awarded to private refineries could not yield fruit as the scope and large financial outlay required for the project precluded the awardees from breaking ground. Also, high entry barriers in terms of cost to build and purchase relevant equipment as well as high exit barriers for potential liabilities all contributed to further complicate the task. In addition, the perception from foreign counterparts that many African countries carry additional risk involving currency fluctuations, local content requirements, corruption, political, civil and economic instability contributed to difficulties in fostering partnership with local players.	An overview paper	Conference paper
Gary <i>et al.</i> (2007)	Petroleum refining technology and economics	Economies of scale tend to favour the expansion of existing refinery infrastructure to the construction of new ones. Also, shrinking global margins for refineries currently make it more difficult and economically unviable to build new refineries.		Published book
Atumah (2016)	Nigeria's Oil Refineries in Oblivion	There is enough incentive for investment in building Nigeria's refining infrastructure, including the potential for exports. Growth in energy demand was a major driver for refinery construction in Nigeria between 1975 and 1989. The market value for the construction of the last three refining assets was nearly 2 billion dollars and this was mostly filled by expatriate labour.	Interview report	National daily
Nwachukwu (2015)	Buhari approves 65 licences for private refineries	The challenges of refinery construction in Nigeria are tied to political, land, funding, crude feedstock and market availability. The difficulties of securing capital from banks due to high collateral or guarantees also constitute additional barriers.	Interview with a refinery expert	National daily
Boyo (2015)	Fuel imports: the real cabal	There is a cabal of Nigerian importers determined to frustrate efforts to salvage Nigerian refineries in order to continue reaping from the petroleum subsidy funds to the detriment of the national economy.	Qualitative	National Daily

PwC (2017)	Nigerian refining revolution	Refineries are highly capital intensive; with the conventional ones running into billions of dollars for construction and the modular types into tens of millions of dollars. Nigerian investors may not have the financial muscle to invest in the more profitable conventional types but may do better with the modular ones. However, due to economies of scale, the conventional types are more profitable than the modular types except for the diesel units which may have a more limited market size.	A country analysis	Consultancy report
Wapner (2017)	Key Points Downstream Beneficiation Case Study: Nigeria	There is enough incentive to invest and build Nigeria's refining infrastructure. The growing demand for RPPs which is fed by imports from foreign countries and the local availability of crude oil to supply the refineries provide evidence to this fact. However, govt policies towards the realization of this objective has been incoherent and ineffective.	Qualitative	Policy paper
DPR (2017)	Guidelines for the establishment of hydrocarbon processing plants in Nigeria	Three tiers of licensing scheme are presented. There are certain bureaucracies associated with the guidelines and requirements to navigate these steps, which raise the barriers of entry for some organisations.	Government guidelines	Government paper
Angela <i>et al.</i> (2019)	Challenges and prospects of converting Nigeria illegal refineries to modular refineries	Some companies which expressed interest in refinery construction encountered difficulties at various stages of the projects. Common reasons cited by many include insufficient funds for capital project, political issues, government price regularization on products, un-conducive environment, power and security challenges and the unwillingness of the Federal Government to support local investors	Expert views	Journal Paper

Table 4: Summary of differences for key drivers in refinery construction for the 1965 - 1989 versus 1999 - 2019

FACTORS	1965 - 1989	1999 - 2019	KEY REFERENCES
Project Ownership	Government was project owners/partners or sponsors of the refinery construction projects in this period.	Since after Nigeria's transition to democracy, the focus of ownership of new refinery assets now rests with the private sector, which face different challenges from those experienced by the government in the previous era.	Turner, 1977; Ogbuigwe, 2018; Nkaginieme, 2005; Olufolahan <i>et al.</i> , 2017 and Nwachukwu, 2015
Availability of capital and inconsistent government priorities.	The massive injection of petrodollar arising from the oil windfall of the 1970s coupled with the construction boom in the oil sector at the time, fuelled developments of built assets and facilities in the industry.	Although the current period has equally enjoyed some fluctuated price increases from oil (2007 – 2014), government attention has, however, focused less on oil infrastructure developments compared to public capital projects. Also, the prolonged delay with the passage of the Petroleum Industry Bill (PIB) as well as uncertainties about its implementation may have deterred investors from such undertaking.	(Ogbuigwe, 2018; Pedersen, Kweka 2017a, Nkaginieme, 2005 and Nwachukwu, 2015; Strassmann, 1989; Speight 2010, Gary <i>et al.</i> , 2007 and Osunmuyiwa & Kalfagianni, 2017)
Access to land for construction	The introduction of land use act (1978) under the military government paved the way for easier access to land by the state than it is for the private sector, which bear this as additional burden.	The process of land acquisition for the private sector is more participatory with stakeholders who must be compensated than it was for the government in the previous era. Also, low investor confidence and perception of Nigeria as a high-risk nation by most lending institutions make access to loan capital more difficult for local players.	Ako 2009; Nwachukwu, 2015)
Cronyism and corruption	This was hardly a hindrance for infrastructure developments in the oil sector at the time.	Highly connected import cartel who benefit from subsidy payments frustrate govt. policies towards refinery establishment.	Chikwem, 2014 and Chikwem, 2016; Ogbuigwe, 2018; Nkaginieme, 2005 and Boyo, 2015
Political will	Political will in government circles was quite high in this era as the ownership of such assets as refineries were considered major signs of development.	Moderate to low political will. Government communicates willingness to get the sector working but does little to turn around the situation. This is partly connected to corruption fuelled by personal gains for politicians and their cronies.	Chikwem, 2016, Nwachukwu, 2015, Ogbuigwe, 2018; Wapner, 2017 and Eti <i>et al.</i> , 2003
Licensing scheme	The Federal Government drafted the Petroleum Act of 1969, which governed the establishment of hydrocarbon processing	Current licensing scheme by the DPR designed for the public sector has been ineffectual and considered by private investors to contain requirements presenting high entry/exit barriers.	Nkaginieme (2005); Nwachukwu, 2015

	plants. As such, it was much easier for the government to operate by their own agreement.		
Security Issues	There were hardly any incidents for pipeline attacks on refinery infrastructure during this period. Therefore, most of the RPPs were reliably distributed from local refineries making such arrangements much cheaper than paying high premiums on subsidies.	Attacks on pipelines due to persistent militancy make Nigeria a potentially high-risk environment for such project development. This has sometimes helped to justify market conditions for product imports as a cheaper alternative for fuel supply in Nigeria.	Ogbuigwe, 2018; Wapner, 2017, Pwc, 2017
Economic factors and economy of scale	The last three refineries built by the federal government were all conventional refineries, which economies of scale tend to favour.	Economies of scale suggest that the construction of the more expensive large-scale conventional refineries is more viable than the smaller plants.	(Gary <i>et al.</i> , 2007; Chikwem 2014, Akanle, <i>et al.</i> 2014, Wapner, 2017 and Nkaginieme, 2005)
Regulated downstream market	With government as project owners, the sale of RPPs at fixed prices means that govt would have to pay for the shortfall via subsidy funds.	The private sector cannot fare well in a regulated market environment and must be allowed to sell at prevailing market conditions to recoup their project costs in a reasonable timeframe.	Ogbuigwe, 2018