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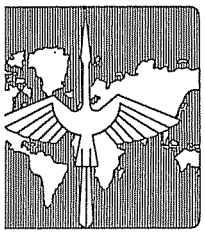

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Nigeria's first refinery was commissioned in October 1965. A second refinery is under construction and is scheduled to come on stream in late 1977. This paper compares and contrasts the two projects in terms of how the process of transferring refinery technology has changed over the last decade. An attempt is also made to account for and assess the changes which occur.[1]

When discussing the transfer of technology it is useful to distinguish between the transmission of scientific and technical knowledge in general and the transfer of technology needed directly for economic growth.[2] The general knowledge is created by research and is not directly the object of commercial transactions. In contrast, the technology that is closely linked with productive activities is transmitted for a price. The elements of knowledge needed for investment and production have become increasingly science-based and hence are created mostly in developed countries according to the existing division of labour in science and technology. These elements are commercialized through what has been called the transfer of technology. It is these aspects of commercialized technical knowledge that are of most interest in the following discussion of the two refinery projects in Nigeria. They include[3]

1. Those elements needed in the pre-investment and construction phases of a project:

(a) feasibility studies and market surveys prior to investment;

(b) information on the range of technologies available;

(c) engineering design and selection of machinery;

(d) plant construction and installation of equipment; and

(e) process technology.

2. Those elements needed in the production phase:

(a) knowledge concerning the management and operation of the production facilities;

(b) marketing information and techniques; and

(c) on-the-job improvement of the production process.

Of these elements, design engineering and process technologies are the most science-based and therefore the most foreign to developing countries. The institutional modes or mechanisms for their transfer can be classified as follows:

1. Concessions or licence to use patented formulae, designs, models, procedures or specific pieces of technical knowledge;

2. Contracts for the supply of equipment and corresponding operating instructions; and

3. Contracts for the supply of technical services associated with the provision of any of the other elements of technical knowledge mentioned above.

Contracts and licences are combined in different ways, ranging from the most *packaged* arrangements to the most *unpackaged* ones, depending on how many groups or individuals are separately contracting with the technology recipient. In the most packaged case the recipient contracts with only one contractor to supply the whole technological ensemble needed for what is then a turnkey project. At the other extreme the recipient contracts with one supplier for each element of technical knowledge and might even be supplying some itself.

The degree of packaging usually reflects the degree of external ownership. Technology is highly packaged in the case of a subsidiary which is wholly-owned by a parent company, but it is less packaged in the cases in which the new project remains in national hands after the transfer is completed. But ownership and control over the process of acquiring technology are not always positively correlated. For instance, fully national enterprises commonly maintain links with foreign suppliers of technology through technical or managerial assistance agreements.

The institutional options connected with packaging and ownership are central to three issues deriving from patterns of technology diffusion and underdevelopment:

1. The cost of the transfer of technology;

2. The degree to which the technology is appropriate; and

3. The degree to which local scientific and technological capabilities are encouraged to develop.

The issues arise not only because of the international division of labour in science and technology but also because the technology market is imperfect and the buyer is usually in a weak bargaining position vis-à-vis the seller. The following conditions contribute to this situation:

1. the supplier has thorough knowledge of the object of the transaction and the buyer does not;

2. the buyer does not have enough knowledge about alternative sources of technology and transfer conditions;

3. the supplier knows how to sell technology as that is his trade while the recipient does not know how to buy it since he usually purchases the technology for a single project;

4. the supplier is protected by industrial property legislation and practices, whereas the buyer usually does not have any legal structure to guide him, let alone protect him;

5. as a rule the marginal cost of the technology is low and decreasing for the supplier, whereas it is high and risky for the buyer;

6. the supplier often has close and helpful connections with the financing agents;

7. the supplier is often assisted by his own government and by other 'political' externalities;

8. the supplier often has large marketing resources in the form of publicity, public relations, prestigious trademarks, etc., with which to impress the buyer;

9. the technology transaction is usually welcomed by local industrialization policies.

The buyer who is in a weak bargaining position is compelled to accept expensive conditions in order to acquire technology. However, the strong bargaining position of the supplier is reinforced in those situations in which the buyer in the underdeveloped country gains personal advantage, often in the form of kickbacks, from the transfer. The problems of technology transfer, while orginating in the commercial structure and policies of technology owners in developed countries, are intensified by the behaviour of those groups in underdeveloped countries which, in search of individual advantage, obtain technology on less than optimum terms. In pursuing their personal and often pecuniary interests, members of this intermediary stratum tend to accept and enjoy transfer conditions which as a whole jeopardize the possibility of autonomous development in their countries.

To summarize, in the following case studies we are concerned mainly with the technical knowledge and equipment needed directly for investment and production; the institutional mechanisms of transfer, including the degree of packaging and the structure of ownership; the problems of appropriateness, cost and development of indigenous science and technology capabilities; and finally, the relative bargaining positions of supplier and recipient, given imperfections in the international technology market and the fact that groups exist in underdeveloped countries which benefit from the current situation.

CASE I: THE PORT HARCOURT REFINERY

Project initiation: Nigerian oil was discovered in commericial quantities in 1957 and first exported in 1958 by Shell-BP Petroleum Development Co. Ltd, a jointly-owned subsidiary of the major Anglo-Dutch oil corporations.[4] As early as 1954 Shell-BP secured the option to build a refinery under the terms of the Oil Prospecting Licences which the colonial regime in Nigeria granted the oil company.[5] In June 1958 a 30-year Oil Mining Lease was signed by the company and colonial government giving Shell-BP the right to build a refinery when production reached the (very low) level of 10,000 barrels a day (bd).

Both the oil company and the Nigerian Government which was to take office in 1960 favoured the establishment of a refinery. The government welcomed a savings of some £13 million or $40 million annually in foreign exchange spent on product imports.[6] In the early 1960s refineries - like airlines - were among the most sought-after industrialization projects in underdeveloped countries.

Major oil companies established a pattern in the early 1950s of building large refineries near major markets. Products were then exported to small underdeveloped country markets. But since World War II, and especially since the early 1960s, there has been a spate of refinery construction in poor countries with small markets. In 1950 less than half the products consumed in oil-importing underdeveloped countries were refined locally. By 1965 the proportion had increased to five-sixths.[7] The refinery building boom was partly due to pressures exerted by recipient governments, but it also reflected the competition between major oil companies and smaller independent firms which had become established since the war in a context of crude oil surplus.

There is some evidence that major oil companies had a refining strategy for Africa as a whole but that an aggressive drive by small oil companies such as Italy's ENI forced the majors to accelerate their implementation of the programme. Barry Herman, viewing the African refining problem on a continent-wide level, notes that

> ...it is easy to see how costs could be reduced and mutuality of interest made more secure if the majors could agree to divide up among themselves the responsibility for building and operating the refineries in the various necessary locations. Indeed, one industry executive has admitted that, since in most

> African countries only one refinery would be allowed by the governments, the majors achieved an understanding among themselves as to which of them it would be in each country: i.e. they agreed which one would 'lead' in refinery project proposals in different countries (Shell in Kenya, BP in Nigeria, Stanvac in Ghana, etc.). The 'leader' was supposed to win the right to build a refinery. It would then be in a position to process the oil of the other majors in exchange for the same privilege at their refineries in the other countries.[8]

Small independent oil companies such as Phillips and Union Oil along with Italian and Soviet state firms possessed crude by the early 1960s. They sought markets for crude and products through offering low prices and favourable terms. In particular by offering host governments equity in new refineries, the newcomers made inroads into the major international companies' share of the refining industry. The majors'[9] share of refinery capacity outside North America and the Soviet bloc dropped from two-thirds in 1961 to about two-fifths in 1965.[10]

In response to this successful drive by small independent and state-owned oil companies, the majors joined the refinery building boom. Motivations included a '...normal commerical desire to safeguard or enlarge their share of the rapidly expanding market for petroleum products,'[11] and a need to pre-empt the expansion of other oil entities. In order to maintain the position in Africa the majors dropped the economically optimum strategy of supplying small markets from huge Caribbean and European refineries and replaced it with a policy of building local plants, but they did so no sooner than competition from minors made necessary. Shell-BP secured the option to build a Nigerian refinery in 1954: eleven years later it was operating.

In September 1959 Shell-BP brought a survey party from the UK to select a refinery site.[12] In July 1960 the Nigerian Government and BP-Shell, not yet a company, began negotiations on building a refinery. A month after Nigerian independence in October 1960, the government issued a White Paper which authorised BP and Shell to build a refinery. The two firms formed a joint operation called BP-Shell Petroleum Refining Co. Ltd, and undertook a study which showed that a plant capable of processing 1.5 million tons of crude oil a year (30,000 bd) would cost N£9.6 million or about $28.0 million.

British Petroleum Trading Ltd, the London head office, controlled all aspects of the project. However,

in anticipation of government shareholding and to preserve the legally separate identity of the Nigerian subsidiary, BP-Shell, and BP Trading, the appearance was maintained that BP-Shell was controlling and managing the project. For instance, the distinction between BP London and BP-Shell was maintained formally through the use of BP Trading letterhead for 'conveying advice and assistance from London', rather than memorandum paper which was restricted to 'conveying instructions'.[13]

In January 1962, BP Trading signed a Construction Service Agreement with its refining subsidiary in Nigeria and site preparation began at Alesa-Eleme near Port Harcourt in the Eastern Region. According to the Agreement terms, London was to provide technical, administrative and general advice as well as services outside Nigeria. The responsibility for project coordination rested with the Commercial Division of the Refineries Department in BP head office. A London-based Project Superintendent liased with the refinery General Manager in Nigeria, Mr. Sheldrake, who was seconded from BP Trading. After this mechanism was set up, BP-Shell invited bids for refinery construction and in 1962 surveyed manpower availability in Nigeria prior to recruiting personnel.

Ownership: In 1962 the Nigerian Government was brought into the project as a 'sleeping partner' by securing a financial interest. The Refinery Agreement, signed on 25 July 1962 by BP-Shell and Alhaji Yussef Maitma Sule, Federal Minister of the Ministry of Mines and Power, provided for a refinery with 1.6 million tons of crude capacity to be owned 50% by the Government and 25% each by BP and Shell. Capital of 10.2 m. Nigerian pounds (about US$28.6m.) was raised as follows:

share capital		*N£4 m*
Government	2 m A shares	2m
BP	1 m B shares	1m
Shell	1 m B shares	1m
loan capital	100%	6.2m
Government	50%	3.1 m
BP	25%	1.55m
Shell	25%	1.55m

BP, the operator of the project, appointed the Managing Director who was also Chairman of the Board. The

government had no experience in the refining industry and relied completely on the foreign companies. The Refinery and Operating Agreements were accepted by a new government, not yet fully staffed by Nigerians.[14] However, some politicians and Nigerian technicians-in-training felt that concessions to the companies were overly-extravagant.[15] In November 1963 six government representatives joined the Board of Directors and the company's name was changed to the Nigerian Petroleum Refining Co. Ltd (NPRC).

With A and B shareholders each having 50% of equity the refining company lacked a majority voice. This posed no immediate problem because British Petroleum Trading as the operator made all decisions. It supplied materials and personnel for all stages including design, fabrication, erection, commissioning and operation. The only concern of government was with location[16] and in fact BP supplied a turnkey project.

The technology package: Within limits, economies of scale favour the building of large refineries but, in response to the refinery boom in developing countries during the 1950s and 1960s, oil companies designed small plants which '...by sacrificing technological sophistication.../could/ sometimes operate reasonably economically....'[17] BP designed a simple, small and low-cost refinery for Nigeria. The Port Harcourt plant was designed at 1.9m tons crude capacity per year (38,000 bd) to turn out products as follows:[18]

product	*tons per year*	*% of total production*
motor spirit	315,000	16.6
kerosene	210,000	11.1
gas, diesel oils	593,000	31.2
fuel oils	781,000	41.1
	1,899,000	100.0
	(37,980 bd)	

Two process units were used to produce this range of products:

crude distillation unit	38,000 bd (1965)	60,000 bd (1973)
catalytic reformer	4,600 bd (1965)	6,000 bd (1973)

By 1966 a liquefied petroleum gas unit with a capacity of 10,000 tons a year had been added and was operating. The capacity was increased from 28 to 60 tons a day in

1973.

Was the choice of technology appropriate? Two criticisms of the plant design can be made. First the refinery was too small. Within 18 months of operation it was running at full capacity. Even with the dampening effect of the civil war, consumption soon outran the capacities of the original design. Since the small plant failed to meet local demand, the marketing subsidiaries were able to continue selling imported petroleum products in Nigeria. Gearing capacity to demand at the time the plant went on stream meant that it would begin operations at nearly full capacity. This is an effective way of minimizing operating costs and realizing a faster return on investment. But the costs to the national economy of built-in capacity shortages are considerable in terms of supply interruptions and foreign exchange expenditures for imports. BP and Shell took a short-term commercial view of the oil product market although they were in a position to conduct demand studies via their marketing subsidiaries in Nigeria. There was no consideration of the impact which crude oil production and attendant state revenues would have on product consumption. Throughout the planning period the government remained uninvolved in capacity and demand questions.[19]

The second problem with the refinery design has to do with the large proportion of fuel oil it produces. The plant was originally geared to produce enough gasoline and fuel oil for the local market. In the mid-1960s thermal electricity plants were the main users of fuel oil. With the commissioning of the Kainji Dam in 1968, consumption of fuel oil was cut by 60%. The oil companies diverted the excess fuel oil to export markets where it was in high demand and in which the companies could sell it at their own price. Nigerian gasoline consumption soon outstripped production, partly because road transport gained in importance as the railroad system atrophied due to poor management. Marketers were able to import and sell regular and premium gasoline. This imbalance in the production-consumption pattern suggests that the BP design did not take the planning of the Kainji Dam into consideration.[20] Finally, the demand for gasoline was badly estimated.

After choosing a design and receiving government advances against share and loan capital in January 1963, BP awarded the refinery contracts. While it is known that the project jobs were put out to international tender, nothing is known about the methods used in choosing contractors or about the terms and conditions of the

contracts.[21] The biggest job, worth N£3.9m ($11m) went to the British subsidiary of Procon Ltd, an American company which itself is a subsidiary of Universal Oil Products. Procon's contract included the crude distillation unit, a catalytic reformer for the production of high grade gasoline, tankage, control room, utilities, engineering services, laboratory, stores, workshops and administration building.[22] Other companies receiving contracts included George Wimpey (US), Britain's Taylor Woodrow, Lloyds' Examiners and Surveyors, X-Ray and Gamma-Ray Interpreters, and finally, BP Trading which supervised every phase of construction.

The Port Harcourt plant was operated by BP from October 1965 to July 1967 when the civil war brought activities to a halt. But even during the 21 months of operation prior to the shutdown the refinery was affected by politics. Its formal opening in January 1966 was cancelled due to the first coup. The new head of state, General Ironsi, immediately reduced the price of all grades of gasoline.[23] The second coup in July 1966 and the civil bloodshed of July and September seriously disrupted the distribution activities of marketing companies and interfered with product offtake from the refinery.[24]

New governments tend to revise the legislation laid down by their predecessors. The Ironsi and Gowon regimes, impelled by the need for revenue and in line with OPEC initiatives in the international arena, opened negotiations with oil producing subsidiaries during 1966 and 1967 on pricing, tax and royalty questions.[25] In this context objections to certain aspects of the Refinery and Operating Agreements were raised. The most serious concerns related to cost and the development of Nigerian technical and managerial capabilities. These issues in turn were related to the refinery ownership structure and pattern of operational control.

The issue of cost: The costs of technology are notoriously difficult to measure. This paper does not attempt to quantify costs but only to identify cost disadvantages on the basis of interview information which is corroborated by actual changes in the terms of refinery operation. It is useful to distinguish between direct or explicit costs and indirect or implicit costs. Explicit costs are incurred through paying for licencing, capital equipment and operating contracts. They are payable in hard currency. Implicit costs relate to transfer pricing, trade restrictions and loss of control. They affect

the balance of payments through restrictions on exports, tying-up of imports and credits, the repatriation of profits and, in general, the loss of control over the national economy.

Because pre-production phases of the refinery were completely in BP hands, there is virtually no information available on the direct costs of equipment, the services of the construction contractors or the licence for the Universal Oil Products platforming process. Informants long associated with the Port Harcourt plant state that in the case of contracts, price inflation was present. But in the absence of BP records for the period, this remains an open question.[26]

The direct cost of management services was much inflated. The fault which led to this situation lay in the 1962 Operating Agreement which was entirely drawn up and made by two representatives of British Petroleum. A BP employee representing NPRC's interests agreed with a representative of BP Trading Ltd on terms according to which the Nigerian plant would be operated by the London firm. The Board of Directors' meeting fell short of being an effective forum for accountability to Nigerian interests because it was chaired by a BP representative by virtue of that company's operating role. The chairman could, in the case of a six-six voting split, cast his second vote and decide the deadlock. The only means Board members had of informing themselves on plant operations was to question the Managing Director-Chairman. Ex-Nigerian Board members reported that this avenue for involvement was less than satisfactory.

According to the terms of the Operating Agreement, BP agreed to provide a Managing Director and other expatriate staff as needed to operate the refinery in a safe and efficient manner. The staff were to be provided in such numbers and for such a period as the company, NPRC, considered necessary, '...it being understood that such expatriate personnel will be replaced by trained and qualified Nigerians as soon as the company deems such replacement feasible.'[27] Remuneration under the terms of the Operating Agreement was, for expatriate staff, to be according to BP's conditions of Service. The duties of these employees were, in the broadest terms, to manage the refinery by providing or contracting technical and maintenance services, providing supplies, buying abroad and managing recruitment, career development and training. The Operating Agreement allowed for BP to '...arrange for its obligations to be performed by any associates...' (that is, companies in which BP owns more than

50% of the voting shares) and included an undertaking that '... BP shall exercise due diligence in providing or procuring the services to be rendered by BP under this Agreement and such services shall be in accordance with customary practice in the oil industry.'[28]

Not only were the terms of the Agreement vague in the extreme, but their execution was completely at the discretion of BP. There was no system of accountability. Investigations in the late 1960s revealed that the result was a high cost to NPRC for management services and the discouragement of the development of Nigerian refining capabilities. This manpower situation stemmed from the fact that the Managing Director determined total staff needs and was free to decide that no suitably trained and qualified Nigerians were available. Furthermore in the face of BP's international policy of personnel 'localization' there was a staff surplus in BP London. The difficulties of retrenchment and redundancy in the London office were eased to the extent that excess personnel could be seconded to Nigeria. Expatriate staff stayed longer than the training of Nigerian staff should have taken. As operator, BP had to decide when replacement was feasible with the result that the proportion of expatriates remained high until the Agreement was revised. Finally, the remuneration to individual expatriates was high relative to their UK incomes, their qualifications and the demands of their jobs. The payment to BP London for supplying a management was very high as is indicated by the fact that the oil company accepted a 40% reduction under the revised Operating Agreement.

One of the indirect costs of technology has to do with the overpricing of inputs.[29] This issue can be serious if ownership or operating terms allow for the parent company to supply the subsidiary with materials and attach an often arbitrary transfer price. As Operator, BP could decide on the kind, quantity, price and source of supplies and bring them into Nigeria duty free.[30] For purchasing on behalf of NPRC, BP charged a handling fee. The purchasing procedure routed all orders through BP head office, London, which then invoiced the NPRC. BP London retained the invoices from original suppliers. Widespread cost inflation in transfer prices was confirmed by investigations into open market or discounted bulk prices.[31] The revised Operating Agreement incorporated some safeguards against price inflation.

BP receives discounts as large as one-third for buying in bulk. Such trade advantages were not passed on to NPRC, although the needs of that company were contributing to the size of BP's bulk orders. Tetraethyl lead,

an expensive additive for upgrading gasoline octane, is obtained by BP from Associated Octel in which BP has a shareholding. The discount was not passed on to NPRC. Charges levied by BP for shipping materials from the UK were much higher than those charged by commercial shipping agents. An inventory of the Port Harcourt refinery stores revealed considerable over-supplying and the stocking of materials not needed in the refinery operation but which were brought in duty-free. BP has buying agreements with 'brother' companies which are often subsidiaries or UK-owned. Nigerian refinery demands were directed towards these firms while local linkages were neglected.[32]

Another indirect cost of the transfer of technology to the first refinery derived from restrictions on trade, in this case on the export of petroleum products. BP was willing to set up a refinery geared to the internal market but was not prepared to construct an export-oriented plant geared to the West African product markets because these could be supplied more profitably from the majors' own export refineries. In addition, the cost of shipping products from Nigeria to neighbouring countries, in the absence of a national tanker fleet, virtually rules out the project. A second trade restriction deriving from the terms of technology transfer was the exclusive right BP had to undertake purchasing for the operation.

One example will suffice to illustrate how another type of implicit cost, loss of control in favour of the supplier, can be burdensom. Port Harcourt is a processing refinery: the NPRC owns no crude and no products. It charges a fee for refining crude owned by the marketers.[33] This arrangement was agreed between Shell and BP and the five other companies marketing in Nigeria.[34] This was to the advantage of the other marketers since if BP-Shell operated a crude and product *owning* refinery it could supply products to the BP and Shell marketing subsidiaries on favourable terms. Similarly if the government had an interest in a crude and product-owning refinery it would be well placed to exclude foreign firms from the local products market. In the early 1960s there was some controversy among the companies over whether BP-Shell should run an owning or a processing plant and the dangers of those firms increasing their share of the Nigerian market were the former choice made. But when the other companies threatened to retaliate in kind outside Nigeria, Shell and BP readily agreed to establish a processing refinery. The government had no part in this decision by the companies that Port Harcourt would

be a processing refinery. It was to the disadvantage of public interest in two ways. First, the government could not control what products were produced in the refinery, what amounts were produced or the destination of the products. Second, the refinery profit margin was fixed at 15%. Thus even if the government wished to manage the NPRC as a profit-making firm, it was constrained within the limits of profitability. All other components of profitability were passed on to the marketing companies.

Local science and technology capabilities: BP was reluctant to reduce its operating role by replacing expatriate staff with trained Nigerian personnel. Because the pace of Nigerianization was left to BP under the terms for operating the plant, its pace was slow.[35] For example, as late as March 1971, of the 63 senior staff at the supervisory level and above, only 17 or 20% were Nigerian. Of the total staff of 321, 47 were expatriates in 1971.[36] The government found this rate of transfer unacceptable and took action which by 1973 resulted in the reduction of expatriate staff to 4% or 10 out of 408. Complete Nigerianization was planned for 1976.[37]

The terms of transfer discouraged the development of local research and development facilities. BP called on head office resources to solve the most elementary problems. Opportunities for Nigerians to gain familiarity with local crude oil characteristics were foregone. Finally, very few local suppliers of materials and services were patronized by the BP management with the result that after almost a decade the refining company had established virtually no linkages with the Nigerian economy.

Between 1967 and 1973 changes were made in the terms of operation. A revised Refinery Agreement (1972) brought together these government reforms. The changes were brought about by Nigerian members of the NPRC Board of Directors who had been appointed in 1967 by the military regime. Some of these new appointees had previously been refinery employees in technical capacities. They and other new board members were spokesmen for Nigerian staff whose frustrations had accumulated under BP management and acquiescent Nigerian civil servants and politicians who had no technical knowledge of refining. Members of the Board before the 1966 coup had been political appointees with no special interests in the business of refining. In contrast the military appointees were technocrats with financial and engineering expertise as well

Table 1

Employment in the Nigerian Petroleum Refining Co. Ltd as of 31 March 1971 *

categories	Nigerians	non-Nigerians
management	-	4
professional	7	9
intermediate and supervisory	10	33
clerical and secretarial	50	1
skilled labour	182	-
unskilled labour	15	-
others	10	-
Total	274	47

* Source: Federal Ministry of Mines and Power, Division of Petroleum Resources, *Annual Report 1970-71* (Lagos: Federal Ministry of Information), Table 14, p. 32.

as some top level military officers. As a group these Director's were accustomed to expect efficiency and accountability at all stages. They requested the operator to release records and brought basic information on refinery operations before government ministeries for the first time. Those records were used in a concerted campaign to lobby government support for majority ownership and revised Refining and Operating Agreements.[38]

The revised terms took effect from 1 October 1971. The most fundamental change was in ownership structure. The state became the majority shareholder by acquiring 10% of equity from BP and Shell who were left with 20% each. In line with 60% state ownership, the new settlement provided for a Nigerian Managing Director, Chairman and refinery manager; it spelled out the government's policy on Nigerianization of personnel and provided timetables leading to complete local operation. The Board of Directors was empowered to review and revise the expatriate salary budget and, in general, to monitor operating costs and import prices. Staff size was increased to 400 and the maintenance function was no longer contracted out. In addition, the government froze the price of crude oil which Shell-BP supplied to the refinery at about $1.90, the original level negotiated in 1962.[39] A new technical department for research and development was established as part of the Port Harcourt refinery, the aim being to produce solutions to problems locally rather than import them.

CASE II: THE WARRI REFINERY

In late 1976 Nigeria's second refinery is about to be constructed. It will likely be on stream somewhat later than October 1977, the date announced by the government in 1975. In comparison with the first refinery, the Warri project is very much under Nigerian control. This difference reflects a gradual accumulation of experience, changes in Nigerian government policy and new forces within the world oil industry.

Three developments contributed to the formation of a cadre of experienced Nigerian refiners. First, involvement in the production phase at Port Harcourt yielded trained chemical engineers and other personnel able to run a refinery. Second, the process of revising the 1962 Refining and Operating Agreements and putting the new terms into effect fostered a certain amount of technocratic and managerial competence. Third, the task of fueling the Biafran war effort provided further experience. Products were produced in the captured Port Harcourt refinery for some months from July 1967[40] and later in several simple crude distilleries erected in Biafran territory. The Biafran refiners, many of them trained in the Port Harcourt plant,[41] effectively set up refineries under wartime conditions. They undertook research to improve quality and extend the range of products. These efforts went some way towards dispelling the myth that refining technology was beyond the immediate capacity of Nigerians.

The gradual build-up of refinery personnel and confidence was reinforced by new government policy on foreign investment. Like the Balewa regime of the civilian era, Gowon's military government favoured a strong private sector. The innovation of the early 1970s was the requirement that Nigerian businessmen have a significant participating interest.[42] Further, the Second National Development Plan (1970-74) stipulated that major projects, especially those in the oil sector, be at least 55% government-owned.[43] The state's policy of pragmatic economic nationalism reflects the government's perception of a greater need for management and technology than for investment capital.

The central role of the state in the new refinery project also has to do with the move in the early 1970s from an international crude surplus to a shortage. It was clearly evident by late 1972 that the buyer's market in crude oil had been transformed into a sellers' market. Some discussion of the great changes in the international

oil industry is warranted since Nigeria has become a major crude exporter, ranking third in 1976.

The 'revolution' in the petroleum industry has to do with the ownership of crude oil. Beginning in October 1972 OPEC member governments took control of oil company exploration and production subsidiaries operating in their countries through the buying of majority interest. Governments thus have control over crude oil and can regulate the volume produced and the price charged. Posted price increases and sales of government participation crude at high prices have vastly increased revenues from oil. Producing countries are therefore well placed to spend on programmes of industrialization. Since hydrocarbons are under government control, an obvious industrialization strategy is to add value to the crude and thereby produce petroleum products for local consumption and export. This is the context of a trend '...towards increased control by producer governments over the international oil trade, through the construction of state-owned or state controlled export refineries of the largest possible scale.'[44] Oil-importing countries are also concerned about secure product supplies, and in 1973-75 this concern was for some importers particularly intense. There was a move in the early 1970s to build up refining capacity in the importing countries (to the extent that they could secure guaranteed supplies of crude) and to open markets to product exports from oil producing countries. In short, concern for industrialization and security of supply led many countries to initiate the construction of refineries and it appeared that a refinery-building boom was imminent.[45]

Ownership: Local manpower availability and the world demand for petroleum were factors which figured in the government's decision to own 100% of Nigeria's second refinery. But additional political and economic considerations led the Federal Executive Council, Nigeria's top policy-making organ, to decide on recommendations from the Ministry of Mines and Power in March 1973 that the second refinery would be 100% state-owned. The state was participating to the extent of 60% in the first refinery. A wholly public undertaking would be an improvement on that. As a crude-exporting country, Nigeria was in a good bargaining position to obtain technology without having to compensate the supplier with equity. Since the refinery was for the local market there was no pressure to yield participation to an international oil company in order to secure export outlets and the use of

Table 2

Composition of Federal Government Revenue: oil and non-oil sources 1970-71 to 1975-76 in percentages

fiscal year	total revenue	oil revenue	non-oil revenue
1970-71	100	27.4	72.6
1971-72	100	50.2	49.8
1972-73	100	40.9	59.1
1973-74	100	62.0	38.0
1974-75	100	84.4	15.6
1975-76	100	95.0	5.0

Source: Central Bank of Nigeria

Table 3

Rates of Growth of Recurrent Federal Revenues 1974-6 (N'000s)

fiscal year	total revenue		oil receipts		non-oil receipts	
	amount	%	amount	%	amount	%
1970-1	556,910	100.0	152,284	100.0	404,626	100.0
1971-2	1,410,911	254.5	707,522	465.1	703,388	173.6
1972-3	1,389,911	249.6	569,397	374.3	820,514	202.7
1973-4	1,569,974	261.9	974,293	640.8	595,681	147.2
1974-5	3,121,761	560.5	2,635,941	1734.2	485,820	120.0
1976*	5,010,520	899.7	4,760,000	3120.0	425,895	105.2

Source: Central Bank of Nigeria
**Financial Times* (8 March 1976) report from United States Treasury figures

a marketing network. Crude exports had provided revenue in quantities sufficient to eliminate the need for foreign capital investment. As oil came to dominate the Nigerian economy its control by the state became politically more important. By 1973 oil provided four-fifths of total export value[46] and by 1975-76, 95% of federal revenue. In the five years between 1970-71 and 1974-75 total recurrent revenue had increased nine times. This was the result of oil revenue increasing 31 times and of an increase in non-oil revenues of just one-fifth. Clearly oil had become such a powerful economic force that to leave it in the control of foreign companies would call into question the country's political independence. But perhaps the most important single reason for complete state ownership was the government's decision to supply the Nigerian economy with low cost fuel and to control the local energy market. This objective requires that the state develop an integrated oil industry, a policy which in 1974 had gained prominence within OPEC. This decision by the state to completely own the refinery was taken in an oil industry context of capital shortage. Oil companies were showing a preference for service and technical contracts while leaving investments to OPEC member governments.[47]

One hundred percent ownership of the crude-owning refinery is a logical corollary of state involvement in oil production and crude marketing.[48] The state owns crude which is obtained at no more than the cost production.[49] This crude can be refined at about 80 cents a barrel and the products sold in states outlets at prices based on political and economic calculations. In this integrated operation government price decisions are based not on cash flows geared to the most rapid return on investment, but on broad considerations of development need and social benefit. Given the normal commercial imperatives of an oil company, a refinery partnership could involve basic disagreements over company policy.

Project initiation: State ownership does not translate automatically into national control of the process of selecting and transferring technology. Nor does government control guarantee that citizens get the most appropriate technology on the least expensive terms and in such a way as to encourage local technological development.

In 1967 the Ministry of Mines and Power was aware that the Port Harcourt refinery would not meet local

demand levels beyond 1973 if demand increased by 8% per annum. More refinery capacity was necessary by the beginning of 1974. But a considerable period of time elapsed before the pre-production phase of the new refinery project got underway. During this interim the government received unsolicited proposals for a 55,000 bd refinery from Mobil, Texaco, CFP (French Petroleum Company), Agip, the Japan Consulting Institute and from BP-Shell.[50] The revised Port Harcourt Refinery Agreement stipulated that '...within three years from October 1, 1971 the NPRC must consider the economic feasibility of additional capacity and of making additions to manufacture other petroleum products for the Nigerian market.'[51] In 1971 BP and Shell submitted a detailed proposal to build a 55,000 bd plant near Lagos, costing £14.5 or about $40.6m, to be '...owned, managed and operated by the Nigerian Petroleum Refining Company Ltd.'[52]

Among those who had political influence within the Federal Military Government, refinery location was a controversial point. The BP-Shell proposal had selected South Lagos after comparing the costs of four alternative locations. The government decided to submit six possible sites to an independent consultancy firm hired by the Ministry of Mines and Power. The French company BEICIP (the French Petroleum Institute's Bureau of Industrial Studies) was hired in 1971 and in that year the Federal Executive Council received its recommendations. A decision on Warri in the Mid-West State was finally made in 1973.

There were further delays due to decisions to increase the refinery's capacity. In 1973 it was thought that a 65,000 bd plant would be adequate, but by August 1974 it was announced that Nigeria's second refinery would process 100,000 barrels of crude a day. This 54% increase in refinery size can be partly explained by response to extremely rapid growth in local demand for petroleum products. Consumption increased by 72.2% between 1970 and 1973 rather than by 24% as was anticipated by planners counting on an eight % annual consumption increase.

Nigerians consumed more oil products than was anticipated for several reasons. Road construction and improvements, increased vehicle imports, industrial expansion and the introduction of uniform prices for six petroleum products on 15 October 1973 are important factors, but one further explanation for this amazing rate of growth is product smuggling to neighbouring countries where prices are much higher than in Nigeria.

Table 4

Consumption of refined products in Nigeria 1970-4

year	consumption '000bd	percentage increase
1970	28.4	
1971	34.3	20.8
1972	39.8	16.0
1973	48.9	22.9
1974*	68.0	35.0

Source: A. A. Kubbah, *OPEC Past and Present* (Vienna: Petro-economic research centre, 1974), Table 4, p. 166.

*expected consumption

A semi-packaged transfer: After the government had settled on the Warri location in early 1973 the second refinery Project Team was set up within the new Nigerian National Oil Corporation. However, by August 1974 the project was moved outside the National Oil Corporation's jurisdiction by the Ministry of Mines and Power. The Project Team, six-strong in late 1974, had its own budget and vote of funds directly from the Ministry of Finance. The Team was charged with monitoring the entire project from the consultancy stage to commissioning.

BEICIP, having proved cooperative in assessing alternative refinery locations and having produced a comprehensive four-volume site optimization study in 1971, was kept on. The consultancy agreement between BEICIP and the Project Team could be described as a semi-packaged arrangement for transfering refinery technology. A semi-packaged deal is one which involves the monitoring intervention of a third party between the buyer and the seller of technology. The third party, BEICIP, is charged with working in the interests of the recipient and is paid to do so. While several firms may contract to provide the Warri refinery with materials and services, BEICIP advises on their selection. Depending on its initiative, the Project Team can have more or less of a role in the choice of suppliers and in the negotiation of terms. Because the Project Team is neither acting directly nor placing the total project in the hands of

an outside company, it is appropriate to describe the transfer as semi-packaged.

The consultant and the Project Team chose a specific site in Warri. After the project scheme was prepared the two parties elected process licences. Processes were chosen on the basis of economic considerations. IFP (French Petroleum Institute), the parent company of BEICIP, supplied the crude oil analysis and BEICIP recommended the optimal processes after examining unit capabilities, product yields and operating costs. In some cases the advantages and disadvantages of a process were discussed by the two parties before they agreed to acquire it. In another case, talks were opened with a licencer on the consultant's recommendation but were discontinued by the Project Team. Below is a list of process units specified by the Project scheme and the companies which are selling their process licences:[53]

Process units	*Process licencer*
crude distillation unit	not licenced
catalytic reformer	IFP (France)
catalytic cracker	Kellogg (USA)
Merox unit (for purifying gas and LPG from catalytic cracker)	Universal Oil Products (USA)
unisar (for kerosene hydrogenation)	Union Oil of California (USA)

Of a total plant cost of N150m (US$243m), licences for the four processes cost about N2m ($3.24m) or 1.5%. For each process there were several suppliers and the supply of process units is not tied to the supply of the licence. Each licencer has guaranteed that his process will produce a specified yield. The project team commissioned the process licencers to prepare design specifications for vital parts of the process units. The licencers provided a list of fabricators for these special parts from which the project team made a selection. Having decided on the general refinery design, the process units and the licences, the project team and BEICIP began in 1973 to choose a contractor for the main refinery plant. Pre-qualification documents were completed by some 20 firms, three of which indicated their willingness to submit fixed cost rather than cost-plus bids. With the project team supplying the philisophy, BEICIP prepared tender documents which spelt-out details of the project for which bids were being sought. In October 1974 the tender documents were given to three contractors who were expected to submit bids by February 1975.

On 27 October 1975 ENI, the Italian state oil corporation, announced that Snam Progetti, its subsidiary, had been awarded a UK£285 million contract to build the Warri refinery.[55] In twelve months the refinery's cost had escalated at least 157%. It was not until April 1976 that ENI formally signed the contract which was then estimated to be worth US$500 million.[56]

The issue of appropriate technology: Given Nigerian needs, how appropriate is the Warri refinery design? The decision to locate the plant at Warri may be uneconomic. A British Petroleum and Shell study in 1971 indicated that Warri was the most costly of four locations because of the need for expensive facilities to remove and distribute the petroleum products. After controversy and delay over siting the refinery, BEICIP was hired to recommend among six sites. Federal ministries examined the Site Optimization Study and in March 1972 forwarded recommendations to the Ministry of Mines and Power and to the Federal Executive Council. While BEICIP did not recommend the Warri location, effective criticisms were made of the data used by the French consultant in rejecting the site. The decision on Warri may involve higher costs than, for instance, Lagos but it has advantages such as industry dispersal for security and development purposes. The deadlock in the Federal Executive Council over siting continued for almost two years and cost Nigeria millions of naira. It was resolved in 1973 only when a decision was made to build two refineries: one at Warri in the Bendel State to the South and one at Kaduna in the northern Kaduna State. Nigeria's third, 70-75 thousand bd refinery is expected to cost N190m and be commissioned in 1980.

The inclusion of a catalytic cracking unit in the Warri refinery design may be inappropriate. It is by far the most expensive piece of equipment, accounting for a third of the refinery battery's capital cost and a third of operating costs. The catalytic cracker enables the refining process to produce larger volumes of high grade gasoline by separating cuts of fuel oil. But the need for high octane gasoline in the Nigerian market is slight, although consumption habits and a premium-regular price differential of less than four kobo (100 kobo to a naira) a gallon[57] encourage a preference for it, even for low combustion engines in motorcycles and volkswagons.

A further difficulty with catalytic cracking

Table 5

Capital costs of a 55,000 bd refinery in four locations 1971 (millions of Naira)

location	refinery plant	crude supply and product offtake	total cost
Port Harcourt	14.20	1.30	15.60
South Lagos	23.50	5.55	29.00
North Lagos	19.80	21.12	40.18
Warri	20.88	30.00	50.60

Source: British Petroleum Development Co. Ltd and Shell NV, *Nigeria: Additional Refinery Capacity* (Lagos 1971)

relates to the bonding characteristics of Nigerian crude. The crude oil has been found to be highly resistant to cracking by British Petroleum and other refiners.[58] It produces only 8-15% additional gasoline instead of 25% more after cracking as does the average Middle East Crude. These considerations have given rise to questions about the inclusion of a catalytic cracker in the new refinery. Among the explanations for the purchase of what is thought by some to be inappropriate refining technology are that planners and the project team may not be fully versed in the relevant technical details.[59] Again, there is evidently a degree of 'revenue permissiveness' at play.[60] Prestige associated with having sophisticated process units and thus a complex rather than a simple refinery, may be a factor on the same level as the habit of using premium gasoline for all vehicles. Finally planners may be ill-advised by their consultants and the possibility that technocrats are motivated to acquire inappropriate technology deliberately cannot be ruled out. In October 1975 the *New Nigerian* editorialized against inclusion of the catalytic cracker in the Warri plant and suggested that transportation economics would better justify its being part of the northern Kaduna refinery.[61]

Among the arguments for the appropriateness of the catalytic cracker in the Warri refinery are the claim by Kellogg, the supplier, that flexible design enables its unit to deliver the percentage yield of gasoline desired. The company's bid was tied to a specific yield and the process was guaranteed. Again the cracking unit will eliminate the export of low sulphur fuel oil for heating purposes since this heavy oil will be cracked

for gasoline and aromatics used in petrochemcials. That it will reduce the problem of distillation residue disposal in Warri is a final point in favour of including the catalytic cracker in the second refinery.

The development of local science and technology capabilities: Technology is being acquired in such a way as to increase Nigerian involvement relative to the Port Harcourt project. The Warri project team is committed to using local contractors, especially for civil engineering, whenever possible. Experience gained from the Warri project will enable Nigerian refinery planners to undertake a larger and more complex role in the next refinery. Technology is being transferred in a semi-packaged form through necessity. Given that there is local experience in the operating, but not in the process design or construction phases, an unpackaged arrangement would amount to Nigerians shopping for technology in the world market but not knowing what to buy. Were the project team buying a total package they would not be gaining experience of monitoring the project. Thus, semi-packaging seems to be a useful arrangement under the circumstances. The fact that the project team chose Snam Proggetti for the building contract rather than a French associate of the consultants BEICIP indicates that it is exercising some independent judgement.

The issue of cost: It can be argued that the refinery project is too costly given the relative prices of Nigerian crude oil and imported products. Nigeria produces one of the highest quality crudes in the world and this is reflected in its price. In 1975 a barrel of petroleum products in demand in Nigeria could be imported for around $11.00. Since local crude can be sold for some $12.50, local refining involves a net foreign exchange loss of at least $1.50 a barrel. It is clear that the state has deliberately chosen to bear a substantial reduction in revenue in order to develop a local refining capacity designed to supply the Nigerian economy with cut-rate fuel and petroleum products. Security of supply is perhaps as important as low prices to the consumer. Nigeria would, for example, find it difficult to support an OPEC or AOPEC programme of crude production control or selective exports if the country were dependent on external suppliers for petroleum products. In the case of another oil shortage, would product-short Europe continue exporting to Nigeria while that country

is itself contributing to the shortage by withholding crude? Local refining capacity increases the flexibility of Nigerian foreign policy and decreases the costs of maintaining OPEC unity. But for the general population local refining holds the hope of relief from chronic petrol shortages which have immobilized the country regularly since early 1974.

The most serious and intractable cost problem has to do with the terms of trade. Inflation is probably the biggest obstacle in technology transfer today. A quarter of a billion dollars for a 100,000 bd refinery was extremely expensive in 1974 but this cost was doubled by 1975. Inflation has hit refinery equipment especially hard. Steel prices have risen steeply and shortages have been experienced. Capital goods for refining doubled in cost between 1970 and 1974 but doubled again in the space of a year.[63] In 1975 it was estimated that for each year of delay in getting the Warri refinery on stream, the overall cost of the project will increase by one-third. Delays are endemic because of raw material shortages and a building boom in the oil sector. This staggering rate of inflation is quickly eroding the purchasing power of Nigeria's oil dollar and hence the country's potential for industrialization.

CONCLUSION

It is clear that significant changes have occurred in the process of acquiring refinery technology over the past decade in Nigeria. With regard to ownership structure, there has been a move from accepting 50% foreign participation coupled with operational control to the present policy of 100% public ownership with active state involvement. While the first refinery was completely packaged, the Warri project is semi-packaged. For the current refinery a Nigerian project team has selected a design, negotiated licence terms, commissioned fabrication designs and chosen contractors to erect the plant - all under the guidance of a French consultancy firm.

Changes in ownership and degree of packaging have implications for planning objectives and choice of technology. In the case of the second refinery, planning is more appropriate to national needs. The new 100,000 bd refinery is geared to a large expanding market while the first plant was designed to operate at full capacity almost at once, thus ensuring a rapid return on investment at the expense of capacity shortfalls and the need for

plant expansion. Because of inappropriate planning, products from the first refinery were ill-matched to consumption patterns largely because fuel oil amounting to two-fifths of production was not used widely for industrial or heating purposes in Nigeria. The new Warri plant will minimize fuel oil yield and maximize the production of gasoline, but at the expense of installing a catalytic cracker. Finally, the Warri plant is appropriate in terms of national security. Self-sufficiency in products supply goes some way toward justifying the project's immense cost. In conjunction with the Port Harcourt and Kaduna refineries, the Warri plant will produce a volume of products capable of satisfying even the 25-30% increases in product consumption presently being recorded. Increased exports to Niger, Chad, Dahomey, Ghana and Benin (formerly Togo) will be possible. Since the production pattern is geared to the Nigerian market, the need for imports will be much diminished. This self-sufficiency enhances Nigerian security and makes an independent policy on crude production, pricing and use more feasible.

The direct and indirect costs of the second refinery are much higher than those of the first, but the state has more control over them. High costs are the result of extremely high rates of inflation, the larger size of the Warri refinery, and inclusion of an expensive catalytic cracking unit. Increased control over costs follows from the project team's direct involvement in all phases of implementation. Because a Nigerian public refining company will operate and manage the plant, albeit with foreign technical assistance initially, transfer pricing, inflated invoicing and other such practices can be checked. In contrast, the organization of the Port Harcourt plant gave British Petroleum control over purchases and operation. Despite some abuses, British Petroleum did operate an efficient refinery which yielded a return on investment after seven years, of which four were years of actual operation. It remains to be seen whether public control of costs will be linked with spending discipline in the new project.

The second refinery is more consciously geared to encouraging the local development of science and technology than was the first. On the principle that you learn by doing, Nigerian personnel are involved in all phases, from process design to construction and operation. As a result of the first refinery and the distillation activities in Biafra, there are Nigerians with considerable experience in refinery operation. There

is less experience in construction and virtually none in process design. Nigerians are now involved in each phase but there is increased reliance on consultants in the more complex stages. It is expected that this involvement will produce an experienced team capable of establishing the country's next refinery with even less outside assistance. The turnkey nature of the first refinery contrasts with the current project which is guided by the conviction that the fastest way to transfer technical knowledge is to take charge and receive advice. Nigerian staff for the new refinery, some 500 personnel for four shifts, are being recruited from the Port Harcourt plant and from abroad, others are being trained in universities, technical schools and in other refineries. Foreign management and technical advisers are under contract for a specified and limited time to provide services and train their replacements. Such contracts oriented towards developing indigenous technical capacities are very different from the 1962 British Petroleum Operating Agreement which, while accepting local takeover in principle, delayed indigenization as much as possible in practice.

Nigerian technical and material inputs into both refineries have been minimal. Equipment is not fabricated in the country and it is said that contractors of sufficient sophistication are not available. A study of available manufacturing and engineering capabilities would resolve the question of what actually is available. Beyond this, it would seem that the principle of learning by doing is just as applicable to the skills of fabricating and construction as it is to project organization. While a commitment to use Nigerian materials and expertise would increase the overall complexity of the project, since dozens of ancillary firms would need to be encouraged, such an approach could increase the rate of technological development immensely. Furthermore the view is widely held in Nigeria that local competence is passed over for foreign firms which in some cases are less capable than their Nigerian counterparts.

The main reason for the changes which occurred in the process of acquiring refinery technology is the development of local refining expertise. Great increases in the numbers of university graduates, especially in physics, chemistry and engineering, added to the pool of technological knowhow. The numbers of Nigerians with working experience in the Port Harcourt refinery and more important in the 17 oil exploration and producing companies active in the country, added further

to local competence.

A number of changes in the international and national contexts have made the aggressive role of the state possible. First, the civil war ended with a strong federal state. Due to petroleum profits tax, the Federal Military Government soon controlled relatively large amounts of revenue and could pay for 100% of a very expensive project and thus control it. Second, Nigeria has abundant crude oil which by virtue of government participation in the equity of producing companies, is partly under state control. Crude at cost is available for local refining. Given that three-quarters or more of product cost is due to the cost of crude, and due to the disrupted nature of international trade in petroleum products in 1974, local refining made economic and political sense. Third, Nigeria as a member of OPEC is influenced by that body's policy recommendation to process hydrocarbons locally to the greatest extent possible.[64] The emergence of a sellers' market from 1972 made this policy most attractive. Finally, the acquisition of technology for the Warri refinery has been much facilitated by the increasing availability of consultants, process licencers and equipment suppliers. There is no monopoly on 'middle-aged' refinery technology of standard specification. In fact, in a drive to obtain stable supplies of crude or products, oil companies were competing to supply downstream technology to producing countries.

Gains have been made in the process of technology transfer in the decade separating the two refining projects. But there is cause for concern in at least two areas. First, in the 1974-75 and 1975-76 fiscal years, Nigeria will not be able to usefully deploy all oil income because of a lack of absorptive capacity. This contributes to a tendency towards 'revenue permissiveness' which is evident in connection with the Warri refinery. By including a hard-to-justify catalytic cracker, capital and operating expenses were increased by a third. Again, the choice of Warri as a refinery location was perhaps uneconomic. However, the revelations of wholesale corruption and private appropriation of public funds which followed the July 1975 coup removing General Gowon, have changed the yardstick with which one measures wasteful expenditure. The spending on the Warri refinery may be ill-advised and excessive but relative to spectacular waste such as the one or two billion dollar cement scandal,[65] the refinery project stands vindicated as it will eventually provide tangible goods

for which there is demand.

A second area for concern relates to rapid inflation in the cost of refinery equipment and of capital equipment in general. Inflation of 25% a year between 1970 and 1974 and perhaps twice that since for refinery materials erodes the buying power of oil dollars very quickly. A single poor country has little bargaining power when it comes to inflation. OPEC has issued warnings on price hikes and in 1975 even seriously discussed the possibility of indexing crude prices and seeking payment in SDRs (special drawing rights from the International Monetary Fund) rather than in dollars. But as yet no coherent OPEC strategy has emerged for countering price increases by industrial exporters. This points to the fact that even after poor countries build a local foundation in science and technology and acquire technical knowhow and bargaining skills, the escalating price of technology will continue to pose an immense barrier to its acquisition. Equity in the terms of trade has become a political issue which can be taken up only by groups of countries, most usefully within an international body such as the United Nations and its agencies.

How have the changes in the process of technology transfer affected the foreign investor who supplies technology? The refinery case studies suggest a pattern of behaviour based on company-government interaction. British Petroleum entered the refining industry in Nigeria under attractive terms which promised the company a fair return on investment. The period during which Nigerians gained more understanding of the industry was the oil company's technological lead time. In that interim British Petroleum aggressively maximized its commercial advantages by all possible means. We have seen how transfer pricing, inflated salaries, overstocking and overall planning to BP objectives constituted costs to Nigerians but were consistent with the oil company's commercial interests. Meanwhile the agencies of the state gained experience and confidence while Nigerian technicians, newly out of school when the project began, reached career maturity and were ready for management responsibilities. Experience in Nigeria and elsewhere shows that when companies maximize their advantage, a national backlash develops and takes the form of nationalization, exclusion of the firm from new ventures, or some kind of state regulation. The Refinery Agreement (1962) and the terms of operation were revised by a government which has refused to consider further joint

activities with British Petroleum. More judicious handling of the Port Harcourt plant would have given the company an edge over others in future projects in the oil sector.

NOTES

1. Data were collected in Nigeria and London during 1974 and 1975 from interviews and documents. The refinery comparison is selective due to the need to limit discussion to a few important points and because the second refinery reached the construction stage only in 1976.

2. Carlos Anez, 'Science, Technology and Underdevelopment: review and synthesis' (The Science Policy Research Unit, University of Sussex; August 1973), mimeo.

3. C. Cooper and F. Sercovitch, 'Channels and Mechanisms for the Transfer of Technology to Developing Countries' (Geneva: UNCTAD, 1971).

4. British Petroleum Company Ltd's capital is 68 percent owned by the British state including a 20 percent holding by the Bank of England. Royal Dutch Shell is 39 percent owned by British nationals. On the basis of sales proceeds Shell is by far the largest industrial company outside the USA and is the second largest oil corporation after Exxon. BP is the second largest non-American corporation and the biggest industrial concern in the UK. Of the ten largest British industrial corporations, Shell and BP together account for half of all assets and three-fifths of all profits. British Petroleum, *Annual Report* 1975 (London: April 1976), p. 1, and *Fortune* (September 15, 1967).

5. Nigerian Petroleum Refining Company, *The Nigerian Refinery* (Port Harcourt, n.d., 1966?), p. 7.

6. Scott Pearson, *Petroleum and the Nigerian Economy* (Stanford University Press, 1970) p. 94. Pearson, who equates three dollars with one pound, reasons that the refinery, operating at 31,000 bd, could produce products replacing imports valued at £14 million in 1967. The import content cost of refining was about £1.8 million while products worth £0.8 million were exported, giving foreign exchange benefits of £13 million if it is assumed that crude used in refining would not otherwise have been exported.

   On currency equivalents the *International Labour Organization Yearbook for 1975* (Geneva: ILO, 1976) p. 815, states that one Nigerian pound was worth $2.80 until 1972 when it was worth $1.52. The

naira was introduced in January 1973 and two naira equal one old Nigerian pound. From March 1973 one naira was worth $1.52 and from the beginning of 1974 a naira was worth $1.62. From 19 April 1974 the Nigerian currency has been floating and was considered in 1975 and 1976 to be one naira to $1.6234 and $1.6103 respectively. The *Financial Times* of May 18, 1976 listed the selling price of a naira at £1.166.

7. Michael Tanzer, *The Political Economy of International Oil and the Underdeveloped Countries* (London: Temple, 1969), p. 136.

8. Barry Herman, 'Multinational Oligopoly in Poor Countries: how East Africa got its petroleum refineries' (University of Michigan, Ann Arbor: Center for Research on Economic Development, Discussion Paper 39, September 1974) pp. 9-10.

9. The majors, in order by size of sales are Exxon, Shell, Mobil, Texaco, Gulf, Socal and BP.

10. *Petroleum Press Service* (August 1965). By 1965 newcomers and state oil companies with international operations owned about two-fifths of refining capacity, while state oil entities in their home countries owned the remaining one-fifth.

11. *Ibid*, March 1963.

12. NPRC, *The Nigerian Refinery*.

13. BP Trading, *Memorandum to BP-Shell* (London: typed, 1962)

14. In 1959 the Hydrocarbon Section (Mines Division) of the Federal Ministry of Mines and Power was created and headed by an expatriate. The Petroleum Division, established in 1962, was headed by a Nigerian in 1963 well after the refinery project was underway.

15. A Nigerian petroleum technologist reported that while on attachment to BP in the UK during the early 1960s his request to see the refinery plans was refused by company officials. On 25 March 1964 a Member of Parliament, Mr. Odulana, criticised the refinery design for excluding a catalytic

cracker: ' The refinery...is half baked...grossly uneconomic...Nigeria will now have to continue to import...high quality grade oil.... It is therefore crystal clear that the present refinery when completed will not be meeting the needs of our developing nation as envisaged by the promoters... this is a means of holding our nation to ransom at the advantage of other foreign oil companies....' *Debates of the House of Representatives*, 25 March 1964 (Government Printer: Lagos).

16. Interview information from ex-refinery administrator, Lagos, 1975. On the question of location the pamphlet celebrating the refinery's opening states that 'Six alternative sites were eventually selected for intensive study, three of them in the Lagos area, the remainder around Port Harcourt, these being the two principal ports along the Nigerian coast. The team were looking for about 300 acres of land, firm enough to support the heavy and expensive plant to be erected upon it, close to an existing road and railway network, within easy reach of deep water and the open sea, and not too far removed from the sources of crude oil. After due consideration of these matters, and in particular of the cost of sea and inland transportation of products, it was finally decided that the site most nearly meeting all requirements was near Alesa-Eleme.' *The Nigerian Refinery*, p. 7.

17. *Petroleum Press Service* (March 1963).

18. British Petroleum news release (October 1965).

19. Interview with Nigerian employee of BP during the mid-1960s, Lagos, 1975. A London-based market survey team was employed by BP but there was no government input and the report was a gross miscalculation. *The Nigerian Refinery*, p. 13, also refers to 'recent market estimates' which indicate a throughput of 1.6 m tons in 1967 to meet 'the full Nigerian demand for motor spirit and fuel oil....'

20. Nigeria's government borrowed heavily from the World Bank to build an electricity-generating dam despite the fact that natural gas was being flared. Refinery planning without reference to the dam project is astonishing given that they were under consideration at the same time and involved huge expenditure.

21. *The Nigerian Refinery*, p. 5 states that 'Early in 1963, three main contractors were appointed, each one being made responsible for a major phase of the projected development... /earlier/ BP Trading Limited, who were appointed Technical Advisors to the Refinery, called for tenders from international refinery builders.'

22. British Petroleum news release, 'Achievement' (London, 5 April 1963).

23. *Financial Times* (27 January 1966).

24. Petroleum haulage was largely controlled by Ibo lorry drivers and railway operators who were unable and unwilling to transport products to the North after the massacres began.

25. The negotiations resulted in a decree issued in January 1967, retroactive to January 1966, which amended the Petroleum Tax Act to provide for the establishment of posted prices, payment of royalties and tax on those prices and the expensing of royalties.

26. Interview information, Lagos, 1975. In rebuilding the plant after federal troops gained control of Port Harcourt in 1968 it was necessary to award several contracts. During this process, Nigerian members of the Refinery Board were interested in learning how original construction was arranged, and called on BP for the records. On the basis of this investigation, it is reported that the original contracts included some elements of price inflation. In addition, Nigerians who took the jobs of expatriates who were evacuated as the civil war broke out had access to company records for the first time. It was one officer's judgement that the costs of construction and management services were high.

27. *The Operating Agreement* (Lagos: 1962), mimeo.

28. *Ibidem.*

29. Overpricing refers to increases in prices over the average price obtained in competitive world markets for the same or similar goods and which are paid by the buyer of technology who is compelled, in most

cases, by the contractual agreement governing the technology transfer.

30. The 1962 Agreement specified exemptions for all materials, equipment, plant and machinery imported for operations, maintenance, alteration or extension of the refinery. Also exempt were refinery feedstocks, blending components, catalysts, additives and other chemicals.

31. Interview information (Lagos, 1975).

32. Scott Pearson, *Petroleum and the Nigerian Economy*, gives an assessment of oil-related linkages.

33. The processing fee, charged per ton of crude processed, covers operating costs and a 15% rate of return on investment calculated on the basis of a discontinued cash flow. The fee is 80 US cents a barrel or about $6.00 a ton.

34. The seven marketing subsidiaries of international oil majors were keen to maintain their Nigerian markets and had made major investments during the 1960s. A. Melamid, 'The Geography of the Nigerian Petroleum Industry', *Economic Geography*, Vol. 44 (January 1968), p. 40.

35. The expectations of BP and the Nigerian government were different. A BP spokesman stated in 1966 that 'Ultimately nearly 90% of the staff will be Nigerian out of 200 employed'. In contrast the government expected 100% Nigerianization ultimately and wanted timetables for expatriate replacement spelled out. *The Nigerian Refinery* (Lagos: Lagos Chamber of Commerce and Industry, 1966) Vol. 8.

36. Federal Ministry of Mines and Power, Petroleum Division, *Annual Report 1970-71* (Lagos: Ministry of Information), 1972.

37. Nigerian Petroleum Refining Co. Ltd, *Annual Report and Statement of Accounts 1973* (Lagos: April 1974) p. 3. This decision may have been reversed in light of the Third National Development Plan (1975-80) announcement that the Port Harcourt refinery was to be extended from 60,000 to 75,000 bd

capacity and that the policy of Nigerianization in general was to be relaxed. In August 1975 BP employees seconded from London were working in the refinery.

38. The Refinery Agreement (1972) and The Refinery Operating Agreement (1972) (Lagos: 1972) mimeo. A prominent supporter and advocate of the reforms was A.A. Atta, Permanent Secretary of the Ministry of Finance to 1971 when he became Secretary to the Federal Military Government. A year before his death Atta noted that among 'the outstanding achievements of the military rule /was/ a radical approach to petroleum affairs...' 'The development of Nigeria's Political Personality', *Quarterly Journal of Administration* (October 1971).

39. The price at which marketers buy crude from Shell-BP remained at this 1962 level to 1976 but the increases in royalty and petroleum profits tax of 1974 and 1975 were not passed on to crude destined for the refinery.

40. In May 1968 federal troops took control of Port Harcourt and found that the refinery installations had suffered considerable damage arising from both military action and disuse. The petroleum Division reported that 'It is believed that the refinery was in operation for most of 1967 but the record of its operations during the time it was in the hands of the rebels are not yet available.' *Annual Report 1967-68* (Lagos: Ministry of Information 1970), p. 14.

41. Data on NPRC staff in 1967 is not available but it is unlikely that its ethnic composition differed from that of the Nigerian staff of Shell-BP Petroleum Development Co. Ltd in Port Harcourt. Ninety percent of Shell-BP's Nigerian staff were Ibo and from the Eastern Region.

42. The Nigerian Enterprises Promotion Decree (1972) requires that Nigerians own 100% of the equity in simple businesses and 40% of a group of more complex undertakings. The Second National Development Plan document includes a discussion of this new policy. *Plan 1970-74* (Lagos: Federal Ministry of Information, 1970), p. 144.

43. *Ibidem* pp. 144-45.

44. *Petroleum Economist* (September 1974), p. 344.

45. The *Petroleum Economist* of September 1974 reported '...strong building activity in North America and a succession of proposals for large-scale export refineries in the Middle East'. The US Federal Energy Administration has forcast 4 mbd additional capacity in the US by the end of 1977. In 1974 Nigeria was considering three or four large export refineries of some 200,000 bd each.

Excluding the Communist bloc, a total of 264 refinery projects (new plants and expansions) are planned with a total capacity of 1,498 m metric tons a year or 29.96 mbd. Given that world capacity in 1973 was 2,643 m metric tons a year this is an immense projected increase which will swell refinery capacity by more than half. In contrast, the last three years show a rate of capacity increase of 8% per annum. The appendix includes a table showing existing refining capacity and the proportion of total planned expansion by region. *Petroleum Economist* (September 1974).

46. Central Bank of Nigeria figures show that for 1973 the total value of Nigerian exports was N1,695,600,000 of which N1,376,000,000 or 81.2% was contributed by crude oil exports. See Table 2 in the appendix.

47. For instance Sir Frank McFadzean, Chairman of Shell, introduced the 1975 *Annual Report* by observing that Shell companies '...have improved their position as international buyers and traders in oil and despite the changes in ownership /of exploration and production subsidiaries/ a very considerable degree of flexibility and reliability in quality and sources of supply has been restored. /Shell companies/ are also developing new lines of business in the provision of technical advice and support, in some cases linked to oil supply arrangements.' *Financial Times*, 14th May 1976.

48. State marketing results from the acquisition in 1975 of 60% of the equity in Shell Marketing Nigeria. Given that state marketing outlets will be supplied with products from the state-owned re-

finery, they may receive favourable treatment which in turn can be translated into an expanded share of the market. From this perspective, Shell's marketing partnership with the government makes business sense.

49. In 1974 the cost of production was from 35 to 40 US cents per barrel. By 1976 the producing subsidiaries were reporting costs of 75 to 150 US cents a barrel. The new refinery will likely acquire crude at tax-paid cost (production and other taxes due government) but in effect one state agency is paying tax to another agency. Rather than the consumer paying for these taxes as part of his price of purchase, it is likely that the state will bear them through transferring other oil income.

50. *Press Release* (Lagos: Federal Ministry of Information, 27 November 1971).

51. *The Refinery Agreement (1972)* (Lagos: 1972), mimeo.

52. British Petroleum Company Ltd and Shell Petroleum N.V, *Nigeria: Additional Refinery Capacity, 1971* (Lagos: 1971), mimeo. The proposed refinery was to be commissioned on 1 January 1974.

53. In October 1973 the state introduced fixed prices at the lowest level at which oil products were being sold and decreed that these prices should prevail throughout the Federation. This reduced product costs in the northern states and undoubtedly increased consumption. Products affected are motor spirit (regular and premium), kerosene, automotive gas oil, low power fuel oil and liquid petroleum gas. The Federal Government bore the cost which amounted to a loss of about $25m in excise duties, the amount gained in 1972, and $10m which was paid to the states to compensate them for revenue lost through the abolition of Purchase Tax. These tax sacrifices were made possible by the increase in state revenues from the Petroleum Profits Tax on crude production.

54. Data from interviews (Lagos and London, 1974 and 1975). Decisions on the refinery's product lines determine what process units are needed. Where

the difference between one process and another is not great, parent companies tend to promote their license successfully. For instance, the Port Harcourt refinery was built by Procon which used the parent company Universal Oil Products' process in the catalytic reformer (platforming). It is not known how BP chose that process but optimization studies done by IFP and BEICIP favoured the IFP reforming process which was chosen for the second refinery.

55. *Times* (London, 28 October 1975). The story reports that originally 40 companies from different countries bid for the tender. In contrast a member of the project team reported in late 1974 that 3 of 20 pre-qualification submissions culminated in bids.

56. *Petroleum Intelligence Weekly* (5 April 1976), p. 12. The report refers to 'the turnkey contract'.

57. The price was fixed in October 1973 at 8.8 kobo per litre for regular gasoline and 9.5 kobo per litre for premium. Premium gas in Nigeria is 93 octane which in some countries is the octane number of the regular grade. Proponents of the catalytic cracker hope to see 101 octane premium gas on sale in the future.

58. Interview information, British Petroleum Co. Ltd (London 1974).

59. Interview information (Lagos, 1975).

60. Thanks is due to John Peel who defines revenue prodigality or permissiveness as a spendthrift spirit occasioned by abundant oil revenue.

61. *New Nigerian* (13 October 1975); '...the Kaduna refinery, without a cracking unit, will produce a lot of heavy products such as gas oil and bunker fuel. As there are not enough industries in the northern states to consume these heavy gases, it means that they will have to be exported'.

62. After the July 1975 coup which overthrew Gowon the new government under Muratala Muhammed established the Uputa Commission to investigate petrol short-

ages. It emerged that with controlled product prices foreign marketing subsidiaries were not able to profit sufficiently to make their activities of high priority. Since the enquiry petrol shortages have ceased, except in a few northern areas.

63. Interview information from official of the Nigerian National Oil Corporation (April 1975). In the 1974-75 Budget Speech, General Gowon stated that '...oil is not the only commodity whose price has gone up in the past year or two. Prices of practically all finished products, particularly capital equipment, have doubled and in some cases even trebled during the past year or two.... the prices of manufactured goods have steadily increased over the last fifteen years while oil prices have remained stable and unchanged'. *A Better Life for the People, 1974-74 Federal Budget* (1 April 1974).

64. OPEC, *Declaratory Statement of Petroleum Policy in Member Countries* (Vienna: June 1968).

65. Terisa Turner, 'The Nigerian Cement Racket' in *Africa Guide 1976-77* (London, 1976).

APPENDICES

1. Nigeria: annual values of total imports and exports and crude oil exports 1958-1975

2. Comparison of government revenue per barrel of crude oil exported

3. Federal government oil revenue

4. Exploration and production companies; Nigeria 1975

5. Crude oil production in selected countries

6. Sub-Saharan Africa: crude oil exports 1972-74

7. Sub-Saharan Africa: energy resources 1974

8. Sub-Saharan Africa: energy consumption 1974

9. Africa: oil product consumption in selected countries 1974

10. Refinery capacity: Sub-Saharan Africa excluding Southern Africa 1975

11. Refineries in Africa 1976

12. Africa: projects for new refineries in 1974

13. Refinery expansion in Africa 1974

14. Existing and planned refining capacity by region

APPENDIX 1

Nigeria: Annual Values of Total Imports and Exports and Crude Oil Exports 1958-1975

Year	Value Total Imports	Exports			Percentage Increase Over Last Year		Trade Balance
			Value Crude Oil				
	N Million	Value Total N Million	N Million	Percent Total Export	Total Export	Crude Oil Export	N Million
1958	333.8	271.4	1.8	0.7			-62.4
1959	358.8	271.6	5.2	1.9	0.07	188.89	-81.2
1960	430.4	329.8	8.4	2.5	21.43	61.54	-100.6
1961	444.8	347.0	22.6	6.5	5.22	169.05	-97.8
1962	406.0	337.2	34.4	10.2	2.82	52.21	-68.8
1963	415.0	379.2	40.4	10.7	12.46	17.44	-35.8
1964	508.6	429.2	64.2	15.0	13.19	58.91	-79.4
1965	550.6	536.8	176.2	25.4	25.07	112.15	-13.8
1966	512.8	568.2	184.0	32.4	5.84	35.10	-35.4
1967	447.2	483.6	144.2	29.8	-14.89	-21.63	37.0
1968	385.2	422.2	77.6	18.4	12.70	-46.19	37.0
1969	497.4	636.2	301.4	47.4	50.69	288.40	138.8
1970	756.4	885.4	509.8	57.6	39.17	2.79	129.0
1971	1076.4	1297.4	951.8	73.4	46.53	86.70	221.0
1972	980.6	1405.2	1152.6	82.0	8.31	21.10	424.6
1973	1194.8	1695.6	1376.0	81.2	20.67	19.38	500.8
1974	1666.0	6106.0	5671.0	93.0	260.00	312.14	4440.0
1975	3700.0	5050.0	4700.0	93.0	-17.30	-17.12	1350.0

Source: Central Bank of Nigeria

APPENDIX 2

Comparison of Government Revenue Per Barrel of Crude Oil Exported (US cents)

Year	Kuwait	Saudi-Arabia	Iran	Iraq	Libya	Venezuela	Nigeria
1958	81.7	81.7	89.0	88.9	n.a.	111.6	10.0
1959	77.8	75.8	83.6	82.4	n.a.	98.4	65.6
1960	76.4	75.0	80.1	78.6	n.a.	89.2	57.5
1961	74.4	75.5	75.8	76.6	62.7	92.9	51.6
1962	74.8	76.5	74.5	76.5	64.7	97.2	49.7
1963	74.3	78.7	79.7	80.7	65.0	98.6	54.1
1964	76.9	82.0	81.8	80.1	62.9	95.4	48.3
1965	78.9	82.2	82.9	81.7	83.8	95.0	38.3
1966	78.4	83.4	83.2	81.3	87.0	91.2	29.5
1967	78.5	84.2	83.5	85.4	99.7	98.3	42.8
Average	77.2	79.5	81.4	81.2	75.1	96.8	44.7

Source: *Petroleum Intelligence Weekly* (16th September 1968)

APPENDIX 3

Federal Government Oil Revenue
(₦' million)

YEAR	AMOUNT
1958	n.a.
1959	0.6
1960	2.6
1961	14.2
1962	17.0
1963	10.0
1964	24.4
1965	26.8
1966	37.4
1967	54.2
1968	33.4
1969	53.8
1970	176.2
1971	542.4
1972	747.6
1973	985.6
1974/5	2,635.9
1976	5,010.5

Source: Central Bank of Nigeria

APPENDIX 4

Oil Companies Engaged in Exploration and Production: Nigeria 1975

Company	%	Area (sq ml) Present	Subsidiary and Parent Company
1. *AGIP*	22.5		- Nigerian Agip Oil Co Ltd. subsidiary of the Italian state company ENI
Phillips	22.5		- Phillips Oil Company (Nigeria) Ltd, Nigerian subsidiary of Phillips Petroleum Co of Oklahoma
NNOC	55.0	2,031	- Nigerian National Oil Corporation, Nigerian State Oil Company
2. *Ashland**	100.0	432	- Ashland Oil Nigeria Co, subsidiary of Ashland Oil Co of the US *Note*: Production sharing contract, Ashland will explore at its risk until production is established, at which time, Ashland will start to recover exploration costs from a portion of the production while NNOC and Ashland will split the rest at 65-35% for output up to 50,000 bd and 70-30% if production exceeds 50,000
3. *Deminex*	44.0		- A Nigerian subsidiary of the German oil consortium. Deutsche Schachtbau (gov't) has 10% , Gelsenberg (gov't) has 18.5% Preussag (gov't) has 7% , Saarbergwerke (gov't controlled) has 9% , Viba Chemie, Wintershall (gov't) and Union Rheinische (private) with 18.5% each
NNOC	51.0		
Niger Pet. Co	5.0	900	- Niger Petroleum Corporation, Nigerian Independent
4. *Elf*	45.0		- Enterprise de recherches et d'activités pétrolières, French State oil corporation and owning 40% in Elf Nigeria. Sogerap, Société de gestion et de participation de Elf Erap owns 10% and Safex, Société Africaine d'exploitation pétrolières, owns 50%
NNOC	55.0	1,178	
5. *Gulf*	45.0		- Gulf Oil Company (Nigeria) Ltd, subsidiary of Gulf Oil Co.
NNOC	55.0	5,002	
6. *Japan Pet.*	49.0		- Japan Petroleum Co (Nigeria) Ltd, wholly owned subsidiary of Nigeria Oil Company which is formed of Japan Pet. Dev., Teijin, Mitsui and 16 other Japanese Industrial firms
NNOC	51.0	536	
7. *Japan Pet.*	40.0		
NNOC	51.0		
Niger Oil Res.	9.0	616	- Niger Oil Resources, Nigerian Independent
8. *Mobil*	45		- Mobil Producing Nigeria, subsidiary of Mobil Oil Corporation
NNOC	55	1,024	
9. *Mobil*	50		
Tenneco	37.5		- Tenneco Oil Co of Nigeria, subsidiary of Tenneco Inc of Houston
Sun DX	12.5	872	- Sun DX Nigeria, wholly owned subsidiary of Sun Oil Co of Philadelphia

10.	*Occidental*	49		- Occidental Petroleum (Nigeria), subsidiary of the Occidental Petroleum Corp of Los Angeles
	NNOC	51	290	
11.	*Pan Ocean*	100		- Pan Ocean Oil Co (Nigeria), subsidiary of Pan Ocean Oil Corp of New York
	Delta		388	- Delta Oil (Nigeria) Ltd, Nigerian company controlled by Mr. Amachree of Lagos. Owner of the OPL 71 which was farmed out to Pan Ocean. Overriding royalty interest of 3.7% in Pan Ocean
12.	Phillips	100	175	
13.	*Shell*	22.5		- Wholly owned subsidiary of Royal Dutch Shell and forming with BP Shell/BP Petroleum Development Co of Nigeria Ltd
	BP	22.5		
	NNOC	55.0	16,931	- British Petroleum Oil Co forming with Shell the Nigerian company named above
14.	*H. Stephens*	49		- H. Stephens and Sons Ltd, a Nigerian private enterprise
	NNOC	51	30	
15.	*Texaco*	50		- Texaco Overseas Petroleum Co (Nigeria) Ltd, subsidiary of Texaco of New York
	Chevron	50	43	- Chevron Oil Company (Nigeria) Ltd subsidiary of the Standard Oil Company of California

* Ashland is actually under contract to NNOC whose concession it is.

Operator in italics.

Source: Petroconsultants SA, *Nigeria: Annual Review 1974* (Geneva: March 1975)

APPENDIX 5

Crude Oil Production in Selected Countries

Production in million tonnes

Country	1965	1966	1967	1968	1969	1970
USA	387.6	411.9	437.5	452.9	458.7	478.6
Venezuela	182.2	177.0	186.1	189.9	188.7	195.2
Iran	95.0	105.2	129.6	141.8	168.1	191.3
Libya	58.9	72.4	84.1	125.7	149.9	159.8
Saudi Arabia	100.6	118.8	129.0	140.9	148.6	176.2
Kuwait	109.1	114.4	115.2	122.1	129.5	137.5
Iraq	64.4	68.1	60.2	73.9	74.9	76.9
Nigeria	13.5	20.4	15.6	7.2	26.4	52.9
Algeria	26.6	34.2	39.1	42.9	44.5	48.5

Source: BP *Statistical Review of the World Oil Industry*, (1975)

1971	1972	1973	1974	1975	Yearly change in % 1975/ 1965	1975/ 1970	1975/ 1974
469.9	470.1	457.3	436.8	415.2	+ 0.7	- 2.8	- 4.9
187.7	171.5	179.0	158.5	124.7	- 3.7	- 8.6	- 21.3
227.0	251.9	293.2	301.4	267.9	+ 10.9	+ 7.0	- 11.1
133.1	108.2	104.9	73.5	71.9	+ 2.0	- 14.8	- 2.2
223.4	285.4	364.7	412.4	343.9	+ 13.1	+ 14.3	- 16.6
147.1	151.2	138.4	114.4	92.4	- 1.6	- 7.6	+19.2
83.5	72.1	99.0	96.9	109.3	+ 5.4	+ 7.3	+12.8
74.7	88.9	100.1	112.2	88.8	+ 20.7	+ 10.9	- 20.9
36.5	50.1	51.2	48.5	45.0	+ 5.4	- 1.5	- 7.2

APPENDIX 6

*Sub-Saharan Africa:**
Crude Oil Exports 1972
(thousands of barrels daily)

		1972	1973	1974
Angola to -	North America	61	99	96
	South America	21	4	-
	Western Europe	22	16	43
	Far East	31	26	11
	Total	135	145	150
Gabon to -	North America	24	16	45
	South America	25	30	39
	Western Europe	52	68	94
	Other Africa	4	5	2
	Far East	-	-	1
	Total	105	119	181
Nigeria to -	North America	457	568	683
	South America	115	278	240
	Western Europe	1080	1003	1130
	Other Africa	26	30	34
	Far East	78	99	95
	Total	1756	1978	2182

Source: Angola-Shell estimates, Gabon and Nigeria, *OPEC Annual Statistical Bulletin (1974)*

* Excluding Southern Africa

APPENDIX 7

Sub-Saharan Africa: Energy Resources, 1974 (Fossil Fuels)*

	Proved Reserves (million barrels)	Production (million barrels)	Proved Reserves (billion m^3)	Production (billion m^3)	Reserves (million tons)	Production (million tons)
Angola	1,410	63	50	2	-	-
Congo (People's Republic of)	950	17	180	Negligible	-	-
Gabon	650	80	50	Negligible	-	-
Malagasy Republic	-	-	-	-	40	-
Mozambique	-	-	-	-	80	0.4
Nigeria	19,600	820	1,420	21	250	0.6
Tanzania	-	-	-	-	180	Negligible
Zaire	-	-	-	-	720	0.1
Zambia	-	-	-	-	50	0.9

Sources: Crude Oil and Natural Gas - *World Oil* (15 August 1975);
Coal - World Energy Conference 1974

* Excluding Southern Africa

APPENDIX 8

*Sub-Saharan Africa:**
Energy Consumption 1974
(Commercial Primary Energy)
(thousands of barrels daily oil equivalent)

Country	Oil	Coal	Natural Gas	Hydro-Electricity	Total
Angola	27	-	-	5	32
Ghana	16	-	-	23	39
Ivory Coast	22	-	-	2	24
Kenya	38	1	-	4	43
Mozambique	14	7	-	2	23
Nigeria	59	8	4	12	83
Senegal	28	-	-	-	28
Zaire	21	6	1	24	52
Zambia	17	13	-	23	53

Note: Oil demand comprises refined product consumption and refinery use/loss hydro-electricity is expressed in terms of input equivalent.

Source: Shell estimates

* Excluding South Africa

APPENDIX 9

Africa: Oil-Product Consumption in Selected Countries 1974
(thousands of barrels daily)

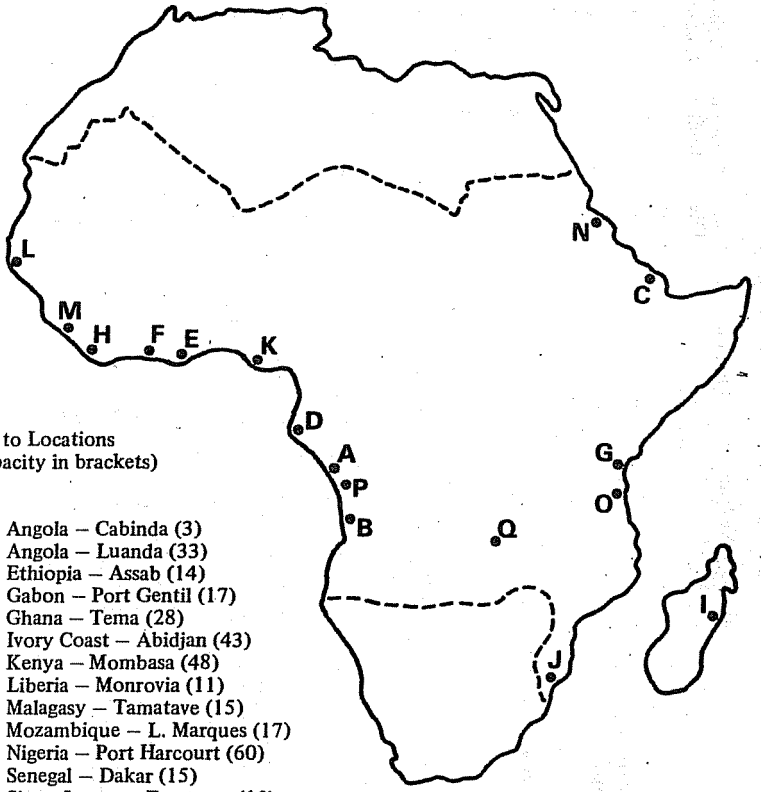
	Motor Gasoline	Kerosine	Gas Oil/ Diesel Fuel	Fuel Oil	Aviation Fuels	Ocean Bunkers	Other Products	Total Refined Oil Products
Angola	3	1	8	2	5	5	1	25
Cameroon/Central African Republic/Chad/Congo/Gabon	4	2	8	1	2	2	1	20
Equatorial Guinea	-	-	1	-	-	-	-	1
Ethiopia	2	-	4	2	1	-	1	10
French Territory of Afars & Isas	-	-	1	-	2	4	-	7
The Gambia	1	-	-	-	-	-	-	1
Ghana	5	2	4	1	1	1	1	15
Guinea	1	1	1	2	-	-	-	5
Guinea-Bissau	-	-	1	-	-	-	-	1
Kenya	5	1	6	8	6	7	2	35
Liberia	1	-	3	4	-	1	-	9
Malagasy Republic	3	1	3	1	1	2	1	12
Malawi	1	1	1	-	-	-	-	3
Mozambique	1	1	6	1	1	2	1	13
Nigeria	20	6	14	7	3	1	4	55
Senegal/Dahomey/Ivory Coast/Mali/ Mauritania/Niger/Togo/Upper Volta	10	3	14	12	3	15	2	59
Sierra Leone	1	1	1	1	-	2	-	6
Somalia	1	-	1	-	-	-	-	2
Sudan	2	1	7	3	1	1	1	16
Tanzania	3	2	6	3	1	-	1	16
Uganda	2	1	2	1	1	-	-	7
Zaire/Rwanda/Burundi	4	2	6	2	2	2	1	19
Zambia	4	-	8	3	1	-	1	17

Source: Shell estimates

APPENDIX 10

Refinery Capacity: Sub-Saharan Africa, excluding Southern Africa, 1975

Thousands of Barrels per Day



Key to Locations
(Capacity in brackets)

A : Angola – Cabinda (3)
B : Angola – Luanda (33)
C : Ethiopia – Assab (14)
D : Gabon – Port Gentil (17)
E : Ghana – Tema (28)
F : Ivory Coast – Abidjan (43)
G : Kenya – Mombasa (48)
H : Liberia – Monrovia (11)
I : Malagasy – Tamatave (15)
J : Mozambique – L. Marques (17)
K : Nigeria – Port Harcourt (60)
L : Senegal – Dakar (15)
M : Sierra Leone – Freetown (10)
N : Sudan – Port Sudan (22)
O : Tanzania – Dar es Salaam (16)
P : Zaire – Muanda (16)
Q : Zambia – Ndola (25)

Source: *Oil & Gas Journal* (30/12/74)

APPENDIX 11

Refineries in Africa 1976

KEY

D = Distillation
H = Hydrocracking
Vis = Visbreaking
C = Cracking
R = Reforming
B = Bitumen
} classified as C { = Catalytic, T { = Thermal
L = Lubricating oils
( ) = Completion date
n.a. = Not available

Company and address	Refinery location	Type of refinery	Distillation capacity	Cracking	Reforming	Current crude throughput
			In barrels per calendar day (*stream day)			
ALGERIA						
Sonatrach, Chemin du Reservoir, Hydra, Alger 8	Hassi Messaoud	D	4 700	..	...	n.a.
Sonatrach-Raffinerie D'Alger, P.O. Box 71, El Harrach, Algiers	El Harrach	D/R	60 000	..	13 000 C	n.a.
ANGOLA						
Companhia de Petróleos de Angola, Caixa Postal 1230, Luanda	Luanda	D/R/B	35 000	..	2 000 C	35 000
Companhia de Petróleos de Angola	PROPOSED *Luanda*	*R*	*13 000**	..	*3 000*C*	*(1976)*
		D/B	*22 000**	..	*3 000*C*	*(1979)*
ETHIOPIA						
Ethiopian Petroleum Share Company, Addis Ababa	Assab	D/R/B	14 790*	..	2 000*C	14 790*
GABON						
Soc. Equatoriale de Raffinage, P.O. Box 530, Port Gentil	Port Gentil	D/R/Vis	17 000	7 000 Vis	2 000 C	n.a.
GHANA						
Ghanaian Italian Petroleum Co. (GHAIP) Ltd., Accra	Tema	D/R	28 000*	..	4 500*C	25 900*
IVORY COAST						
Soc. Ivoirienne de Raffinage, B.P. 1269, Abidjan	Abidjan	D/R	37 000	..	5 150 C	26 000
KENYA						
East African Oil Refineries Ltd., P.O. Box 90401, Mombasa	Mombasa	D/R/B	86 000	..	9 000 C	n.a.
LIBERIA						
Liberian Refining Co., Industrial Park, Monrovia	Monrovia	D/R/B	*15 000*	..	2 000 C	10 500
Liberian Refining Co.	PROPOSED *Monrovia*	*D/R/B*	..	..	*3 000*	*(1975)*
LIBYA						
Esso Sirte Inc., Tripoli	Port Brega	D/R	9 000*	..	2 000 C	9 800*
Libyan Government	UNDER CONSTRUCTION *Zavia*	*D*	*60 000*	..	..	*(n.a.)*
Libyan Government	PROPOSED *Tobruk*	*D*	*130 000*	..	..	*(n.a.)*
MALAGASY						
Société Malgache de Raffinage, P.O. Box 433, Tamatave	Tamatave	D/R	15 000	..	1 000	n.a.

MOROCCO						
Soc. Chérifienne des Pétroles, 27 Charia Maulay Harran, Rabat (Now state-owned)	Sidi-Kacem	D/C/R	28 000	4 600 C	2 800 C	20 000
SA Marocaine-Italienne de Raffinage (SAMIR), Mohammedia	Mohammedia	D/R	50 000*	..	6 500*C	34 000
MOZAMBIQUE						
SONAREP (Soc. Nacional de Refinacao de Petróleos), Caixa Postal 1866, Lourenco Marques	Matola	D/R/B	16 000*	..	2 500*C	11 000
NIGERIA						
The Nigerian Petroleum Refining Co. Ltd., P.O. Box 2161, Lagos, Port Harcourt	Port Harcourt (Alese)	D/R	60 000	..	5 700 C	n.a.
RHODESIA						
Central African Petroleum Refineries (Private) Ltd., P.O. Box 391, Umtali	Umtali (Not Operating)	D/C/R/B	20 000	7 000 C 6 000 T	3 000 C	n.a.
SENEGAL						
Soc. Africaine de Raffinage, P.O. Box 203, 15 Bld. de la Republique, Dakar	Dakar	D/R	12 000	..	2 000 C	n.a.
SIERRA LEONE						
Sierra Leone Petroleum Refining Co. Ltd., B.P. House, Cotton Tree	Freetown	D	10 000	..	..	n.a.
SOUTH AFRICA						
Caltex Oil (S.A.) Pty. Ltd., P.O. Box 13, Milnerton, Cape Town	Cape Town	D/R/B/C/Vis	65 000*	10 000*Vis 11 000*C	11 000*C	51 000
Mobil Refining Company of South Africa (Pty.) Ltd., P.O. Box 956, Durban	Durban	D/C/R/B	100 000	14 500 C	16 000 C	n.a.
National Petroleum Refiners of South Africa (Pty.) Ltd., P.O. Box 234, Sasolburg, O.F.S.	Sasolburg	D/C/R/H	72 000*	17 000*C 9 800*H	10 700*C	72 000*
SATMAR Ltd., P.O. Box 5083, Boksburg North, Transvaal	Boksburg	D/C/B	3 900*	1 000*T	..	3 100*
Shell & BP South African Petroleum Refineries (Pty.) Ltd., P.O. Box 3179, Durban, Natal	Durban	D/R/B/L/C	200 000	20000 C	24 000	n.a.
		UNDER CONSTRUCTION				
Caltex Oil (S.A.) Pty. Ltd.	*Cape Town*	*C*	..	*3 000*C*	..	*(1977)*
	Cape Town	*D/C*	*50 000**	*12 300*C*	..	*(1978)*
SUDAN						
Shell and BP (Sudan) Ltd., P.O. Box 354, Port Sudan	Port Sudan	D/R	24 000	..	2 000 C	n.a.
TANZANIA						
Tanzanian and Italian Petroleum Refining Co. (TIPER) Ltd., P.O. Box 2608, Dar-es-Salaam	Dar-es-Salaam	D/R	17 000*	..	3 000*C	15 500*
TOGO						
		UNDER CONSTRUCTION				
Planet Oil & Mineral Corpn. (for Togo Government)	*Lome*	*D/R/H*	*20 000**	..	..	
TUNISIA						
Soc. Tuniso-Italienne de Raffinage, 33 Ave. de Paris, Tunis (Now state-owned)	Bizerta	D/R	25 000*	..	3 000*C	24 000*
ZAIRE (CONGO-KINSHASA)						
Soc. Zairo-Italienne de Raffinage (SOZIR), Coin Avenues, Tomba-Baye et Kasai	Kinlao-Moanda	D/R	17 000*	..	3 500*C	13 000*
		PROPOSED				
SOZIR	*Kinlao-Moanda*	*D/R*	*+6 500*	..	..	*(n.a.)*
ZAMBIA						
Indeni Ltd.	N'Dola	D/R/B	25 000*	..	5 600*C	16 500*

APPENDIX 12

Africa: Projects for New Refineries in 1974

country	planned capacity '000 tons per year	probable completion
Libya		
Tobruk (Govt)*	11,000	1978
Zuetina (Govt)*	20,000	1978
Tunisia		
Gabes (Govt)*	7,500	nd
Algeria		
Skikda (Sonatrach)*	15,000	1978
Mauritania		
Nouadhibou (Govt)*	1,000	1976
Togo		
Lomé (Govt)*	1,250	1975
Nigeria		
Kaduna, North Central (Govt)*	3,750	1980
Warri, Midwest (Govt)*	5,000	1977
Cameroon		
location uncertain (Govt)*	2,000	nd
Congo (Brazzaville)		
Pointe-Noire (Sibetra)	1,000	nd
Angola		
Lobito (SP de Exploracia de Petroleos)	2,000	1975
South Africa		
Richards Bay (Trek-Beleggings)	6,000	1977
Reunion	600	1975
Somalia		
location uncertain (Govt/INOC)*	500	nd
Sudan		
Port Sudan (Triadnaft/ Govt)*	7,000	nd

Source: *Petroleum Economist* (September 1974)

* Wholly or mainly state-owned

APPENDIX 13

Refinery Expansion in Africa 1974
('000 tons per year)

country	present total	planned total	net addition	probable completion
Libya				
Zawie (Govt)*	3,000	6,000	3,000	1978
Morocco				
Mohammedia (Govt)*	2,200	5,700	3,500	1977
Tunisia				
Bizerts (STIR)	1,250	2,250	1,000	1975
Gabon				
Port Gentil (Elf-Union et al)	1,000	2,000	1,000	nd
South Africa				
Capetown (Caltex)	2,300	3,000	700	1975
Durban (Mobil)	3,000	5,000	2,000	1974

Source: *Petroleum Economist* (September 1974)

* Wholly or mainly state-owned

APPENDIX 14

Existing and Planned Refining Capacity by Region (million tons)

region	1975 capacity at year's end	% share of total 1973 capacity	% share of projected expansion in 1973	% share of total 1975 capacity
North America	874	31.1	21.4	24.33
Latin America	381	11.5	10.4	10.61
Western Europe	1,042	34.4	29.4	29.00
Middle East	139	4.8	16.8	3.87
Africa	62	2.0	5.8	1.73
South East Asia	144	16.2	16.2	4.01
World	3,592	100.0	100.0	100.00

Source: *BP Statistical Review of the World Oil Industry 1973 and 1975*