**CHAPTER 1**

**INTRODUCTION**

* 1. **Background of the Study**

Exploration for crude oil commenced in Nigeria in 1937 when Shell D’Arcy was granted the sole concessionary rights over the whole territory of the country [Nigerian National Petroleum Corporation (NNPC)]. Crude Oil was first discovered in commercial quantity in Oloibiri in present-day Bayelsa State in 1956 when Shell D’Arcy drilled the first successful well. That same year, Shell D’Arcy changed its name to Shell-BP Petroleum Development Company of Nigeria Limited. It continued development activities in 1957 and the first shipment of crude oil from Nigeria took place in 1958. According to Fayose as quoted by Oloruntegbe et al. “The first cargo of crude oil was shipped in February 1958 through the oil tanker ship *Hemisfusus* to Britain” (Oloruntegbe, K. O., Akinsete, M. A., Odutuyi, M. O. 2009). As the economy of the nation grew, the demand for petroleum products was met by importation. Shortly after independence, the Shell-BP Petroleum Development Company saw an opportunity to meet the product needs of the country. It embarked on a project to build the first refinery in the country near Port Harcourt. The 38,000 barrels per day (bpsd) Shell-BP Refinery was completed and commissioned in 1965. It was a simple hydro-skimming plant. The Federal Government of Nigeria acquired 50% shareholding under a participatory agreement with Shell-BP. It was registered as the Nigeria Petroleum Refining Company (NPRC) in 1972 when the Government of Nigeria increased its shareholding to 60%, but it remained as a JV Company under private sector control and management (NPRC Company reports 1972). The premier refinery was debottlenecked in 1972 and a Naphtha Catalytic Refining Unit (CRU) added. The capacity was increased to 60,000 bpsd. The plant met all the normal petroleum product needs of the country except for bitumen which was still imported. The refinery was a fully private

company and sold its products directly to the marketing companies in Nigeria under an arrangement in which they paid for stated capacities of crude supplied, lifted products realizable from those capacities, and paid the refinery a processing fee accordingly. It was a very efficient and profitable arrangement for all parties involved. The Federal Government earned tax revenue and excise duty. The Federal Government acquired the remaining 40% shares in 1978 under an outright buyout and renamed it NNPC Refinery, Port Harcourt. It was thereafter fully Nigerianised and came under Government control. This acquisition occurred just a year after the formation of the Nigerian National Petroleum Corporation (NNPC) in 1977. The NNPC was created as a merger of the Nigerian National Oil Corporation (NNOC) and the Ministry of Petroleum and was manned mainly by professionals who were recruited from the private sector International Oil Companies (IOCs) to grow capability for Nigeria to be an active player in the fast-developing Oil Industry in Nigeria. It may be necessary to state that the geopolitics of oil influenced several decisions made in the early years of the industry in Nigeria. Nigeria joined the Organisation of Petroleum Exporting Countries (OPEC) in 1971. (Danielsen 1982; Sonny Atumah 2016, Vanguard Publications). OPEC was founded in 1960 to coordinate the petroleum policies of its members and to provide member states with technical and economic aid. As a grouping of petroleum exporting countries, it could be argued that a major objective was to wrest

control of the pricing of crude oil from the IOCs and increase the take by the host country Governments. To a large extent, they have succeeded.

A publication by Ugwukah and Ohaja puts this in perspective: “Nigeria’s proven oil reserves are estimated by the United States Energy Information Administration (USEIA) as between 16 and 22 billion barrels (3.5 × 109 m3), but other sources claim there could be as much as 35.3 billion barrels (5.61 × 109 m3). Its reserves make Nigeria, the tenth most petroleum-rich nation and, by far, the most affluent in Africa.

Nigeria has a total of 159 oil fields and 1481 wells in operation, according to The Ministry of Petroleum Resources. Nearly, all other country’s primary reserves are conciliated in and around the delta of the Niger River, but offshore rigs are also prominent in the well-endowed coastal region. Nigeria’s petroleum is classified mostly as “light” and “sweet” as the oil is largely free of Sulphur. Nigeria is the largest producer of sweet oil in OPEC. The sweet oil is similar in composition to the petroleum extracted from the North Sea. This crude oil is known as “Bonny light”. Other crude oil types found in Nigeria named after their export terminals are Qua Iboe, Escravos Blend, Brass River, Forcados and Pennington Anfani”. By the late 1960s and early 1970s, Nigeria had attained a production level of over two million barrels of crude oil per day. This oil wealth and their large population gave Nigeria a voice.

Optimization is a crucial science for high-performance refineries (Zhang, 2006). The goal of refinery optimization is to push operation towards the maximal profit until it reaches the limit at which any further profitability increase is dependent on changes in the existing hardware. As pointed out by Moro (2009), many investment plans for refinery capacity expansion were postponed as a result of the recent world economic slowdown and the optimization of the existing plants, which had lost priority in favor of the design of new ones, came again to prominence. In other words, optimization also means flexibility (Zhang, 2006). For an existing refinery, especially when it has been in operation for a considerable period of time, more and more shortcomings emerge, largely due to market dynamics and technology evolution. For instance, an existing plant may not have enough capacity to meet current and future market demand; it may not satisfy new environmental regulations and/or product specifications; it may consume too much energy; it may not have sufficient reliability, etc. Investing capital to build new units can directly solve those problems. However, revamping (debottlenecking) an existing plant is typically a much more attractive option since it can usually be modified more quickly with less capital investment and risks than installing a new one. To maintain its competitiveness, oil refineries are constantly searching for optimization opportunities to improve their operations. Traditionally, oil refineries typically perform the following types of periodic optimization

studies:

i. Strategic plans for future years and expansion projects;

ii. Annual plans for budgeting, term crude contracts, and programmed maintenance shutdown planning;

iii. Monthly rolling plans for crude selection and conducting refinery operations in line with foreseen demands;

iv. Short-term (typically weekly) plans for finding operating strategies regarding either precise or a good level of knowledge about crude availability, product delivery, operational and logistic constraints, as well as economic issues;

v. Profitability improvement plans for local or plant-level modifications, and revamp projects.

Although the potential benefits of production planning optimization in oil refineries have long been observed with applications of linear programming in crude blending and product pooling (Symonds, 1955), refinery planning is currently a key-business layer since it represents not only the foundation for decisions that have the biggest impact on refinery profitability (see Kelly and Mann, 2003) but also vital feedback for continuous revaluation of corporate supply-chain operation and performance. Supporting this activity, OR techniques have provided the automation to allow refinery planner teams to efficiently solve the integrated production problem at the strategic and tactical levels.

* 1. **Statement of the problem**

* 1. **Aim and Objectives of the Study**

The aim of this study is to use PERT to analyze and optimize the refining process at KRPC, Kaduna.

The objectives of this study are to;

1. Evaluate the flowchart of the refining process of KRPC, Kaduna
2. Develop a flowchart for refining process for KRPC, Kaduna using PERT
3. Analyze the flowchart of the refining process for KRPC, Kaduna
4. Optimize the flowchart of the refining process for KRPC, Kaduna
   1. **Scope of the Study**
   2. **Significance of the Study**
   3. **Definition of Terms**