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Technology Policy Failures in Nigeria

Akin O. Adubifa

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TECHNOLOGY POLICY FAILURES IN NIGERIA

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FOREWORD

The following report resulted from a research project carried out by Dr. Akin O. Adubifa between 1985 and 1987 at the Nigerian Institute of Social and Economic Research (NISER). It examines Nigeria's attempts over two decades to formulate and implement policies aimed at regulating practices relating to technology in four subsectors of industry (vehicle assembly, cement manufacture, iron and steel, and petrochemicals). From the outset, it was suspected that, save for a few exceptions, those policies may not really have been successful. One of Dr. Adubifa's objectives in this study, therefore, was to discover why they had failed. A second objective was to suggest ways in which failure might have been avoided.

Policies may be viewed as instruments, tooled with the benefit of past experience, for regulating present activities in order that their results may add to produce net movement toward a preferred future. Without them, present activities are likely to be undertaken ad hoc, independently of each other, and sometimes at random or even at cross purposes. In that case, their effects are likely to cancel among themselves, resulting in little progress towards the chosen future. Dr. Adubifa's study of the factors responsible for the failure of technology policies in Nigeria, therefore, is of interest not only to that country but also to others in Africa and elsewhere con-

cerned with how the present may be made to influence the future in desired ways.

Policies fail for different reasons. Sometimes they fail because the capability for changing society in the ways they envisage simply does not exist, for lack - for example - of necessary resources. At other times they fail because the causes of the problems they address are so poorly understood that the solutions they enact are themselves poor or even wrong. At yet other times, they fail because the actors responsible for formulating or implementing them turn them into opportunities for personal gain. At still other times, they fail because insufficient use is made of analytic and other methods for improving the quality of decisions preceding or underlying them. There are still other reasons why policies fail. One of them involves a "lack of political will", references to which are made often in this report and other writings on the formulation and implementation of policy in Africa.

By examining the reasons behind the failure of technology policies in Nigeria, this report also contributes to the broader ongoing debate regarding the performance of African public institutions generally, both as sources and implementors of policy. I hope that researchers and decision-makers in Africa will find it useful. I must

emphasize, however, that the International Development Research Centre does not necessarily agree with the views and recommendations contained in it.

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PREFACE

Technology has elements of history and natural endowment; of culture, national discipline, and national will; of environment; of knowledge and resourcefulness; and of politics and ideology. In short, technology is the interaction of science and society. It is not an entity that can be simply procured and used once enough funds are available.

Often policies on technology fail because of inadequate knowledge about the many contributing elements and their relation to national development or because of insufficient attention to links between different policies, the focus of this study.

In Nigeria, the links between different domains of policy, rather than being forged by imaginative action, do not exist; instead there is a gap in the system through which issues simply disappear from sight.

The links deserve particular attention because in countries such as Nigeria underdevelopment of technology is coupled with underutilization of the existing technologic capacity. In fact, Nigeria -- because of its size, population, and potential -- could benefit more than most countries by developing links complemented by appropriate action.

In fact, this study was undertaken to examine the links. The purposes were to explain why the manufacturing and industrial sectors have not met their stated objectives; to determine how the existing policies contributed to the failure; and to recommend changes in the industrialization strategy such that the failures will not be repeated. Studies of this kind are scanty in developing countries; yet they not only provide an interpretation of cause and effect -- consequences of strategies and policy dictates -- but also help decision-makers to understand policy options as they are determined by, and in turn determine, national circumstances.

The study evaluates the performance of public policy within four industrial and manufacturing subsectors:

- Vehicle assembly;

- Cement manufacturing;
- Iron and steel; and
- Petrochemicals.

All four are heavy industries; small-scale industries should be looked at separately. Small-scale industries operate under a realm of inconsistent policies that, on the one hand, place inappropriate responsibilities on them and, on the other, deny them the support to perform efficiently even their traditional role.

INTRODUCTION

Project Background and Objectives

Nigerians and foreigners alike legitimately ask why this young nation was never able to cash in on its promising economic future. It was not for want of planning, nor lack of resources; it was the inadequate framework for decision-making and the absence of a foundation built on a national consensus and political will.

The federal government, which has changed several times since independence, has bowed to pressures from international agencies to create policies that are replicas of those used successfully elsewhere. But some of the policies -- developed under different circumstances and sometimes for different purposes -- did not succeed in Nigeria.

Policies on technology were no exception, and the failures of policies on acquisition, growth, and development of technology are the central themes of this study.

After many interviews and 18 months of sifting through documents related to national economic and development planning in Nigeria, my conclusion was that the planners and policymakers never understood the force (represented by the technology) that could be harnessed for national development. Even when their agenda for planning was expanded because of external pressure to include science and technology, the subject was treated independently, i.e., without regard for its link with the rest of the economy. For this reason, attempts to transfer foreign technologies and to generate indigenous ones have been inefficient and, sometimes, inappropriate.

Because science and technology are only just becoming rooted in the country, it would be rather difficult to study technology policy per se and studying the lack of it would be frustrating. For this reason, I have

studied technology policy in the context of industrial policies where it has been implicit until recently.

Over the years, the industrial policies have attracted much criticism from all but those who designed them and, surprisingly, those who administer them and enforce the regulations. The latter group should be in the best position to identify and rectify inherent weaknesses; yet they defend the status quo and have usually resisted change. Several so-called policy reviews have taken place but yielded no measurable improvements in the industrial circumstances of the nation. In fact, the reviews have sometimes resulted in inappropriate or ill-considered policy changes. In some cases policies had not existed long enough to be evaluated before they were altered, having already been labeled a failure.

The performance of policies formulated to guide the industrial and technological development of the country cannot be judged without an examination of the way and manner those policies were formed, the sources from which they emanated, and the obstacles that prevent their successful application. As a lot of research, internally and externally, has been devoted toward this type of examination, one must also examine whether the results were linked to the formulation of national policies for development.

Policy failures become most visible during crises and when performance is measured against objectives. To determine the reasons for failure, one must begin with scrutiny of the characteristics of the policies. In Nigeria, it is also pertinent to examine the institutional support for implementing policies and the constraints within which they were to operate. My approach was to analyze issues and events that affect or are affected by the policies.

For the purposes of this study, the absence of policy in particular circumstances was regarded as a failure because my aim was to identify not only the obstacles to be removed but also the gaps to be closed and the links to be established or strengthened.

The overall objective of this research project was to examine the performance of industrial policies and their implicit technologic initiatives during the past two decades in Nigeria. Within this framework, I focused on:

- Historical development of the policies;
- Policy formulation and decision-making;
- Policy failures and successes as manifested in domestic industries for vehicle assembly; cement manufacturing; iron and steel production; and petrochemicals;
- Technological capability and performance of the subsectors;
- Nigerian performance compared with Brazilian and Caribbean experiences, respectively, in the vehicle-assembly and petrochemical industries; and
- Implications of the study findings for the development of technology policy and planning for industrialization in Nigeria.

Science and Technology in Nigeria

Gradually, Nigerian authorities are recognizing that science and technology are the primary vehicle for development, but, to date, the recognition has not been matched by investment in resources, human or material. Funding for science and technology has never been a priority and has often resulted from external pressure rather than domestic conviction.

Activities have been mostly in the public domain where they have been limited to establishment of institutions for research or to development of technical personnel, with emphasis usually being placed on formal technical training rather than on skill formation, practical experience, and innovation.

Regrettably, policymakers continue to have a hazy conception of the role of science and technology and have thus failed to optimize its use for

national development planning. Nigeria, like the majority of African countries, has not yet mustered the political will and commitment. Without this commitment, countries cannot raise the effectiveness of the functioning of their economy, radically improve labour productivity, or optimize the use of their resources. The countries have come to depend mostly on foreign R&D, personnel, technology, even raw materials for their industries. In October 1979, a separate ministry of science and technology was created to take over the responsibilities of the National Science and Technology Development Agency, which, since its inception in 1977, had been groping unsuccessfully with development of a domestic capability.

The ministry was given the mandate to promote and develop scientific and technologic research in the country. Its responsibilities were to include:

- Formulation of national policy on science and technology;
- Promotion of scientific and technologic research;
- Liaison with universities and institutions of higher learning; and
- Promotion and administration of technology-transfer programs.

Previously, programs for science and technology (S&T) had been established individually by the ministries and government departments responsible for their respective activities.

Before 1960 (when Nigeria attained independence), no policies dealt directly with S&T nor even with industrialization since the concern of the colonial authorities was mostly commercial: the development and transfer of agricultural commodities as raw materials for Europe.

Strategies and objectives for postindependence were made explicit for industrialization and have remained relatively unchanged despite a shift in emphasis toward exports. At the same time, the nation has moved gradually toward modest mobilization of resources for S&T.

The Second National Development Plan proposed to strengthen technical and scientific education and, thereby, to build technologic infrastructure. Imports of foreign technology were regarded solely as a means to

manufacture goods rather than to acquire skills. The plan identified the need for research in agriculture but did not promote it. Some institutions were established to pursue agricultural programs, but their efforts did not reach local farmers.

During the Third National Development Plan, serious thinking and discussions on S&T commenced, and achievements began emerging from domestic agricultural and industrial research: new crop varieties and animal breeds, new products from local raw materials (e.g., soy-ogi, cocoa butter, cola wine), and mechanized methods for food processing.

In the Fourth National Development Plan (1981-85), S&T was, for the first time incorporated as a separate sector with a budget. A total capital program of nearly NGN 600 million (Nigerian naira) was budgeted for research on agriculture (NGN 383.85 million), industry and technology (NGN 144.11 million), medicine (NGN 20 million), and natural resources (NGN 5.5 million).

During the period covered by the Fourth Plan, S&T emphasis was on basic research, establishment of institutions, and training of middle-level technical personnel overseas. Too little attention was devoted to applied technological research, to innovation, and to adapting technology. No incentives or recognition were offered to people who pursued these activities.

In contrast, the investment in creating institutions has been enormous; the achievements are only modest. Interaction between institutes is poor; they seldom share ideas, results, resources, or facilities. Thus, they are guilty of wasteful duplication.

Despite the significant improvement represented by creating a distinct sector for S&T, weaknesses still plague the system. Among them are that:

- Few targets have been set for achievements in S&T;
- Where objectives have been indicated, the activities to reach them are poorly formulated. No incentives are given for achievement and no sanctions are prescribed for failure;

- No channels exist to introduce into the national economy the results of research in S&T;
- Most of the finances for S&T go toward the running of research institutions (now numbering 26 -- Appendix -- under the Ministry of Science and Technology), and no significant provision is made for other vital aspects of S&T development;
- Funding for R&D is grossly inadequate and sometimes misdirected. Furthermore, existing policies do not strengthen links between R&D and the production system. There is little evidence of local innovation and development of technology;
- No national programs have been charged with popularizing S&T or creating a favourable environment for related research; and
- No real effort has gone into developing a national system for scientific and technologic activities, although access to such a system is a prerequisite for technologic development.

The research institutes (which are all government-owned) have been unable to become the vibrant centres they were created to be; they are constrained by inadequate facilities, personnel, and contacts. For example, the Federal Institute of Industrial Research (FIIRO) and the Project Development Agency (PRODA) require special engineering workshops if they are to attempt innovation, conduct pilot plant programs, and build prototypes.

Their inability to recruit and retain qualified staff can be traced to the conditions of service -- the lack of incentives and recognition. Also the absence of contracts or formal links with the production system means that the products and processes developed are never commercialized.

The burden of financing S&T activities in Nigeria is borne by the government. The only nongovernmental research of note in the country is being conducted by the International Institute of Tropical Agriculture (funded by aid agencies within the Consultative Group on International Agricultural Research). Some R&D is reported to be taking place in

multinational manufacturing firms, but I was unable to obtain reliable documentation of the extent or achievements. Many of these firms annually announce huge and increasing profits and declare substantial dividends to their shareholders, but they usually rely on their parent companies and other foreign-based laboratories to undertake R&D. Furthermore, local entrepreneurs make almost no grants in aid of R&D or other technologic activities.

It is somehow believed that development will occur through a strong association with developed, industrialized countries. The nation, therefore, has come to depend rather heavily on foreign development assistance; foreign technology; foreign R&D; imported raw materials, machinery, and equipment; as well as foreign technical management and expertise.

Until 1980, Nigeria did not have any policy instruments to control the influx of foreign technology. The one exception was the Patent and Trade-Mark Law, stipulating only that patents and trademarks would not be applicable or registrable in Nigeria unless they had earlier been accepted and registered in the UK. Having established this law, however, the government did not put in place a mechanism to monitor its performance or to enforce compliance.

In 1979-80, following intervention by the United Nations Industrial Development Organization (UNIDO), the country established the National Office for Industrial Property (NOIP) to screen contracts to be executed in Nigeria. It took 4 more years to recruit staff and to commence operations. NOIP is empowered to deny registration for any contract that is judged objectionable according to the published guidelines or to equity provisions that protect the Nigerian counterpart, but it does not have the power to prosecute for such violations. Also, although NOIP is expected to prevent importation of undesirable technology, it does not have the capability to design technical alternatives nor to modify unsuitable ones that have already been imported and installed.

Being able to judge the appropriateness of industrial technology depends greatly on a flourishing system of R&D. One primary objective of research programs and projects should be to energize the nation's potential to judge technology and to capitalize where possible on local resources under circumstances favourable to the natural environment. This objective encompasses encouragement of innovations, adaptation of foreign technologies, and substitution by new indigenous processes and products suited to local taste and conditions.

The nation has taken little initiative outside organized government-sponsored centres of R&D, which are only beginning to rise to the challenges of their trade. For example, despite being aware of mineral ores that could be exploited for the local manufacture of industrial chemicals, companies in both the private and the public sector have neglected to research the potential for use of the ores.

A number of new institutions were slated for creation during the Fourth Plan but have been indefinitely delayed by the country's economic slumps. The plan provided for establishment of facilities for the popularization of science and technology as well as:

- National Technology Development Centre (to evaluate, analyze, and modify imported technologies; undertake engineering design of machines; and adapt existing and foreign designs to suit local conditions and needs). One focus was to be applied physical sciences; projects were to include the establishment of workshops of engineering design and research, construction of specialized laboratories, and setting up of instrumentation workshops;
- National Institute for Chemicals Research (to conduct R&D on industrial and allied basic chemicals, e.g., acids, alcohols, dyes, pesticides, and to establish research facilities for work in textiles and pulp and paper);
- Research Products Development Corporation (to facilitate commercialization of R&D results); and

- Technology Potential Data Bank and Documentation Centre.

To date, the only two prominent, flourishing centres for R&D in industry are the Lagos-based Federal Institute of Industrial Research (FIIRO) and the Enugu-based Project Development Agency (PRODA). FIIRO concentrates its activities in the area of food and food technology, with emphasis on postharvest technologies for industrial processing of local foodstuffs. PRODA concentrates on R&D of electrical power and electronics, including pilot manufacturing of components, accessories, and complete electronic units.

Their efforts, though modest in comparison with the country's needs in science and technology, may signal the beginning of integration of research into Nigeria's industrialization.

Economic Overview

The Fifth National Development Plan declared that the overriding aim of Nigeria's development efforts is to improve the living conditions of the population. Toward this end, a number of specific objectives were set:

- Increase the real income of the average citizen;
- Distribute income more equitably among individuals and socioeconomic groups;
- Reduce the level of unemployment and underemployment;
- Increase the supply of skilled personnel;
- Diversify the economy to reduce dependence on a narrow range of activities;
- Achieve a balance in the development of the different sectors of the economy and the various geographical areas;
- Encourage participation by citizens in the ownership and management of productive enterprises;
- Increase self-reliance -- or reliance on local resources to

achieve objectives of the society. This implies increased efforts to achieve optimal use of the human and material resources;

- Develop technology;
- Increase productivity; and
- Promote discipline, good attitudes toward work, and responsible use of the environment.

In the last few years, agricultural production and processing have been the highest national priority. Education and human resources development have enjoyed the next order of priority, followed by the strengthening of economic infrastructures (power, water supply, and telecommunications). Housing and health sectors constitute the next set of priorities, while manufacturing, according to the plan, "will also receive appropriate emphasis."

During the 1980s, manufacturing was expected to grow about 15% annually because of several projects listed for execution by government and because of increased use of existing capacity. The relative contribution of the manufacturing sector to growth of the gross domestic product (GDP) was projected to be about 18%.

But midway through the decade, the manufacturing sector had not acquired, nor did it seem able to acquire, the energy and vitality to grow as expected. Beset by problems arising from inconsistent policies and government bureaucracy, stifled by shortages in raw materials, and suffocated by the foreign exchange crunch, the sector's capacity utilization dwindled to about 30% in 1984. Large-scale retrenchment of workers followed, and the sector's overall performance fluctuated wildly in respect of local value added and employment.

The GDP at 1977-78 factor cost was estimated to have grown from NGN 27.4 billion in 1975-76 to NGN 35.2 billion in 1979-80, giving an average annual growth of only 5% compared with the planned average of 9.5%. Up till 1980, the fastest growing sector of the economy was manufacturing,

which grew an average 18.1% annually in the 1970s. Agriculture, during the same period, recorded negative growth (-2.1%) as opposed to its projected 5.0%. The structural distribution of the GDP was most unsatisfactory: agricultural distribution accounted for 21.6% of the GDP while manufacturing accounted for only 4.8%. This portrays a structural imbalance in the economic set up of the nation.

The amount of capital formation in 1975 stood at NGN 5 billion, rising rapidly to NGN 11.6 billion by 1980. In all, capital formation during the Third National Development Plan totaled NGN 42.3 billion. Of this amount NGN 29.4 billion (or about 70%) was capital investment in the public sector.

Investments were mainly in building and construction activities

Table 1. National investment programs, 1962-85 (Nigeria, Federal Ministry of Economic Development 1962, 1970, 1975, 1981).

National development plan (years)	Total planned investment (NGN billion)	Public sector investment		Private sector investment	
		NGN billion	%	NGN billion	%
First (1962-68)	2.37	1.59	67.0	0.78	33.0
Second (1970-74)	3.19	1.56	48.9	1.63	51.1
Third (1975-80)	53.30	43.30	81.2	10.00	18.8
Fourth (1981-85)	82.00	70.50	86.0	11.50	14.0

(61.1%), whereas machinery (21.Ø%) and transport equipment (16.6%) made up most of the remainder.

The level of gross capital formation was projected to rise to NGN 2Ø.1 billion by 1985 compounded annually at 11%. The total would be about NGN 82 billion during the Fourth Plan (1981-85). Of the projected amount, the public sector was expected to supply about NGN 7Ø.5 billion (or 86%).

In fact, the role of the private sector has continually been deemphasized, even though successive development plans since independence have professed to carve out a larger role for private business (Table 1).

Agriculture, which was the mainstay of the economy, has declined steadily, and Nigeria has become a major importer of food. Agricultural output declined both in absolute and in relative terms from NGN 4.4 billion in 1978 to NGN 3.7 billion in 1982 -- from 15% of GDP to 13%. The decline has occurred in spite of NGN 2 billion, which was pumped into the sector in the form of fertilizer, machinery, irrigation projects, etc. during the period.

External Transactions (Imports and Exports)

Imports between 198Ø and 1985 were expected to rise at a compound rate of 12% annually and to change such that the share of food would decline substantially. Neither expectation was met, nor were any other projections about imports for the period (Table 2). For example, the level of imports of capital goods was to rise "unavoidably" while the share of consumer goods as a proportion of total value of imports was to fall. In absolute terms, the national expenditure on imports was dramatically lower than the planners' projections (as low as 21% in 1984 and 1985) -- discrepancies that call into question the reliability of the national planning apparatus.

The projections for exports were not much better. Although oil exports declined as a proportion of total value of exports, they constituted the bulk of the nation's exports and annual revenue.

Table 2. Trade (imports and exports), 1977-85 (Nigeria, Federal Ministry of Economic Development 1981; Federal Office of Statistics 1977-85).

	Import c.i.f. (NGN million)		Exports f.o.b. (NGN million)	
	Projected	Actual	Projected	Actual*
1977	-	7.631	-	7.630
1978	-	8.137	-	7.077
1979	-	6.194	-	17.872
1980	13.524	8.941	15.533	13.712
1981	15.196	12.593	16.483	11.034
1982	17.076	10.096	17.679	9.232
1983	19.092	6.550	18.941	7.752
1984	21.320	4.481	20.268	9.989
1985	23.780	4.952	21.658	11.739

*Figures include domestic and foreign produce.

Strategic Orientation of Science and Technology in National Development

In some developed countries, as much as half the increase in national productivity in this century has been attributed to innovation and improvements in technology. Labour and capital account for the balance (Lalkaka and Mingyu 1984). Yet only a few developing countries are effectively pursuing the acquisition of technology. The rest fall further behind the developed world. Their future generations may lose access to the means of self-reliant development rather than becoming active

participants in the international economy of a changing world.

Governments of developing countries are aware of the negative consequences of technological dependence but are not certain how to overcome it. Their dependence creates weakness, which in turn reinforces their dependence. The pressures increase, as each technology in developed countries seems to breed new generations of technology at faster and faster rates. The developing countries find it more difficult to keep up with the advancements in the developed countries and become more confused about what their focus should be in technology acquisition.

One appropriate starting place is a national audit of available resources and infrastructure so that the government can determine the level of technological inputs that can be supported by the infrastructure and that can make optimal use of the available resources. Such a procedure would guide a developing country to achieve the critical mass for a take-off of technological development.

At increasing speeds, industrialized countries have evolved infrastructures for science and technology: Europe took about 200 years; America, about 100 years; Japan, 50 years. The developing countries need to evolve theirs rapidly if they are to seize the benefits from existing knowledge. With high rates of population growth, poor economic growth, distorted patterns of income generation, and even more distorted patterns of income distribution, the developing countries can no longer await the natural evolution of a scientific and technological infrastructure. They must plan and integrate activities into the overall strategy for national development.

The strategy is concerned with general trends in the growth and structure of industry and its subsectors, but the focus of action is usually the individual investment project or enterprise (e.g., establishment of a new manufacturing activity). The industry component of national development plans, therefore, rapidly becomes a summary of aggregations of individual projects. Or the plan rapidly decomposes at

implementation into such individual projects. Policy considerations are neglected in technology acquisition, and the need to harness projects for mutual reinforcement is forgotten. Yet individual projects must be set in the context and framework of the long-term growth of industry -- part of a rational sequence of similar and technologically related projects.

Even when the focus for industrial development is on long-term structural changes and sustained growth, the main concern of economic policy and planning is often investment in production capacity -- fixed capital and associated inputs to produce goods -- rather than investment in knowledge. Since analysis of national economic development can be reduced simply by econometric modeling, the dominant concern of economists is parameters and aggregated quantities defined in national income accounts and capital stock (which are measurable). Little attention is given to the accumulation of knowledge-capital (which is largely unmeasurable).

Those responsible for policy and planning do perceive the need to develop their human resources, but the training offered in schools, colleges, universities, and polytechnics, focuses on the achievements and documented knowledge of the developed countries rather than on the processes involved in creating knowledge, adapting technology, and increasing technical know-how. The institutions do not normally enjoy a significant demand from the production sector.

In other words, policymakers and planners have often been concerned with development of scientific and technological capacities in organizations and institutions that are <u>outside</u> the structure of industrial production, i.e., in universities, specialized government-sponsored research centres, institutions for the administration of technology matters, etc. However, they should work toward the accumulation of technological capacities <u>inside</u> the production system. Effective links between the production system and research centres and universities depend on the existence of technical capacities <u>within</u> industry (Adubifa 1983).

The requirements and interests of production enterprises differ

markedly from those of universities. Similarly the motivations and productivity of their personnel, especially the scientists, engineers, and technologists, differ. The interests must be reconciled and the links between academic institutions and industrial enterprises must be strengthened. There are too few human, financial, etc. resources for the two groups to remain isolated.

In developing countries, imbalances between the supply and the demand for technical personnel are obvious. Often, the training given to scientists and engineers is simply inappropriate to the low level of sophistication of the work assigned to them in factories.

A survey published in the early 1970s (Cooper 1972) concluded that engineers and scientists, when far-removed from industry and its demands, carve out and pursue (in isolation) areas of research interest.

It would be unfair to condemn authorities in developing countries because of the misallocation of resources in scientific education and to technical activities. They have not yet established the foundation on which to develop the field. They are under pressure from many sources, internal and external, to push their societies into economic development, but they have few resources at their disposal.

If the resources are to be allocated effectively to national priorities, then programs and activities must be designed, not by the political leaders but by the scientists. Scientists must in turn, be willing to work together -- temporarily abandoning vested interests and working beyond their narrowed, independent specialties to present a strengthened common front for increased appropriations and rational allocations for science spending.

Setting national priorities, when there is little to share, becomes very difficult. A critical but fundamental question is whether to focus on long-term development and growth in the face of imminent social chaos or to address immediate problems in the hope that the future will take care of itself. No wonder science and technology are often forgotten.

Similarly, policy research that focuses on the long-term welfare of the nation and prevention of development failures draws low priority for support. The problems confronted are immediate and, if not solved, may end the political future and, hence, the long-term plans of those in power. Yet if policy research were to address existing problems, it would be weakened since it could do nothing to prevent those problems.

A share of the available resources must go toward the acquisition of technology, but the considerations are not strictly technical. For example, factors such as external debt determine whether developing countries can, or will, gain access to technology. The impact of debt on the borrower nations and the effect of the burden on the future prospects of industrial development in countries like Nigeria are staggering.

The World Bank (1985) reported that the disbursed public, and publicly guaranteed, debt for subsaharan Africa rose by 250% in the years between 1976 and 1983 (Table 3).

Table 3. Debt (US$ million) guaranteed by public authorities in subsaharan Africa, 1976, 1982, and 1983 (World Bank 1985).*

	1976	1982	1983
Public	16606	50510	55589
Private	1139	3231	2918
Total	17745	53741	58507

*The figures exclude loans that were not guaranteed. Such loans could be worth an additional 40%.

Nigeria's total debt in 1983 was reported to be US$15 523 million, of which US$5287 million (or 34%) was attributable to the manufacturing sector. Under these circumstances, can borrowing nations mobilize sufficient resources to uphold the strategic place of science and technology in their national development plans?

FRAMEWORK FOR POLICY FORMULATION

History of Industrial Development in Nigeria

Industrial development can be said to have commenced in Nigeria after the early 1950s when the country had adopted, a priori, an industrial strategy of import substitution.

Nigeria was still a colonial nation under Britain, with only a measure of self rule. But, even then, the indigenous politicians and decision-makers recognized that imports indicated a demand and that a country seeking to establish an industrial program and manufacturing activities should first examine the structure of its imports. Thus, they focused the nation's future activities on the local production of the goods accepted by consumers.

Among the first industrial activities was the establishment of extractive industries (e.g., oil from palm, groundnut). Next was processing of timber, rubber, cotton, etc. into semifinished goods for export to the traditional colonial markets and industries of Europe. As the nation approached independence, it became necessary to fashion a national development plan, including a plan for industrial development.

The First National Development Plan (1962-68) gave high priority to the industrial sector: 13% of total capital expenditures. The primary objectives were (Nigeria, Federal Ministry of Economic Development 1962, p. 60):

> ...to stimulate the establishment and growth of industries which contribute both directly and materially to economic growth; to enable Nigeria to participate to an increasing extent in the ownership, direction and management of Nigerian industry and trade; to broaden the base of the economy and minimize the risk of overdependence on foreign trade, to secure full employment for the people and to make the fullest use of available resources.

Import substitution was, thus, installed as policy. Most of the industries established, especially with foreign equity, were to make "final" products from imported goods for consumers. Some simply mixed and bottled finished formulations; others dressed and packaged finished goods or simply cut and packaged bulk items. The new pharmaceutical "industry" imported pills, capsules, and other formulations in large tankards, and local personnel simply counted and bottled the drugs. All these activities were called industrialization.

Both the industrial climate and the industrial policy favoured this type of "industry." For example, the Pioneer Status certificate granted by the government (which attracted tax exemption incentives) covered the production in Nigeria of a list of imported goods. The so-called manufacturer qualified for reductions on import duties levied for machinery and "raw materials." Other incentives included accelerated depreciation as well as initial capital allowance.

A government evaluation of the performance of the industrial sector during the First Plan period probably entrenched such inappropriate policies. The report was highly favourable, reaffirming what planners and policymakers believed to be the right path. It effectively blocked consideration and examination of other policy choices, stating (Nigeria, Federal Ministry of Economic Development 1970, p. 141):

> ...the policy of import substitution pursued since independence has earned rich dividends. It has been the main determinant of the high growth rates recorded in the manufacturing sector. For a few industrial products like cement, flour and beer, the process was nearly complete.

Not mentioned was that the only local contents of, for example, cement were limestone and water. Still imported were the machinery, gypsum, additives, kraft paper (for bagging), and skilled labour. Similarly, for flour, the machinery, the wheat, the cotton bags, and even labour were imported, as were the machinery, hops, malt, chemicals, bottles, corks, and

management for beer brewing.

The setting into which the Second Plan was introduced limited the nature and scope of future foreign investment, while it created a definition of how "success" would be measured. But the Plan recognized that "import substitution" as pursued, had brought about a rise in imports of raw materials, intermediate and capital goods, concluding (Nigeria Federal Ministry of Economic Development 1970, p. 141): "...the manufacturing sector has thus become highly dependent on imports."

The Second National Development Plan created new policies in an attempt to arrest the undesirable effects on the manufacturing sector. It also called for government to invest directly in major industrial initiatives to ensure compliance with national objectives. The new policies were intended also to guide investment by the private sector and to make it more productive. Implicitly, the new policies set the stage for export promotion as a strategy, especially as emphasis was put on the establishment of industries that would earn foreign exchange.

The Second National Development Plan launched the country into a series of large capital-intensive projects in the industrial sector. The move was partly to earn foreign exchange and partly to act on persistent external advice that the level of intermediate and capital goods production should be raised. Such external intervention failed to take account of the inadequacy of managerial capability and infrastructure. If the proposed projects had materialized as planned, the nation would not have been confronted with the economic problems and debt burden that have threatened to cripple its social and economic life in recent times. A look at the present status of some of the major projects originated at that time is indicative:

- Pulp and paper mill, Jebba (producing at 20% capacity);
- Iron and steel complex (partly on stream at exorbitant capital cost);
- Pulp and paper project, Iwopin (70% complete, apparently

abandoned because of lack of funds);

- Salt refineries, Sapele and Otta (producing, after more than 400% cost overrun and more than 7-year delay);
- Petrochemical complex (still on the drawing boards);
- Nitrogenous fertilizer plant (now under construction); and
- Passenger car assembly plants (producing at high cost, far from targets in local content).

The Third National Development Plan (1975-80) was launched in 1975, but none of the above-listed projects had taken off. However, the nation's oil sector had become vibrant and prosperous, and it created a false perception of national prosperity that, in turn, opened the gates for imports. The taste for foreign goods became almost insatiable, and the need for local industries to make these goods declined. (Consumers became "sophisticated," thereby stifling the growth of infant local industries.

During this period, foreign firms used the liberal policies on import substitution and the related incentives to establish more "finishing" industries such as the assembly of radios and televisions, knocking together of shoes from imported uppers and soles, bottling of soft drinks after mixing of imported concentrates, counting of tablets and pills into imported bottles and labeling, etc.

An indigenous engineering or design industry was conspicuously absent. No investments were made into machine design, toolmaking, foundries, etc. The planners and policymakers seemed unaware of the critical role of such activities in the efforts of any developing country to break the cycle of dependence. They showed little concern for the high fees (in foreign exchange) that were being paid for imported technology, services, and industrial artifacts.

At the end of the Plan period only 10-17% of industrial projects had been implemented. In several cases critical decisions had not been made in a timely fashion and, sometimes, not until escalating costs had rendered the investment no longer feasible. The Third Plan period therefore failed

to make the nation any stronger in its industrial growth and reinforced the nation's technological dependence on the developed countries.

Only in the preparation of the Fourth National Development Plan (1981-85) did the nation begin to make sense of the opportunities and resources available to it. The early part of this Plan period coincided with the arrival of a civilian regime after 13 years of military interregnum. Even though the plan had been drawn up beforehand, the civilians took almost 2.5 years before releasing it for implementation. This delay and the reasons for it were a preview of the destructive posture of the new regime toward industrialization. The new administration was concerned with politics more than with development and, hence, almost ignored the articulations of the Fourth Plan. Although the planners had recognized and identified the now-persistent maladies of the manufacturing industry and had proposed mechanisms by which public and private sectors would complement each other in reorganizing industry and emerging with a growth-oriented profile, the ambitions were frustrated by the new administration's inept and corruption-filled procedures. The administration was indecisive because of vested interests. The only projects it commissioned during the period were those whose planning and implementation were already under way before it came to power. (For more than 4 years, the administration could not decide on the site of the proposed petrochemical complex even though all the technical data required for decision-making were before it.) Existing industries were starved of foreign exchange, unable to import raw materials and spares for ailing equipment and machinery. The scarce foreign exchange was used to finance importation of rice, luxury cars, and personal items.

This foreign-exchange crunch brought to the fore the weaknesses of the industrial sector and compelled a somber review in 1984 of the industrial policies and strategies. One of the results of this review was the recognition of the conspicuous gap created by the absence of policy studies in planning for the industrial sector. Although several studies and publications had been done (e.g., Skoup and Co. Ltd. 1981; NISER 1982; Igwe

and Ndekwu 1985), apparently none had influenced policy formulation.

The inability and unwillingness of the civilian administration to act exacerbated the problems rooted in Nigeria's industrial sector -- problems that grew out of the approach followed in the planning of national development.

Industrial Development Planning In Nigeria

Many developing countries seek assistance from advanced countries and international agencies in formulating their development plans. The agencies have commonly prescribed classical methods that proved reliable in the advanced countries. The methods have not always succeeded in developing countries perhaps because of different circumstances and purposes.

Nigeria falls into the category of developing countries whose technological foundation was initially determined externally and whose continued growth has depended greatly on external intervention and assistance. This dependence has created weaknesses in the capability of the nation to sustain its own industrial and technological growth.

One major weakness can be found in the administrative infrastructure for development planning. The Federal Ministry of National Planning and the Federal Ministry of Industries take joint responsibility for planning for industrial development, but the latter has responsibility for execution of the plans.

The officers of these ministries see their roles as civil servants to implement decisions of government. Yet they also make recommendations for the decisions. Often, the proposals of the planners have resulted from external advice and recommendations. They are received as mandates by administrative officers who advance them, sometimes with modifications, to the political leaders for approval and funding.

The fundamental weakness in this administrative structure is the absence of input by a professional technical cadre who could evaluate the development plan: the order of priorities, the appropriateness of projects and technological parameters in fostering links for a smooth and complementary overall industrial development.

An assumption since colonial days has been that good administrators are also good planners. This is not necessarily so. Although administrative officers in the civil service are usually led through a series of well-programed courses of instruction that sometimes include planning methodology, they hardly ever take courses in planning specific sectors. Yet planning for industrial development requires not only formal training but also practical experience. An industrial planner needs to understand and appreciate the complex nature of industrial links, the possible alternatives in technology and performance measurement, the balancing of economic and social options of policy, the nature of policy instruments, and the judicious use of such instruments and mechanisms to achieve particular goals.

In many respects, the present structure is a legacy of the past. The British colonial service that administered Nigeria was never intended to create or manage industries or the production system. It was to preserve law and order in the British interest and to promote trade and acquisition of raw materials, also in the British interest. It succeeded.

The colonial servants did not directly establish industries; rather, they were instrumental in the penetration of transnational corporations (TNCs) into Nigeria. These TNCs engaged initially in commerce and transport, collecting and shipping produce from Nigeria to be used as raw material for the industries of the developed countries and bringing finished goods, especially textiles and processed food, for the Nigerian market. Later, they put into practice the import substitution that became the first step toward industrialization locally.

In other words, the colonial service in Nigeria did not concern itself

with industrialization. It made rules and regulations to guide the occurrence of industries, monitored their performance, and probably modified industrial objectives to take account of the developing market, but it did not create any formal mechanism for the participation in the production system as a function of government.

After independence, the national government did not radically change the service. The transition was smooth, since the change did not involve any structural modifications. For this reason, the Federal Ministry of Trade and Industries that emerged after independence was composed essentially of administrative officers who had gone through the tutelage of the British. Although some expatriates were retained as advisers to the ministry, they were less a professional cadre than an administrative one.

A prominent feature of the civil service, and one that has adversely affected its capability to implement industrial projects, is that civil servants are rotated periodically, not only between departments and divisions of a ministry but also between ministries and agencies of government. This rotation has contributed to inefficiency in planning and inconsistency in policies. For example, during 1974-79, the government, through the Federal Ministry of Industries, negotiated and contracted for five new major cement works, as well as the repair and resuscitation of three existing ones. During this period, no fewer than 14 changes were made in the projects' leaders within the ministry. Although the proceedings were maintained on file, no consistency of approach, let alone price determination, could be mustered, and no standards were established. Today the nation's cement industry is made up of nine producing plants that bear little resemblance to each other in form of capital formation, machinery, process, standards, production/labour ratio, infrastructure, unit capital cost, or source of technology.

The country relied rather heavily on strategies that had been used and proven in other countries, both developed and developing, but Nigerian circumstances, especially socioculturally, defy definition in any manner

that provides quantifiable units and parameters for use in translating local circumstances into so-called formulas.

Nigeria cannot be said to have failed in its development efforts. The country certainly has made progress, but its achievements have not been commensurate with its potential.

National development plans have never been followed as conceptualized and published. The plans contain political objectives that express the aspirations of the country, but the planners take little cognizance of the means of achieving these objectives. Commonly, the development plan is a list of intentions to be undertaken if the means are available. After a plan has been formally presented to the nation, everyone returns to his or her post to carry on as before.

The new plan usually contains no mechanisms to link ongoing activities with proposed activities. It is simply hoped that the former will somehow transform into the latter. As no strategy has been outlined to achieve the transformation, it becomes difficult to allocate resources to alter the course of events. Usually, no guidelines have been drawn up to facilitate the winding down or reorienting of low-priority activities. In some cases, activities are brought to a halt, with significant losses of the investment made, and in other cases, projects that would qualify as low priorities are allowed to continue because so much has already has been invested in them.

Before 1977, no major agency of government was responsible directly for technological planning. Technological growth occurred haphazardly:

- In agriculture, the government encouraged the provision and use of more modern equipment and facilities; the rationale apparently was the equipment's successful use elsewhere.
- In transportation, passenger and commercial vehicles were allowed to be imported without provisions for local maintenance; they flooded the market, congested the roads, and littered the environment in unserviceable bodies and parts.
- In the manufacturing industry not only did machinery and

equipment (often secondhand and repainted) flood into Nigeria, but no appropriate effort was made to ascertain the relevance and necessity for such imports. Hence, factories were established whose raw materials were to be wholly imported.

By failing to coordinate technological activities centrally, the nation achieved a high-cost assortment of desirable and undesirable technological inputs.

The First Plan did recognize industrialization as a major vehicle for national development. In the pattern of other developing countries that had successes to show for their efforts Nigeria initially relied on foreign investment supported by generous tax rebates and pioneer incentives. Import substitution was the primary objective.

The Second Plan period witnessed a rapid increase in government revenue from oil and also witnessed a change in the focus of public policy on industrialization, the aim being to promote dispersal of manufacturing industries, expansion and diversification of the industrial sector and export-oriented industries.

The Third Plan continued to give emphasis to the objectives of the Second Plan. Its industrial theme was to transform the structure of manufacturing industries so that production was dedicated to intermediate and heavy capital goods. This transformation was probably premature as it led into all kinds of complications and problems. The period witnessed increased public-sector investment in industries, and the government unconsciously placed itself in direct competition with the private sector.

The Fourth Plan, which was later revised, also gave high priority to industrialization, particularly:

- Ensuring increased self-reliance in the supply of industrial products;
- Maintaining rapid growth of the manufacturing sector and increasing its share to 12.9% of GDP;
- Increasing local content in manufacturing output through

increased substitution;

- Increasing employment opportunities;
- Promoting the development of export industries;
- Improving the competitiveness (price and quality) of Nigerian-made goods; and
- Promoting more even dispersal of industries.

The Fourth Plan was to cover 1981-85. It had a projected capital expenditure of almost NGN 82 billion, but anticipating an unstable international oil market, it concluded that the revenue projections might not be fully realized and, in such event, that "there will be a re-ordering of priorities in every sector to ensure the optimal use of available resources."

The statement is significant in that it sums up the government's approach to planning: not exactly haphazard but casual and flexible. Why the nation had to wait for the foreseeable collapse of the oil prices before reordering its priorities is unclear. The national priorities and development goals could have been fashioned such that shortfalls in expected revenues simply prompted cancellations of programs and projects of least importance.

It is to be noted that the industrial sector started with a narrow base. For example, records of the Federal Office of Statistics indicate that at independence the numbers of major industrial businesses were negligible and by 1964 -- the First Plan -- only 687 manufacturing establishments had been registered in the country, i.e., had 10 or more employees. At the beginning of the Third Plan, however, 1310 establishments had been registered, and total employment had risen to almost 250 000.

Planning in the Manufacturing Sector

The Third Plan addressed the ever-present bottleneck of red tape and

administrative inefficiency in implementation. It said among other things (Nigeria, Federal Ministry of Economic Development 1975, p. 75):

> Experience has shown that it is necessary to streamline these [implementation] procedures so that projects are not delayed because of unnecessary administrative bottlenecks. For this purpose the existing implementation procedure has been fully reviewed and modified to ensure a much more rapid pace of implementation.

The statement expressed the problem, documented recognition by government, but did not identify exactly what had been done to modify the old procedures. In fact, the procedures have become much worse -- more complex. Now, another decade later, the procedures have become so complex, so inefficient, and so fraught with fraud, that several industries are grinding to a halt, while new ones incur unprecedented cost overruns. Obviously, the political will and commitment to implement the ideals were not there.

The introduction to the Third Plan states:

> No departures from the approved Plan without due authorization as specified in the Plan will be allowed. For this purpose appropriate sanctions have been devised and will be applied to any agency which is found guilty of Plan distortion.

The threat was never acted upon, although the Plan not only was distorted, as far as industrialization programs were concerned, it was mutilated (Table 4). Overall performance of the federal government for the first year of the Plan was a mere 2.2%. At that rate, the performance for the entire period would have been no more than 11%. Also, the planned expenditure in this sector for fiscal year 1975-76 was NGN 876.42 million, of which NGN 167.97 million, 23%, was actually spent. The corresponding aggregates for federal ministries and agencies were 15% and for state governments 60%.

Table 4. Major manufacturing programs and projects, sponsored by the federal government in the Third Plan, 1975-80.*

Project title	Estimated total 5-year expenditure (NGN million)	Total first year expenditure (NGN million)	Expected completion	Status in 1984
Blast furnace complex	641	-	1980	Producing but not completed, with an additional NGN3124 million for the Fourth Plan
Direct reduction, iron and steel	250	-	1982	Producing but not completed, with an additional NGN757 million to be spent during the Fourth Plan
Expansion of cement factories	78	na	na	na
New cement factories (Ashaka, Benue, Sagamu)	85	na	1977-78	Completed 1981
Commercial vehicle assembly	12	1.40	na	Not completed
Pulp and paper: carryover projects (Ijebba, Calabar, Iwopin)	200	12.41	1979-80	Not completed
Pulp and paper: new projects	72	-	1979-80	Not completed

Table 4 continued.

Pulp wood plantation	58	11.00	na	Not completed
Fish trawling and distribution	19	3.16	na	Not completed
Combined fish and shrimp project	6	0.65	na	Not completed
Integrated sugar (Savannah, Sunti, Lafiagi)	280	10.00	1979-80	Not completed
Other sugar projects	40	-	na	Abandoned
Petrochemical complex	300	0.88	1978	Revised estimate for cost, NGN 1000 million, of which NGN 375 million was to be spent during Fourth Plan
Nitrogenous fertilizer	70	0.04	1977	Budgeted at NGN 130 million in Fourth Plan, not yet commissioned
Two refineries for home market	350	23.38	1979-80	Completed
Two export refineries	376	-	na	na
Two LNG plants	1260	0.12	1978	Expected to cost NGN 7000 million, not commissioned
Large-scale carbonization of coal	29	0.17	1979-80	Abandoned

*na = not available

Government has established a large number of supporting institutions, but their achievements in meeting government objectives and aspirations have been limited in most cases. Reorganizing them and providing them with adequate funds would be the first steps toward strengthening their performance. Key among this group are:

- Industrial research institutes;
- Industrial development banks;
- Industrial development coordinating centres;
- Industrial training fund;
- State investment companies;
- Export promotions agency; and
- Enterprises promotions board.

Evidence of the inadequacy of the strategy is the nation's near-total dependence on foreign sources for raw materials to run its industries even though the nation has continued to pursue import substitution. There was no conscious review or stocktaking. The strategy initially meant local production of a group of consumer goods to replace imports of such goods in their finished forms.

It was necessary, initially, to import some of the raw materials to manufacture the goods while local labour was brought into the production system. The local contribution was enhanced steadily in terms of shareholding, ownership, employment, infrastructure, distribution, and marketing. The government did not express concern or anxiety about the mounting expenditures on imported capital equipment, services, and raw materials. In fact, it was somehow believed that industrialization could not be achieved without massive imports of machinery and services.

While industrialization may have depended initially on imports, one would have expected that arrangements were being made simultaneously to create as much local capability as possible. The need was recognized, but

the planning was grossly inadequate. Government, on one hand, took responsibility for all such planning and made little effort to involve the private sector where the bulk of industrial development programs would be executed. Furthermore, the government distrusts the private sector as somehow greedy, not nationalistic, and motivated only by self-interest.

But was it necessary also to import the raw materials? This is the question for which the answer appears to be "no," and planners have no explanations for the omissions or for the increases in raw material imports.

Decision-Making

The review of the national development plans shows the good intentions during policy conception. None of the policy ideas was frivolous, but neither was any one policy particularly effective. Thus, policy formulation and decision-making need thoughtful consideration if one is to make them more effective.

There are three principal levels of decision-making within the federal government:

- President-in-Council, which is the highest administrative and executive organ during civilian regimes of government. During military regimes it is the highest executive body, with the Supreme Military Council acting as the highest political organ and directing the affairs of state. The President-in-Council meets sparingly for its deliberations, and industrial programs and projects are not normally a matter for this body.
- Ministries, which are headed by a minister, a direct representative of the President. The permanent secretary is the accounting officer and is responsible for the implementation of ministerial decisions. All the officers in the ministry are civil servants, although the minister is a political appointee.

- Schedule officers, who are senior civil servants, charged with overseeing the affairs of subsectors of social and economic activities under the auspices of a ministry. For example, within the Ministry of Industries, such "schedules" include the agro-allied industries, chemicals and petrochemicals, engineering industries, and small-scale industries. The schedule officers, along with their subordinates, carry out plan programs, field supervision, and monitoring of development activities. They often also make recommendations for the Permanent Secretary to formalize as the ministry's official input into national economic and development programs.

At the state level, the structure is the same, although the governor substitutes for the President, and there are no military councils in the states.

These groups are the sources of industrial policies, which are made public either in national development plans or in announcements between plans. Similarly, policies published in the plans are sometimes modified or canceled by similar announcements. In fact, new and revised policies are announced so frequently, one can conclude only that either the policies were not formulated with enough care and consideration or they are not operating long enough before being judged inadequate. (The policy response being measured could still be from previous policies whose effects have not totally disappeared.)

Although most of the new policies and policy amendments emanate from the President-in-Council or ministerial levels, they usually reflect advice and intervention from outside government -- sometimes from offshore and sometimes from powerful interest groups within the country. Because Nigeria's governments have always strongly valued foreign investment and aid, the bilateral and multilateral agencies who provide resources often invite themselves to carry out evaluations of the economic prospects of the country and proffer their advice and recommendations. The staff within

ministries then find they must grapple with technical and economic issues that have not emanated from their own perspectives.

One of the mechanisms employed for dealing with such externally generated issues is to appoint consultants (local or foreign) to carry out "in-depth" studies. Policy recommendations arise from the studies; these are sector-specific, usually technically appropriate, but also usually deficient in identifying the effects on other sectors of the economy or other policies.

The conclusions and recommendations arising from commissioned studies are evaluated by schedule officers and their staff before being presented to higher authorities. The evaluation in some cases involves interministerial committees or representatives of ministries whose interests and activities could be affected by the new policies. This essential and crucial procedural provision could, under different circumstances, be used as the bedrock of appropriate policy evaluation, the stage at which all pertinent factors and applications are critically appraised. Guided by articulate national development objectives, the individuals doing the evaluation at this stage could ensure the policies were sound and purposeful. Unfortunately, to date, schedule officers and interministerial committees have not reviewed the commissioned studies in sufficient depth to make useful contributions. Decision-making thus becomes rather superficial, as the ministers draw substantially from the officers' work. The proposals and recommendations that go to the President-in-Council are circulated to all ministers who, along with their permanent secretaries, are often too heavily burdened with administrative details and official obligations to address themselves to the full range and depth of the technical matters. They often do not have the benefit of comprehensive advice.

Constraints that contribute to the poor performance of the administrative machinery arise form longstanding traditions of the civil service and from the inadequacy of the national managerial capability. For

example, the principal officers dealing with programs are transferred frequently, sometimes intraministerially and sometimes interministerially. The tradition was established by British colonial officers, who believed a good and effective administrator had well-rounded exposure to the machinery of government, but the responsibilities of the service have expanded considerably beyond trade and peacekeeping. No special permanent cadre of planners and policymakers takes long-term responsibility for policy formulation and evaluation, so officers see themselves as transient executors of whatever policies are in place.

Serving officers are seldom committed to the successful implementation of policies. They have no special incentives for outstanding performance and no penalties for failure. In fact, the system works in such a way that it is often difficult to identify the contributions of individual officers to the success or failure of policies and projects. In any case, the officers seldom stay long enough in one job to make a lasting impact.

Also, the managerial capability within the civil service is inadequate for the wide array of responsibilities. The inadequacy is both in terms of numbers of trained managers and in terms of specialization.

The Ministry of Industries, for example, has administrative functions covering not just the public sector nor the private sector (entrepreneurs, banks, etc.) but also the foreign domain (investors, technology suppliers, bilateral and multilateral agencies, etc.). Its technical functions include difficult and knowledge-intensive activities such as project identification, development, implementation, and monitoring. These activities involve a myriad of consultants, contractors, banks, foreign agents, technology vendors, machinery fabricators, management agents, etc. To expect a group of administrative officers to manage all these satisfactorily and efficiently is a major weakness of the national planning structure.

What's more, the administrative machinery in support of industrialization has become an obstacle to industrialists because of the

unwieldy process of getting to the decision-making stage.

A look at the steps in obtaining approval indicates why. One needs a locational permit from the Ministry of Industries to establish an industry; a permit from the Ministry of Internal Affairs to operate a business; a permit for an expatriate quota; a permit from the Ministry of Finance to bring in or utilize foreign capital; a licence from the Ministry of Commerce to import machinery; a licence to import raw materials under "approved user status"; a form "M" from the Central Bank of Nigeria to process the foreign-exchange payment for imports; a certificate from the Inspectorate Division of the Ministry of Industries indicating the site and facilities have been inspected, a certificate from one of the foreign inspectorate firms retained by government to certify the shipments of foreign orders leaving for Nigeria.

In principle, each of the approvals is justified, but the officials who process the licences and permits often exercise undue power over the applicants. Rather than facilitating, they frustrate the efforts of entrepreneurs, sometimes for financial benefit. The bureaucratic regulations create an unwholesome and unfavourable climate for both local and foreign investment. Although similar applications are fully processed within a month in developed countries, they take up to 18 months in Nigeria and involve unrelenting visits to the various offices. They often also involve payments to corrupt officials and intermediaries. They are known, even by policymakers, to be time-consuming and counterproductive, but no effective system has been devised to remove the malaise, partly because the chaos and fraud have become a way of life and partly because the administrative capacity within the public service is inadequate to handle the work.

Obviously, the magnitude and scope of the projects that the government embarks upon and supports overburden the existing administrative machinery. Yet government has given little attention to operational planning by which its activities and programs could be tailored to its existing executive,

managerial, and technological capacities while its capacities are expanded.

CHOICE AND ACQUISITION OF TECHNOLOGY

The majority of planners, politicians, and even researchers have not developed a clear conception of what constitutes technology and its transfer. Mihyo (1984, p. 183) came to a similar conclusion about Tanzania, saying:

> There is a general failure to differentiate between the physical transfer of technological hardware and the transfer of technical expertise embodied in the application of that hardware to the local development needs.

In other words, the nation does not appreciate the difference between transfer and acquisition of technology. While "transfer" implies the delivery of the object by the owner (supplier) to the recipient, "acquisition" implies direct action by the recipient to seek and obtain the object of its desire. The former is passive and depends for success on the owner's willingness and dictates; the latter is a deliberate and planned effort by the recipient who pursues various means to achieve its goals. Such means would include the development of endogenous technology, the adaptation of imported technology, and the purchase or even stealing of technology. For any developing country to achieve its development goals, it is necessary not only to develop the right policies but also to have the right attitude toward technology.

Nigeria depends almost totally on foreign imports and foreign technology, being unable at present to contemplate the development of endogenous technology. Under these circumstances choice of technology rapidly becomes choice of foreign sources of technology. The setup for decision-making often reduces the criteria to secondary, inconsequential, and nontechnological factors. The quality of a decision is normally a function of the decision-maker's skill and experience, the nature and quality of available information, and the decision-making environment. Currently, all these are weak in Nigeria.

Technology is being chosen continually in both the public and the private sectors, although the machineries of decision-making in the two sectors are radically different. Government is accountable not only for its failure to fashion policies directing the choices for public and private sector. Government is expected to draw up guidelines and a framework within which the private sector performs, to monitor the performance, and to ensure compliance with stipulated regulations and procedures.

Choosing technology may mean comparing technologies that achieve the same purpose or, as is the case more often in Nigeria because no direct alternatives exist for technologies, or deciding among sources, prices, guarantees, financing arrangements, project-completion times, and general conditions of sale. The problems afflicting the public sector in making such choices arise from the institutional setup of government machinery.

The technology is seen by decision-makers as an operating factory to manufacture the goods associated with that technology. The first and most important factor, therefore, is the estimated cost of procuring and erecting that factory. This figure determines the governmental level at which the decision (and, thus, selection) is to be made. The decision is about the acquisition of the factory, and not about its management or personnel development, or about the acquisition of skills and knowledge. The decision-makers take for granted that these will follow naturally.

Typically, staff within the ministry that will eventually have responsibility for implementation organize preinvestment activities and summarize the results as input for decision-making by interministerial committees (ministries relevant to the implementation of the project), technical committees, the economic and finance committee, and finally the federal Cabinet. If the decision is taken to accept the project, the project is included in a national development plan.

Seemingly appropriate and logical, this procedure at no point includes evaluation of the technological character of the project. The initiating

ministry has no responsibility for technology policy and has no links with technological institutions. Its primary role is to facilitate the establishment of industrial and manufacturing enterprises for the nation's economy.

The interministerial committee has a chance to inject technological considerations into the appraisal only if a technologist is one of its members. Often, if the Ministry of Science and Technology is invited, its representative is an administrative officer rather than a technical professional and his or her contributions are limited to initiative suggestions.

The weakness of the interministerial committee, the technical committees, and even the economic and finance committee (which is composed of permanent secretaries of the economic ministries) stems from the absence of clear policy guidelines for acquiring technology. There are no dos and don'ts for officials to follow; there are no checklists; and there are no measurements of appropriateness of decisions or even recommendations. Under these circumstances, personal interests and rivalries surface among officials who, then, perceive their roles with different possibilities.

The approach by the private sector, because of commercial interests, differs markedly from that by the public sector. The criteria for making technological choices are restricted. Not estimated cost but preferred source of supply is the principal criterion: the goods must come from a foreign ally or partner; for multinationals, this means the parent company; for others it means a business associate. Cost is the second criterion.

The rationale for giving lower priority to cost than to source is that the market value of technology varies little, but its ultimate cost to the recipient could vary widely. The private sector protects itself against unknown costs by working with allies and trusted partners. This approach reduces the potential of paying highly for accessory services.

In the absence of guidelines and regulations from government, the private sector leaves itself to be "advised" by an array of foreign

experts, usually from parent companies, foreign associates or affiliates, technical partners, etc., who all have vested interests. For this reason, Nigeria's industrial sector is overflowing with technological artifacts -- relevant and irrelevant, appropriate and inappropriate, new and old, operating and discarded -- from almost as many sources as there are business partners. Many companies have found it convenient and profitable to dump these artifacts on a nation that couldn't care less.

Clearly the nation's (and the government's) attitude toward technology determines the environment in which the technical capacity is allowed to grow. For instance, the nation had its first oil refinery installed in Port Harcourt in the mid 1950s by Shell and British Petroleum. It was run essentially by foreign management and a handful of Nigerian operators. Port Harcourt was in the battle zone during the civil war, 1967-70, and was "liberated" by federal troops. Technically oriented Nigerians fighting against the federal troops were able to produce gas oil, petrol, and other products to run their war machine. Clearly, the innovative spirit existed in the country and enabled endogenous technology to be rapidly developed and perfected. Since the war, no effort has been made, however, to build on that initial effort. No policies have been promoted to encourage it, and the initiative seems to have come to an end.

Ministries and institutions of the federal government are littered with hundreds of disused photocopy machines. The label "unserviceable" means that the suppliers or maintenance agents either do not have the necessary spare parts to repair them or are not sufficiently knowledgeable to identify and repair the fault.

The government's solution is to abandon the machines and to order new ones so that government work is not delayed. In most, if not all, cases, a different brand or model of machine is ordered, the rationale being that the former was not good enough. This practice is a major incentive to suppliers and maintenance agents not to repair even minor faults in the existing machines and to charge so much for repairs and maintenance to

make repairs uneconomical.

Photocopying machines are just one example of how the lack of standardization, coupled with the existing policy of unrestricted importation, is responsible for substantial waste in foreign exchange annually.

The attitude of civil servants contributes to the waste. For example, NOIP, which was established in 1979 to take an inventory of all technology agreements, licences, and patents in the country, took more than 5 years to design the forms for collecting the information (Eleazu 1984). In the interim, the nation continued to import technology that was already available.

To select technology appropriate for an industrial or manufacturing activity, a developing country like Nigeria must have people who understand the components of the technology, either embodied or disembodied, and who know alternatives to that technology or its components. Nigeria possesses sufficient trained personnel to perform this function reliably; however, they are not being mobilized and they do not have access to an information system that can provide the data and analysis for necessary comparisons and selections.

Like many other developing countries, Nigeria has not appreciated the vital nature of an extensive and reliable information system for technology acquisition. Yet, such a system enables one not only to conduct highly technological commercial and industrial business but also to disseminate and popularize technology itself.

At present, no system links the nation's technological centres and institutions, encouraging them to pool their resources of knowledge, data, and innovation. Consequently, efforts are duplicated and energy is dissipated in these institutions. The only information hookup to external sources is found in NOIP, which has become a member of the Technology Information Exchange (TIE), an international service that supplies, at a fee, information to client-members.

Until recently, there was no legal requirement that technologies being imported into the country conform to criteria of appropriateness, complexity, source, or cost. Even now, with the establishment and functioning of NOIP, the government exerts only peripheral influence on choice of technology. NOIP does not help to determine a firm's choice; rather it ensures that the contractual terms and conditions for a transfer of technology are not unfavourable.

NOIP is the only institution of government that has a chance to influence directly technological choices, although some other institutions exert control indirectly (e.g., the Ministry of Finance approves foreign-exchange payments for imported technology; and the Central Bank effects the payments; the Customs and Excise Department inspects the imports and determines rates of duty payable; and the Ministry of Internal Affairs grants expatriate quotas for foreign personnel and staff). NOIP was set up by Decree; its functions include "the development of the negotiating skills of Nigerians with a view to ensuring the acquirement of the best contractual terms and conditions by Nigerian parties entering into any contract or agreement for the transfer of foreign technology" (Nigeria, Government of 1979). The Decree also listed 18 conditions under which the Director of NOIP should not register contracts or agreements (Nigeria, Government of 1979). These conditions dealt with the fairness of the terms of contract and not with the technology content of the contract.

At present, officials at NOIP falsely believe that they are institutionally affecting technological choice by:

- Refusing to register a technology that is already available in Nigeria. (Availability does not imply appropriateness, desirability, quality, or economic superiority.) The intention underlying this criterion is probably to stop paying for old technology, but the effect is likely to be the acquisition of an alternative (maybe less desirable) technology.
- Refusing to register a contract that stipulates a price not

commensurate with the technology being supplied. This criterion presupposes that NOIP is in a position to determine the value of various technologies being peddled. In any case, the use of price as a criterion for selection of technology could be counterproductive, especially since the costs of sustaining the use of that technology may be too high.

The crux of the issue is that the onus for the selection of technology for use in Nigeria still rests with the supplier, and the selection, in many ways, limits the nation's ability and opportunity to develop its own technology.

The Industrial Sector: Case Studies

Data on value added and employment show that the manufacturing sector (Tables 5 and 6):

- Contributes relatively little (8%) to GDP.
- Produces consumer goods as more than 90% of total output, recording hardly any production of capital or intermediate goods.
- Comprises mainly low-technology, light industries (food, beverages, tobacco, textiles, sawmilling, etc.).
- Lacks engineering, design, and tooling-up capabilities. (What passes for an engineering industry consists mainly of metal furniture, fixtures, and products. The manufacture of industrial machinery, plant, electrical goods, and transport equipment is almost nonexistent.)
- Records a low level of value added in the production of technology-intensive intermediate goods like basic industrial chemicals, fertilizers, etc. (Consumer-oriented chemicals for detergents and toiletries have highervalue added.)

Table 5. Value added (%) by major industrial groups (1965-75) (Nigeria, Federal Ministry of Economic Development 1975, 1981).

Product of industry	Value added (%)			
	1965	1971	1973	1975
Meat	Ø.9	1.6	Ø.3	Ø.5
Dairy	Ø.3	Ø.4	2.2	3.6
Vegetable oil milling	5.4	3.1	2.6	1.6
Grain milling	3.3	2.4	2.Ø	2.1
Bakery	1.4	1.3	4.6	1.6
Sugar and confections	1.7	1.8	2.7	7.2
Other food and animal feeds	13.9	Ø.8	Ø.3	Ø.2
Spirits and beer	14.6	14.7	18.3	9.1
Soft drinks	1.3	1.3	1.5	Ø.9
Tobacco	-	9.7	7.9	Ø.9
Textiles	1Ø.9	17.5	1Ø.7	14.1
Tanning	Ø.8	Ø.4	Ø.5	Ø.3
Footwear	Ø.3	1.1	1.4	2.5
Sawmilling	1.4	2.1	2.Ø	2.6
Furniture and wood products	2.4	Ø.6	Ø.6	1.1
Printing	2.8	3.Ø	3.2	3.5
Basic industrial chemicals	Ø.6	1.1	Ø.4	Ø.8
Paints	1.Ø	Ø.9	1.3	1.5
Other chemical products	6.4	Ø.9	7.1	8.8
Products of petroleum and coal	-	8.3	6.3	2.9
Tires and tubes	2.3	2.3	2.3	1.4
Cement	4.7	2.2	3.6	Ø.7
Basic metal, hardware, etc.	7.Ø	Ø.9	Ø.4	2.6
Structural metal products	-	2.Ø	1.5	3.8
Fabricated metal products	-	3.5	3.4	2.5

Table 6. Structure of manufacturing: employment (%) by major industrial groups (1965-75) (Nigeria, Federal Ministry of Economic Development 1975, 1981).

Product or industry	Employment (% of formal labour force)			
	1965	1971	1973	1975
Meat	1.5	1.1	Ø.6	Ø.7
Vegetable oil milling	6.3	4.1	3.8	1Ø.6
Grain milling	Ø.8	1.Ø	1.2	Ø.8
Bakery	2.5	3.3	3.4	2.1
Sugar and confections	5.4	3.6	3.5	3.9
Spirits and beer	3.Ø	2.5	2.8	2.4
Soft drinks	1.Ø	Ø.5	Ø.9	Ø.9
Tobacco	-	2.9	2.5	Ø.9
Textiles	15.Ø	22.4	23.6	2Ø.6
Clothing and other textile goods	2.1	2.7	1.8	1.9
Footwear	1.9	2.Ø	2.4	1.7
Sawmilling	5.8	6.7	6.1	5.6
Furniture and wood products	4.8	3.7	2.5	2.9
Printing	6.5	5.4	5.Ø	5.1
Basic industrial chemicals	Ø.3	Ø.4	Ø.2	Ø.3
Soaps, cosmetics, etc.	-	2.7	3.5	2.6
Other chemical products	4.Ø	Ø.9	Ø.8	Ø.6
Tires and tubes	1.8	1.2	1.4	Ø.7
Cement	3.8	2.1	1.7	Ø.9
Basic metal, hardware, etc.	8.3	1.6	Ø.7	1.1
Structural metal products	-	2.7	2.1	3.8
Fabricated metal products	-	5.2	4.7	3.2

- Relies heavily on the contribution by the subsector in petroleum refining.
- Employs about 30% of the labour force that makes up the formal economy (a high percentage, perhaps 40%, of this labour force has been laid off since 1983).
- Depends largely on imported raw materials, and recent shortages in foreign exchange have shut down some industries and drastically reduced use of capacity in others.

The contribution of the manufacturing sector to GDP was an average 4% annually from 1970 to 1974, rose steeply to about 7% for each of the next 2 years, then declined to about 6% until the 1980s when efforts pushed it to about 8%. Problems that have prevented a more rapid growth of the sector include:

- The infrastructure: the base left by the colonial government when the country became independent in 1960 was not able to attract or encourage investment in manufacturing activities;
- The competition from other sectors for resources and inputs like capital, labour, and entrepreneurship: construction and commerce have offered higher short-term returns and hence appealed more to investors; and
- The poor technological base for establishment of manufacturing activities.

Even though the manufacturing sector is dominated by a handful of industrial groups, namely beverages, textiles, tobacco, and petroleum products, the country is not self-sufficient in any industrial product. The degree of dependence on imports in the supply of industrial and agricultural equipment is 98.8% and 93.9% respectively (Nigeria, Federal Ministry of Economic Development 1981). Similarly dependence on imports is estimated to be 93.6% for household electrical apparatus, 89.2% for basic

industrial chemicals (including fertilizers and pesticides), 88.9% for wearing apparel, and 83.8% for drugs and medicines.

A World Bank study, which was reported recently in the Financial Times (2 March 1987) of London, showed that protectionism was high and increasing in some industrial subsectors. Import licences introduced in 1984 as the major instrument of control of foreign-exchange disbursement, according to the study, exacerbated the instability and uncertainty of industrial production, with protection rising to 216% in the assembly industries and 150% in the consumer goods industry. Yet, industries processing domestic raw materials had rates of effective protection of only 40% as against 67% for those processing imported raw materials; and export-oriented industries received a net negative protection (-15%) -- rather strong disincentive.

As part of the national policy for industrial development a number of incentives are provided by government to stimulate investment and encourage entrepreneurs in manufacturing activities. These have been used with various degrees of success. In Nigeria, the prominent ones are:

- Pioneer Status, which gives income tax relief for up to 5 years during the early years of enterprises engaged in pioneer industries. Formalized by the Income Tax Relief Act, the special status is expected to attract foreign investment for development of natural resources and growth of industrial capacity. For an entrepreneur to obtain pioneer status, the product or the industrial process being proposed must be declared by the government to be pioneer efforts in Nigerian development.
- Approved User Scheme, which reduces (sometimes eliminates) import duties. The scheme is meant to provide temporary assistance to new or existing industries to expand production capacities. The incentive is made available to enterprises when circumstances make it impossible for them to obtain local goods or services at prices competitive with the imported equivalent. The scheme is also applied as tariff protection against imported finished

goods, which attract import duties at rates lower than those for materials imported to manufacture the same or similar goods in Nigeria.

- Custom Duties Act, which permits the imposition, whenever necessary, of a special duty on goods that are being dumped into Nigeria or that are being subsidized by a government or other authority outside Nigeria. The appropriate level of the special duty is determined by government to ensure that the entry of such goods into Nigeria does not threaten a potential or established industry in the country. The duties are not expected to conflict with the country's obligations, set out, for example, by the General Agreement on Trade and Tariffs (GATT).
- Customs drawback regulations, which allow importers to seek a refund of import duty payments if the goods imported are reexported in the same state and condition or are used in the manufacture of goods that are exported. (For composite goods that contain imported ingredients, a fixed-rate drawback of duty may be granted on proof of exportation of such goods.)
- Companies Income Tax Act, which provides for accelerated depreciation of capital assets. The intention is to enable enterprises to amortize such assets during their early years and thus build liquidity for sustained growth.
- Industrial Development Act, which is one of the earliest provisions allowing for import duty relief and repatriation of capital and dividend according to government guidelines and procedures.
- Land Use Decree, which is a relatively new instrument vesting ownership of all land in the government -- the intention being to make land procurement and acquisition for industrial purposes easier and cheaper.
- Nigerian Enterprises Promotion Decree, which assists local

businesses and entrepreneurs in acquiring investment.

- Graduated Excise Tax Reduction for Local Value Added, which is a concession (granted initially for 3 years) to assist manufacturing industries in achieving a minimum of 50% local value added within a reasonable period after their establishment.

Despite promises to establish effective R&D activities, little visible improvement has occurred, and the links between R&D and production activities have not been forged.

Although a large number of institutions, universities, public and private enterprises claim to be involved in research, few engage in purposeful work for industrial development. The so-called research institutions operate on shoestring budgets; they lack appropriate tools, equipment, and incentives; and they are unable to propel their research results into the technological marketplace.

The mechanisms that have now been developed and are being used to promote stronger links between R&D and industry include:

- Training workshops that draw on locally developed or adapted technology (e.g., for baking, palm-wine bottling, quality control);
- Publication of technical information bulletins; and
- Provision of industrial extension services (especially with respect to use of local raw materials.

Probably the most serious operational constraint to R&D in manufacturing is the current infrastructure, which compels significant increases in both the initial capital and the operating costs of projects. The poor availability and high cost of services such as water supply, electricity, communication facilities, and transport have constituted major problems to manufacturing enterprises. In cases where the public sector plans infrastructural improvements, the projects are characterized by long gestation and costly delays. Restrictive industrial policies and bureaucratic bottlenecks frustrate both the planning and the execution of

worthy projects.

Entrepreneurs must pursue a multiplicity of authorities to obtain permits, certificates, and licences before commencing or continuing manufacturing activities.

Other constraints to manufacturing include the shortage of industrial labour (making the sector less attractive to investors than, for example, trading and construction) and the dearth of technological know-how.

All the major constraints have been recognized by government, which is constantly attempting to formulate policies that remove these problems and redress the imbalances. The present set of policy objectives for the manufacturing sector can be categorized as:

- Increasing self-reliance in supply of industrial goods;
- Removing administrative and infrastructural bottlenecks;
- Liberalizing procedures and reviewing incentives to encourage indigenous and foreign entrepreneurs;
- Stimulating local ownership of business through increased intervention by the government-sponsored Nigerian Industrial Development Bank (NIDB) and the Nigerian Bank for Commerce and Industry (NBCI);
- Absorbing technology by ensuring local technicians are exposed to advanced technology in a manner that guarantees efficient transfer;
- Increasing support for R&D activities;
- Dispersing industries to promote development throughout the country; and
- Increasing the amount of local resources being used in manufacturing.

Among the measures announced by government for the rapid and proper development of the industrial sector are planned improvements in the efficiencies of government-owned enterprises and incentives for private-sector industries (Nigeria, Federal Ministry of Economic Development 1981,

p. 142).

Since 1983, manufacturing has declined and the current output is less than 70% of the 1982 level. Available capacity is not being used. Although figures vary widely among sectors and enterprises, the national average use is estimated to be no more than 35% of capacity.

To maintain even this level of production, about 60% of raw materials are imported. At the same time, manufacturing enterprises often have to provide their own standby generators for electric power, boreholes for water, communications equipment, and other costly infrastructural facilities. All this makes Nigeria's manufacturing industry a high-cost sector, hardly in a position to compete with its counterparts in Taiwan, Korea, Hong Kong, Philippines, Brazil, etc. A look at Nigeria's automotive, cement, iron and steel, and petrochemical industries compared with those in other developing countries, provides some insights into setups that improve performance.

Automotive Industry

Nigeria

In the late 1960s, the federal government decided to accelerate the pace of industrialization by investing in capital-intensive projects. It hoped to speed substitution of imports, attract foreign participation, and encourage transfer of technology.

Among the industries considered "essential" by the authorities was the automotive subsector. Initially three car-assembly plants were envisaged, and accordingly, in 1969, the government called for proposals. Several foreign manufacturers (including Nissan, General Motors, Ford, Fiat, Peugeot, and Volkswagen) responded.

Following discussions (clarifications, interviews, and negotiations) during the next 2 years, Peugeot of France and Volkswagen of Germany signed

formal agreements with the government. Both companies are multinationals with subsidiaries in developing countries. The government later sought proposals for an industry in commercial vehicles.

The decision to establish plants to assemble passenger cars in Nigeria was based on:

- The sizable domestic market;
- The steady imports, draining foreign reserves and adversely affecting the nation's balance-of-payment position;
- The perceived opportunity to acquire technical know-how in this sector; and
- The potential for development of new industries by backward integration, and the attendant opportunity to use local raw materials in intermediate products.

The first effective activity in the development of the automotive industry in Nigeria was the establishment in 1959 of a plant in Lagos by the Federated Motors Company (FMC, a branch of the United Africa Company) to assemble commercial vehicles, primarily Bedford trucks. But the real technological development of this industry did not begin until 1975 when Peugeot Automobile Nigeria (PAN) Limited and Volkswagen of Nigeria (VWON) Limited were established in Kaduna and Lagos, respectively.

The two companies were joint ventures: equity participation in PAN was by the federal government of Nigeria (35%), Kaduna State government (10%), local distributors (10%), the Nigerian Industrial Development Bank (5%), and Peugeot (40%). Similarly, VWON represented equity participation by the federal government (35%), Lagos State government (4%), local distributors (10%), the German Investment Bank (11%), and Volkswagen (40%).

Both companies began assembly in 1975 from completely-knocked-down (CKD) components.

The essential features of the technology agreements were that:

- PAN and VWON were "to assemble/manufacture" passenger cars using CKD components supplied by their parent companies but were

"subject to progressive replacement with such parts, components, and elements made under licence in Nigeria or purchased from Nigerian suppliers."

- PAN and VWON were to procure necessary equipment from their parent companies.
- The mix of models to be assembled was to be determined by local market demand.
- The parent companies were to "assist the local assembly plants in achieving substantial local parts incorporation, and in making use of locally manufactured parts when available, provided that the quality is acceptable."
- In the first 3 years, the plants were to achieve 30% local content by value of the CKD -- 15% through in-plant manufacture and 15% through purchases from local manufacturers. The plants were to achieve 50% local content after 5 years and 100% after 13 years.
- The initial capacity of each plant was to be a minimum of 10 000 vehicles/year.
- The ex-factory prices of the CKD components consigned to Nigeria were to be the same as those charged other countries.
- The builtup passenger cars imported by the assembly plants from their parent companies were to enjoy a 10% duty concession, although importation of such vehicles would be placed under licence.
- Royalties and licence fees were to be payable to the parent companies only when "the deletion value or the CKD pack of a car exceeds 30% of its ex-factory price, but subject to negotiation in accordance with the prevailing laws and regulations in Nigeria."
- Indigenous managerial and technical staff were to be recruited and trained locally in all essential activities such as "design

and procurement of equipment, planning, installing and maintaining assembly machinery, tools, and jigs."

A study by Thomas (1981) of available records showed that as of 1980 local contents averaged about 10% of the value of each CKD vehicle. Although 30% had been stipulated in the technology agreement, the government took no steps to rectify the shortfall.

In 1985, a major dispute about local content erupted between the companies and the independent Nigerian experts who were advising the government. The experts produced calculations and analysis showing that local content was less than half what the companies claimed: yet, government made no visible move to deal with the claims.

Between 1975 and 1984, domestic production of passenger cars peaked in 1980 (Table 7) and was characterized by continuous debates among

Table 7. Production and sales of passenger cars in Nigeria, 1975-84 (data from NISER, Industrial Consultancy Division).

Year	Local production (units)	Total domestic sales (units)
1975	13728	71049
1976	31003	73224
1977	40223	90950
1978	42841	67304
1979	56880	63381
1980	83984	83984
1981	82984	106079
1982	78743	78743
1983	55832	55832
1984	61903	61903

Table 8. Performance parameters for passenger car industry in Nigeria, 1979-82 (data from the Federal Ministry of Industries, 1986).

	1979	1980	1981	1982
Value of output (NGN million)	255	332	450	434
Sales (NGN million)	254	342	472	485
Value added (NGN million)	61	64	68	82
Production cost (NGN million)	252	330	446	431
Expenditure on raw materials (NGN million)				
Imported (c.i.f.)	177	255	264	250
Local purchase	15	25	61	87
Profit (loss) before taxation (NGN million)	(4.9)	(3.9)	16	(7.8)
New capital expenditures (NGN million)	17	14	11	5
Total assets (NGN million)	142	185	312	252
Estimated national demand (10^3 units)	63.4	75.4	106	90
Fixed assets (NGN million)	127	141	151	156
Plant, equipment, machinery	67.4	78.7	87.9	91.81
Other	53.6	62.3	63.1	64.2
Number of firms in the industry	2	2	2	2
Total number of employees	8740	10700	12560	12400
Total installed capacity (10^3 units/annually)	145	145	145	155

policymakers, planners, the general public, and plants' management over issues of policy and performance.

The most important single issue has been the inability of the plants, deliberate or otherwise, to achieve a level of local content anywhere near contractual provisions (Table 8). Other issues for examination include: quality of products; management practices and labour relations; transfer of technology to local staff; production costs and product pricing; and channels of distribution of products.

These plants dominate the automotive industry in Nigeria, although FMC was joined by SCOA Motors, Leventis Motors, CFAO Motors, and BEWAC Automotive Products Ltd. in the assembly of pickup (Ø.5-Ø.75-t) trucks and between 1979 and 1981 four more plants were established to assemble commercial vehicles. These joint ventures have equity participation similar to those for passenger-car assembly:

- Leyland Nigeria Limited (1979), located in Ibadan, is a partnership between Nigeria and British Leyland Motor Company;
- Steyr (Nigeria) Limited (1979), located in Bauchi, is with Steyr-Daimler-Puch of Austria;
- Anambra Motor Manufacturing Company (198Ø), located in Enugu, is a partnership with Daimler-Benz of Germany to make Mercedes-Benz vehicles including buses; and
- National Trucks Manufacturing Company (1981), located in Kano, is with Fiat of Italy.

Despite the rapid growth in numbers of the commercial vehicle assembly plants, the demand and production of passenger cars far outweigh those for all types of commercial vehicles, including buses and tractors (Table 9). As was the case with passenger-car assembly plants, local materials used in the commercial vehicles were much less than 3Ø% of the total (Table 1Ø).

The establishment of two joint ventures for passenger car assembly, closely followed by similar arrangements for four plants to assemble commercial vehicles denied the nation an opportunity to learn from mistakes and inadequacies. In particular, the nation lost the possibility of bargaining with the several foreign automobile firms. The procedure

Table 9. Production and sales of commercial vehicles in Nigeria, 1975-84 (data from NISER, Industrial Consultancy Division).

Year	Local production (units)	Total sales (units)
1975	-	-
1976	-	28416
1977	-	33625
1978	10381	27381
1979	12200	15804
1980	13400	15638
1981	17700	20502
1982	10464	10464
1983	7801	7801
1984	6034	6034

followed by the government in the negotiations did not allow price competition between the firms, and the prices of the products were to be subject to government controls rather than to market forces.

Also, the industry was not properly founded on an understanding of local demand or of links in long-term development of the nation's industrial sector.

The usual path to establish a flourishing automobile industry in developing countries and newly emerging industrialized countries follows a sequence:

- The importation of fully builtup vehicles with sales and service outlets that import the bulk of spare parts and components;

Table 10. Performance paramenters of the medium/heavy commercial vehicle (including subsector tractors) industry in Nigeria, 1978-82 (data from Federal Ministry of Industries, 1986).

	1979	1980	1981	1982
Value of output (NGN million)	100	365	480	450
Sales (NGN million)	315	350	460	415
Expenditure on raw materials (NGN million)				
Imported (c.i.f.)	55	117	217	183
Local purchases	4	6	12	10
Total assets (NGN million)	200	270	330	420
Estimated national demand (10^3 units)	13.8	15.6	20.5	17.7
Fixed assets (NGN million)	120	138	145	146
Plant, equipment, machinery	15	21	25	30
Other	105	117	120	116
Number of firms in the industry	3	5	5	5
Total number of employees	1300	2500	3400	3000
Plant installed capacity (10^3 units)	24	40	40	40

- The development of repair and maintenance capabilities and the local production of simple spares and components;
- The importation of CKD components for local assembly; and
- The integration of locally made components and selected machine-cores for vehicle production.

Nigeria bypassed the development of a local capability to repair and maintain the imported vehicles. This critical phase offers the greatest opportunities for technology acquisition and innovation.

The technical activities and processes involved in the production of vehicles are horizontally integrated. Assembly is a set of operations that take little skill, although the design of the assembly line and the manufacture of major components like transmission boxes involve complex technological inputs. The "de-skilled" activities in assembly serve only to introduce the technological concepts and frameworks. They do not provide local staff with real technological manufacturing capability. In Nigeria, after more than a decade of such activities, there does not appear to be a serious national program aimed at achieving the integration to transform the firms into manufacturers rather than assemblers. The government continues to leave the responsibility for the transformation in the hands of technical partners who have no incentive to make the change.

The government also continues to believe that rapid industrialization is possible by arriving quickly at the apex of an industrial production setup. It still fails to recognize that most of the technology transfer to be achieved would result from local manufacture of parts and components.

The strategy employed by government in demanding that technical partners participate in equity is consistent with its performance and similar demands in the development of other industrial subsectors during the 1970s. It believed that this demand would ensure that the technical partners would perform their obligations fully and manage the venture adequately to ensure commercial success. The move gave government a false sense of security -- that the technical partners' equity removed the risk of failure. What's more the government believed that equity partnership with foreign private manufacturers would guarantee preferential access to foreign technology markets. The perception was false. Now, the government is blaming the plants (directly implicating the technical partners) for the failure of the industry.

A look at what happened to the automotive industry in Brazil suggests that naivete on the part of the government played a major role in the failure.

Brazil

Before 1950, the automobile industry in Brazil consisted of assembly of imported CKD vehicle parts, and the auto-parts industry was rudimentary.

However, the government introduced a series of policy measures from 1950 onward and clearly demonstrated its wish to establish industrial facilities for the local manufacture of automotive vehicles. In 1952, for example, the government's industrial development commission created a subcommittee to examine the establishment of the local manufacture of jeeps, tractors, trucks, and cars. One of the first actions of this subcommittee was to ban imports of vehicle parts already being produced locally. In 1953, the subcommittee prohibited the importation of fully assembled motor vehicles. Other measures included a tariff exemption on imported machine tools (and this action encouraged entrepreneurs to invest in the auto-parts industry).

During the first half of the 1950s Willys-Overland established a jeep production unit in Brazil, and Volkswagen started production of cars and vans, but not until the second half of the decade, following the creation by government of the executive group of the automobile industry (GEIA) in 1956, did the auto industry really begin to develop. In that year, GEIA approved 17 projects, out of which 12 were implemented. The American firms GM and Ford produced trucks, and Chrysler became a minority shareholder in the French Simca. But the European firms of Volkswagen and Daimler-Benz took the lead in the production of cars and trucks, respectively.

From this period onward, the government also permitted the importation of secondhand machinery. The Brazilian auto industry was able thereby to commence production of obsolete models of vehicles, using outdated methods.

Governmental support for the infant industry was not restricted to direct incentives; it included indirect policy measures. For example, between 1955 and 1961, road construction and paving rapidly expanded, and the highway network was extended by more than 40 000 km. In turn, from 1957 to 1962, the automotive industry increased production more than 600%. In the meantime a large number of autoparts manufacturers -- many of them foreign -- had emerged. The foreign investment was spontaneous in some cases, stimulated by an expanding market. In other cases, the investment resulted from pressure from assemblers who, when compelled by law to meet certain indices of indigenization, tried to guarantee their supply of parts and components.

The growth of the industry declined from 1963 until 1966 but not before local content was 86-94% in the various vehicles. The period up to 1966 is therefore considered in Brazil to be the first growth phase. Production was not highly diversified -- a total of 30 different models having been introduced. In the next year, 21 more models were introduced and during the next 10 years, 139. (Model in the industry refers to the array of listed options deriving from a smaller number of basic cars.)

The second phase of accelerated growth commenced in 1968 and ended in 1974. Simultaneously, the market for secondhand cars grew significantly. A wave of takeovers eliminated the two major national producers -- Vemag and FNM.

After 1974, despite the downturn in the rate of growth of the industry and the opposition from existing firms, Fiat and Volvo started production in Brazil. Fiat received strong governmental support -- the state of Minas Gerais invested so that the factory would be located there. Also, Fiat entered the truck market by acquiring Alfa Romeo and using its production facilities. Volvo specialized in the production of trucks and buses. Both companies used relatively advanced technologies such as transfer machines designed for the production of each basic model. The last major takeover in the industry occurred in 1980, when Chrysler was absorbed by Volkswagen.

Until 1980, automobile production continued to grow fairly steadily, although more slowly toward the end of the period. However, the crisis of the Brazilian economy, which was triggered, among other factors, by the second oil crisis in 1979-80, hit the industry very hard. The extremely high interest rate on consumers' loans discouraged the purchase of cars. The government's restriction on oil consumption had a similar effect. The production level in 1983, although higher than that in 1981 and in 1982, was lower than the level reached between 1974 and 1980.

Export of automobiles was stimulated by the creation, in 1972, of BEFIEX, a bank that aimed at promoting the growth of Brazilian exports and at reducing the excessive dependency of the subsidiaries of multinational companies on their foreign principals. The BEFIEX programs allowed firms that achieved a certain volume of exports to benefit from a series of concessions, such as exemption from import duties and from taxation of imports of industrial goods used in export-oriented production. Of all export deals handled by BEFIEX up to 1981, 40% were related to the automobile industry.

The national production of automobiles in Brazil (Table 11) reflects the shift in government policy, although the country is now facing increased obstacles to exports of its automobiles -- the major ones being the present economic crises of importing countries and the competition from Japanese cars, which now account for about two-thirds of the car imports of Third World countries. Some Brazilian assemblers have resorted to exporting CKD vehicles to that they do not lose the economies of scale in production at their installed facilities.

According to Tavile (1984), Brazil's industrialization in the last 30 years or so was stimulated largely by the local automobile industry and the government's decisive support of the industry through the creation of the infrastructure necessary for its development. Agencies such as the World Bank and the International Monetary Fund played no significant role in the development and growth of this industry in Brazil.

Table 11. Production, sales, and exports of the automotive industry in Brazil, 1957-85 (data from ANFAVEA, Sao Paulo, 1986).

Year	Domestic sales (10^3 units)	National production (10^3 units)	Exports (%)
1957	31.0	30.5	-
1958	60.9	61.0	-
1959	96.7	96.1	-
1960	131.5	133.0	-
1961	144.8	145.6	0.3
1962	190.2	191.2	0.1
1963	173.8	174.2	-
1964	180.9	183.7	-
1965	188.1	185.2	0.1
1966	221.6	224.6	0.1
1967	226.9	225.5	-
1968	278.6	279.7	-
1969	349.5	353.7	-
1970	416.7	416.1	0.1
1971	509.6	517.0	0.3
1972	601.4	622.2	2.2
1973	735.2	750.4	3.3
1974	835.1	905.9	7.1
1975	858.5	930.2	7.9
1976	896.1	986.6	8.2
1977	853.0	921.2	7.6
1978	972.4	1064.0	9.0
1979	1014.9	1128.0	9.4
1980	980.3	1165.2	13.5

continued

Table 11 continued.

Year	Domestic sales (10^3 units)	National production (10^3 units)	Exports (%)
1981	580.7	780.9	27.2
1982	691.3	859.3	20.2
1983	727.7	896.5	18.8
1984	677.1	864.7	22.7
1985	763.2	966.7	21.5

The president at the time, Jucelino Kubitschek (1956-61) and his advisers saw the automobile industry as a means to generate employment (Table 12), and history proved them right. Total employment rose by 77% in 1960-70, by 123% in 1970-80, and decreased by 9% between 1980 and 1985. Before 1976, the ratio of production to employment (P/E) had risen steadily, declining slightly for the period 1977-80 while total employment figures continued to rise. The ratio dropped sharply in the early 1980s, with the marked reduction in total employment (reinforced by worldwide economic recession). The industry presently seems to be regaining, with significant increases in both employees and production.

The efficiency of the industry measured as cars per unit labour, continued to increase, and this may be interpreted as the industry assimilating foreign technology and engaging in innovation.

The Brazilian authorities consistently addressed the long-term issues of development of this industry and formulated policies that accelerated the growth effort.

In the early 1950s, policy studies called for development of an

Table 12. Employment in the Brazilian automotive industry, 1957-85 (data from ANFAVEA, Sao Paulo, 1986).

Year	National production (P)	Total employment (E)	P/E
1957	30542	9773	3.13
1958	60983	19248	3.17
1959	96114	29323	3.28
1960	133041	38470	3.46
1961	145584	37753	3.86
1962	191194	49790	3.84
1963	174191	45604	3.82
1964	183707	46296	3.97
1965	185187	52047	3.56
1966	224609	54023	4.16
1967	225487	51673	4.36
1968	279715	57479	4.87
1969	353700	66641	5.31
1970	416089	68012	6.12
1971	516964	75110	6.88
1972	622171	83427	7.46
1973	750376	99307	7.56
1974	905920	117283	7.72
1975	930235	116454	7.99
1976	986611	123175	8.01
1977	921193	128890	7.15
1978	1064014	140356	7.58
1979	1127966	146872	7.68
1980	1165174	151680	7.68

continued

Table 12 continued.

Year	National production (P)	Total employment (E)	P/E
1981	780883	134619	5.80
1982	859304	125462	6.85
1983	896462	121044	7.41
1984	864693	123250	7.02
1985	966708	137710	7.02

automobile industry as part of a national transport policy. The studies pointed out that the railway system and its future expansion would not be sufficient to cater to the country, which is large. The formulation of the policy on Brazil's automobile assembly/manufacturing was, therefore, not an isolated event, although the policies put in place were not immediately implemented. Political instability, including the suicide of the populist leader in 1954, delayed implementation, as did the effort to attract American and European capital.

During the second half of the 1950s, Brazil's new leader, Kubitschek established a development-oriented program with a 50-year perspective. He invested in infrastructure to prepare for an efficient and rational takeoff of national development, launching activities in steel, oil, coal, transport, and commercial shipping.

The main initiatives were state owned, and both the shipbuilding and the automobile industry created conditions to attract European capital. Offering concessions on imports of used machinery for these activities, it provided opportunities for foreign companies to use their capacity and it looked toward the country's future in a policy to nationalize segments of the industries after a given period.

The government made commitments to manufacture key parts and achieve local capability in certain activities (steel, engine blocks, machining) within a specified period. The automobile firms themselves were also committed to these objectives and continued therefore to invest in the ventures. This was essentially the first stage.

In the early 1960s, the profile of the industry was reoriented: the market began to be emphasized. By the end of the Kubitschek regime in January 1961, 7-8 times as many trucks as cars were being produced. By the end of the decade, the automakers were producing seven cars to each truck. This was the second stage.

The third stage, and probably the most important period in terms of net growth, occurred between the late 1960s and the late 1970s. Production jumped from about 200 000 to about 1.2 million vehicles a year. During this period, a landmark in policy was the shift to production of middle-class consumer goods (television, records, etc). Government economic policy was aimed at increasing consumption to stimulate economic growth. Mechanisms were already in place to finance and facilitate middle-class consumption. Once the automobile industry was serving the market, the government adopted a policy to develop an export market, as foreign exchange became increasingly scarce.

In the early 1980s, Brazil's economic condition changed almost completely, with a sudden reversal of fortunes. There were high unemployment, high internal debt, and high interest rates. Government policy for the automobile industry, therefore, called for increased exportation to new markets (Iraq, Saudi Arabia) and provided incentives to the automakers. Brazil has now transformed its marketing strategy for exports by shipping fully builtup units to fulfill previous long-term contracts and CKD units to other markets.

At present, the government is pursuing technological policies that will enable selective modernization by microelectronics in the country. Although labour in Brazil is cheap and there may not be a compelling need

for robots, the government perceived the value in precision and quality from automated processes and in selective technological innovation.

Brazil deliberately developed two types of automobile industry -- passenger car and farm equipment -- and used different approaches. For the passenger car industry, Brazilian managers, not the multinational partners, took the initiative. Two types of arrangements emerged: Volkswagen staff made key technological decisions abroad, but Ford sent experts to Brazil where work commenced at the drawing board. For the farm equipment industry, the multinationals first imported the products but later created maintenance capability. Government policy encouraged manufacturing of parts and implements and provided timely subsidy. Furthermore, the foreign firms were not allowed to establish parts factories. The nation also achieved adaptation of equipment to cultural practices.

The government seized the opportunity that arose for research and development. For example, its automotive industry pioneered alcohol-fueled vehicles, 1979-81, using World Bank assistance and government incentives and subsidies. It received challenges from the existing Air Force Institute, which already had strong R&D.

The immigration laws attracted foreign experts and entrepreneurs. The government made generous offers to attract such expertise.

On the political front, along with the commitment visible in the nation's leadership, the government legitimized lobbying, thereby recognizing its role and the positive contribution it makes when properly controlled.

In 1957, Volkswagen entered a joint venture (80%) with private Brazilian investors (20%), with assistance from the national bank for development, which provided special conditions for financing. There was no government participation in the equity, although the government had initiated the joint-venture program.

The role of the government in the early years was to define the types and quantities of vehicle parts to be produced in Brazil. Assembly

operations commenced with trucks in 1957 with imports of CKD parts. In that year, 50% of the vehicles were produced in Brazil. This ratio went to 85% by 1959 and attained 95% in 1960.

Following government guidelines, the local content (by weight) achieved about 50% in 1961 and 65% by 1963. Now, essentially 100% of parts used in the automobile industry in Brazil are made within the country. Now, hundreds of small and medium companies manufacture models and components (including electrical, radios, etc.) and supply them to the automakers.

How did Brazil's approach differ from Nigeria's?

The primary objective of establishing the vehicle assembly industry in Nigeria was to conserve foreign exchange and promote industrialization. The scheme was a continuation of import substitution as the country had practiced it since independence. In Brazil, the policy objectives were to establish an alternative to the railways in transport; to acquire technology; and to generate employment.

Establishment of the automobile industry emanated partly from the Brazilian government's desire to provide suitable public transport, whereas the Nigerian government at best considered this a secondary goal. In fact, Nigeria's public transport is still far from adequate, and domestic production of motor vehicles is unable to satisfy local demand.
Also notable is the consistency with which the policies in Brazil were reviewed, monitored, and reinforced. This followup was glaringly absent in Nigeria.

In Nigeria, the government invested 40-45% of the capital for the passenger car assembly plants. The foreign manufacturers put in 40%, and only 10% of the contribution was from private investors from Nigeria. In Brazil, the government provided guidelines and incentives, but shareholding was by the foreign manufacturers and private capital.

Among the implications of government participation are:

- Dictation by government of plant location, staff recruitment,

etc.;

- Government influence on board decisions and commercial activities;
- Political interference in decision-making and management; and
- Unnecessary bureaucratic interference and regulation.

Before the establishment of the industry in Brazil, there was the seed of a repair and maintenance culture; some vehicle parts, such as mufflers, were already being fabricated locally and used as replacement parts for imported vehicles. In Nigeria, the automobile industry jumped from importing vehicles to assembling CKD vehicles without the intermediate acquisition of a local capability for repair and maintenance or for manufacturing of simple parts.

Another difference in approach by the two countries was clear in the relative ease with which the Brazilian government permitted residency of foreign nationals. Expatriate quotas were given generously to firms who wished to bring in their foreign experts. In Nigeria, on the other hand, expatriate quotas are difficult to secure, and the bureaucracy, high cost, and long delays are an obstacle to foreign businesses and, hence, foreign investment.

Volkswagen Company of Brazil, as an example of the auto industry in that country, marketed its products only through appointed dealers who received a 17% commission. Such dealers, now numbering more than 800 in the country, are constantly monitored and compelled to adhere strictly to the quality and standards demanded by the company.

In Nigeria, the firms in vehicle assembly sell mostly to appointed dealers, but government interferes in the commercial transactions of the firms (sometimes demanding priority allocation of vehicles to government

departments and officials). The dealers are not always selected on the basis of merit or past performance, and, often, their capability to provide services is not evaluated. Furthermore, the firms' compliance with quality standards is largely unmonitored.

The Nigerian government controls the pricing structure of vehicles through its Pricers Productivity and Incomes Board, the rationale being to avoid unnecessary increases in the cost of living, but unmet demand for adequate transportation compels buyers to pay outrageous prices to unscrupulous dealers. In Nigeria, also, a cadre of intermediaries exists but is essentially absent in Brazil. These intermediaries provide no benefit to consumers other than apparently (and often fictitiously) facilitating "timely" receipt of purchases, but they add on a sizable percentage of cost. The government has so far ignored the impact of these intermediaries, but the cost to the economy is substantial.

Cement Manufacturing

Eight cement plants currently operate in Nigeria and one in the Republic of Benin is a joint venture. The total capacity is about 5 million t/year, which, because of technical and management problems, is much higher than the effective production. The industry directly employs about 8000 people; adding indirect employees such as drivers, distributors' staff, suppliers' staff, cement traders, etc. would swell the cement industry's labour generation to about 15 000. A look at its historical development is worthwhile.

Cement production in Nigeria commenced with importation of clinker for grinding and bagging by a small grinding station in Lagos. Shortly thereafter, in 1954, the first cement plant was established in Nkalagu, with a design capacity of 480 000 t/year. Partial production began in 1957.

In the late 1950s, Geological Surveys Nigeria Limited (GSN), a

government agency, identified several deposits of limestone, the most essential raw material for cement production, in various parts of the country. These deposits varied in quantity and quality but, essentially, favoured wet-process manufacturing in the south and dry-process in the north.

In 1959, Associated Portland Cement Manufacturers (APCM), from the United Kingdom, came in to establish a cement plant after a technical feasibility evaluation of the deposits at Ewekoro. Many of the other deposits could not be confirmed to exist in commercial quantities, but Ewekoro contained soft, easily mined limestone in a vast and extensive belt. APCM designed a medium-sized plant (550 000 t/year) to cater to the expanding Nigerian market, ordered the machinery and equipment, and erected the plant. Production commenced in 1961, but the initial foreign investment was made in 1959 before the end of British rule over Nigeria.

Thus in the 1960s, all the cement being manufactured (at Nkalagu and Ewekoro) and imported (Lagos) was in the south. It was carried by railways to northern locations in the country. As cement is bulky and much cheaper to produce than to handle, transport, and transship, officials of governments in the northern states formed a cement company in 1962 and invited foreign investment by way of technical partnership with equipment suppliers. The dry process had to be employed, and provision had to be made for substantial electrical power to operate the crushers for the very hard limestone available. A small plant (100 000 t/year) was designed and installed, and, after a series of delays caused by unavailability of funds, cost escalations, and internal problems, the plant was commissioned in 1967.

Subsequently, cement consumption rose in the country, and imports increased to supplement national production. Additional plants were erected (Ukpilla and Calabar) by state governments in partnership with foreign investors who provided management services; APCM consolidated its domination of the market by expanding production facilities at Ewekoro and

upgrading capacity to 840 000 t/year.

By the mid-1970s, the Nigerian economy had become buoyant from sharp increases in oil revenues. Construction was booming, and the government lunged into an ambitious development program that included construction of several dams for river basins as well as construction of several thousand kilometres of road. New states had been created, and each one commenced its own program of construction of government headquarters, secretariats, residences for officials, and housing projects for the development of urban centres.

The demand for cement was overwhelming (Table 13), and the federal government, anxious to achieve rapid development, made one of its most disastrous policy decisions: it gave priority to the provision of procurement of cement "from whatever source possible," and, by implication, at whatever cost.

A NISER study (Adubifa et al. 1977) projected consumption to be 6.2 million t for 1980 and almost 11 million t for 1985 based on the pace of construction in the mid-1970s. Actual figures were much lower as the boom collapsed with oil prices (Table 14).

One factor that led to the policy allowing massive imports of cement in 1976 was military construction to provide barracks for the country's large armed forces and to provide schools, hospitals, and other social services for the military personnel and their families. To achieve these goals, the government not only sanctioned immediate large-scale importation of cement by private firms and organizations but also provided extrabudgetary funds for the expansion of small plants and establishment of a number of large plants in different parts of the country.

The crisis and confusion that arose from these two measures greatly affected the rest of the economy, especially the paralysis of Nigerian ports by cement-bearing ships that could not be unloaded for several weeks or months. The situation culminated in a comprehensive review of the industry and government policies toward its development, presenting a

Table 13. Cement production and consumption in Nigeria (1966-76) (data from the Federal Office of Statistics).*

Year	Domestic production (10^3 t)	Imports (10^3 t)
1966	na	158.1
1967	739	134.4
1968	574	90.1
1969	566	102.9
1970	596	466.0
1971	644	977.0
1972	1137	710.0
1973	1222	855.0
1974	1226	1923.0
1975	1470	1738.0
1976	1275	2001.2

*na = not available.

unique opportunity to effect a reorganization and rationalization of the subsector. This review was undertaken by a committee appointed by the government to find solutions to the scarcity of cement.

The industry entered a new phase with the expansion and building programs. The federal government decided to approach the five existing plants with an offer of equity for the purchase of additional equipment and machinery as well as erection and management services. Plants in Calabar (southeast) with a capacity of 100 000 t/year and Ukpilla (midwest) with a capacity of 150 000 t/year were each planning to boost capacity by 200 000 t/year, the former to be commissioned in mid-1977 and the latter in mid-1979. Sokoto in the northwest, with a capacity of 100 000 t/year was to jump to 500 000 t/year, with commissioning expected in 1980.

Table 14. Production (10^3 t/year) of cement 1978-85 from eight plants operating in Nigeria (data from a NISER field survey).

Plant	1978	1979	1980	1985*
Ewekoro	800	840	840	840
Sokoto	20	80	100	600
Nkalagu	600	700	750	750
Ukpilla	150	200	350	450
Calabar	350	350	400	400
Sagamu	350	500	550	600
Ashaka	-	300	600	900
Benue	-	360	700	900

* Estimates.

In addition, the federal government, as primary investor, contracted for three new plants, with token equity participation by state governments and a fourth in a joint venture with the government of Benin (with 10% shareholding by the technical partner for 10 years) (Table 15).

Table 15. Design capacity, location, and expected commissioning of four cement plants sponsored by the Nigerian government.

Plant	Location	Design capacity (t/year)	Expected plant commissioning
Sagamu	Southwest	600 000	end 1977
Ashaka	Northeast	900 000	early 1979
Benue	North	900 000	mid-1979
Onigbolo	Benin	500 000	end 1979

None of the work planned was commissioned on schedule.

Six major problems plagued the industry at that period (1976):

- Inappropriate size, insufficient technical personnel, and incompetent management.
- Lack of gypsum, a secondary raw material that constitutes about 4% of finished cement. This commodity was being imported, and the supply could not be guaranteed so government considered prospecting for and mining gypsum, which was said to be near Nigeria's border with Niger.
- Shortage of papers used for cement bagging, reportedly causing some plants to shut down or cut back production. The establishment of paper plants by government and the expansion of Jebba Mill was planned to minimize the problem, and cement companies were encouraged to develop bulk shipping facilities so their distribution network could operate with some flexibility.
- Power outages, which were said to be responsible for considerable damage to the companies' kilns as well as for losses in production. The expansion projects and new plants took measures to procure standby generators -- a step that protected them against outages but increased capital and operating costs.
- Irregular and haphazard distribution, prompting regular complaints, especially in the northern states, about Nigeria Railways. Rumours that thrived on the poor distribution and supply created panic among consumers, with the result being high prices of the commodity.
- Inconsistent pricing, which gave rise to transshipments across various markets, with no producer being able to claim a territory. The transshipment of the commodity and transverse distribution both led to higher transportation costs. It was recommended that government spearhead a move to bring all local cement producers together to work out a pricing structure -- a

floor price reflecting the intrinsic value of the commodity and a market price responding to the demands of distribution and market forces.

The government did not introduce policies to guide the development of the industry, which was treated as a subsector of chemicals and subject to the policies for all efforts toward industrialization. Pioneer status was granted generously to all the manufacturing companies to allow them to take advantage of tax holidays, amortization, etc.; Approved User status was, similarly, easily available for imports of secondary raw materials and parts.

The government failed to recognize its first opportunity to plan for the development of this industry: when the results of the nationwide survey of limestone deposits became available in the early 1960s from GSN, its own agency, the government had the information to identify the most economic deposits for exploitation and to rationalize plans for cement plants, deciding optimal sizes, appropriate processes, locations, and sequence.

The arrangements for the establishment of each plant were individual and isolated, so the lessons from experience were lost. In some cases (Nkalagu, Calabar, Benue), the technical partners (Table 16) were solely contractors choosing not to take equity shares in the business but simply procuring the machinery and equipment; overseeing construction of the works; and providing initial management. In other cases (Ewekoro, Ashaka, Onigbolo), the technical partners took equity shares. In fact, investment was a condition on being the technical partner in the Onigbolo plant. Some of the contractors were equipment suppliers rather than cement manufacturers (Calabar), and at Sokoto, they were simply agents who assembled a freelance team of erectors.

One outcome was that the major equipment for the plants came from a variety of sources, embodying different technologies that were not interpreted or compared. Because of the lack of standardization, the

plants are unable to come to each other's aid.

The technology involved in cement manufacturing has been mastered worldwide, and innovations have taken place in several countries to meet local needs. The technology embodied in the machinery is still proprietary knowledge, monopolized by a few enterprises, although a great deal of

Table 16. Cement Company, location, installed capacity, and technical partner, Nigeria, 1954-78.

Company	Year established	Plant location (state)	Installed capacity (10^3 t/year)	Technical partner
Nkalagu	1954	Anambra	480 (1957)	F.L. Smidth
			750 (1977)	(Danish)
Ewekoro	1959	Ogun	500 (1961)	APCM
			840 (1976)	(British)
Sokoto	1962	Sokoto	100 (1967)	Ferrostal AG
Ukpilla	1964	Bendel	150 (1972)	Coutinho Caro
			350	and Co
Calabar	na	Cross River	100 (1970)	Polysins
			300 (1978)	(German)
Sagamu	1975	Ogun	600 (1979)	APCM
				(British)
Benue	1976	Benue	900	Cementia
				(Swiss)
Ashaka	1976	Bauchi	900	APCM
				(British)
Onigbolo	1978	Republic of Benin	500 (1982)	F.L. Smidth
				(Danish)

standardization of these items has been achieved. New cement works can tailor equipment to the characteristics of their environment and raw materials, thus reducing both capital and operating costs. (For example, the dust content of the effluent gas of a plant far removed from human habitation does not have to be as low as that of a city-based plant and can be obtained by conventional dust filtration, obviating the need for an expensive electromagnetic precipitator.

Despite the flexibility possible, Nigeria has not acquired the capability to design and assemble its own cement plant; it has acquired only the capability to run and maintain a cement plant. In other words, after establishment of nine costly plants, Nigerians have acquired minimal technology -- probably not enough to design and erect a plant.

This inadequacy arises from the nature of indigenous participation in, and exposure to, the technological activities involved in establishing plants. Although a large number of Nigerians were on site during construction, they provided cheap labour for erection activities rather than disembodying technological artifacts for transfer of knowledge (Table 17). Evidence indicates the local contribution to technology during the early years of the industry in Nigeria was almost nil, although it varied among plants, usually reflecting the arrangements with technical partners. Perhaps most important was that local participation was always lowest in engineering design and equipment fabrication.

The final costs of erected plants were usually excessive, with overruns being caused by bureaucratic delays during project implementation and by inadequate contractual provisions.

To date, the government has neither exploited locally available gypsum deposits nor alternatively facilitated exploitation and refinement by the private sector. This is unfortunate because the total amount required for production is substantial -- 160 000 t/year for 4 million tonnes of cement. Also, the cost of this product is escalating because of its strategic role in cement production.

The extent of the Nigerian gypsum deposits is not known, but no attempt was ever made to investigate it. People living near the border between Nigeria and Niger have often dug small quantities for sale to consumers, including the nearby Sokoto cement plant. The consumers claimed that the raw gypsum contained impurities, and efforts were made to interest the Federal Ministry of Industries in beneficiation of the gypsum for commercial use. As all mineral deposits belong to the government, the private sector would need permits and mining licenses to undertake the work, and, at the time, government policy was not to yield such mineral deposits to private hands.

Although gypsum is a naturally occurring compound (Ca $SO_4 \cdot 2H_2O$), it

Table 17. Technological contribution of Nigerians (N) and foreign personnel (F) in the erection of cement plants, 1954–82.

	Nkalagu		Ewekoro		Sokoto		Ukpilla		Calabar		Sagamu		Benue		Ashaka		Onigbolo	
	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N
Feasibility and preinvestment activities	6	Ø	6	Ø	6	Ø	5	1	6	Ø	4	2	5	1	5	1	5	1
Engineering design	6	Ø	6	Ø	6	Ø	6	Ø	6	Ø	5	1	6	Ø	6	Ø	6	Ø
Infrastructure and civil works	4	2	5	1	6	Ø	4	2	4	2	3	3	4	2	4	2	5	1
Equipment fabrication and supply	6	Ø	6	Ø	6	Ø	6	Ø	6	Ø	6	Ø	6	Ø	6	Ø	6	Ø
Plant construction and installation	5	1	5	1	6	Ø	5	1	5	1	3	3	4	2	4	2	5	1
Training (technical and managerial)	6	Ø	6	Ø	6	Ø	5	1	6	Ø	2	4	5	1	5	1	6	Ø

can be produced chemically. In fact, the starting material was being discharged as an unwanted by-product of a government-owned plant producing superphosphate in Kaduna. A small group of chemical engineers (Nigeria, Federal Superphosphate Fertilizer Company 1978), with access to this plant, had conducted some informal R&D with the by-product, had successfully produced a chemical complex containing gypsum, and had identified a solution to dissolve and remove the unwanted components, and, thus, produce a high-grade gypsum powder. The work was brought to the attention of the Ministry of Industries, which initially took some interest in it but later dropped it from consideration.

Among other limitations, the successful manufacture of gypsum on a commercial scale would require a reorientation of the fertilizer plant to yield adequate quantities of the by-product. Nevertheless, not to have seized the opportunity presented by this experience was a major policy failure. The government could have looked at the activity as a means to:

- Promote R&D in the cement subsector;
- Strengthen the link between R&D and the production sector; and
- Facilitate the development of a raw material that is vital for industry.

Government failed also in its approach to the perennial shortage of kraft paper needed by the industry to bag the cement. The lack of paper bags not only prevented already manufactured cement from getting to the market but also caused the storage bins to fill quickly, resulting in temporary shutdowns until the bins could be emptied. The shutdown severely affected the economics of cement production as well as the efficiency in utilization of technical inputs.

To stem the flow of imports into the country, government required that anyone intending to import locally manufactured items (e.g., paper bags) obtain a certificate from local producers indicating that they would be unable to meet the order. The difficulty in determining availability in advance is clear, as local producers are all subject to the power outages,

shortages in raw materials and spare parts that hinder the cement subsector.

An unmistakable lesson here is that the government authorities need to consult regularly with members of the private sector, rather than relying on questionable production statistics for their decision-making. The local infrastructure for gathering and processing data is too weak to sustain appropriate decision-making and planning for the enormous economic activities of the nation.

Consultations with the private sector should extend to an evaluation of requirements for human resources in the industry. Development of personnel has always been left for the manufacturing plants to do, and, because the companies are competing and are concerned with production (rather than social responsibilities), they recruit and train just enough staff to fill vacancies. Their training programs are restricted and narrowly applied. Under these circumstances, the industry as a whole does not have adequate personnel, especially in critical technological areas of operation. Even though unemployment is high across the country, the cement companies usually find it difficult to acquire trained and qualified staff for the technical activities. A government policy based on an understanding of the needs of the industry would have created the means, institutionally, to foster relevant training programs that would provide the core for industry's recruitment.

Clearly, the large-scale importation of cement in 1976 was an error in judgment and an example of how government decisions are sometimes based upon single objectives, without careful analysis of the implications on other sectors and economic activities.

The primary objective of government in ordering almost 7 million t of cement in 1976 when local production was just over 1 million t was to ensure rapid completion of military barracks for the armed forces and to develop infrastructure quickly with the rather sudden wealth from oil exports. Little thought was given to the logistics in delivery of this bulky product, and the combined capacity for unloading at all Nigerian

ports was far too small to cope with the deluge of ships arriving to deliver the orders. Within a few weeks, Nigerian ports became jammed, with hundreds of ships waiting up to 3 months.

The military administration compounded the folly by declaring cement a priority commodity, giving preference to cement over other essential supplies that were easier to unload. So it was that Nigeria learned about demurrage: ships that are unable to complete their discharge of goods within 2 weeks of arrival at ports are entitled to compensation for each additional day, at escalating rates.

As there was no overall strategy for developing the cement industry, there were no specific targets or regulations. The lack of policy guidelines resulted in the creation of an industrial subsector dominated by inefficient factories located improperly. The factories have remained in their infancy -- at best, profitable, with enough know-how to be operated and maintained. The level of development can be considered absorption of imported technology, but the design and building of new or improved machinery is beyond local capabilities as is the expansion or replacement of existing plant capacity.

Iron and Steel Industry

As a matter of policy, the iron and steel complex was kept within the public sector. A project had been conceived during the First National Development Plan as the cornerstone of the industrial sector but had never progressed beyond the investigation stage before the Second Plan. The project was then given greater priority, coming after only the agro-allied and the petrochemical industries.

The country had shown interest in the establishment of an iron and steel industry right from independence. This interest arose partly from reliance on import substitution as the strategy for industrialization and

partly from conviction that the foundation of engineering technology and true self-reliant industrial development was iron and steel. Somehow, the picture of an industrial revolution, with casting and forging of steel as its centrepiece (as was the case in Europe), was irresistible to Nigerian planners. Furthermore, Nigeria's construction industry was characterized by massive use of steel and concrete.

Initially, the government was reportedly interested only in the establishment of rolling mills but expanded its horizons as the existence of large deposits of iron ore, coal, and limestone became known, reinforcing belief in the economic feasibility of an integrated iron and steel plant. Thus, between 1960 and 1967 (when civil war broke out), the federal government invited and received several proposals on the feasibility of establishing a plant in the country.

The search for local inputs for the production of iron and steel began in 1958, and surveys indicated that iron ore was available in Agbaja and Udi, coal at Enugu, and limestone in various parts of the country. Extensive market studies were carried out to determine steel demand and consumption, and with the construction of the hydroelectric dam in Kainji, electricity was expected to be available in sufficient quantity. The first pilot test on the ore from Agbaja and Udi, using Enugu coal as gasified fuel in direct reduction, did not succeed. In 1962, a small scrap-based steelworks to produce steel rods was established as a joint venture between the former Eastern Regional Government and some private concerns.

In 1967 UNIDO (United Nations Industrial Development Organization) was requested to carry out a market survey. At the same time, a feasibility report carried out by experts from the Soviet Union recommended a blast-furnace plant, with an annual capacity of 570 000 t of rolled products. The Soviet report further recommended that geological surveys be carried out to identify raw materials of higher quality than the ores available. In 1970, the Soviet company, M/S Technoexport, was commissioned to carry out aeromagnetic and ground surveys and to drill for more suitable types of

iron ore and coking coal.

The same year, the Second National Development Plan made provision for the construction of a plant with capacity of 750 000 t/year, and two more scrap-based plants -- Continental Iron and Steel Company (50 000 t/year) and Universal Steel Limited (90 000 t/year) -- were established at Ikeja by private owners. In April 1971, the Nigerian Steel Development Authority was established by Decree 19 to emphasize government's determination to proceed. The Authority was charged with establishing steel plants and managing the steel industry in the country. By 1973, the iron ore deposits had been discovered at Itakpe, Ajabanoko, and Shokoshoko; late that year Technoexport was commissioned to prepare a preliminary report on establishment of the first iron and steel plant in Nigeria. The report was submitted in 1974, rationalized and accepted in 1975. Itakpe iron ore was to be the raw material, and a blend of local and foreign coal was to be used as fuel. The plant was to manufacture long products and was to be sited at Ajaokuta -- a political decision made after consideration of several choices. The decision was considered by many experts to be politically expedient but economically suboptimal.

Also in 1975, the Third National Development Plan indicated government's interest in setting up two direct-reduction steel plants. A report, entitled "Application of the Direct Reduction Process for Iron and Steel Making in Nigeria" reviewed the technological progress in, and the attractiveness of, the process for Nigeria, and recommended inland rolling mills to cater to the various markets around the country. In 1977, the federal government signed agreements for the construction of the Delta Steel Plant and turned down a proposal from the government of Gabon, which was willing to make available its good iron ore in a cooperative project. Nigeria was already committed to Guinea where it held 13% equity in ore mining.

In 1979, it commissioned steel rolling mills at Jos, Oshogbo, and

Katsina. It also dissolved the National Steel Development Authority and created two major steel companies -- Ajaokuta and Aladja. During the same year, it signed a global contract with Tiajpromexport of the Soviet Union to prepare working drawings; to supply and erect equipment and structures; and to train personnel for the Ajaokuta project. Before the end of the Plan period, new plans were conceived for a high-grade alloy steel plant, an aluminum smelter, a flat-products steel plant, and foundry projects. These were to be in addition to the projects under way.

By the beginning of the Fourth National Development Plan, the iron and steel projects had hardly gone beyond preinvestment. The newly installed civilian administration gave implementation a great boost in 1980 by awarding three contracts for civil works for the Ajaokuta steel plant. In 1981, construction began on the plant, and a contract was signed for project monitoring and technical services. The administration paid little attention to costs and incessant overruns, and some of the projects are only now swinging into operation (Table 18). A lot of development is still required for fully establishing, and improving upon, the base of raw materials and energy for the industry. For example, in 1983 a substation for electrical power (132 kV) was necessary, and in 1985 the complexes for both Ajaokuta Steel and Aladja Steel companies, which are wholly owned by the federal government, had to be rescheduled.

The events presented opportunities in skill acquisition and human resources development, many of which were missed.

The technical input of Nigerian experts and technicians during project planning and design was minimal. The government assigned all initiatives and responsibilities to the Soviets. In fact, by the end of 1977, government officials had cut off Nigerian experts from, for example, NISER who had carried out prefeasibility studies or had participated in feasibility studies, especially of the direct-reduction plant.

Government commissioned several studies from external sources, and the reports often proved superficial and of little assistance in

Table 18. Capacity, process, production, and employment at Nigeria's steel plants.

	Ajaokuta Steel Plant	Delta Steel Plant	Rolling mills (at Katsina, Oshogbo)	Private-sector steel plants
Installed capacity	Phase 1, 1.3×10^6; Phase 2, 2.6×10^6; Phase 3, 5.2×10^6	Phase 1, 1.0×10^6; Phase 2, 2.5×10^6;	Phase 1, 210000; Phase 2, 420000; Phase 3, 720000	Lagos, 190000; Kano, 60000; Enugu, 20000
Process	Blast furnace, basic oxygen furnace, continuous casting and rolling mills	Direct reduction, electric-arc furnace, continuous casting and rolling mills	Rolling mills	Rolling mills
Product mix	320 mm products (angles, bars, flats, hexagons, squares, rounds, etc.); 150 mm wire products (rods, reinforcing bars); 700 mm products (beams, angles, channels, bars, flats)	Concast billets (120 x 120 mm); Light section mill (bars, rounds, flats, shapes)	Wire rods, bars	Rounds, shapes

continued

Table 18 continued.

	Ajaokuta Steel Plant	Delta Steel Plant	Rolling mills (at Katsina, Oshogbo)	Private-sector steel plants
Production (t/year)	Light section mill (320 mm products), 400000; 150 mm wire rod mill, 130000; Medium section mill (700 mm products), 560000	Concast billets, 660000; Light section mill, 300000	Wire rods, 42410; Bars, 167500	Lagos, 140000; Kano, 30000; Enugu, 6000
Estimated personnel	9114	6400	3000	2000

identifying the critical requirements for products to help the country achieve industrialization. For example, in 1981 staff at NISER reviewed a study that omitted vital products and export opportunities and inadequately considered the market represented by the Economic Community of West African States (ECOWAS). As NISER was able to identify weaknesses in several of the commissioned studies, it probably possessed the capability to have executed the studies -- possibly with greater precision and relevance, and less expense. In any case, if the exercise had been carried out by NISER or another indigenous organization (in collaboration with foreign experts where necessary), skills and expertise of Nigerians would have been enhanced.

Other examples of missed opportunities to acquire technical skills

locally can be found in the design, construction monitoring, etc. for the federal steel plants. In particular, MECON of India (a mechanical engineering consultancy company) was awarded a contract for Delta Steel and no provision was made, despite enormous pressure from Nigerian firms, to attach a local counterpart to MECON. At the time, MECON had practically no experience in the direct-reduction process on which Delta Steel was to be based. MECON did possess experience with construction of steel plants, and the government stated preference for MECON over more experienced foreign firms because of its origin from another developing country (India), reasoning that its experience would, thus, be relevant to Nigeria.

MECON used the Nigerian contract as its training ground in steelmaking by the direct-reduction process, gathering expertise while Nigerian consultancy firms learned almost nothing.

Probably the greatest irony of this episode occurred in 1985 when the Lagos State Government appointed MECON as its consultant for a mini-steel plant because MECON cited the Delta Steel contract as proof of international performance. Yet another opportunity for developing national expertise had, thus, been missed, and, unfortunately, there are other examples.

In August 1981, NISER proposed a study to the steel development authorities of the Executive Office of the President, with the aim of developing a handbook for the iron and steel industry in Nigeria. The cost of the study and handbook was projected to be NGN 51 000. The proposal was discussed once and, despite several reminders from NISER, was never pursued further.

In January 1983, however, the same authorities accepted a commissioned report called "Handbook of Iron and Steel Industry in Nigeria" by Pride Investments Services Limited, a joint venture led by a foreign firm with Nigerian associates. The Executive Office of the President then exerted pressure on NISER to participate in the discussions and approval of the report.

A metallurgical training institute is now being built to provide personnel support for the Ajaokuta Steel Plant; yet, for technology acquisition and development rather than simply for maintenance and service, government should put the training institute in place before the installation of the steel plants. Then, the trainees would have derived benefit from participating in the planning and execution of the physical installation and commissioning of the operating units.

These missed opportunities indicate that the Nigerian steel authorities were dealing with far too many technical subjects simultaneously; most of the authorities were nontechnical inexperienced civil servants. Besides overseeing establishment of two major steel plants, they were trying to establish a machine tools design plant, a coke-oven plant, an automobile parts fabrication plant, and a foundry centre. They were overwhelmed by technical proposals and feasibility studies from overseas, and understandably they were confused, especially as they were beset by political and other pressures in Nigeria. The result is that many ingredients essential for a feasible operation are still not in place.

For example, the raw material is still being studied, and the suitability of Nigerian iron ore for the technological processes installed has not yet been proved. The export market has not been fully determined, and indications are that the product mix is not definitive although production has commenced. The steel item most required by Nigerians is the flat products group, which has only recently drawn efforts to be incorporated into installed plants. The blast furnace process installed is based on importation of coking coal from a yet-to-be- confirmed source.

Petrochemical Industry

Nigeria

In the late 1960s when Nigeria's oil industry commenced its phenomenal growth with new and rapid discoveries of large oil deposits along the delta area, government started to receive proposals from foreign firms and multinationals to establish new complex, highly technical industries. Many foreign firms seized the initiative to capitalize on the new discoveries.

Manufacturers, equipment fabricators, brokers, consultants, all suggested new projects and joint ventures with the government in the exploitation and utilization of the oil and its associated gas. Among the core projects being promoted were oil refineries; manufacture of methanol, liquefied natural gas, urea; ethylene polymerization; and methyl fuel production. Most of the projects were to use gas offtake from the facilities producing crude oil and already dominating the economy. Even though the gas was judged to be a good source of thermal energy and was simply being flared at the time, none of the initial proposals contemplated the collection and processing of it for home cooking and domestic utilization.

Likewise, the government focused on the externally generated initiatives rather than potential uses in households. Convinced that the proposals submitted by foreign firms contained justification for entering this field of high-technology, high-risk industrialization, the government put the establishment of a petrochemical industry on its agenda for the Second National Development Plan. This action was the beginning of a long and costly learning process, as the proposed complex did not take off until 1985, about 15 years after serious considerations had commenced.

Postponed and amended several times, the project was scheduled for completion in 1984, but a new timetable was drawn up for the two plants to be built in Warri and Kaduna. The foreign contractors have completed the

bulk of their work at the Warri plant, but precommissioning problems have beset the program. Lack of a power supply and other infrastructure has meant considerable increase in the capital budget (to cater, for example, for the unexpected installation of a gas turbine to generate power).

The initial decision to establish a petrochemical complex in the country was based on a desire to:

- Develop a direct use for the vast quantities of associated gas from the oil wells, especially as substantial increases in production of crude oil were being planned. Because of the difficulty in gathering the gas over a wide and scattered area, almost all the gas was being flared; less than 1% was locally consumable, and storage was totally infeasible for such large quantities.
- Diversify the economy, which was relying primarily on oil revenues, by production of fuels for export.
- To exploit the attractive international market for petrochemicals for the industrial and energy needs of highly industrialized economies (with large unfulfilled demands of methyl fuel, liquefied natural gas, liquefied petroleum gas, liquid ammonia, etc.).
- To widen the nation's industrial base by manufacture of consumer goods (e.g., plastics) from products and by-products of the petrochemical plants.

Clearly, using resources for domestic purposes (e.g., home cooking, power generation, etc. did not feature in the government's priorities.

The production of plastics and thin films from imported polyethylene and polypropylene pellets and powders commenced in the mid 1970s but is not a landmark in the production and manufacture of petrochemicals in the country, as the technical processes or industrial activities that occur after polymerization are not part of petrochemical manufacturing. Hence, making plastic products from polymerized pellets or powder may qualify as

import substitution but not as petrochemical manufacturing.

The first major step taken by government toward the establishment of a petrochemical industry in Nigeria was in January 1972 when the federal Executive Council considered gas liquefaction and related industrial undertakings. The Council entrusted all responsibilities for gas matters to the Ministry of Mines and Power with a mandate to commence arrangements for establishment of the industry.

Shortly thereafter, the Ministry of Industries requested a stay of implementation, pleading for reconsideration of the decision regarding the executing agency. Its representatives objected that a petrochemical project under any other agency would prevent it from proceeding properly with a number of downstream activities, and they rationalized the lateness of their objection, stating that a top official of the ministry was absent at the time the government considered the matter.

Government opted early for the production of liquefied petroleum gas (LPG) for export. It did not consider an ethylene plant, even though the nation was projected to require a gas/ethylene plant for the chemical complex and production of nitrogenous fertilizer. The LPG plant had been proposed in 1968 and agreed to by government. Government did not know then (and probably did not bother to find out) that the company -- Guadalupe Gas Corporation of the USA -- had never established, nor helped to establish, nor even operated a gas plant of its own anywhere in the world.

After several years, government decided to invite consultants to conduct a feasibility study for the federal Ministry of Industries. Without in-house professionals capable of understanding the technological packages being offered, the ministry was dealing simultaneously with several consultants and manufacturers from different developed countries. These included the International Management and Engineering Group (IMEG), UK, who eventually did the feasibility study; Japan Consulting Institute, and Imperial Chemical Industries Ltd. (ICI), UK, who were negotiating for a joint venture in polyethylene manufacture.

The petrochemical project suffered considerable delays, partly caused by the ever-changing decision about product line and product mix (each change being based upon the latest foreign contractor or investor's interest and partly caused by inept handling by government officials and agencies). Decision-making at high governmental levels was slow at best, with minimal attention being paid to the cost implications.

By 1975, the Nigerian economy was riding high on oil revenues. One more decisive effort was made to revive the petrochemical project. Determined to take the initiative, government signed a consultancy contract in October 1975 with Chem Systems International, UK, to prepare tendering documents, decide on a short list of foreign partners, evaluate bids, and investigate the foreign markets for long-term contracts for Nigeria's petrochemical products. The government also appointed a project coordinator (government official) to facilitate the commercial activities and preparation. The new effort was soon bogged down by the technical details of the proposed plant. In the consideration of the most suitable feedstock for the petrochemical plant, technical agencies of the government disagreed. Although the consultants had prepared a technical report on feedstock, the government officials frustrated further progress with incessant (and sometimes ignorant) arguments.

The records and documents on this project provide considerable evidence of interministerial disagreements on procedure, definitions, and even concepts. The lack of cooperation -- some deliberate -- on projects (while the agencies fought for control) contributed to the present unsatisfactory and uneconomic status of this project. The disagreements seldom led to in-depth consideration of available options. They sometimes revolved around semantics and other peripheral issues. Until the end of the decade, this project was distinguished only by the time, energy, and funds expended unproductively on it.

A new chapter began in 1980 with the newly installed civilian administration. During the previous decade of military regimes, a

multitude of civil servants gradually eroded the opportunities to develop a petrochemical industry, and for a different objective, a multitude of politicians would do much the same during the next decade. The contracts and arrangements were reviewed, not so much for their technical or economic suitability but for their potential to provide personal profit and political gain. Under the new circumstances, some of the reputable and competent foreign companies and their investors withdrew.

After several modifications to the product mix, the government and the technical partners finally agreed on primary products:

- Caustic soda, 40 000 t/year;
- Vinyl chloride monomer, 40 000 t/year;
- Polyvinyl chloride (PVC), 40 000 t/year;
- Polyethylene, 40 000 t/year; and
- Ethylene, 100 000 t/year.

The Nigerian petrochemical plants in Warri and Kaduna are still essentially on the drawing boards. Since this industry is still in its infancy, Nigeria can learn from experiences elsewhere. The opportunity is available to execute these projects so that domestic enterprises can assimilate the technology in preconstruction and construction. Trinidad and Tobago provides some valuable lessons for Nigeria.

Trinidad and Tobago

The petrochemical industry in Trinidad and Tobago consists of fertilizer and ethanol plants. The major enterprises are FERTRIN and TRINGEN, which were both established after the 1973 oil boom. FERTRIN owns two ammonia plants, and TRINGEN has plants producing ammonia and methanol. Before the establishment of these enterprises, Fedchem, a subsidiary of the transnational corporation W.R. Grace, had been engaged in fertilizer production in Trinidad since 1960 but apparently had bad relations with indigenous staff, prompting demands for its nationalization.

The primary objective of building large fertilizer plants was to find industrial activities that would make intensive use of the natural gas available from Trinidad's booming oil industry. The world fertilizer market would not only provide foreign exchange for the country but would also diversify the economy, which was dependent on oil. Acquisition of technology was a secondary, and totally implicit, objective. Efforts were made only to acquire enough skills to operate the plants successfully, but the policy option to use the industry to build technological capacity was apparently not considered.

FERTRIN is a joint venture between the government and Amoco, an American transnational corporation. The joint-venture company was formed in 1974, the necessary feasibility study commenced in 1976, and construction began in 1977.

Amoco had no significant experience in manufacture of ammonia-based fertilizer and had to subcontract the works. The contract was eventually executed as a turnkey project from a design provided by Kellogg. However, a conscious attempt was made to involve indigenous personnel in the design, engineering, and construction of the project.

Amoco, not the government, chose Kellogg, and little attempt was made by government to seek an alternative with possibly better terms and conditions. The choice had implications for the plant and the design and engineering specifications, and the two plants procured by Kellogg had been built for customers in the US and Canada who had decided not to proceed because of the imminent changes in the world market for fertilizer. Nevertheless, the plants were reportedly purchased at a discount.

The plants were not suited to local conditions and had to be adapted during erection; several of the modifications were expensive: addition of a cooling tower; use of a freshwater interchange instead of seawater to reduce corrosion-generated maintenance; a system for recycling fresh water because of the uncertainty and inefficiency of the local water supply.

The plants, each with a capacity of 1150-t/day were procured and

erected simultaneously. A single, 2300-t/day plant would have posed greater problems of fabrication, shipment, and assembly at site. Under the circumstances, the acquisition of two identical plants could have been spaced to create opportunity for indigenous learning by doing and participation of local staff in the technological activities. The local management felt that savings would be made in costs if two similar plants were erected simultaneously.

Kellogg had built a number of not only ammonia and other fertilizer plants but also petroleum refineries, gas-processing plants, inorganic chemical plants, petroleum refineries, and petrochemical plants, and its experience enabled the first plant to achieve production at full capacity within 6 months of commissioning, although the feasibility study had predicted production at half of capacity for the first year.

At the same time, TRINGEN was conceived as a joint venture to establish two 1000-t/day ammonia plants. The proposal came from W.R. Grace, offering 25% equity to the Trinidadian government, to be increased at 2.5% annually for 10 years, to a maximum 50%. Although W.R. Grace had sought Kellogg as its main contractor, it eventually secured the services of Fluor Engineering Company, another US transnational.

Several of the technical activities on site were contracted out, mostly to other foreign firms, including Toyo Engineering Company of Japan, which provided the design for the methanol plant. A fraction of the civil engineering was contracted to local firms, and expatriate subcontractors were responsible for major activities such as design, procurement, plant construction, and even pipe welding. Local participation reportedly might have been greater but for a provision in the joint-venture agreement that gave veto powers to the foreign partner over the use of local subcontractors, equipment, and materials.

The management contract was for 15 years, giving the government the right to terminate the contract with 3 years' notice. The contract included no provision for the training of local staff, and, as late as

1982, 20 expatriates occupied key technical and managerial positions and none of the 780 local staff held a position higher than superintendent. Maybe the most damaging clauses in the contract provided that for 15 years Trinidad could not contract any other firm to carry out the activities and could not exercise any choice in the source or nature of the technology. Even after the 15 years, a nondisclosure rule shall be in effect such that all know-how, technical information, specifications, etc. supplied by the partner for the manufacture of ammonia must be kept confidential.

Indigenous participation in the technological activities was greatly restricted because of these unfavourable provisions. Furthermore the management contract is unusually long and cannot be terminated in fewer than 3 years -- more than enough time for permanent damage.

FERTRIN and TRINGEN interacted little with national institutions, scientific research bodies, or the university. The lack of interaction reflects the low priority accorded R&D by the Trinidadian authorities whose primary interest was to use foreign know-how in benefiting from an abundant resource that was being wasted.

Little interaction or exchange of skills or information took place between FERTRIN and TRINGEN during construction, and no exchange occurred between them and their counterparts in other developing countries.

Trinidad and Tobago, like Nigeria, clearly has not not acquired the maximum from its efforts toward development of a petrochemical industry. In contrast, Brazil acquired technological capability in petrochemical manufacturing by carefully choosing its venture partner and by using a series of planned and progressively complex technical activities.

Brazil

The initial policy objective for the development of the petrochemical industry in Brazil was to build self-sufficiency. The government's approach toward the projects not only achieved this objective but added a

new dimension -- export-oriented industrialization.

The first ethylene plant (in Sao Paulo) was acquired as a turnkey package, with a negligible share of inputs coming from domestic engineering and procurement.

The second plant (Bahia), however, had increased local participation, especially in the engineering, planning, design, and procurement components of the project. Brazil gradually, but deliberately, moved to increase the share of domestic content in the establishment of petrochemical plants (Table 19).

Table 19. Brazil's share (%) in the capital goods and engineering services for three petrochemical plants.

Location	Startup	Domestic input (% of total)	
		Capital goods and materials	Engineering services
Sao Paulo	1972	38	negligible
Bahia	1978	65	54
Rio Grande do Sul	1982	70	61

Although this review of Brazil's efforts is brief, the status of that country's petrochemical industry affirms the efficacy of the approach. Whether or not Nigeria can repeat the success is unclear.

To date, the lack of focus and clear guidelines on national objectives in the petrochemical field has jeopardized opportunities. During the delays, the world market has changed, other producing plants have come on stream all over the world, and the dynamics of petrochemical manufacturing not only have changed but have become more complex. What's worse is that those responsible for the Nigerian project seem to be oblivious to

experience in petrochemical projects elsewhere -- the Philippines, Mexico, and Indonesia, for example.

In a technology-intensive field like petrochemicals, the strategy of acquisition is a key to development of the industry. Some countries have utilized the turnkey approach successfully, but they usually have already possessed the infrastructure for the activities, and their primary objectives have usually been commercial.

In the case of Nigeria, the joint-venture approach is fraught with obstacles to efficient technology transfer. The technical partner does not share the government's primary objectives and is not concerned with national development. It wants to design, supply, and manage a petrochemical facility as profitably as possible and would not seek indigenous participation in the design, specification, and fabrication of plant units. Nor would it disembody technological units and components of the plant that are standard packages.

The implication is that present efforts at developing a competitive and self-reliant petrochemical industry will not achieve much success in technology acquisition if the government is trying to conserve funds. Acquisition of technology in a field like petrochemicals involves not just learning about production nor even developing the skills to improve upon a manual about production. The recipient must learn enough to be able to rewrite the manual completely.

CONCLUSIONS

Nigeria seems to regard technology as a commodity owned by foreigners, and it has the mistaken belief that technology transfer occurs naturally when the owner or supplier hands the technology over to the recipient or purchaser.

This interpretation of "transfer" is not surprising in a country that has no public policy to popularize science and technology nor to promote public awareness of the contribution of technology to society and vice versa. Under such circumstances how can the few gains from expenditures on technology be integrated efficiently into national life and the economy?

Policy studies are hardly ever commissioned by the Nigerian government, and without review and monitoring of policy performance, the nation cannot recognize policy inadequacies and failures early enough to take remedial action. Policy studies initiated by those outside government seldom influence government's action so scholars and researchers have little incentive to embark on such work. For example, Adegoye (1981) reviewed the strategy and policy options for Nigeria's industrialization and had identified a number of policy omissions, recommending, among other things, the formulation of a comprehensive plan for science and technology. According to Adegoye, the plan should set out not only priorities but also measures designed to acquire technology and should indicate the implications for all sectors of the economy. Also, the study called for "the institutionalization of a mechanism by which the science and technology plan will be integrated into the interactive basis." To date, the recommendations apparently have been unheeded.

Some evaluation of the performance of policies has been carried out by those who formulated or implemented the policies, but the results -- at times self-praise and false claims of achievement (e.g., Nigeria, Federal Ministry of Economic Development 1970, p. 144) -- often prevented objective reexamination.

The information available suggests that policy formulation has generally been ad hoc, uncoordinated, and, sometimes, conflicting because several ministries and government agencies (including the ministries of national planning, industries, science and technology, commerce) are working independently -- even, at times, in competition. Likewise, national research institutes, the national office of industrial property, and university research centres are pursuing their goals in isolation. Duplication of efforts coupled with the competition for financial and human resources has stymied progress. Reliable and comprehensive data should be shared in a computerized bank that would serve many purposes, including S&T policy formulation, analysis, and execution.

Commonly, the criterion for determining feasibility of projects has been the rate of return on investment. Alternative payoffs in technological gains are rarely taken into consideration. Yet the nation depends totally on foreign sources of technology; it imports machinery and equipment to erect factories; when the plants break down, it imports foreign experts to do repairs; and when the plants are inoperable, it imports finished products to satisfy domestic demand. The capital diverted from the country in the form of profits, royalties, management fees, etc. is alleged to be greater than the amount returned to the domestic economy by the venture; in turn, leakage of incomes contributes to the huge deficit of the country. (Other events that have contributed to the deficit are the decline of agriculture and the movement of labour away from rural areas, both of which add to the imports of food.)

The administrative machinery is a fundamental obstacle to the development and use of science and technology. For example, the clumsy and unwieldy process for approval of industrial endeavours is a disincentive.

The existing bureaucracy delays project preparation and execution in the public sector and hinders the private sector. For example, the planning of projects that could create necessary links within industries has never been done.

Even as recently as the Fourth National Development Plan, no specific provision was made for science and technology in the programs of the manufacturing sector, although the chapter on the S&T sector carves out an isolated role for one agency to promote technology in manufacturing.

S&T plans must be an outcome of national review and discussion, involving all key actors in the technological system. They must be practical, taking into account constraints. These plans need the support not only of the ruling class but also of farmers, artisans, etc. Without involvement of all sectors in planning, one cannot ensure that the plan is relevant or that it will mobilize the population.

The narrow base of the current policymakers is probably one reason that unpackaging of embodied technology has never been given much attention. Although the initial cost of this undertaking is daunting, it is essential in the long term and eventually pays for itself. Embodied technology is often inappropriate, geared to use resources in some other country and to cater to a particular consumer market. For example, several breweries in the country import wheat malt to feed their imported technology rather than developing a process for malting that uses local corn or millet as raw materials. In other words, conspicuously absent are efforts to use technology transfer to enhance domestic capacities for generating endogenous innovation or technical change.

Even when local capacities exist to produce elements of technology or innovation needed in industry, they often have not been harnessed. In fact, the record in managing technological dimensions of industrial development indicates an orientation against, rather than toward, the use of local sources of technology. Existing capacities, such as brick production, open opportunities to channel investment into the local economy but have been virtually ignored in Nigeria.

A look at the available policy choices that have been used to date by the public sector in Nigeria indicates some avenues for improved action in future. For example, the government has commonly:

- Selected foreign contractors (and therefore foreign technology) before bringing in consultants to evaluate, plan, or advise on the technical aspects of the proposed activity;
- Demanded that foreign contractors take equity shares in the proposed industrial venture (as "proof" of the economic feasibility of the venture and the seriousness of the contractor);
- Selected from interested bidders rather than seeking partnership based on criteria to meet its objectives.
- Tendered a management contract as a means of technology acquisition, allowing management by consultants, manufacturers, idle contractors, and even freelance agents;
- Entered turnkey arrangements with minimal local input; and
- Purchased technology without considering standardization or rationalization of plants with respect to countries of origin, technology management, major equipment, or appropriateness.

Since the officials had no definite policy to guide their decision-making, they often selected the foreign vendors with the best sales pitch, the result being inconsistencies both in the planning and in the implementation of industrial enterprises as well as in the eventual performance and cost-effectiveness of the acquisition.

The practice of replacing machinery or equipment whenever it needs repair and importing new versions at concessional rates of duty has contributed to the lack of standardization and has discouraged the development of a local capability in maintenance. What's more the new machinery embodies technological developments that have occurred since the original equipment was imported. Essentially, then, the factories would be moving unconsciously from one technology base to another. The changes occur in spurts since the technology would have been modified little or not at all during the interval. This pattern contrasts sharply with what occurs in developed countries. The failure in policy is that local

factories do not receive incentives or opportunity to develop continuously in response to new technology.

In other words, firms are not pursuing paths of technically dynamic change. Crucial areas of industry lack capabilities to respond efficiently to stimulation because they have failed to develop the kinds of human capital and knowledge needed to generate and sustain technical change. Also, they do not encourage research and development by personnel in institutions, such as universities, where the skills are found.

The links between universities and industrial endeavours are practically nonexistent, and Nigeria has few institutions whose mandate is to undertake research. The science anad technology groups in the country are weak and dispersed. Furthermore they have almost no access to the centres of political power where resources are largely allocated.

The few existing R&D facilities are relatively well developed but are inadequate for the size and potential of the country, and their institutions are rather limited with respect to personnel and resources. Budgetary constraints have forced them to operate at suboptimal levels. A rethinking of the nation's posture toward these institutions is necessary. The resources may need to be regrouped and rationalized, with a deliberate attempt to strengthen the link between R&D and the production sectors of the economy. Among other things, it may be possible to remove the extreme disincentives for researchers and technologists, especially the salary conditions and the lack of appropriate environment. Lack of popularization of S&T at the local level, coupled with a general lack of confidence in the local S&T machinery, has prevented efforts to promulgate relevant policies and attract adequate resources to implement important R&D programs.

Although some scientific research takes place, the efforts have customarily occurred without sufficient allocations for experimental development and without targets for commercialization and application. The paucity of endogenous technical entrepreneurial talent (as distinct from retailing and wholesaling), coupled with scarcity of venture capital,

further contributes to weak S&T infrastructures and gives the impression that neither the supply nor the demand for technology warrants elaborate attention to S&T policies.

Financing for R&D in particular and S&T in general is too weak to sustain growth and development. At the planning level, several approaches have been adopted in determining allocations for S&T work in each sector and in creating institutions to improve areas like management of research activities, strengthening consultancy and engineering services, and exchange of S&T information. Additional ways have to be examined such as the use of risk venture capital and research institutions that are directly connected to the productive sector and have a mandate to commercialize R&D results.

Until recently, efforts to encourage the development and use of local raw materials for the manufacturing industry have been feeble. While the policy of self-reliance in the use of locally available materials had been explicitly put in place in 1975, little effort or political interest has been devoted to enforcing it. The policy does not recognize that resource-based industrialization has to be properly planned and systematically pursued. The confusion over what to do about local raw materials has escalated because the nation lacks a policy on resource utilization, as distinct from a policy on the development and use of local raw materials.

The absence of a policy on resource utilization has meant that the nation does not know what resources are available in the country, what quantities, what locations, what uses they have, at what rate they should be depleted, etc. It also has meant that no deliberate planning has been done.

A policy on resource utilization would have prevented the situation, for example, in the tin-mining industry, by which the resource was totally exploited, leaving behind a debris of dilapidated ghost towns.

Complementary Engineering Industry

The design and manufacture or fabrication of machinery and equipment represent a key component of development for any country, and their absence in Nigeria constitutes a limitation to the nation's effort to acquire technology for development. In fact, the general industrial environment in Nigeria does not seem ready for this component of development. This is understandable because it is a lot easier to establish a cement-producing plant, for example, than to operate the facilities to make cement kilns and other plant machinery. By contrast, in the developed countries, a large number of enterprises contribute to the design and fabrication of different components of a plant. Hardly any corporate relationship exists, for example, between the manufacturers of electric motors, kilns, crushers, conveyor belts, etc. Since technological changes and improvements are taking place continuously in each of the processes for making these items, the cumulative technological change in an integrated cement works is considerable.

Policies in Nigeria work against groups who might willingly produce the equipment. For instance, a large number of industrial activities established by the public sector stipulate that local counterparts cannot participate with the foreign contractors. Although the stipulation was largely to avoid delays (and, hence, costs) that would be caused by the learning process, experience now shows that the short-term savings are long-term costs. The irony is that the country continues in its inability to provide the required machinery, engineering design, etc. because it has failed to acquire the technological capacity to do so.

Moreover, by restricting local inputs, government has ensured that local people who already have appropriate skills are passed over for foreigners. Government lacks an appreciation of how crucial local consultancy capabilities are for self-reliant industrial development. The capabilities need to be strengthened because self-reliance does not mean

the ability to operate and manage firms and factories efficiently; it includes the indigenous skills and abilities necessary for planning rationally, choosing investment projects wisely, selecting technologies appropriately, designing projects prudently, and executing them efficiently.

The development and use of local consulting firms would benefit not only the firms themselves but also the government, project-financing agencies, and local or foreign investors. Local consultancies would offer their clients several obvious advantages over foreign firms, including

- Reduced dependence on foreign expertise;
- More appropriate technological input (in the form of know-how suited to the local conditions and environment);
- Readily available followup; and
- Savings in absolute terms as well as in foreign exchange.

At present, Nigerian consultancy firms engage mostly in the execution of feasibility and market studies. They are seldom involved in project design, equipment design, specifications, monitoring, etc. They also fail to serve as links between R&D and the production sector -- a traditional role for which consultancy firms are best suited.

Recommendations

There is now the need for a comprehensive nationwide audit of the infrastructure for science and technology. This would allow appreciation of the major scientific and technological features of the national development effort. It would also identify gaps in the system and would facilitate the development of appropriate programs to fill these gaps. It is recommended that a national workshop be organized to review the results of the audit and to outline the institutional, managerial, and operational programs required to upgrade the framework. It may also help to identify

the external assistance needed.

There is also now the need to integrate S&T policy, both sectorally and institutionally, into the economic and social development planning of the country. Among the steps recommended is a national shift from the view of technology transfer as the purchase of embodied technology. This view has worked against achievement of the stated national objectives. A more appropriate phrase is "technology acquisition," which places the onus for technological development on the recipient, to seize the initiative to exploit the technology of the developed world. It also promotes the development of indigenous technology.

It is recommended that efforts be stepped up to develop a cadre of suitably trained personnel who can undertake active research, training, and management in the field of technology policy. It is no longer adequate for a country the size and level of development of Nigeria to rely solely upon the efforts of career civil servants to deal with such technical matters. Future generations of planners and policymakers must be equipped with proper understanding of the issues and problems involved and with the skills to deal with them. The nation must, therefore, develop a capability for policy research.

The interaction between policymakers and scholars and researchers must be strengthened. Current issues cannot be decided simply by the uninitiated. Policy formulation requires detailed research to identify not only the workable solutions but also the full extent of the problems. There is need then to create the forum and the opportunity for this interaction, by which policymakers benefit immensely from the research results and researchers gain insight into the practical limitations of policy execution.

As for technology acquisition in industrial enterprises, the recipients' technological learning should not come out simply as a by-product of the transfer arrangement but as central to it.

Efforts in the industrial enterprises should aim not only at

substituting domestic for foreign hardware and detailed engineering services but at making maximum use of local technical skills. The recipients must acquire, both in technical and legal terms, all the assets and skills regarding state-of-the-art processes, know-how, engineering design, and R&D facilities. There should therefore be a radical departure from previous approaches.

Apart from the provision of infrastructural support facilities like power, water, telecommunications, etc., government must work to streamline the administrative infrastructure for industrialization so that investors and entrepreneurs don't have to deal with so many agencies. The proposed Industrial Development Coordinating Centre (IDCC), which would be a one-stop control centre should be approved and established without delay.

Along similar lines, the package of industrial incentives should be reviewed and aligned with the objectives of the manufacturing sector, particularly that of increasing the local content of manufactured goods.

With respect to the development of raw materials for industrial use, it is recommended that an input/output matrix of materials be established for items now being imported as raw materials and those being produced for interindustry links. Such a matrix would help to determine priorities.

A clear modality must be established for extension of scientific and technological progress throughout the national economy.

Clear and specific targets and challenges must be set. In this context, government could consider sanctions and penalties for nonperformance, and commensurate recognition and reward for outstanding achievements.

While provision has usually been made by government for engaging in R&D, no significant funding has been made available for other vital aspects of scientific and technological activities. It is recommended that new and innovative mechanisms be explored for satisfactory funding. These could include forms of enterprise taxation, venture capital, etc.

Nigeria's current expenditure on science and technology is far below

the 2% of gross national product (GNP) unanimously accepted by the Lagos Plan of Action as the minimum level for developing countries seriously intent on the development of science and technology. While Nigeria has made some progress in the formulation of policy on science and technology, it has not yet been integrated into national economic planning. It is, therefore, operating inefficiently. The isolation of such policy underscores the failure of planners to recognize the singularly strategic position of science and technology in overall development now and in future.

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APPENDIX

Research Institutions for Science and Technology in Nigeria

Agricultural Extension and Research Liaison Service (Ahmadu Bello University -- ABU)
Cocoa Research Institute of Nigeria
Federal Institute of Industrial Research (FIIRO)
Forestry Research Institute of Nigeria
Institute of Agricultural Research (ABU)
Institute of Agricultural Research and Training (University of Ife)
Kainji Lake Research Institute
Lake Chad Research Institute
Leather Research Institute
National Animal Production Research Institute
National Cereals Research Institute
National Horticultural Research Institute
*National Institute for Chemicals Research
National Institute for Medical Research
*National Institute for Remote Sensing and National Resources Assessment
National Root Crops Research Institute
*National Technology Development Centre
National Veterinary Research Institute
Nigerian Building and Road Research Institute
Nigerian Institute for Oceanography and Marine Research
*Nigerian Institute for Energy Research
Nigerian Institute for Oil Palm Research
Nigerian Institute of Trypanosomiasis Research
Nigerian Stored Products Research Institute

Project Development Institute (PRODA)
Rubber Research Institute of Nigeria

* In the process of establishment.