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Technology Transfer and Acquisition in the Oil Sector and Government Policy in Nigeria

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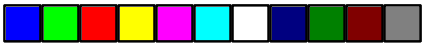

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Contents

Abbreviations and Acronyms

BPSD	Barrels Per Stream Day
EPCL	Eleme Petrochemical Company Limited
GCE	General Certificate of Education
HND	Higher National Diploma
IDSL	Integrated Data Services Limited
ITF	Industrial Treaining Fund
KRPC	Kaduna Refinery and Petrochemical Company
LNGC	Liquefied Natural Gas Company
MOC	Multinational Oil Companies
NPIMS	National Petroleum and Investments Management Services
NEC	Nigerian Expansion Council
NETC	National Engineering and Technical Company
NGDC	Nigerian Gas Development Company
NLNGC	Nigerian Liquefied Natural Gas Company
NNPC	Nigerian National Petroleum Corporation
NPDC	Nigerian Petroleum Development Corporation
NUPENG	Nigerian Union of Petroleum and Natural Gas
OND	Ordinary National Diploma
OPEC	Organization of Oil Exporting Companies
PHRC	Port Harcourt Refinery Company
PPMC	Pipelines and Products Marketing Company
PTI	Petroleum Training Institute
PENGASAN	Petroleum Natural Gas and Allied Services Association of Nigeria
PTDF	Petroleum Technology Development Fund
SSCE	Senior School Certificate Examination
STD	Staff Training and Development
TAM	Turn Around Maintenance
TSR	Teaching Staff Return
UNCTAD	United Nations Conference on Trade and Development
UOP	Universal Operating Processing
WAEC	West African Examination Council
WRPC	Warri Refinery and Petrochemical Company

List of Tables

Abstract

The analysis presented in this report shows the level of development and upgrading of the core technological capabilities in the Nigerian oil industry since independence in 1960. The study examines the nature of technological capabilities formed in the Nigerian oil industry and the effects of government policy on technological capability building in the oil industry. The study is focused on Nigerian National Petroleum Corporation (NNPC) and its four refineries in Nigeria. It evaluates the strategy and effort of training adopted by the Nigerian government as a means of transferring the acquisition of oil technology by Nigerians. The study also evaluates the impact of technical change on the production and financial performance of the NNPC. Surveys were conducted on NNPC and its refineries. The surveys relied mainly on the published and unpublished reports of the NNPC.

Assessments of the nature of the transfer and acquisition of oil technology in the Nigerian oil industry shows that learning of technology was initiated and achieved through the Petroleum Technology Development Fund (PTDF). The fund provided scholarships for Nigerians to study engineering and technology courses within the country and abroad. The oil companies also supported the development of engineering-based programmes in the Nigerian universities as a result of the Petroleum Decree of 1969. The establishment of the Petroleum Training Institute (PTI) was a major step towards the development of technological capabilities in the oil industry. The result of these post independence training effort and the accompanying learning experience was the significant technical change that occurred in the industry in the following decades. The firm history assessment of the NNPC shows that the nature and magnitude of investment, equipment and engineering profiles of the NNPC and its subsidiaries, reveals the prospects of significant technical change. This manifests in the production and financial performances of the NNPC. The future of the oil industry is perceived to be dependent on the development and upgrading of these technological capabilities and government responses to the technology needs of the oil industry. Government policy on technology shifted from technological capability building to actual divestiture and the sale of equity to oil firms that have the required technology for a modern oil industry.

Chapter One

Introduction

When oil was discovered in Nigeria, the country had very little human resource to manage and operate a sizeable modern petroleum sector. The foreign oil companies and the government played major roles in establishing the prerequisites for the establishment of linkage and minor change capabilities, especially in developing human resources for the petroleum industry. At the onset, the oil companies supported the establishment of departments and appropriate curricula for the training of Nigerians in oil-related technological, science and engineering disciplines in Nigerian universities. Scholarships were awarded in significant numbers for overseas study and training in these disciplines. Assistance was given for relevant programmes of training in technical schools. This was also extended to in-house training programmes within the oil companies. Training centres of oil companies offered both non-technical and technical training, especially in drilling, production, transport, maintenance and repairs. The pioneering effort of Shell and British Petroleum initiated the training of mechanics, drilling and derrick men, seismic operators, rig-moving staff, crane drivers, laboratory technicians, core sampling experts and a host of other specialists. Government decisions and policies, especially those targeted at the petroleum industry, influence the strategy of human resource development in Nigeria's oil industry. Degree level courses in petroleum-related disciplines were established in Nigerian universities. The Multinational Oil Corporations (MNOCs) helped establish professorial chair in geology, while institutional cooperation in petroleum-related disciplines were undertaken between the universities of London and Nigeria. By the 1980s no fewer than eight Nigerian universities offered degree level courses in geology and allied sciences related to petroleum. The government's effort to alleviate the shortage of technicians led to the creation of an industrial training fund (ITF) to promote and encourage the acquisition of skills in the industry. Since the creation of the ITF, encouragement was given to a broad industrial training effort integrated into companies' manpower plans and work places. In addition, the Petroleum Technology Development Fund (PTDF) was established in 1973. It was an offshoot of the aid to education grant offered to Nigeria by Gulf Oil Company in 1962. The gulf scheme was subsumed into the PTDF. The fund received contributions from the petroleum inspectorate, and several personnel currently working in the oil industry at various levels, owe their training to the support from the PTDF. These efforts consolidated the establishment of minor change and linkage capabilities in the Nigerian National Petroleum Corporation (NNPC). Two important policies of government influenced the development of these capabilities in the oil industry.

- Government imposition of regulations on the oil companies to employ Nigerian personnel rather than expatriate staff. This was enforced through the refusal by government to issue work permit to certain levels of expatriate staff. This compelled the MNOCs to quickly train Nigerians to take over certain core petroleum engineering and management jobs. This was given further emphasis by the promulgation of the petroleum decree No.51 of 1969.
- The establishment of the Petroleum Training Institute (PTI) in 1975. The institute is located at Effurun, Warri in Delta State within the locality of the Warri Refinery and Petrochemical Company. It was established to train technicians and skilled personnel required for oil production. Its activities have improved the provision of research facilities in oil technology.

The development of production and strategic marketing capabilities is evident in the extent to which Nigerians have adapted to petroleum technology. Substantial investment capabilities are evident in the activities of the NNPC, particularly in respect of petroleum contract negotiations and bargains for petroleum technology — machines, equipment and expert personnel. This is also evident in project execution — civil engineering and associated oil services.

Production capabilities are evident in the way Nigerians undertake production-engineering processes in both upstream and downstream oil operations, especially with respect to organizing internal Turn Around Maintenance (TAM) of the refineries. These include the general maintenance and repairs of refining equipment in Nigeria's four refineries. Strategic marketing capabilities are noted in respect of the improvements in product mix, quality and diversification. Major change capabilities are not immediately evident in the activities of NNPC, especially in respect of new ideas, patents and methods of production. This study has evaluated in detail the core capabilities identifiable in the NNPC since the discovery of oil and the start-up of upstream and downstream oil operations in Nigeria. It has identified five core capabilities in the NNPC, production, investment, minor change, linkage and strategic marketing capabilities, while major change capabilities are not identified. The study relied on survey data and information from the NNPC and all its subsidiaries, especially the refineries. A considerable level of capacities has been developed in the NNPC.

Statement of the Problem

Nigeria depends on the export of crude petroleum for economic growth and development. Importantly, the production of oil in Nigeria has been profitable for the international oil companies. These companies initiated oil exploration and production in Nigeria and have dominated the industry for many years. Considering the role of oil in national development, the struggle for indigenous control of activities in the industry has persisted over the years. Among oil exporting countries like Mexico and Libya, this struggle has culminated in apparent revolution, which ultimately forced out foreign oil firms from the industry and made way for national control of oil operations. However, the foreign oil firms generally have isolated the host country from the technology of oil operations. Governments have also taken alternative approaches to counter this isolationist policy of the MNOCs. These approaches

include the offer of a network of incentives and attempts to achieve economic stability through reforms. Beyond the revolution and alternative approaches adopted by governments, there is a critical problem. Put differently, after the foreign firms have left the oil fields and returned to their home countries, who takes charge of future oil operations in the host country? The answer to this question brings to the fore the issues about the acquisition, development and upgrading of technological capabilities in the oil industry. Technological capabilities involve the entire spectrum of technological knowledge acquired through technological learning and advanced through industrial training and work experience. The main concern of this study is to examine the nature and magnitude of technological capabilities acquired by or transferred to Nigeria's oil monopoly, the NNPC. In contracting the services of foreign oil companies for exploring and developing indigenous petroleum resources, a host developing country has two main goals:

a. To secure the investment risk and the technical and managerial expertise necessary for thorough and rapid exploration of the controlled area.
b. To develop any commercial discovery in such a way as to ensure maximum production and economic benefits (Zakariya, 1982).

In the transfer of technology, there is divergence of interest between the host country, government and the foreign oil companies. In order to prolong their lucrative role, the foreign oil companies keep the host developing country in a state of dependence on their services. It is certainly not in their best interest to contribute positively to any process that would eventually enable the host country to dispense with their services partially or completely. This divergence of interest is always borne in mind when contractual clauses pertaining to transfer of technology are negotiated or when they are being monitored during implementation.

The product of this divergence of interest is the emergence of aberrations of what might be considered as a real transfer of technology. It is instructive to note that as far as petroleum operations are concerned, the mere importation of the necessary tools and human skills by the foreign firms for their own purposes does not constitute in any real transfer of technology. This is merely a relocation of equipment and human skills to create temporarily, an artificial enclave of technical knowledge and sophistication, in isolation from the rest of the economic and social life of the community. Ideally, a real transfer of technology lies in the ability of the host developing country to purchase or hire directly the most advanced technical means of petroleum exploration and development, at a reasonable price. Furthermore, it lies in the development of the mental skills of the citizens in order to utilize these technical means with minimum or without supervision. The grievance of oil producing developing countries is that foreign oil operators in the territories have not been as instrumental as they should in bringing about a real transfer of oil technology. It is common knowledge that the MNOCs have dominated both the petroleum industry, and the search for and development of the technology for the petroleum industry throughout the world. However, over the years indigenous oil companies have adopted various strategies and training efforts tailored towards the eventual acquisition of petroleum technology for both upstream and downstream activities. Generally, the ability of any country to acquire oil technology depends on the degree of its openness to the inflow of foreign technology. It also depends on the tuning of the strategy of training adopted to develop the needed capacity to meet the

peculiar need in that country to acquire oil technology transfer (through purchase, imitation, stealing or smuggling). Training is usually tailored to meet the specific technological needs of oil firms. This means that whatever training strategy is adopted by the oil industry at any time, the focus is on technological learning which forms the basis for the development of technological capabilities. Broadly, the achievement of technological development in the oil industry depends on the pattern of technological capacity building in the oil industry and the identifiable prerequisites for building up capabilities in the oil industry. It also depends on the impact of government policies on the incentive system, and the capacity of the oil industry to acquire, develop and upgrade their technological capabilities. In these respects, this study is guided by the following specific research questions that aim at determining the nature, magnitude and impact of technological capabilities in the Nigerian oil industry, NNPC:

- What are the sources and identifiable prerequisites for the development of technological capabilities in Nigeria's four refineries and gas plants operated by the NNPC?
- To what extent are increasing technological capabilities of Nigerians reflected in increased innovation and technical change in these refineries and gas plants?
- To what extent has technological learning and technical change influenced the performance of these refineries and gas plants?

Objectives of the Study

The broad objectives of this study are to:

- characterize the core capabilities in NNPC (production, investment, linkage, minor change, major change and strategic marketing).
- study the historical experiences of NNPC in acquiring and developing these capabilities.
- study the impact of technical change and government economic policy on the performance, and capacity of NNPC to acquire, develop and upgrade these technologies.

Specifically this research is aimed at investigating the:

- strategy of training in NNPC.
- historical practices of NNPC to nationalize the core skills in various aspects of petroleum operations.
- changes in financial performance, productivity and level of capacity utilization of NNPC
- impact of government economic reform policy on the development of technological capabilities in NNPC.

Significance of the Study

Oil production in Nigeria is dependent on the foreign technology transferred into the country by foreign multinational oil companies. After independence in 1960, the Nigerian government initiated a programme of development in oil exploration, refining and transportation. Part of this initiative was the introduction of training and subsequent expansion of the training effort to create an absorptive

capacity to acquire oil technology provided by the foreign multinational oil companies, through oil exploration and production contracts. This study is premised on the need to evaluate the transfer and acquisition of oil technology in Nigeria through the effort of the government and the oil companies. The study reviews the technology transfer literature and the political economy, and provides evidence on the nature of the inherent conflict in the transfer process. Furthermore, the study attempts to characterize the technology, and identifies the level of technological capabilities in the Nigerian oil industry. The focus of this characterization is the NNPC, which owns several subsidiaries, including four refineries. The study evaluates the level of technical change due to the training effort in the industry and the impact of the technical change on production and financial performance of the NNPC.

Chapter Two

Methodology

Conceptual Framework

The framework adopted in this research follows the firm level technological capabilities defined in Ernst, Mytelka and Ganiatsos (1994), and applied in Gee and Kuo (1994), Wie and Pangestu (1994) and Poapongsakron and Tonguthai (1994). The definition of technological capabilities is based on the concept of technological learning. Technological learning comprises of formal, non-formal and informal learning. Formal leaning is defined as a planned and evaluated sequential programme, leading to certificate, degree or diploma. Non-formal learning if defined as organized learning that is usually not graded, non-sequential and or part-time, characterized by on-the-job training and professional development. Informal learning is defined as a lifelong process by which people who work in foreign affiliates or in domestic companies, which closely interact with transnational corporations, may acquire values, attitudes and beliefs embedded in the organizational culture of transnational corporations, through daily experience, observation and exposure to indoctrination. Technological learning involves the challenge of acquiring technological knowledge. Generally, it is argued that two main components of technological knowledge that firms need to acquire and absorb are the public and tacit knowledge elements of technology. The public knowledge component includes such items as engineering blue prints and designs, and the underlying genesis of scientific knowledge. It also includes management manuals, handbooks describing system features, performance requirements, material specifications and quality assurance criteria, and the organizational methods and routines required for the implementation of these codified items. Furthermore, it includes individual practitioners' knowledge of the way such scientific, engineering and organizational principles are applied or the knowledge about how things work in practice. Tacit knowledge is derived from and tied to the localized and collective learning experience of a given company through technological capabilities, into six capabilities: production, investment, minor change, strategic, linkage, and major change.

Production capabilities include the knowledge and skills used in plant operation, where shop floor experience and learning-by-doing, continue to play an important role, despite the growing science intensity of industrial manufacturing. Three broad types of activity are included in this category. They are production management and engineering, and repair and maintenance of physical capital. The first involves organization and control of the production process and interaction with upstream, downstream and ancillary activities. Production engineering includes raw materials' control, production scheduling, quality control and trouble-shooting. Repair and maintenance of production equipment influence the production process. Investment capabilities refer to the knowledge and skills utilized in

the identification, preparation, design, and establishment and commissioning of a new industrial project, or the expansion or modernization of existing ones. This includes pre-investment capabilities and project execution capabilities. Pre-investment capabilities include all activities prior to and including feasibility studies, site selection, and the scheduling of investment to the search for sources of technology, negotiation of contracts, scheduling of investment and bargaining for suitable transfer conditions. Project execution involves civil engineering and associated services, selection and procurement of equipment, detailed engineering, training and recruitment of workforce and start-up operations. Minor change capability is a firm's ability to improve and adopt continuously its products and processes. It covers adoptive engineering, organizational adjustments involved in the more mental upgrading of product design, performance features and process technology. It includes the accumulation of the deeper forms of knowledge, skill and experience, required to generate continuing parts of more mental change. These improve on the original performance standards of the technology in use, and modify its inputs, outputs and processes, in response to changing input and product markets.

Strategic marketing refers to knowledge and skills required for collecting market intelligence, the development of new markets for the establishment of distribution channels and the provision of customer services. Linkage capabilities relate to the knowledge, skills and organizational competence associated with the transfer of technology at three levels within a firm. These levels are from one enterprise to another, between the firm and the domestic scene and technology infrastructure. Within a firm, linkage capabilities refer to the capacity to manage interaction and information sharing among divisions and business functions, such as research and development, design, engineering, procurement, production, marketing, sales and customer services. Inter firm linkages encompass activities such as the procurement of materials, parts and components, services, related exchange of information with suppliers, and the sharing of marketing and distribution activities, joint development of product design, production technology and related scientific knowledge. Linkage with the country's science and technology infrastructures relate to a firm's capacity to attract, absorb and upgrade the available pool of human resources, and to screen and scan new technology developments and establish close interactions with applied and basic science. Major change capabilities refer to the knowledge and skills required for the creation of new technology, that is, major changes in the design and core features of products and production processes. These include in particular new product ideas, applied and scientific knowledge, and the ability to develop patents. Major change capabilities are derived from sources such as in-house research and development, universities, and public or private research and development laboratories. However, besides identifying the formation of these capabilities in the firm, a fundamental argument is that technological capabilities are not free and easy to achieve.

They are developed through conscious and sustained efforts by both firms and governments. Generally, the essential prerequisites for technological capability building include:

- The need to bring awareness to develop capabilities, willingness to do so and macroeconomic stability,
- The incentive system or the combination of the array of government policy instruments

which affect firm level innovation strategies directly or indirectly, market forces and historical practices,

- The broad strategies adopted by firms to develop technological capabilities and the various channels they have used to acquire technology.

Method of Data Collection

This study is conducted through surveys. Extensive archival studies were carried out in addition to direct observation and spot assessment of factual information and data on technical change and technological capabilities at the four NNPC refineries. The archival studies concentrated on annual reports, audited accounts, engineering reports, memoranda, statistics of NNPC, rolling plans and annual national budget documents. The surveys covered broad aspects of the study as follows:

1. Technological Learning: The surveys were directed at the linkage and minor change capabilities in NNPC, the training effort of NNPC, sponsorships for training in and out of Nigeria, linkages with research and development institutions in and out of Nigeria, type of training by specialization and mode of selecting trainees.
2. Firm History: The surveys were directed at the investment and production capabilities of NNPC. These include the profile of technology involved in NNPC activities, the schedule of equipment and main assets of the refineries, local technology and fabrication used in the refineries, the proportion of Nigerians to expatriate staff involved in oil operations periodically, NNPC projects schedule and prioritization.
3. The Impact of Technical Change on Performance: The surveys were directed at the major change and strategic marketing capabilities in NNPC and specifically the impact of technical change on production and financial performance as follows:
    a) Productivity of the refineries, growth of output, product mix, quality and diversification.
    b) Capacity utilization and installed capacity of refineries, unit-time utilization and annual average production level of petroleum products.
    c) Financial performance, product sale, unit cost, total sales cost, operating costs, federal budgetary support for NNPC, NNPC's capital financing and sources of funding.

Chapter Three

Background

Overview of the Nigerian Oil Industry

Oil exploration in Nigeria began in 1908. A German company, the German Bitumen Corporation started, exploration in the Araromi area of present Ondo State of Nigeria. It was the first attempt to search for hydrocarbons in Nigeria. Unfortunately, this pioneering effort did not last long and the company terminated its operations at the outbreak of the First World War in 1914. Another major effort was embarked upon in 1937 by an Anglo-Dutch consortium, Shell D'Arcy (the forerunner of the present Shell Petroleum Development Company in Nigeria). This was after being awarded sole concession rights covering the whole territory of Nigeria. Shell D' Arcy's operation, were interrupted by the Second World War and exploration did not resume until 1947. After many years of search and an investment of over Naira (N)30 million, a commercial discovery of petroleum was recorded at Oloibiri in the Niger Delta in 1956. In 1958, shell started oil production and export from Oloibiri field in the present Rivers State at 5100 barrels per day. In 1959, the sole concession rights over the whole country granted to Shell were reviewed. Exclusive exploration rights were extended to companies of other nationalities in line with the policy of increasing the pace of exploration, while at the same time ensuring that the country was not too dependent on one company or nation.

The success of Shell encouraged other companies to join in the exploration and in 1961 Mobil, Gulf, Agip, Statrap (now Elf), Tenneco and Amoseas (now Texaco/Chevron), had joined the explorers for oil in both on and off shore. Discovery was made by Gulf on the Okan field of former Bendel State in 1964. Many new companies also made significant discoveries. The initial interest of the Nigerian government in the oil industry was limited to collecting the royalties and other dues, which the oil companies offered to pay to it, and making laws to regulate the activities of the industry. Immediately after the Nigerian civil war in 1970, oil became predominant and more strategic to the economy of Nigeria. Nigeria also joined the Organization of Oil Exporting Countries (OPEC) in 1971 as the eleventh member. In the same year, the NNOC was established by decree 18 of 1971. It was charged with responsibilities for upstream and downstream activities in the industry. There was a ministry of petroleum resources operating concurrently with NNOC. Its functions were mainly regulatory and did not involve any participation. However, in 1977 the NNOC and the Ministry of Petroleum Resources were merged to form the NNPC by decree 33 of 1977. The functions of NNPC necessarily combined the commercial objectives of the NNOC, namely, exploration, production, transportation, refining, processing, marketing and research, including the regulatory functions of the former Ministry of Petroleum Resources.

The public sector of the Nigerian oil industry started as a section of the mines division of the Ministry of Lagos Affairs in 1958. It was originally a one-man unit. The responsibilities of that unit increased very quickly as oil operations expanded. In 1963, with oil becoming relatively more significant in the national economy the hydrocarbon section of the Mines Division was upgraded to a division within the Ministry of Mines and Power. As the development of oil resources increased, the department of petroleum resources was further upgraded to a full-fledged ministry in 1975. The Ministry of Petroleum Resources and Energy later became the Ministry of Petroleum and Mineral Resources. With the establishment of the NNOC in 1971 and subsequently the NNPC in 1977, the corporation became an integrated national oil company engaged in exploration, production, processing, transportation and marketing of crude oil, gas and their derivative. The affairs of the NNPC were being managed by a board of directors, appointed by the President of the Federal Republic of Nigeria. The board was made up of an alternate chairman, a managing director, and the permanent secretaries of the Federal Ministries of National Planning, Finance and three other members selected from the private sector. In accordance with sub section 4 (2) of the NNPC decree of 1977, a review of the structure of the corporation was made after a year of its operation. In October 1985, the corporation was also reorganized into six service units headed by coordinators. The aim of these changes was to encourage innovation, efficiency and effectiveness in the management of the oil industry. The six units were oil and gas, refineries, petrochemicals, pipelines and products, marketing and petroleum and inspectorate. The inspectorate, which had been an integral arm of the NNPC, was later transferred to the supervising Ministry of Petroleum Resources. It is currently a directorate in the ministry, vested with regulatory functions. In 1988 NNPC was reorganized with a commercial objective. The new structure of the corporation included:

- corporate services (finance, administration, public affairs, personnel, technology and corporate/legal matters),
- operations (exploration and production of gas and petrochemicals, and international marketing), and
- national petroleum investments (crude oil marketing and joint venture activities in exploration and production sector of the industry).

Furthermore, eleven subsidiary companies of the NNPC were established under the operations arm of the corporation as follows:

1. Nigerian Petroleum Development Company (NPDC),
2. Integrated Data Services Limited (IDSL),
3. Warri Refinery and Petrochemical Company (WRPC),
4. Kaduna Refinery and Petrochemicals Company (KRPC),
5. Port Harcourt Refinery Company (PHRC),
6. Pipelines and Products Marketing Company (PPMC),
7. Nigeria Gas Development Company (NGDC),
8. Eleme Petrochemical Company (EPCL),
9. Nigerian Engineering and Technical Company (NETCO),
10. Nigerian Liquefied Natural Gas Company (NLNGC), and
11. National Petroleum Investments and Management Services (NAPIMS).

Government Policy on the Oil Industry

Government policy on the oil industry is propagated through various legal and contractual arrangements, which guide operations and activities within the industry (Olisa, 1987; Omorogbe, 1986; Osunbor, 1988; and Onwioduokit, 1994). These legal relations include:

1. The concessions, which require the oil companies to solely bear all risks and costs of exploration, development and production. The concession is stated as oil mining lease in the Petroleum Act and the oil companies were liable for all royalty and petroleum profit tax payments.
2. The joint ventures, which are defined in terms of four legal arrangements, namely:
    a) The Participation Agreements,
    b) The Operating Agreements,
    c) The Head of Agreements and
    d) The Memorandum of Understanding. The government has acquired 60 per cent participating interest in the concession held by Shell, Gulf, Agip, Mobil, Phillips, Elf, Texaco, Pan-Ocean and Chevron. Under the participation agreement, respective rights of partners to the joint venture are set out. The interest paid for and acquired by the government through NNPC is known as "participating interest" in:
        i. oil mining;
        ii. fixed and movable assets of the company in Nigeria in areas of exploration, development, production, transportation, storage, delivery and export operation and associated assets, such as offices, housing and welfare facilities; and
        iii. working capital application to the operation of the mining leases.

    The heads of agreement provide that there will be undivided interest in the rights granted with respect to petroleum. Each interest owner may lift only as much its full equity share of crude oil; a make-up right shall accrue to the interest owner to nominate the balance of its equity in the future. The operation agreement spells out the legal relationships between the owners of leases or concessions and lays down the rules and procedures for the joint development of the area concerned and the property owned by the two parties. In this respect, joint property is defined to include expenditure for practically all the activities and services of the oil company (Olisa, 1987).
3. The Production Sharing Contract. This is an arrangement in which the output from the contract is shared by the parties in predetermined proportions (Omorogbe, 1986). Emphasis here is placed on the contractual status of the oil company by making NNPC the concession holder and by specifically excluding the company from claiming any title over the produced crude oil.
4. The Service Contract. It is designed as an improvement on the Production Sharing Contract. The distinguishing feature of the service contract is that no title to or right over the production of crude oil, is given to the contractor. The contractor is paid for services rendered either in cash or kind, although there are contractual provisions that give the contractor a first option to buy the crude oil produced. These contracts of work with the government,

bear all the risks which are termed as "Pure Service Contracts". However, when all risks and investment are placed on the contractor, as is the case in Nigeria, they are referred to as Risk Service Contracts (Onwioduokit, 1994).

However, historical evidence shows that the most significant legislation on oil during the period before 1971 were the Mineral Oils Act of 1962 and the Petroleum Profits Tax Ordinance of 1959 (Asiodu, 1979 and Olisa, 1987). Under the Nigerian tax law, the government adopted a practice in which petroleum profits were shared at 500% basis with the oil companies.

Another important legislation of the Nigerian government, is federal decree in 1969, requiring the oil companies to establish posted prices, expense royalties and other payments. The expending of royalties meant that such payments were to be created as expenses and not as part of the 50 per cent share of the government in the profits from petroleum. All companies including foreign oil companies (MNOCs) operating in Nigeria, were required to be incorporated under Nigerian laws. Furthermore, the major comprehensive legislation in the period before 1971 was the Petroleum Decree of 1969, which:

- redefined petroleum to exclude gas;
- reduced the length of the concession period to 20 years;
- set out clearly the period and stages of surrender of acreage granted under concessions; and
- required that within 10 years of operation the MNOCs must employ Nigerians in the senior positions up to 75 and 100 per cent for other cadres. It further required MNOCs to produce schemes for the exploration of gas associated with their petroleum production. Government policy after 1971 centered on deepening indigenous participation and control. Various participation agreements were signed, which began with a minimum of 35 per cent participation in all concessions and programmed to 51 per cent by 1981. It is expected that over time, Nigeria would take over 100 per cent of all oil concessions in the petroleum industry. Already Nigeria is controlling 60 per cent participation through NNPC, with all MNOCs in the oil industry (Olisa, 1987, Omorogbe, 1986, Onwioduokit, 1994).

Mainstream Arguments on the Transfer and Acquisition of Technology

Four major factors in literature are considered to be the determinants of the transfer and acquisition of technology as follows:

1. Technology market imperfection and barriers between the developing country buyer and the developed country seller.
2. The prevalent host government industrial policy and the package of incentives to investors.
3. The policy of MNOCs in response to host country economic, industrial and technology policies.
4. The existing political relations among the different social and political classes that compete for dominance in the determination and direction of state matters in the host country.

The Imperfect Technology Market Argument

Substantial United Nations Conference on Trade and Development (UNCTAD) literature on the transfer of technology concentrates on the technical questions of unequal information between the buyer and seller, the nature of the bargaining situation, the technology package, costing and general imperfections in the technology market (Turner, 1980; Ewing, 1976; UNCTAD, 1975; UNCTAD, 1976; UNCTAD, 1978). The basic assumption is that poor country governments are seriously striving to obtain technology on the best possible terms. The view in literature is that patents, trademarks and restrictive practices that govern the channels of technology transactions, determine the kinds of technology bought and sold. They could directly be in the form of knowledge or indirectly embodied in goods, and account for the high cost of acquiring technology as well as inhibiting in different ways the adaptation and generation of technology by developing countries. It also led to negotiations for the fundamental reform of the industrial property system embodied in the Paris convention and towards an international code of conduct on the transfer and development of technology. It renewed attention on the policies and institutions in developing countries, which govern, or are capable of governing the acquisition of technology (Ewing, 1982). UNCTAD has largely been associated with works that border on the diffusion of technology, change in technology and its effect on growth and development. UNCTAD is of the view that the capacity to acquire and transfer technology, depends on the capacity in a country or an enterprise, to generate and understand what to acquire.

Indigenization/Nationalization Argument

According to Turner (1982), foreign contractors are well established, experienced and familiar. They may be owned in part or in full by the Oil Company or may be based in its country of incorporation. In this situation, companies have little incentive to encourage the establishment of local contracting capacity or to patronize those contractors that exist, except in very peripheral areas such as grounds maintenance, transport, food supply or minor civil engineering. As a result, the transfer of oil technology for much of the actual operation does not occur without government intervention. Technology connected with the exploration and production phase is not, however, monopolized and unobtainable. The government oil authorities of some OPEC member states have successfully separated the various aspects of the technology package and indigenized the capacity to obtain, use and generate various aspects of technology used in the extractive phases of the industry; the case of Algeria is instructive (Anez, 1975). Sonatrach, the Algerian State Oil Corporation set up in 1963, had established partnerships with nine oil field service firms since 1966. The terms ensure that in the period during which the foreign firms realize their profits, about 15 years later, technology and know how should be localized. By first nationalizing the technical structure serving the oil industry, Algeria was able to acquire 100 per cent ownership of the exploration and production companies by 1974 and achieve almost total control of operations. Dependence on foreign sources of essential exploration and production technology was reduced or eliminated. Sonatrach developed the capacity to hire foreign contractors to do specialist jobs (Turner, 1980; Anez, 1975; and Nore, 1980).

The Displacement and Globalization Argument

Foreign oil company management resists the transfer of technology for use in the processing of crude and gas into petroleum products as part of its efforts to avoid displacement in the upstream and downstream areas. If an oil exporting government establishes an export refinery, not only do the oil companies lose a portion of their crude supply and get displaced in the refining industry, but their international product markets may be penetrated and taken over by the "newcomer" state oil company. This threat to market control is especially serious since state oil corporations have access to crude at no more than the set production, and therefore can afford to engage in price competition. Consequently, oil companies strive to block entry into downstream operation. A major means of doing this is to create obstacles to the transfer of technology required in the processing of crude oil. During the acute oil shortage of 1973, producer governments, crude-short oil companies, independent sources of oil technology including the major oil companies and importers, offered technology in exchange for hydrocarbons, in order to ensure adequate supply of crude oil.

Furthermore, MNOCs resist the acquisition of oil technology expertise by nationals, as part of wider company imperative to retain control of operations. The coordination, flexibility, size and organization of huge multinationals depend very much on the communication between management at various levels. Communication usually occurs most readily among those who share a common cultural background. Reliability and loyalty are further ensured by common class and status affiliation, as well as long years of corporate training and service. While the foreign oil companies do train low and medium level technical assistants, administrators and some engineers, they limit the career development of local oil men to the extent they can do so, given local consciousness and political demands. A few showcase indigenes move in the top echelons as window dressing, while the oil companies deliberately avoid and resist the transfer of technical know-how. Expatriates strive to remain in charge of key functions and in those jobs essential to the actual work of producing oil. Expatriates usually do the supervision of contractors and the maintenance of equipment, when the oil companies have a choice. Foreign oil companies have accommodated nationalist sentiments by recruiting and training nationals for management positions. The majors, in particular the European firms, British Petroleum and Shell, do such to minimize their loses by adapting to, foreseeing and guiding social and political change, while simultaneously encouraging commitment by an indigenous stratum to the institutions and values of capitalism (Turner, 1980).

Political Economy Argument

Turner (1980) argues that if the government can bring about transfer of technology and know-how, how can one explain the absence of considerable progress in the acquisition of oil technology in many oil exporting developing countries. Essentially, the class struggle is between a compradorial bourgeois class, which is a product of colonial mercantilism, and technocrat class is propagated through persistent military rule and authoritarian military dictatorship. The ownership of oil is vested in the sovereign state and explanation of the underdevelopment and foreign domination of the industry in most developing countries must start with an examination of the political economy of the state.

It is argued that the comprador nature of the Nigerian state for example, prevents it from organizing the transfer of oil technology and more broadly, from initiating the development of capitalist production. In Nigeria, the Comprador State is based on the local commercial class. Middlemen are more numerous and influential as a result of the oil boom, the policy of import substitution and the state's policy of intervention to foster economic development. As government expenditure and bureaucracy grew, the number of bureaucratic compradors establishing triangular relations with middlemen and foreign suppliers, increased. The logical ally of the technocrat cadre, a local capitalist class of producers, does not exist in Nigeria. Without such support, technocrats lack significant influence in the Nigerian State and the comprador state is unsteady, because it has been unable to override specific capitalist interests in favour of broader considerations of national policy.

Comprador authority within institutions of state, derives from the senior and usually administrative positions held by members of the group. Professionals and technocrats have been in subordinate posts in the bureaucracy since the colonial period. Technocrats in the oil administration are marginally more influential than those elsewhere, due to their knowledge of the world oil and the support they receive from OPEC policies and oil technocrats in other exporting countries. However, the base work notable with respect to future actions of Nigeria oil technocrats, is those oil companies which seek to compete with the firms that have a more weighty role, and one in which oil is managed by a sector clearly isolated from the rest of the state apparatus. Oil technocrats may be amenable to coexistence with the foreign oil companies on more organized and nationalistic terms, especially if companies support them in resolving the non-antagonistic contradiction between themselves and compradors. Apparently, oil technocrats resemble a stratum, which seek to become a national bourgeoisie. The scope and force of technocrat oil policies are more probably symptoms of their powerlessness than indications of their commitment to replacing foreign oil companies with integrated state corporations. However, it is observed that middleman comprador alliance has been successful in suppressing the technocratic function within the state. Along with this suppression goes the possibility of any significant state transfer of technology (Turner, 1976).

Generally, although these determinants to a large extent explain the differences in the levels of technological development among developing countries, yet, countries that present favourable indices of these determinants have also remained technologically backward. It is obvious that these developing countries, in spite of their success in conditioning their environment for the inflow of technology, do not have the capacity in terms of trained manpower to acquire and develop technology. The result is the free entry and exit of foreign firms in the economy of these countries and the beginning of fresh negotiations for economic independence from the powerful organizational network of multinational corporations.

Chapter Four

Case Study: Research Findings and Discussion

Technological Learning and Technical Change

Assessments of technological learning and technical change in the NNPC were performed using three broad surveys. First, is a survey of sponsorships by NNPC and the oil sector in general, for training in universities and polytechnics within and outside Nigeria. The Petroleum Technology Development Fund (PTDF) was established in 1973 to motivate technological learning and develop a local absorptive capacity for both upstream and downstream petroleum operation in Nigeria's oil industry. The fund provided scholarships for the training of Nigerians in various aspects of petroleum technology and management. Scholarships were initially limited to core engineering studies such as chemical, civil, electrical, mechanical and petroleum engineering and geology. Scholarships for petrochemical and environmental engineering, and corrosion science, began in 1979. The fund supported a total of 535 Nigerian trainees in various special areas of petroleum technology and management between 1973 and 1983. This amounts to an annual average of 33 awards per year. However, there were no endowments made out of the fund, which lasted untill 1983. Furthermore, the oil companies operating in the oil sector provided a total of 911scholarships for the training of Nigerians between 1984 and 1988. These scholarships emphasized the engineering sciences. Between 1989 and 1995 Shell Petroleum Development Company provided a total of 593 scholarships for the training of Nigerians in engineering sciences and management. The shell petroleum development company scholarships have increased over the years and are usually evenly spread across the states of the country.

Second, is a survey of oil industry linkages with research and development institutions outside the industry, namely, universities, polytechnics and research institutes. The rapid development of oil industry operations in Nigeria paved way for the introduction and strengthening of capacities in engineering studies in Nigerian universities and polytechnics. The oil companies established six professorial chairs in six universities among the 34 universities in Nigeria. These endowments were attributable to the contributions of Shell and Mobil. However, while the number of endowments were limited, Nigerian universities offered a total of 120 petroleum engineering-related courses, out of the 1342 courses offered. The federal universities offer the largest number of petroleum related courses among the different categories of universities. The product of this development is the slow, but progressive increase in the number of engineering graduates produced by the universities annually. As a percentage of total number of graduates produced by Nigerian universities annually, petroleum

engineering-related courses increased from 4.3 per cent in 1981 to 5.7 per cent in 1992. This increase shows the slow rate of growth of the required absorptive capacity and technological learning in the oil sector.

Table 1: The Petroleum Technology Development Fund Scholarship Awards

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Chemical Eng.	4	20	10	10	1	2	14	2	2	1	2
Civil Eng.	4	6	2	6	-	-	10	-	-	-	-
Electrical Eng.	4	8	10	4	-	-	16	-	-	-	1
Mechanical Eng.	13	13	10	11	2	1	10	8	-	1	1
Petroluem Eng.	10	12	8	5	1	-	4	-	10	8	4
Corrosion Science	-	-	-	-	-	-	1	1	2	3	2
Petrochem	-	-	-	-	-	-	9	-	9	6	2
Environmental Eng.	-	-	-	-	-	-	1	1	4	-	-
Geology	5	2	4	8	-	-	5	5	5	-	4
Computer Science	-	-	2	2	-	-	-	3	-	-	2
Survey	-	-	1	5	-	-	-	-	-	-	-
Acct.	-	4	3	1	-	-	-	2	2	-	-
Mgt/Administration	-	-	-	8	-	-	-	4	1	-	1
Economics	-	-	-	8	-	-	-	4	1	-	1
Micro Biology	-	-	1	5	-	-	-	-	2	-	0
Industrial Engineering	-	-	-	-	-	-	-	-	2	1	2
Geophysics	-	-	-	-	2	1	2	6	4	-	3
Natural Gas	-	-	-	-	-	-	0	0	6	6	1
Total	**40**	**65**	**51**	**73**	**6**	**4**	**72**	**32**	**49**	**16**	**25**

Source: NNPC Annual Report, 1983

Table 2: Total Scholarships Awarded by the Oil Sector 1984-1988

Year	1984	1985	1986	1987	1988
Award	120	143	150	288	210

Source: NNPC Annual Report, 1988

Table 3: Professorial Chairs Endowed by the Oil Companies in Nigerian Universities

Professorial Chair	University	Oil Company
Geology	University of Nigeria	Shell
Petroleum Engineering	University of Ibadan	Shell
Geophysics	Obafemi Awolowo University	Shell
Environmental Studies	Rivers State University of Science and Technolgy	Shell
Mechanical Engineering	Ahmadu Bello University	Shell
Petroleum Geology	University of Clabar	Mobil

Source: Estimated from Annual Reports of the Nigerian Universities Commission (NUC) different Years.

Table 4: Nigerian Universities and petroleum technology Related Courses Offered

Status of University	Number of Universities	No. of Petroleum Technology Related Courses offered	No. of non-Petroleum Technology Related Courses Offered	Total Number of Courses Offered
Federal University	16	59	766	825
Federal University of Technology	15	21	123	150
Federal University of Agriculture	3	4	63	67
State University	7	14	187	210
State Universities of Technologies	3	16	83	99
Total	**34**	**120**	**1222**	**1342**

Source: John Admission and Matriculation Board (JAMB) Brochure, 1996/97

Table 5: Percentage of Engineering Technology Graduates to Total Number of Graduates

Source: Estimated from Annual Reports of the Nigerian Universities Commission (NUC) 1981-82.

Third, is a survey of linkages with research and development institutions within the oil industry. The Nigerian Petroleum Training Institute was established through the Petroleum Training Institute Act no.37, 1972, amended by Act no. 52, 1975. This was in consonance with the requirements of the Petroleum Drilling and Production Regulations contained in the Petroleum Act No. 51, 1969. According to the Petroleum Act, "the licensee of an oil prospecting license and the licensee of an oil mining lease, shall within 12 months of the grant of license, submit for the minister's approval, a detailed programme for the recruitment and training of Nigerians in all phases of petroleum operation". The Petroleum Training Institute is located at Effurun in Warri, Delta State of Nigeria. The Institute was established with the objective of providing the required research and development support for technological learning and technical change in the oil industry of Nigeria. It was established to train Nigerians in core oil industry operations such as petroleum, petroleum processing and marketing, and electrical electronics, mechanical, and environmental and safety engineering, and welding and underwater operations. Apart from training, the institute engages in adaptive research towards the development and fabrication of tools for petroleum upstream and downstream operations. The staff profile of the PTI shows that at inception, the pioneer staff of the PTI were mainly, expatriate Russian tutors and later Nigerians with very high qualifications in engineering and petroleum-related studies. The minimum qualification for a lecturer I at the institute is a bachelor's degree in petroleum-related engineering courses, with at least 10 years post-qualification experience in the oil industry.
Over the years, PTI has improved the quality of its training through staff training and development programmes. Table 7 shows the number of PTI staff sent on training each year. The Staff Training and Development (STD) scheme is open to all PTI staff. However, the teaching staff returns, show that a large percentage of the staff are mainly technical staff who do not make up the teaching force of the institute. The proportion of teaching staff sent on training increased as the pioneer expatriate staff of the institute gradually reduced. The Teaching Staff Return (TSR) also shows remarkable improvements in the number of the teaching staff of the institute between 1978 and 1992, with staff returns of 50 and 140, respectively.

The PTI graduates' profile shows progressive increase in the number of Higher National Diploma (HND) and the Ordinary National Diploma (OND) graduates of the institute over the years from 1978 to 1992 and a decline in 1994. Usually the trainees spend two academic sessions in addition to one year on industrial attachment, to complete the 3 -year initial training, leading to the award of the OND. Also, trainees spend an additional two academic sessions and one year on industrial attachment, to complete the required 3 years of additional training leading to the award of the HND. The industrial attachment is spent with the oil firms and is designed to allow the students to alternate between the firms and the classroom. This is possible, because most of the firms are located near the PTI. The oil companies regard the PTI diplomas more highly than any other diploma from the polytechnics in Nigeria, because the training is very specialized and adapted to the technical requirements of oil industry operations. This is reflected in the remuneration of these technical staff. The discrepancy is due to the fact that PTI graduates having trained with the oil companies, have undergone specialized training in oil industry technology, while diploma holders from the polytechnics would have to be retrained and reoriented to participate effectively in the oil industry technical operations. Apparently, the PTI does not prepare students for higher studies. The institute rather produces technicians for the

Table 6: Categories and Qualification of Teaching Staff of PTI

Category	Minimum Qualification	Minimum Experience
Lecturer I	Bachelors Degree	10 years
Lecturer II	Bachelors Degree	7 years
Lecturere III	Bachelors Degree	5 years
Lecturere IV	Bachelors Degree	3 years
Chief Instructor	Bachelors Degree	1 year
Assistant Chief Instructor	Higher National Diploma	5 years
Principal Instructor I	Higher National Diploma	3 years
Principal Instructor II	Higher National Diploma	2 years
Senior Instructor	Higher National Diploma	1 year
Instructor I	Higher National Diploma	1 year
Instructor II	Higher National Diploma	1 year
Principal Lab. Technologist I	Higher National Diploma	2 years
Principal Lab. Technologist II	Ordinary National Diploma	2 years
Senior Lab Technologist	Ordinary National Diploma	1 year
Lab Technologist/Technician	WASC/GCE O/Level	2 years

Source: PTI Annual Report, 1990

oil firms. Since the establishment of the institute in 1975, the PTI has admitted 10,706 students and graduated 5,720 by the end of the 1994/95 academic sessions.

Type of Training by Specialization

The training programme of the PTI comprises seven specialized courses. These are Electrical/ Electronics Engineering, Petroleum Processing, Mechanical Engineering, Petroleum Engineering, Geosciences, Environmental Sciences and Safety, Welding and Underwater Operations. These courses are conducted in line with oil industry standards. These standards are driven by quality of skills imparted to the trainees. The standard is often measured and maintained by the availability of the required training facilities for specialized oil industry technical training for downstream and upsteam operations. These include laboratories, workshops, and equipment for seismic operations refinery work, crude and refined petroleum oil marketing. The profile of facilities for the respective specialized courses is listed in Table 9.

Table 7: Staff Training and Development (STD) and Teaching Staff Return (TSR) in PTI

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
STD	-	29	45	-	19	179	58	199	182	106	41	39	-	-	24
TSR	-	-	50	-	63	66	-	46	-	77	79	90	90	-	140

Source: PTI Annual Report, 1978-1992

Mode of selecting students/trainees

The entry requirements for any course of study in the institute is a minimum of four credit passes in the West African School Certificate, the General Certificate of Education (GCE) or the Senior School Certificate Examinations (SSCE), organized by the West African Examination Council (WAEC) and the Nigerian Examination Council (NECO). This is usually at not more than two sittings and the subjects required are those of the physical sciences, namely Physics, Chemistry and Mathematics. This holds for the OND courses. Entrance examinations are conducted for the selection of qualified students. Successful candidates are screened, based on their credit passes at the WASC/GCE/ SSCE examinations. The minimum admission requirement for the PTI HND programme is the PTI OND certificate with one year industrial experience in an oil firm.

Firm History

The main assets of the NNPC are: NPDC, IDSL, WRPC, KRPC, PHRC, PPMC, NGDC, EPCL, NETCO and NAPIMS. The NNPC has 100% ownership of all Nigeria's refineries except Alesa Eleme and Port Harcourt, where it has 50% ownership. Nigeria has two types of refineries based on the type of crude they process: the ordinary fuel and integrated fuel refineries. The primary fuel refineries refine only light crude, while the integrated refinery refines both light and heavy crude. The integrated refinery produces fuels and non-fuels simultaneously. Out of the four refineries in Nigeria, there are three primary fuel refineries, the Warri refinery and the two refineries in Alesa Eleme (Port Harcourt), and Kaduna is an integrated refinery. The Warri refinery operates with the technological units shown in Table 10.

The refinery produces all its steam and electricity requirements from a very modern power plant. It incorporates a highly sophisticated waste water treatment and contains two modern oil jetties, two wharves, a computerized trunk loading station and connections to products' pipeline. The total capacity of the finished product storage within the Tank Farm is 400,000 cubic m. The process units represent a vital part of the refinery. The unit processes crude in order to obtain semi-finished products rather than finished products that are ready for commercial use. The process units consist of two processes, the primary and secondary. The primary process separates crude into different fractions. These fractions are ready for secondary processing, to improve the quality and obtain other valuable products. The primary processes are atmospheric distillation and vacuum distillation. The secondary processes are catalytic cracking, catalytic reforming, hydro-desulphurization, and alkylation and polymerization.

Table 8: Number of Graduates of PTI by Department and Qualification Obtained

Year	Diploma	EEE	PPD	MED	PEGS	PMBS	ESS	WUW	Total
1978	HND OND	- 15	- -	- 15	- 12	- -	- 7	- -	- 49
1979	HND OND	53 -	- 23	- 30	- 15	20 -	22 -	75 -	170 68
1980	HND OND	- -	- -	- -	- -	- -	- -	- -	- -
1981	HND OND	10 59	10 25	14 85	- 91	- -	10 -	53 -	97 240
1982	HND OND	- 22	- -	- 26	- -	- 26	- 26	17 28	17 128
1983	HND OND	- 10	- 48	- 4	- 30	- 10	- 5	67 34	67 141
1984	HND OND	- 38	- -	- 15	- 10	- -	- -	31 20	31 83
1985	HND OND	8 47	- 5	17 35	- 12	- 36	- 36	21 -	46 171
1986	HND OND	10 33	- -	- 81	- 31	10 -	8 26	44 120	72
1987	HND OND	- 111	- -	20 59	6 -	- 43	- 60	38 121	
1988	HND OND	- 99	7 62	- 155	13 13	- 21	12 31	49 22	
1989	HND OND	25 64	19 -	19 48	4 27	14 -	- -	70 46	
1990	HND OND	26 73	20 40	28 136	9 50	14 62	14 103	116 85	
1991	HND OND	36 202	11 19	27 102	7 47	12 69	17 23	- 76	
1992	HND OND	40 43	32 21	50 35	24 40	19 24	26 40	49 28	
1993	HND OND	38 23	24 68	21 23	21 34	21 20	29 36	18 30	
1994	HND OND	47 22	16 8	50 13	32 13	14 25	24 28	26 34	

Source: PTI Annual Report, 1978-1994; EEE - Electrical Electronics Engineering Department; PPD = Petroleum Processing Department; MED = Mechanical Engineering Department; PEGS = Petroleum Engineering and Geosciences Department; ESS - Environmental Sciences and Safety; and WUW = Welding and Underwater Operation

Technical Change

The occurrence of technical change in NNPC is observed in the local technology and fabrication used, and the internal Turn Around Maintenance (TAM) operations in the refineries.

Local Technology and Fabrication Used in the Refineries

The PTI has designed and constructed a five tons overhead crane used for moving heavy machinery in the refineries and the workshops, a prototype mechanism of the blower used for raising and lowering burner buckets in the refinery, a crude-treater for emulsion crude at the refineries, multi-purpose centrifugal blower, lubricant filling machine and a modified wheelbarrow. The indigenous

Table 9: Schedule and Content of Training at PTI

Training Specialization	Training Facilities
Petroleum Engineering	Exploration Laboratory Drilling Workshop Production Workshop Drilling and Production Workshop Well Control Simulator
Petroleum Processing	Unite Operation Lab./Process Plant Simulator Crude Oil Properties Laboratories
Petroleum Marketing/ Business Studies	Petroleum products Testing Workshop Mini Market Petroleum products Distribution Station
Electrical/ Electronics Engineering	Electrical Machine Laboratory Light Current Laboratory Instrumentation & Control Laboratory/Simulator Pipeline Flow Simulator Electric Workshop Numeric Process Simulator
Mechanical Engineering	Mechanical Tools Workshop Automotive Workshop Thermo Fluids Laboratory Materials Science Laboratory Refining Equipment Workshop Fabrication Workshop Engineering Drawing Room
Environmental & Safety Engineering	Physics Laboratory Analytical Chemistry Laboratory Biology Laboratory
Welding and Underwater Operations	Non Destructive Testing Laboratory Gas Welding Workshop Manual Arc Welding Workshop TIG Welding Workshop Plastic Welding Workshop MIG/MAG Welding Workshop Fabrication Workshop Machine Toos Workshop Swimming Pool Dive Tank Therapeutic Centre with 1800cc Double Cabin Decompression Chamber

Source: PTI Annual Report, 1978-1992

oil service companies mainly provide other local technologies used in the oil industry. These technologies include the design and fabrication of metering stations for oil companies, calibration of oil tools and instruments such as flow meters, proner-loops and furnace for melting steel and alloys. Other local oil contractors provide civil and mechanical engineering support services. There are about 50 indigenous oil contractors in Nigeria's oil industry. These developments enhanced the

proportion of Nigerians employed in oil sector operations. Table 11 shows a rather laudable increase in the number of Nigerians working in the oil industry. The various operations are categorized according to labour and skill. In spite of the large number of Nigerians in the oil sector, what is more crucial for our purposes is the relative percentage of Nigerian to expatriate staff within the professional cadre. The professional cadre includes mainly the core engineering technology staff. Within this category, the ratio of the number of Nigerian to expatriate staff has increased over the years, albeit slowly.

Table 10: Technological Process Units of the Warri Refinery

Processing Units	Design Capacity
Crude Oil Distillation Unit	100,000 MTD
Naphtha Hydrotreater Unit	17,000 MTD
Catalytic Reformer Unit	17,000 MTD
Kerosene Hydrotreater Unit	8,800 MTD
Vacuum Distillation Unit	32,000 MTD
Fluid Catalytic Cracker Unit	25,000 MTD
Liquefied Petroleum Gas Recovery Unit	3,000 MTD
Liquefied Petroleum Gas and Gasoline	
Merox Extraction Units	600 MTD
Sweetening Unit	2,000 MTD

Source: PTI Annual Report, 1996

However, in 1980 and 1981, the expatriate quota decreased drastically. This gradual reduction in expatriate quota should have reflected the desired changes in the level of oil industry technological learning accumulated by the Nigerians. This expectation failed and in 1982 the quota for expatriates was increased to facilitate oil industry operations, especially in respect of oil exploration, services and refining. Table 11 shows that most Nigerians employed in the oil industry operations are involved mainly with managerial, clerical and general labour (skilled or unskilled).

The main projects of the NNPC are largely aimed at repairs of existing refinery facilities and the construction of new pipelines and petroleum depots. Other projects include the construction of the NNPC office and housing scheme at the new federal capital of Nigeria, Abuja; the construction of a tank farm in Jos, Plateau State; and repair of the Apapa Jetty and the Port Harcourt housing scheme for NNPC staff. Among all these projects, there was no effort at either consolidating technological knowledge gained through training or the upgrading of technical knowledge gained through informal and non-formal processes.

Turn Around Maintenance (TAM) Programme of the Refineries

The aim of TAM is to reduce shut down due to failure of equipment or plants. TAM aims at increasing efficiency and improving performance. TAM is therefore required at four levels of maintenance:

1. Preventive maintenance, which is an operation aimed at maintaining the operating apparatus in order to prevent unexpected failure.
2. Maintenance operation following a breakdown as damage to actual plant.
3. Shut down maintenance when plant or equipment is partially or totally shut down. Usually the techniques for this kind of maintenance must permit an optional utilization of resources during the shut down period.
4. Maintenance to improve certain features of equipment, which are carried out to make maintenance easier.
5. Investment maintenance, which involves the extension of plant works and the installation of new equipment.

TAM work in Nigeria's refineries, is mainly shut down maintenance. The refineries require mandatory and periodic rehabilitation to replace obsolete components and overhaul of massive operating systems made up of delicate units such as the fluid catalytic cracker unit, crude distillation unit and Vacuum distillation unit. The standard practice in the refinery industry is that every 2 years, refineries should be closed down for 45 to 60 days for TAM to be carried out. The operating units of the refining plant should function efficiently according to its designed capacity. However, this has not been so with Nigerian refineries, because TAM is not done on schedule due to lack of funds, appropriate spare parts, corruption and political interference in the investment decisions of NNPC. TAM in Nigeria's refineries is categorized into internal and external TAM. Internal TAM refers to mandatory periodic overhauls of refining equipment and operating systems by maintenance engineering staff of the refineries undertaken. It involves a temporary shut down of the refinery and does not last more than 21 to 30 days. It is carried out with available spare parts in the stores of the refinery. Since 1987, internal TAM had been an average of five times at most, of the refineries. However, external TAM involves foreign technicians and the replacement of damaged parts with new spare parts procured from manufacturers abroad. It requires the closure of the refinery for about 45 to 60 days. Since 1992 external TAM was not carried out for 5 years at the Warri and Kaduna refineries.

Table 11: Proportion of Nigerians to Expatriate Staff Involved in Oil Sector Operations

Year	Management		Professional		Intermediate Supervisors		Clerical		Skilled Labour		Unskilled Labour		Others		Total	
	Ng	Ex	Ng	Ex	Ng	Ex	Ng	Ex	Ng	Ex	Ng	Ex	Ng	Ex	Ng	Ex
1972	140	207207	818	647	1302	551	2566	8	4031	1	3191	-	616	-	12604	1414
1973	164	203	986	643	1430	530	2622	6	4060	2	2996	-	493	-	12751	1384
1974	172	197	1271	604	1693	309	2974	-	4221	8	2123	-	564	-	13018	1118
1975	194	172	1386	621	1834	321	3010	-	4582	10	2752	-	401	-	14159	1124
1976	180	156	1444	536	1872	237	3055	-	4635	12	2334	-	317	-	13837	941
1977	240	267	2095	939	2722	882	5679	-	7259	6	7079	-	1633	-	26707	2029
1978	271	126	1722	354	2208	226	3065	-	4857	-	2013	-	522	-	14558	709
1979	160	139	2115	521	2591	39	3923	-	6098	109	4064	-	590	-	19541	808
1980	236	178	2597	457	2701	236	4363	-	6348	14	1809	-	509	-	18563	912
1981	262	102	2463	507	2923	352	4038	1	7987	30	2634	1	2725	2	2303-32	992
1982	309	130	2172	497	3445	478	4045	2	8575	-	3853	1	1197	2	23605	1110

Source: NNPC Annual Report 1996, Ng= Nigerians, EX = Expatriates

Impact of Technical change on NNPC Performance

Production performance

The oldest of Nigeria's four refineries was the first refinery in Nigeria located at Alesa Eleme near Port Harcourt, Rivers State. The refinery commissioned in 1965 was built with an initial crude processing capacity of 35,000 barrels per stream day (BSPD). It was primarily to produce fuel for domestic transportation, gasoline and diesel fuel, which hitherto were imported from Western Europe. The products of the refinery, however, also included liquefied petroleum gas (LPG) and Kerosene. The decision to establish the refinery, followed the discovery of oil in commercial quantity in Nigeria. The federal government decided in 1954 that when daily crude oil production in Nigeria reached 50,000 BPSD, the construction of a refinery would be inevitable. This target crude production level was actualized in the 1959 preliminary surveys around the Port Harcourt and a Shell-BP Petroleum Refinery Company was established to construct and run the refinery at Alesa Eleme.

Table 12: NNPC Priority Projects, 1994-1996 (in Naira Millions)

	1994	1995	1996	Total
Pipelines and Depots phase III	1250	1565	0	2815
Abuja Office and Housing	1055	840	289	2183
Butanization phase I & II	1130	796	0	1926
Gas Supply to ALSCON	600	1127	50	1777
WRPC Rehabilitation	560	'728	384	1672
Rehabilitation of Atlas Cove	76	734	360	1170
Bonny Export Terminal	220	462	440	1122
Apapa Jetty	214	265	0	479
KRPC Rehabilitation	108	166	44	318
KRPC FCC Repairs	308	0	0	308
Calabar Jetty Phase II	185	97	0	281
Okirika Jetty	200	0	0	200
Port Harcourt Housing	68	60	0	128
Old Port Harcourt Refinery Rehabilitation	85	0	0	85
NNPC Office	21	20	0	41
Jos Tank Farm	35	0	0	35
ELP Gas	24	0	0	24

Source: Federal Government of Nigeria, NNPC, 1996

Later in 1962, the government acquired 50% equity holding in the 35,000 BPSD refinery. This paved way for the incorporation of the Nigerian Petroleum Refinery Company Limited. The refinery met domestic petroleum demand for white petroleum product. Its raw materials include the “Umecham crude” and the “Obigbo north blend”, which was locally produced crude. After the civil war, the refinery was rebuilt with a production capacity of 60,000 BPSD. However, since industrial development was slow at the moment, the production of fuel oil from the hydroskining refinery was in excess of national requirement, such that uncracked low sulphur fuel from the refinery was exported to Western Europe at a very low price. Following the rapid industrial growth and the increased economic activities in Nigeria, Premium gasoline and gas recorded annual average growth of 30%. Acute fuel shortages of

the early 1970s compelled the government of Nigeria to refine Nigerian crude abroad in Rotterdam and later re-import the refined petroleum to the country to serve domestic fuel needs. This development paved way for the establishment of a second refinery in Nigeria. This was the Warri refinery established in 1978, to process two types of Nigeria's crude oil. These are the NNPC and Shell Ughelli Control Centre Crude and the NNPC and Gulf Escravos Crude Oil. These crude brands were blended in the ratio of 7:3 with a crude distillation unit of 100, 000 barrels per stream day. The refinery operation at full capacity is designed to produce the
products shown in Table 13.

The operation of the two refineries did not produce adequate supply of refined crude for domestic consumption, hence, the Kaduna refinery was established in 1981. The refinery was to process both light and heavy crude from domestic and external sources. The lubrication plant of the Kaduna refinery processes imported heavy crude (paraffin-based), for producing lubricating oils, bitumen, asphalt, sulphur, waxes and greases. With the third refinery, total refining capacity reached 260,000 BPSD. However, demand-supply balance showed that demand for refined products outstripped supply from the three refineries throughout the 1970s and 1980s (the oil boom years) (Table 14). The demand-supply imbalance led to the expansion of the installed capacity of the Warri and Kaduna refineries. The Kaduna refinery was expanded from 100,000 to 110,000 BPSD, while the Warri refinery was expanded from 100,000 to 125,000 BPSD (Tables 15 and 16). Furthermore, as the domestic demand for petroleum products increased beyond the production capacities of the existing three refineries, the government embarked on the construction of a fourth refinery in Port Harcourt in 1989. The fourth refinery operated with a processing capacity of 150,000 BPSD and was designed to process fuel in order to end fuel importation and create opportunities for exports (Tables 17 and 18). The fourth refinery, combined with refining capacity of Nigeria's refineries was 445,000 BPSD.

Financial performance

NNPC finances are closely related to that of the federal government. The NNPC export revenues are reflected in the Central Bank of Nigeria account, jointly controlled by the government and the NNPC. The government decides how much of this revenue will be passed on to the federation account. It also decides the amount to be allocated to the NNPC in the form of cash calls in order to cover upstream obligations of the NNPC's Joint Venture Companies and how much will be directed to priority investments by means of dedicated oil accounts. The government owns crude oil produced by NNPC, which purchases crude oil at government prices and refines and markets petroleum at government-controlled prices. However, increasing exploration, low product pricing, poor maintenance in the oil fields and the refineries, are noted to cause poor financial performances due to huge financial losses and arrears of payments to Joint Venture Companies. Inadequate upstream financing compels the reduction in oil production and employment. Between 1992 and 1994, NNPC did not deposit expected domestic sales proceeds of N20 billion to the federation account This would have been 14% of the budgeted federally collected revenues. In 1994, planned payment of NNPC arrears to Joint Venture Companies would have reduced potential revenues by about N11 billion. Usually, the main source of financing for the NNPC is the cash calls. It is the NNPC's share of

upstream joint venture exploration and production costs. The cash calls are funded from offshore petroleum export revenues. Furthermore, petroleum refining offers the NNPC and the federal government another source of revenue.

The key issues in this regard is that the price for refined products at the pump, the transfer price of crude sold to the refineries, tax rates, the negotiated margin for distributors and marketers and the residual margin accorded to NNPC, are determined by the federal government. Prior to March 1991, retail price of premium gasoline increased from N0.60 to 70 per litre, less the marketers' margin of N0.18 per litre. This yielded an ex-depot price of N0.52 per litre with an implicit subsidy rate valued at 81%. In 1993, the pump price of petrol was increased to N3.25 per litre and in November 1994, it was increased to N11.00 per litre. However, in spite of the increase in pump price of petrol, the residual margin accorded to NNPC covered only less than half of its estimated minimum costs of refining for nearly 3 years between 1991 and 1993. The new price structure introduced in November 1993 increased the margin to N2.22 per litre, which only covered the minimum costs. The reduction in the margin in October 1994 to N1.70 per litre, covered only 53% of minimum costs in 1994 and 50% in 1995 as shown in Table 19. Other sources of funding for NNPC include dedicated accounts, budgetary allocations from the federal government, external loans and occasionally the sale of equity. Extra-budgetary allocations from oil revenues to NNPC are established in about six dedicated accounts.

Table 13: Petroleum Products Daily Production

Petroleum Products	Daily Production (Tons)
Fuel Gas	306
LPG Propane	187
LPG Butane	459
Gasoline	5015
Dual Purpose Kerosene	2380
Automatic Gas Oil	4522
Fuel Oil	3808

Source: NNPC Annual Report

Table 14: Product Mix and Annual Domestic Consumption Levels (Metric Tons)

Year	Liquefied Petroleum Gas	Premium Motor Spirit	Dual Purpose Kerosene	High Pour Fuel Oil	Automotive Gas Oil	Low Pour Fuel Oil	Lubricating Oil	Bitumen and Asphalt	Others: Grease, Wax, Base Oil
1977	-	1861618	735949	1228395	345005	-	-	-	660000
1978	-	2291514	943645	1765275	744510	-	-	-	417279
1979	-	2515789	1020224	1707544	656315	-	-	-	574742
1980	-	5284570	1823958	2676605	875776	-	-	-	639112
1981	-	6573007	2161368	3131634	1153683	-	-	-	892831
1982	-	4300647	1551484	2604160	1232826	-	-	-	549629
1983	-	4244798	1811914	3035824	1187663	-	-	-	431136
1984	-	4012041	1724021	232601	827217	-	-	-	338091
1985	-	3787895	1520777	1832819	1113837	-	-	-	516969
1986	88717	3597356	1928190	1854275	507188	626271	146936	113050	700854
1987	104114	3625220	2017336	1755580	473057	704506	144910	123942	121680
1988	74482	3103079	1554391	1573996	495350	867235	179449	144164	66049
1989	64457	3256442	1583488	1496644	154773	798608	172198	95417	78940
1990	60373	3302808	1546848	1495739	139569	808725	157336	100825	81050
1991	55661	3380049	1311893	2331018	34134	773803	276167	85685	403790
1992	48907	3969576	1612075	2280125	21888	750787	177783	64310	1866354
1993	36262	3336215	1427784	2054424	65197	688072	144844	140913	775412
1994	20610	3015634	1131057	1596269	40406	670846	112172	37736	1385317
1995	11390	2735700	1023579	1334418	42497	472754	107775	20445	773810
1996	53264	3454326	916204	1573291	568141	715385	281234	6918	784486
1997	136760	2442926	938531	937384	2465752	373183	71308	49087	211749

Source: Central Bank of Nigeria Statistical Bulletin, Vol. 8, No. 2, December 1998

Table 15: Installed Capacity of Refineries

Refinery	Installed Capacity	Operating Capacity Barrels Day
PHRC (Old)	60,000	-
PHRC (New)	150,000	120,000
WRPC	125,000	100,000
KRPC	110,000	80,000
Total	445,000	300,000

Source:NNPC Refinery Reports, 1998

Table 16: Capacity Utilization of Refineries ('000 Barrels/Day)

Refinery	1989	1990	1991	1992	1993
PHRC	110	104	131	118	130
WRPC	80	35	59	95	60
KRPC	44	55	70	64	70
Total	233	244	260	277	260

Source:NNPC Refinery Reports, 1998

Table 17: Crude Oil Production, Supply to Refineries and Exports

Periods	Total Crude Production	Supply to Domestic Refineries	Supply to Off-Shore Refineries	Exports
1988	50997138	4298869	1248810	50781705
1989	55860044	7439946	596595	50023551
1990	60317163	7345425	925456	5134418
1991	57627496	8715204	899850	53322586
1992	61416121	8523460	-	52235188
1993	64193129	7668321	2894512	53371276
1994	64212703	3075255	3984829	60274883
1995	64716076	6711913	-	50311190
1996	71119440	3198807	-	69095788
1997	72168462	5411819	-	70165730
1998	65825215	3319100	-	62179877

Source:NNPC Refinery Reports, 1998

Table 18: Crude Oil Processed and Refined Products by Refinery (Selected Periods)

Periods	Crude Oil Processed			Refined Products		
	PHRC	WRPC	KRPC	PHRC	WRPC	KRPC
1985	660925	945769	911647	648153	898661	727982
1986	583912	442347	518073	561266	264094	446171
1987	394434	1098152	881209	377167	931475	675950
1988	664446	1189025	796570	639959	1046965	673328
1989	641082	889855	555230	428297	822561	450173
1990	1630230	796921	740824	1464148	733364	603068
1991	1545623	1108383	113233	1097755	1038977	116945

Source:NNPC Refinery Reports, 1992

These accounts were set up to earmark revenues for special projects. These are:

1. an account for NNPC's priority projects,
2. an account for NNPC's Liquified Natural Gas Project,
3. a fund managed by the Central Bank of Nigeria on behalf of the presidency,
4. a loan recovery fund,
5. solid mineral fund, and
6. a strategic reserve fund. The cash calls are also referred to as dedicated accounts.

The federal government allocated to NNPC N98 million in 1990, N100 million in 1991, N80 million in 1992 and N57 million in 1993. These funds were used for independent exploration, the bonny export terminal, gas supplies for various industries, the butanization programme, products distribution and infrastructures development. However, in 1994, the increasing costs of refinery breakdowns and TAM, coupled with worsening foreign exchange crises, compelled the federal government to re-trench certain capital expenditures. The 1994 capital expenditure plan shows that NNPC expected to finance the Eleme Petrochemicals Project and a portion of its independent upstream and down-stream exploration activities from external loans. The total external finance for these projects was US$225 million. Another financing option for the NNPC is the sale of equity in its joint venture companies. In 1989 the NNPC sold 20% of its equity stake in one of its joint venture companies for US$2billion. In 1993 it sold 5% in its holdings for US$500 million. It also reduced its stake in the LNG and Oso Phase II projects from 60 to 49% in 1994 and 1995, respectively (World Bank, 1996). NNPC capital financing programme shows the profile of its investment programme and the various sources of finance: mainly cash calls, dedicated accounts, budgetary allocation and loans (Tables 22 and 23). In 1994 it is evident that investment commitments were always above available funding and left large financing gap in all categories of investment. Its total investment finance gap for 1994 in both up-stream, downstream and other investments such as loan repayment and NAPIMs overhead, amounted to N20,024 million, which is estimated to be 20% of total investment costs (World Bank, 1996).

Table 19: Petroleum Prices for Nigerian Consumption, 1979-1990 (in kobo/litre)

Product	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
LPG	32.32	32.32	32.32	32.32	32.32	32.32	40.00	40.00	40.00	40.00	40.00	40.00
DPK	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	15.00	15.00	40.00
Auto Oil	11.00	11.00	11.00	11.00	11.00	11.00	1.00	29.50	29.50	35.00	35.00	50.00
High PF	2.30	2.30	2.30	2.30	2.30	2.30	2.30	19.50	19.00	30.00	30.00	50.00
Low PF	5.43	5.43	5.43	5.43	5.43	5.43	5.43	19.50	19.00	19.00	19.00	50.00
Prem. Sp.	15.30	15.30	15.30	20.00	20.00	20.00	39.50	39.50	39.50	42.00	42.00	60.00
ATK	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	113.60	113.60	113.60

Source: NNPC Corporate Reports, 1990.

Table 20: Petrol Pricing and Margins, 1991-1995

Domestic Prices in Naira per litre *(Premium grade)*	Mar. 1991-Oct. 1993	Nov. 1993-Sept. 1994	As at Oct. 1994	As at Nov. 1995
Crude transfer price, pretax	0.14	0.55	2.35	2.35
Crude transfer price, post tax	0.14	0.55	8.00	8.00
Ex-depotr product price	0.52	2.77	9.70	9.70
Retail petrol price	0.70	3.25	11.00	11.011.000
Estimated Refining Cost *Based on International cost of comparable refineries. It includes capital costs and pipeline operating costs.*	0.85	2.31	3.19	3.40
Actual NNJPC Margin as percent of total refining cost	44	96	53	50
Internal Prices in Naira per litre *valued at period average market exchange rates.* 1. Ex-refinery, FOB Rotterdam 2. Freight, Europe to West Africa 3. Import Parity Price (CIF) (1+2.) 4. PPMC/NNPC distribution costs 5. Ex-deprt product price (5+6) 6. Product Price of Imported	 2.15 0.10 2.25 0.47 2.72 0.54	 5.32 0.40 5.72 1.31 7.03 1.50	 9.98 0.78 10.76 2.12 12.87 2.42	 11.21 0.85 12.06 3.54 15.60 4.04
Retail Price of Imported Petrol (5+6)	3.26	8.53	15.29	19.64
Crude Oil Export Price (FOB) Naira/litre	1.47	4.19	8.08	8.24

Source: Federal Government of Nigeria National Petroleum Corporation, 1996

Table 21: Petroleum Refining Cost (Kobo/Litre)

Refinery	1993	1994	1995	1996	1997
WRPC	73	185	143	51	59
KRPC	34	86	143	71	50
PHRC	36	72	72	109	260
Wt. Average Refining Cost Kobo/Litre	46	103	104	73	83

Source: Oladele (1999) Petroleum and Stabilization of the Nigerian Economy, 20-21 April, Enugu.

Table 22: Federal Budgetary Support for NNPC, 1990-1994

Cost Items	1990	1991	1992	1993	1994
Exploration and Production	28	23	0	0	0
Bonny Export Terminal	70	57	0	0	0
Gas Supply for Industries	0	20	0	0	0
Butanization Programme	0	0	80	57	0
Product Distribution	0	0	0	0	1000
Insfrastructure	0	0	0	0	1000
Total	**98**	**100**	**80**	**57**	**2000**

Source: Federal Government of Nigeria, Nigeria National Petroleum Corporation, 1996.

Table 23: NNPC Capital Financing (in Naira Millions) 1994-1996

Projects	Cost Call	Cash Account	Dedicated Total	Budget	Loans	Total Financed	Gap
Upstream Exploration and Production	62612	59233	2248	0	550	62031	585
1. Petroleum	60368	59233	0	0	550	59783	585
a. Joint Venture (cash calls)	59233	59233	0	0	0	59233	0
b. NNPC	1135	0	0	0	550	550	585
2. LNG Project	2248	0	2248	0	0	2248	0
Down Stream Projects	15778	0	6318	2000	4400	12538	3240
1. Eleme Petrochemicals	4608	0	0	0	4400	4400	208
2. Refinery Repairs	697	0	0	0	0	0	697
3. Product Distribution	2431	0	0	1000	0	1000	1431
4. Gas Supply	281	0	0	0	0	0	281
5. Natural gas/NAFCON II	266	0	0	0	0	0	266
6. Infrastructure	1356	0	0	1000	0	1000	356
7. Priority Projects	6138	0	6138	0	0	6138	0
Other	20596	0	4397	0	0	4397	16199
1. Loan Repayment	2857	0	0	0	0	0	2857
2. Debt Carry Over	10413	0	0	0	0	0	10413
3. NAPIMS	4765	0	4397	0	0	4397	368
4. Direct Exploration Services	2561	0	0	0	0	0	2561
Total	**98990**	**59233**	**12783**	**2000**	**4950**	**78966**	**20024**

Source: Federal Government of Nigeria, Nigeria National Petroleum Corporation, 1996.

Table 24: NNPC Capital Investments (in Naira Billions) 1991-1996

	1991	1992	1993	1994	1995	1996
Upstream Exploration and Production	20207	40971	48625	62616	72857	71800
1. Petroleum	18634	38380	45687	60368	70448	69391
a. Joint Venture (cash calls)	18464	38196	44832	52933	66988	68701
b. NNPC	169	184	855	1135	3459	690
2. Geophysical and Geological	26	42	0	-	-	-
3. Gas (LNG Export Project	1547	2550	2938	2248	2409	2409
Down Stream Projects	4990	14630	12224	15778	17295	5209
1. Eleme Petrochemicals	2297	7871	7179	4608	1192	30
2. Refinery Repairs	313	1233	297	697	1378	456
3. Product Distribution	191	3082	3702	2431	2724	828
4. Gas Supply	763	856	452	281	829	277
5. Natural Gas/NAFSCON II	-	-	-	266	2696	777
6. Infrastructure	319	667	505	1356	1615	1276
7. Priority Projects	-	-	-	6138	6860	1567
8. Laboratory Equipment	13	9	44	-	-	-
9. Petroleum Research Centre	1	0	20	-	-	-
10. Other	792	967	26	-	-	-
Other	0	-	00	20596	64.6	885
1. Loan Repayment	-	-	-	2857	2857	2857
2. Debt Carry Over	-	-	-	10413	367	1001
3. NAPIMS overhead	-	-	-	4765	1564	1661
4. Direct Exploration Services	-	-	-	2561	1617	1366
Total	**24897**	**55601**	**60894**	**98990**	**96557**	**83895**

Source: Federal Government of Nigeria, Nigeria National Petroleum Corporation, 1996.

NNPC capital investment targets in both the upstream and downstream have continued to increase since 1991 as shown in Table 24. Total investments increased from N24,897 to N60,894 billion in 1991 and 1993, respectively. Between 1994 and 1996, it declined from 98,990 to 83,895 billion. This is caused by drastic cuts in downstream investments in 1996. Downstream investments were targeted at 17 priority projects valued at N14,567 billion. These projects are listed among NNPC priority projects. Investments in these projects declined towards 1996. However, investment decisions were not taken by NNPC. NNPC and its subsidiaries could not perform as creditably as they would, because the federal government took pricing and investment decisions. Furthermore, attempts to increase investment funding from the oil revenues would also reduce government expenditure. Therefore, investments were expedient only when they do not interfere with planned budget expenditure of the federal government.

Chapter Five

Conclusions and Recommendations

Technological learning and broad gauged training effort are important prerequisites for the formation of technological capabilities in the Nigerian oil industry in the decade following independence in 1960. Government policy initiated through the Petroleum Decree No.51 of 1969 was the bedrock of its political commitment to technological capabilities formation in the Nigerian oil industry. Furthermore, massive investment through the issue of petroleum contracts and the control of such contracts through the NNPC, paved way for the transfer of oil technology. The product of the initial technological training and learning was the development of some capacity in Nigeria to acquire the oil technology. The consequent technical change resulting from the increased investments, and engineering and equipment profiles of the NNPC, resulted in the enhanced performance of NNPC. Technological capabilities building and upgrading in Nigeria's oil industry is not only necessary for the development of the industry, but also an important indicator of the survival of the industry and the future of the economy of Nigeria, which depends largely on the success of the oil sector. Evidently, some core capabilities have been formed in the industry. These capabilities showed tremendous impact on production and financial performance of the industry.

The success of the oil industry in the early years after 1975, are attributable to these initial capabilities that were developed in the industry. The failure of the industry and the consequent domestic energy crises in Nigeria in the last decade are attributable to the weathering of these capabilities. The future of the oil industry will depend on further development and deepening of technological capabilities in the oil industry. Government response to the technology needs of the oil industry is to restructure the industry. Initial efforts at restructuring the NNPC began in 1988 and 1989. However, these efforts were frustrated with controversies within and outside the federal service. One successful achievement was the approval in March 1989 of management contract with Universal Operating Processing (UOP) at Port Harcourt II, which was to be paid a management fee, but would not share in the refinery profits or losses. UOP has sustained good performance with the Port Harcourt refinery over the period, at reduced operating costs and capacity utilization over and above the rest of the refineries. In 1994/1995 the Kaduna refinery and other refineries deteriorated, because of poor maintenance and lack of funding for the usual TAM (internal and external). These developments compelled the federal government to announce in 1995 that the refineries, PPMC, NPMC, NGC and the LNG project, could be leased to private firms, domestic or foreign, for a period of 10 years, with an option of renewal. Leases were to retain a share of the profits and be expected to supply the necessary funds for maintenance and capital depreciation. The deteriorated state of the refineries suggests that a phased programme

of divestment be initiated to return the refineries to profitable operation and to avert the crisis of petrol scarcity in the country. This begins with rehabilitation and repairs of the refineries. Once rehabilitation is completed, they can be maintained and consideration of divestment should also require an appropriate compliance by the private operators to supply and transfer modern technology. The prospects of restructuring the NNPC are dependent on the current democratic government.

The scope of this study is limited to the Nigerian oil industry and has opened several agenda for future further investigations in the industry. Some of these agenda have been identified and would benefit from this study. The agenda for future research include:

1. The role of indigenous oil contractors in the technological development of Nigeria's oil industry. This study will involve the determination of the technology profile of these indigenous contractors. The study shall provide a detailed classification of their operations in the upstream and downstream areas of the oil industry.
2. The comparative analysis of the technological developments in the oil industry of other oil producing countries. This entails a detailed review of technological developments in some selected oil companies of oil producing countries. The significance of this study is the streamlining of the experiences of these countries with technological capability building.
3. The study of the role of foreign MNOCs in the technological development of oil industries. This is a verification of the operational and management practices of the foreign oil companies in their host countries.
4. The study of the oil technology market. This entails an evaluation of the sources of oil technology supplies. The costs of acquiring such technology and the transfer process for countries in need of such technologies, especially, the oil producing countries.

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