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Building industrial capabilities for economic development in Nigeria

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BUILDING INDUSTRIAL CAPABILITIES FOR ECONOMIC DEVELOPMENT IN NIGERIA

By

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INTRODUCTION

Building Industrial Capabilities is a descriptive form of the term Industrialization, which, in turn, is defined as the extensive development of the manufacturing and production systems of an area.

The mother of industrialization is the industrial revolution in Europe, which took place over two centuries in the 18th and 19th Centuries. Among the favourable conditions that gave rise to the industrial revolution, particularly in Britain, were the possession of colonies and other overseas markets, requiring expanding commerce; long standing political stability; abundant coal deposit for energy production; an earlier agrarian revolution that modernized the farming methods, after which food was produced economically and abundantly. The nation was able to feed itself and able to release excess labour for industrialisation. There was also a wide spread interest in invention, resulting in the formation of local and national societies, organized to stimulate discoveries and development . For example, the Society of Arts was formed during this period (in 1754) to bring together inventors and business people. Entrepreneurship flourished, such that research, such as Watt's experiments on the development of the steam engine, were financed by entrepreneurs eager to solve particular problems in the coal mines. It is necessary to note that the ideas that led to their inventions were based on scientific theories and experiments by people like Papin, Hooke and Boyle. Inventions and development in machinery did not therefore come accidentally as sometimes imagined, but by experimentation and research. A new craft of engineering emerged, providing higher skills to produce machine tools of greater accuracy. Craftsmanship and Engineering Societies also developed.

With higher yield in coal production and relevant technological development to produce coke, coal/coke replaced the use of wood for the smelting of iron. Wood had

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actually become scarce at this period. As a result of Britain's abundance in coal deposits, coupled with the new technologies, its iron production quadrupled between 1806 and 1932.

By the late 19th century, industrialization had spread throughout America and Japan. In the 20th century, the world became divided into the developed and under-developed, first world and third world, characterized principally by the level of industrialization and productivity. Today, a second high-technology industrial revolution is taking place and some third world countries have taken advantage of the present advances in world communication, coupled with their determination and discipline, to seriously challenge the developed world by substantially increasing their industrial capabilities, leading to an enhanced social and economic development and near eradication of poverty. The countries which have made such rapid advances are mainly in Asia (India, Malaysia, Indonesia etc.) and South America (Brazil, Argentina, Mexico).

In all respects, whether in the early industrial revolution or the present high technology industrial breakthroughs, the capabilities necessary for the revolution stem from the acquisition of a science and technology culture, and the establishment of a solid infrastructure which is required for the translation of scientific knowledge into physical materials, equipment and tools which the citizens need for production work and the provision of services. This infrastructure is the Science and Engineering Infrastructure.

Science and Engineering Infrastructure is defined as the sum total of those human, equipment and material assets which are required by a country for the mass-production of capital equipment, including scientific and engineering equipment and materials.

THE NIGERIAN ECONOMY AND ECONOMIC STRATEGIES

Up to 1960, the year of Nigeria's political independence, the country's economy seemed to follow the pattern prescribed by Lord Lugard in his book "The Dual mandate in British Tropical Africa", published in 1929. Henry Hamilton[1] summarized the mandate to mean "The colonies will take our manufactured goods and we shall get raw materials in return. We shall establish law and order among the native people and mould them in the pattern of the white man. They will get modern medicine and movies, sanitation and schools, cheap transport and gramophones". It cannot be disputed that the mandate was meticulously planned an executed. Every establishment worked. They consisted mainly of limited social/physical infrastructure in the way of a rail system, seaports and airports, roads, inland waterways, post offices, schools and some higher institutions and

agricultural and medical research institutes etc. Nigeria's raw materials were exported. These included palm produce, cocoa, rubber, timber, groundnut, cotton, hides and skin, tin etc. Nigeria was self-sufficient in traditional food, but imported virtually all manufactured goods.

By 1970, crude oil exports had become a very important factor in the Nigerian economy, yielding large national income which was invested principally in social infrastructural works and social services. Workers drifted into the urban centres to become tradesmen, business men, traders and paid employees. As a result of the development, Nigerian agriculture collapsed. With the new found wealth, the country started to import all conceivable manufactured goods as well as food. The country then began to incur massive foreign debts which have continued to increase, and put at N240.4 billion in 1989, N298.6 billion in 1990, N328.05 billion in 1991, N544.26 billion (revised) in 1992 and provisionally N633.14 billion in 1993 (figures are from CBN/Federal Office of Statistics) using conversion rate of N22 to the US Dollar.

The deterioration of the national economy continued in spite of the 5-year National Development Plans which commenced in 1960. Successive governments from 1970 started to adopt various mission-oriented strategies intended to achieve specific national economic objectives. The mission-oriented strategies include:

(a) **Import Substitution Policy:**
Under this policy, private-sector factories were established locally for the assembly of consumer goods ranging from foods and drinks to wines and tobacco, soaps, cosmetics and toiletries, furnishings, electronic products, kitchen equipments, space/cooling machines etc. Such factories obtained from overseas their factory machinery, machinery spare parts, and the semi-processed raw materials for their production work, and almost all of them still do so presently. Their production had therefore no local value added, and similar factories have not been established with locally fabricated equipment. The Nigerian industrial economy has therefore been more or less a case of growth without development.

(b) **Operation Feed the Nation:**
This was a campaign in the 1970's to attract farmers and able-bodied youth back to the land for the mass production of food for local consumption. Fertilizer as well as other farm inputs like chemicals, machinery and tools were imported from overseas. The campaign died with the government that launched it. The generation

of farmers that used back-breaking manual labour in their work has faded out. The younger generation can only be attracted to agriculture if appropriate labour-saving tools, and other inputs are readily available, but they are not.

(c) **The Green Revolution:**
This was launched in the early 1980's for the mass production of grain crops, particularly rice, for local consumption. The agricultural research institutes provided foundation seeds, and teamed up with the state agricultural development projects to provide technical support. But the revolution did not materialize.

(d) **Technology Transfer:**
This strategy was adopted for capital goods production and is typified by the establishment of vehicle assembly plants some twenty years ago. Two of them were dedicated to passenger car assembly, while three were concerned with trucks and buses. They were to initially carry out assembly work with imported parts, the so-called Completely Knocked down Parts (CKD), but should within ten years achieve a true local production of the vehicles. That ambition has however not been achieved after twenty years, and the assembly plants are now sick industries threatening to fold up any time.

(e) **Backward Integration Policy:**
This is an on-going strategy under which consumer goods manufacturing industries, which have been importing their semi-processed industrial raw materials inputs from overseas, should develop local substitutes for these materials. Most of such raw materials are of agricultural, or vegetable, or solid minerals, or petrochemical materials origin. The implementation of the substitution of the imported inputs is facilitated by research institutes and the Raw Materials Research and Development Council, which was established in 1987. The bottleneck in this programme is the need for importation of the processing machinery, or some parts of them, at a high foreign exchange expenditure. But by and large, the policy has been a success.

(f) **Small-Scale Industries Programme:**
This is an on-going programme for the training of youths and financing them to establish small-scale industries. In this respect, assistance to the entrepreneurs is rendered by research institutes, the National Directorate of Employment (NDE),

the National Economic Reconstruction Fund (NERFUND), and the Peoples Bank. The programme has already made visible achievements and promises to be an enduring success despite the handicap of equipment importation.

(g) **The Directorate of Foods Roads and Rural Infrastructure:**
This was another people-oriented programme under which development was taken to the rural areas. It consisted of mounting projects in most parts of the country, such as access road construction, rural water supply, rural electrification, supply of agricultural inputs etc. Despite its popularity among the citizenry, it was not conceived to be a permanent feature in the national development scheme, and it has recently been phased out.

(h) **The Better Life for Rural Women Programme; The Family Support Programme:**
The Better Life for Rural Women Programme was established some 8 years ago in recognition of the cardinal role of rural women in the generation of the national product, through the maintenance of the home, field agriculture, food processing and food preservation, petty trading and community development and welfare services. The programme was therefore mounted to give support to the rural woman to maximize these activities by being provided with training, credit facilities, and appropriate labour-saving equipment. The project was a great success, with many women co-operatives springing up and rural industries and markets established. The machinery and tools for the better life industries were mainly the equipment developed in research institutes and locally fabricated. Some two years ago, the Family Support Programme replaced the Better Life with an expanded scope. The family support programme can achieve a remarkable transformation of rural areas if small-scale industry equipment and labour-saving devices are mass-produced, affordable and readily available.

Despite the above strategies, Nigeria's trade figures by commodity section, as hown in (Tables 1, 2 and 3), for 1989 – 1993, give a very poor showing. In 1993 for xample, crude oil export provided 98% of the country's export and only 2% accrued ·om the remaining 8 sections. Note also that 84% of the total import bill in 1993 was pent on machinery, equipment, tools and materials, whether they be for education, or or health care, or for agriculture, industry, transportation, utilities, or whatever. This

is crippling handicap, as it mean that, as the little-valued Naira cannot import much any more, new industries cannot be easily established, existing ones cannot be readily maintained and refurbished, and imported inputs for education, research and development work, agriculture, industry, transportation, health care, utilities etc. cannot be reached. In frustration, many scientists and engineers therefore emigrate to countries with conducive working environments, thus exacerbating the brain drain.

A fundamental flaw in our development planning has also been the demotion of capital goods industries, to which development planners only paid lip service, and the concentration of private sector attention on consumer goods industries. This has created the situation in which the economy grows but without developing, and no measure of self reliance is developed with time. The naivety comes from national development planning being dominated by economists, to the exclusion of engineers and scientists of diverse disciplines. To arrest the rot, therefore, some engineers and scientists in Nigeria are now leaving no stone unturned to ensure that development planning admits the inevitability of a science and engineering infrastructure development programme.

OBSTACLES TO A SUSTAINABLE TECHNOLOGICAL AND ECONOMIC DEVELOPMENT

Obstacles that militate against Nigeria's sustainable technological and economic development are multi-faceted and include scientific and technical manpower deficiencies, an excessive import dependence, the lack of a maintenance culture, and the negative impacts of some of the imported development models.

SCIENTIFIC AND TECHNICAL MANPOWER DEFICIENCIES

A pool of expert and skilled manpower in the scientific, engineering, and technician cadres is a sine-qua-non for a technology-driven national economic development programme, including the establishment of national science and engineering infrastructure. Nigeria possess some basic infrastructure for the provision of the theoretical aspects of scientific, engineering and technical education up to the tertiary level. However, the educational institutions are ill-equipped in terms of specialist libraries, laboratories and workshops for a satisfactory provision of the practical work components of learning. Unfortunately, as most industries are only consumer products factories, they are not well suited to provide the diversified experience in creativity and innovation which students should undergo. It is therefore necessary that bright students should be given opportunities for further training and experience in overseas research

and development centres and industries. This is an area in which foreign assistance in the form of technical aids and training fellowship can be of immense benefit.

The magnitude of the deficiency in scientific and technical manpower of Africa was exposed in the UNESCO 1991 publication (released in 1994) entitled "Estimation of World Resources Devoted to Research and Experimental Development, 1980 and 1985" in which the data presented here as Table 4 was released. From the table, the number of R&D scientists and engineers for all Africa was 1.3% of the world total in 1980 and 1.4% in 1990. The figure of 1.4% for all Africa in 1990 compares with 19 for all north America, 2.4 for all South America, 2.4 for all Asia (including Japan), 21.4 for all Europe, 0.8 for all Oceania (including Australia and New Zealand), and 31 for the former USSR. From these statistics, it may be correct to infer that Africa is yet so low in the world high-level manpower table that, without urgently improving its status in that area, the hope of leap-frogging the technology handicap cannot be realized. Even more depressing is the fact that apart from Oceania, Africa scores the lowest increase in high-level scientific and engineering research manpower between 1980 and 1990. It is clear that if the implementation of a science and engineering infrastructure development programme has to wait until a large enough high-level manpower is developed, the programme will be delayed for long. Therefore, we should immediately commence a crash training programme of qualified scientists and engineers in the critical areas of capital goods production, in order to raise the vanguard of the pioneer team for the programme. Thereafter, the implementation of the national programme will proceed hand-in-hand with manpower development, much of which can then be carried out on-the-jobs. Also, it is to be expected that some expert nationals in industrialized countries will be encouraged to come home for the programme, as was the case in South Korea, India, Pakistan.

EXCESSIVE IMPORT DEPENDENCE

The national development plans and mission-oriented strategies executed by Nigeria over the years were more or less failures in terms of their impact on the sustainability and self-reliance of the national economy. In all cases, the main cause of the failure was the inordinate dependence on importation for the capital goods, the machinery, equipment, tools and spare parts used in production work and the provision of services.

LACK OF A MACHINERY AND EQUIPMENT DESIGN AND FABRICATION CAPACITY

Engineering workshops for the design and production of prototype equipment serve two important purposes, i.e.

(a) the practical training of science and engineering graduates, technologists, technicians and craftsmen; and

(b) the development of proto-type machinery and equipment which private sector industries can mass-produce for the market.

The proliferation of such production engineering workshops is the foundation of a NATIONAL SCIENCE AND ENGINEERING INFRASTRUCTURE which is required for the local mass-production of capital goods.

LACK OF A MAINTENANCE CULTURE:

The lack of a maintenance discipline, except for motor vehicles, is the bane of machinery and equipment in Nigeria. The same indiscipline applies to the management of roads, public buildings and other public assets. It is therefore said that Nigeria does not have a maintenance culture, but practices a replacement culture. Thus publicly-owned equipment scarcely ever last their design life, but are discarded in many cases when failure of a functional part takes place. In contrast, private property is much better cared for by their owners and is kept in functional operation for long periods of use. Similarly, people who manufacture equipment have the highest appreciation of their value and therefore repair and maintain them best. So, the lack of a maintenance habit may also be due to the fact that neither the equipment nor their spare parts are locally made. Whatever the explanation may be, colossal loses are borne on valuable imported equipment which get discarded for minor malfunctions. This indiscipline is one of the traits which a science and engineering infrastructure will eradicate.

AID PACKAGES OF MARGINAL EFFECT

The negative impact of the misapplication of good intentions of technical assistance to a developing country is exemplified by some of the loans readily given to Governments of African countries for projects on which the country should not run up foreign debts. Politically motivated and white elephant projects are typical. In many cases, loans are readily granted for ventures that will not generate wealth in cash or in kind and therefore cannot repay the loans. On the hand in the experience of sub-Saharan African countries, scarcely do international agencies and overseas loan providers grant loans for viable

core projects which would produce a chain reaction beneficial to the national economy, such as engineering materials industries, capital good production plants. Foreign loans have been granted for the building of hotels whose pre-fabricated structure were imported from overseas. Thus, much of the loans often go back to industrialized countries for the payment of imports with which the project are executed. This becomes wasteful when there are local substitutes for the imports. Turn-key projects with marginal or no local inputs have proved particularly prone to failure. Thus, with the exception of parts of loans which are applied to education and manpower training and the hiring of overseas technical expertise, much of the loans which have led to the huge foreign debts with which African countries are now burdened have nothing worthwhile to show for them in those countries. A foreign loan which is difficult to forget is one of over 100 million US dollars given for population control. Much of this went to the importation of condoms. Firstly, condoms are not the sustainable solution to the uncontrolled population problem in Africa. The solutions are education and the generation of scientific awareness of the population, and the rescue of the national economies of African countries, so that men will direct their minds to creative subjects instead of staying at home breeding children. If condoms must also be called in, then the loan should have been used in establishing a local condoms production plant, sine rubber latex abounds locally.

THE STRUCTURAL ADJUSTMENT PROGRAMME (SAP)

The IMF/WORLD BANK - imposed Structural Adjustment Programme (SAP) is the most far-reaching and painful tinkering to which the economies of countries like Nigeria have been subjected. In Nigeria, it has lasted for ten years and has so throttled the economy that it is a matter of surprise that it has not completely collapsed. The IMF/ WORLD BANK conditionalities include the devaluation of the national currency, a free market economy, the removal of subsidy on petroleum and other products, deregulation of interest rates, imposition of high rates of value added tax (VAT), freezing of wages and retrenchment of workers, and the privatization of public enterprises. The IMF/ WORLD BANK had predicted an economic boom for Africa if the Governments made certain sacrifices and faithfully implemented the provisions of the programme. Sub-Saharan African countries had therefore embraced the programme; but what are the results after ten years? The results in Nigeria are that:-

(a) The value of the Naira is now only 1/50th its value at the start of the programme. Contrary to the expectation, the devaluation has had no positive effect on the

country's foreign currency earnings.

(b) The country is now a dumping ground for the manufactured goods of powerful industrial nations, thus discouraging local industrial output and leading to the closure of industries and the retrenchment of workers.

(c) The unprecedented inflation rate has pushed the cost of living to unimaginable heights, and coupled with low wages, has rendered the life of wage earners a nightmare.

(d) By the extreme hardship being inflicted on citizens by the programme, it appears as if it was conceived to cause a revolt of the population and bring doom rather than the promised boom.

It is to be noted that some of the independent experts of the advanced Western nations, from which the SAP economic theory emanated, have made it abundantly clear that there is no single third-world country where the application of IMF/WORLD BANK Structural Adjustment Programme has led to the advancement of the physical economy or an improvement of the standard of living of the population[2]. On the contrary, as in the case of Nigeria, it is under the SAP regime that its foreign debt increased by 330%.

Freeman and Frieseck had concluded that "As long as Nigeria is strangulated by the injustices of the world economic system and continues to be a victim of the so-called free trade arrangement, whereby it is forced to sell its raw materials at the lowest prices and to buy machinery, spare parts and other necessary items at higher prices, there is no possibility for real development of the Nigerian economy." Thus the saying "Free economy is the weapon of the strong", which is credited to Chancellor Otto Von Bismarck, has proved its truism in Nigeria. With the turn of events in respect of the Nigerian economy under the SAP, one recalls the claims of critics of the programme during the national debate, that the IMF/WB conditionalities, which form the canons of the SAP, are nothing but well-thought-out weapons of a new colonialism and economic domination. The whole system is reminiscent of Lord Lugard's mandate of 1929.

THE NATIONAL SCIENCE AND ENGINEERING INFRASTRUCTURE PROGRAMME

Aware of the uninspiring impact on the national economy of the former strategies and policies, government concluded that the existence of a viable and prolific local capacity for the production of essential scientific goods, industrial and engineering

tools, machines and equipment is indispensable in order to ensure a self-sustaining local production and availability of goods and services. It therefore constituted in 1990 a 150 member National Committee on Engineering Infrastructure drawn from the universities and polytechnics, the research institutes, scientific and engineering bodies, the Chemical Society of Nigeria, the Manufacturers Association of Nigeria, the National Association of Small-scale Industrialists, bankers, legal experts and the Federal and State ministries. The Committee was charged with the task of producing a blue-print for the establishment of an engineering infrastructure.

In February, 1991, the committee submitted its report, which presented a comprehensive plan for the establishment of an engineering infrastructure within a time span of 10 to 15 years, under certain conditions. Similarly, the plan for a Science and Scientific Research Infrastructure was produced by a committee of the Nigerian Academy of Science. Consequently, a National Policy on science and Engineering Infrastructure was adopted in 1992 by the Federal Government[3].

The objective of the National Policy is to ensure, by the intervention of Government, the ready availability in the Nigerian market, in adequate quantities, of the primary and intermediate capital products required for machine and equipment design, fabrication, and mass-production, thus providing the necessary environment for a sustainable industrialization. The policy document specified the institutional frame-work, the relevant capital goods sectors, implementation strategies, research and development manpower, manpower motivation and utilization, appropriate information.gathering and dissemination systems and data base, private sector industries, investment and financing, incentives for private sector infrastructure industries, policy stability and continuity. The science and engineering infrastructure will therefore consist of:

(a) The capability for producing the scientists, engineers, technologists, and technicians who possess the skill for developing the technologies for the local mass production of capital goods;

(b) Research, development and pilot production centres where the manufacturing technologies are developed and are real-life tested in production work; and

(c) Private sector industries which carry out the commercial mass-production of the capital goods.

The policy document spelt out clearly the roles of the public and private sectors in the establishment of the infrastructure. These are:

(a) Government will be concerned only with the creation of the industrial environment which is conducive to capital goods mass-production;

(b) Manpower development will be a concurrent subject for the public and private sector, the local venue for the education and training of manpower being public educational and training institutions and private-sector industries;
(c) The infrastructure development centres will, like other research institutes in Nigeria, be owned by government;
(d) The capital equipment and materials output of the system, and their production process, will be taken over by private-sector industries for commercial mass-production; and
(e) The cost of the programme will be jointly borne by government and the private sector.

Thus, public sector activity will dominate the up-stream section of the programme, while down-stream activities will be the prerogative of the private sector.

An important finding of the national committee on engineering infrastructure is that government should be concerned, not with the production of final products for the consumer, such as the motor vehicle, but with the production of primary products which are required by private sector down-stream industries which produce consumer goods, such as primary products which ultimately contribute to the production of a motor vehicle and other consumer goods. Interestingly, this strategy is the same as the Indian model, in which industries are categorized into:

(a) Industries for mass-producing consumer goods;
(b) Industries for producing the capital goods required by other industries for the mass-production of consumer goods; and
(c) Industries for producing the capital goods required by other industries for the production of capital goods.

According to Sukhamoy Chakravarty, in "Development Planning: The Indian Experience," Government should establish only the third type of industries, and only in special case the second type. The policy document therefore listed the technology development centres which government should establish as being those which will lead to local industries flooding the market with certain primary and intermediate capital goods which are required for machine design and machine building to thrive. These capital products which should emerge from the programme are grouped under six sectors, namely:

(i) Engineering material: the irons, steels, non-ferrous metals and alloys, plastics, glass, ceramics etc;
(ii) Industrial and analytic chemical materials; including industrial gases;

(iii) Scientific Equipment; for education, research and industry; including measuring instrument, electronic components, communication equipment and computers;

(iv) Engineering accessories; mechanical, hydraulic, pneumatic, electrical, and electronic;

(v) Power equipment: mechanical, hydraulic, pneumatic, electrical, solar, wind; and

(vi) Engineering tools: hand tools, power tools, cutting tools, machine tools.

This list shows the primary and intermediate capital goods which a national science and engineering infrastructure should produce locally in the required quantities, in order that science education, scientific research, and equipment design and fabrication, will become possible and attractive. It is therefore a list of the areas of indigenous technology development in which government should be actively involved.

The inescapable responsibility of national governments of developing countries in master minding and directing resources to the laying of a solid foundation for a sustainable industrial development, by the combined action of the public and private sectors, was highlighted at the 4th General Assembly of the Third World Academy of Sciences, held in Kuwait in November 1992. The report of its Panel discussions on "Technology and Industry Development in the South; Role of Private Sector" (4) concluded as follows:

> "In the effort to boost science and technology in industry development in the south, each country has to understand it's peculiar problems and develop appropriate strategies for getting to their objectives. In spite of this, a few common features need to be observed. The creation of an enabling environment for industrialization must involve deliberate government action, particularly in the areas of institutional and legal frameworks, and appropriate fiscal and financial measures. Creation of centres of excellence built around scientists of proven ability as research leaders and managers, and funded through fiscal instruments to guarantee them financial independence and autonomy, but ensuring that industry gets the research results with obvious potential for industrial application, should be a strategy pursued by government. The role of government is crucial, for all the other parties in the industrialization effort will necessarily take their cue from it. When government demonstrates a commensurate level of courage, political will and commitment, by

putting in place the appropriate legal, fiscal and financial instruments, industry will usually respond to appropriate and profitable incentives in the medium term investments in industrial technology. It is the role of government to provide the agencies for long term investments."

It is to be noted that each of the six capital goods sectors listed earlier is very wide when broken down into its sub-systems, and would require more than one infrastructure development centre to cover its mandate, otherwise the centre will become too large and unwieldy. In fact, as many as 30 science and engineering infrastructure development centres are anticipated under the National Programme, to develop the six capital goods sectors mentioned earlier. These do not include the foundation industries which are already being created by the Federal Government, namely;

(a) the Ajaokuta Steel Project: a blast furnace complex for the production of cast iron, steel billets, rolled steel sections, flat steel sheets etc;
(b) the Delta steel project: a direct reduction plant for the production of ingots, steel castings, rolled steel sections etc;
(c) the Aluminium Smelter Industry: for the production of aluminium ingots flat sheets, rolled sections and building materials;
(d) the Oshogbo Machine Tools Industry; and
(e) the Petrochemicals Plants.

The science and engineering infrastructure development centres, where the manufacturing technologies are developed and real-life tested in pilot production plants, will utilise the products of the above-listed foundation industries. They will constitute the heart of the national programme. Its diagrammatic representation is given in Fig. 1. Located in different parts of the country, each centre will consist of:

(a) A manufacturing technology development core which is owned by government. This core will have a NUCLEUS of appropriate laboratories and engineering workshops which are supported by peripheral pilot PRODUCTION WINGS;
(b) Many SECONDARY PLANTS, owned by the private sector, will spring from the technology development core. These secondary plants are the SATELLITE INDUSTRIES of the infrastructure development centre, which commercially mass-produce the technologies of the capital goods of the sector with which the centre is charged; for example, fitter's tools manufacturing plants, or fitter's tools themselves. It is to be noted here that such a satellite industry may not be contiguous with the technology development centre, but can be located far from the core in another state of the country;

(c) In time, the secondary plants will give rise to private sector TERTIARY PLANTS which manufacture and provide supplies to the secondary plants, such as electroplated parts, fasteners etc.

The development centre nucleus is, in practical terms, the arena of technology development where the systems are reduced which the secondary plants require for achieving their products. It is an extensive assembly of specialized workshops and laboratories, the types of which are determined by the technology sector of the centre. The centre is sufficiently staffed and equipped to manufacture machinery and equipment to its own designs and replicate existing equipments. It will supply its manufacturing processes, machinery and equipment output, as well as technical assistance, to its satellite industries, and these industries will employ them in mass-producing the capital goods of that sector.

The peripheral production wings of the core of the centre are the pilot plant working spaces where machinery and equipment manufactured at the centre are tested by being used in production work. Also, machinery and equipment which the centre wishes to replicate are installed there while they are being tried out and studied.

The science and engineering infrastructure development centre, with its satellite industries, is a radical departure from Nigeria's traditional industrial research practice, because it brings the R & D organization and the benefiting private-sector industries together. Furthermore, the human and material resources are committed to projects which private-sector industries will pay for and commercialize. Thus, the science and engineering infrastructure development centre is a centre for research, development, and production. It is engaged in technology adaptation, and true transfer of the technologies to satellite industries. The system will solve the so-far intractable problem of industrial research appearing to be irrelevant, and research results wasting away.

It will ensure the ready commercialization and application of useful research results. Equally important will be the local mass-production of badly-needed well-known and common technologies which are now the property of all humanity and do not need to be re-invented. These are the so-called conventional technologies which industrialized the big powers, and which we import in large numbers at the cost of disabling foreign debts. If such common technologies as primary power machinery, electrical power equipment, transportation equipment, hydraulic machinery and fittings, agricultural machinery, food processing and food preservation equipment, industrial machinery, machine tools etc. are mass-produced in the quantities demanded by the economy, it will not only eliminate poverty, but it will also create the environment of

a local-resource-based scientific development in which scientific work will no longer depend completely on imported inputs as is presently the case. It will also through sales, fees, and share-holding in established industries yield regular revenue to the development centre. The centre may even break even or make profits, depending on the activities to which it lays more accent in any particular year, whether on technology acquisition or technology transfer.

While many indigenously-owned infrastructural industries to be established initially as small-scale or medium-scale industries would start as satellites of the development centre, it is expected that foreign-financed infrastructural enterprises, which are likely to be bigger industries (such as alloy steels production) would not need the midwifery of the development centre, but would simply take off independently. The national policy provides many types of assistance and incentives to facilitate the take-off, early maturity, and growth of all these infrastructural industries, indigenous or expatriate.

FINANCING THE NATIONAL SCIENCE AND ENGINEERING INFRASTRUCTURE:

The Science and Engineering Infrastructure Programme put forward here is a colossal, but necessary task which will extend to several years before it fully yields the products. It will demand large capital outlays on specialized manpower training, technical collaboration with friendly overseas bodies, and initial acquisition of machinery and equipment from overseas. In 1993, the initial cost estimate for it's establishment in the country was determined as N55 billion (2.5 billion US Dollars based on an exchange rate of N22 to one US Dollars). The greatest part of the expenditure would be in foreign currency. The expenditure should ideally be spread over a period of not longer than five years.

Regrettably, neither the government nor the commercial enterprises set high premium on R&D. Practically all the commercial enterprises neither maintain in-house research wings nor do they endow or commission pubic sector programmes. It is in realization of this poor state of affairs that the Organization of African Unity (OAU) in its 1980 Lagos Plan of Action adopted 1% of GDP as the minimum rate of Science and Technology (S&T) funding by member states.

Table 5 tells a very sorry story for Nigeria which spends 0.1% of GDP on S&T as against 1.5-2.5% GDP for Tanzania, up to 1.0% of GNP for Malaysia, 2% of GNP for South Korea, 2% for India and as high as 5% for the former USSR to enable it catch up technologically with the West which spends about 2.8% of GNP. Although the figures

do not tell the whole story, it indicate the level of commitment of the various countries.

For Nigeria, the author had recommended to the National Constitutional Conference a funding rate of:

(a) 0.15% of GDP initially, rising by equal annual increments to 1% in the year 2000 by government, and

(b) 2% of pre-tax profits of commercial enterprises initially, rising by equal annual increments to 11% in the year 2000.

This formula will give a Nigerian national rate of funding of 2% of GDP approximately in the year 2000.

The recommendation of the National committee of 1990 for funding the national science and engineering infrastructure programme is 1% of Federation Account plus contribution of 0.25% of turn-over from commercial industries with turnover of N4 million naira and above.

CONCLUSION

The desperate straits to which the national economy has sunk requires that we must mobilize all available resources to fight poverty, by achieving high productivities in all national and individual undertakings. To maximise the profitable use of our resources, a conducive social atmosphere should be established by the institution of good governance, which is corruption-free and which inspires honest service and patriotism, and instils a sense of discipline in citizens who have stashed monies in overseas banks to repatriate them and invest them in productive ventures at home.

No matter what other strategies are adopted to achieve high productivity, production work should now be adequately mechanised to achieve the economic and social objectives without creating new social problems. An effective mechanisation demands the local mass-production of working tools, machinery and equipment. To be able to achieve this, the country should implement a suitably financed science and engineering infrastructure programme which is the only way of building Industrial Capacities for Economic Development. This paper has defined the science and engineering infrastructure which should be established and has presented the programme of work by which it can be achieved over a period of years of sustained effort. Because of the large investments which are demanded by such an infrastructure, the financing should be the joint responsibility of government and private sector commercial enterprises.

In order to achieve economic self-reliance, the country must establish a national science and engineering infrastructure. Only then can it provide productive employment

to its citizens, have functioning and effective education, health care, and utility service, be self sufficient in food supply, make export earnings and achieve a healthy balance of trade, minimise environmental degradation, the incidence of crimes, and brain drain, and participate actively in the new technologies that are now sweeping the world.

TABLE 1

EXPORTS BY COMMODITY SECTION, 1980-1993

(N'Million)

Site	Section	1989	1990	1991	1992	1993**
0.	Food & Live Animals	1,229.8	1,417.1	1,572.0	2,673.0	1,046.6
1.	Beverages & Tobacco	5.9	4.0	*	*	*
2.	Crude Materials Except Fuel	1,847.0	614.5	864.5	1,439.3	1,531.4
3.	Mineral Fuels Lubricants and Related Materials	55,925.3	100,988.7	117,181.7	199,239.2	213,778.8
4.	Animal & Veg. Oil & Fat	0.2	1.1	*	*	*
5.	Chemicals	556.6	277.6	362.9	616.9	656.4
6.	Manufactured Goods Classified by material	176.7	314.2	*	411.1	437.4
7.	Machinery & Transport Equipment	61.5	22.6	241.9	*	*
8.	Misc. Manufactured Articles	148.4	75.1	120.9	205.6	218.8
9.	Commodities & Transaction Not Classified	278.7	392.1	604.7	1,028.0	1,093.8
	TOTAL	59,928.8	104,107.6	120,958.6	205,613.1	218,765.2

Source: Federal Office of Statistics
Note: *Negligible
**Provisional

TABLE 2

IMPORTS BY COMMODITY SECTION, 1980-1993

(N'Million)

Site	Section	1989	1990	1991	1992	1993**
0.	Food & Live Animals	1,720.7	2,653.7	3,581.1	9,995.4	13,912.9
1.	Beverages & Tobacco	111.0	158.4	263.1	244.8	496.9
2.	Crude Materials Except Fuel	881.5	1,082.1	1,790.5	3,072.6	4,306.4
3.	Mineral Fuels Lubricants and Related Materials	211.2	219.7	326.0	646.6	828.1
4.	Animal & Veg. Oil & Fat	57.0	166.0	305.0	810.8	1,325.0
5.	Chemicals	5,745.2	6,841.9	10,795.7	22,172.5	28,322.6
6.	Manufactured Goods Classified by Material	5,337.0	5,565.1	11,954.4	28,156.4	39751.1
7.	Machinery & Transport Equipment	10,086.3	14,048.6	20,854.3	51,205.7	70,226.9
8.	Misc. Manufactured Articles	1,020.0	1,670.0	2,580.4	5,999.0	6,293.9
9.	Commodities & Transaction Not Classified	7.7	102.9	212.6	122.3	165.6
	TOTAL	25,177.6	34,708.5	52,663.1	122,426.1	165,629.4

Source: Federal Office of Statistics
Note: **Provisional

TABLE 3

BALANCE OF TRADE, 1989 - 1993

(N'Million)

Site	Section	1989	1990	1991	1992	1993**
0.	**Food** & Live Animals	-490.9	1,236.0	-2,009.1	-7,322.4	-12,866.3
1.	Beverages & Tobacco	-105.1	-154.4	-263.1	-244.0	-496.2
2.	Crude Materials Except Fuel	*965.5	-467.6	-944	1,633.3	-3,775.0
3.	Mineral Fuels Lubricants and Related Materials	55,714.1	55,714.1	116,855.7	198,592.6	212,950.7
4.	Animal & Veg Oil & Fat	-56.8	-56.8	-305.0	-810.0	-1,324.6
5.	Chemicals	-5,489.6	-6,564.3	-10,432.8	21,555.6	-27,666.2
6.	Manufactured Goods Classified by material	-5,160.4	-7,540.2	-11,712.5	-27,745.3	-39,313.7
7.	Machinery & Transport Equipment	-10,024.8	14,026.0	20,845.3	-51,205.0 -	70,226.6
8.	Misc. Manufactured Articles	-871.6	-1,594.9	-2,459.5	-5,793.4	-6,075.1
9.	Commodities & Transaction not Classified	271.0	289.2	392.1	905.7	928.2
	TOTAL	34,751.2	69,399.1	68,267.5	83,187.0	53.135.8
Current Account Balance		9,2441	19,882.3	-14,357.9	-8,337.9	

Source: Federal Office of Statistics
Note: *Trade Balance is Export minus Imports
**Provisional

TABLE 4
ESTIMATED NUMBER OF SCIENTISTS AND ENGINEERS BY REGION IN 1980 AND 1985, WITH PROJECTION FOR 1990

	Number of Countries Selected	1980		1985		1990	
		Number	%	Number	%	Number	%
Africa (Arab States and others)	36	51,324	1.3	56,76	1.3	73,081	1.4
North America (USA, Canada and Central)	17	719,781	18.4	836,29	19.0	970,582	19.0
South America	11	55,141	1.4	89.35	2.0	123,071	2.4
Asia (Japan, Isreal, Arab, others)	29	788,034	20.1	954.63	21.7	1,229,512	24.0
Europe (Western Europe	24	893,482	22.8	940,35	21.4	1,091,033	21.4
Oceania (Asutralia, New Zealand, others)	10	39,692	1.0	34,17	0.8	41,965	0.8
USSR	1	1,373,300	35.0	1,491,30	33.9	1,587,830	31.0
World	128	3,920,765	100.0	4,402,86	100.0	5,117,044	100.0

Source: UNESCO, 1991

Fig 1.

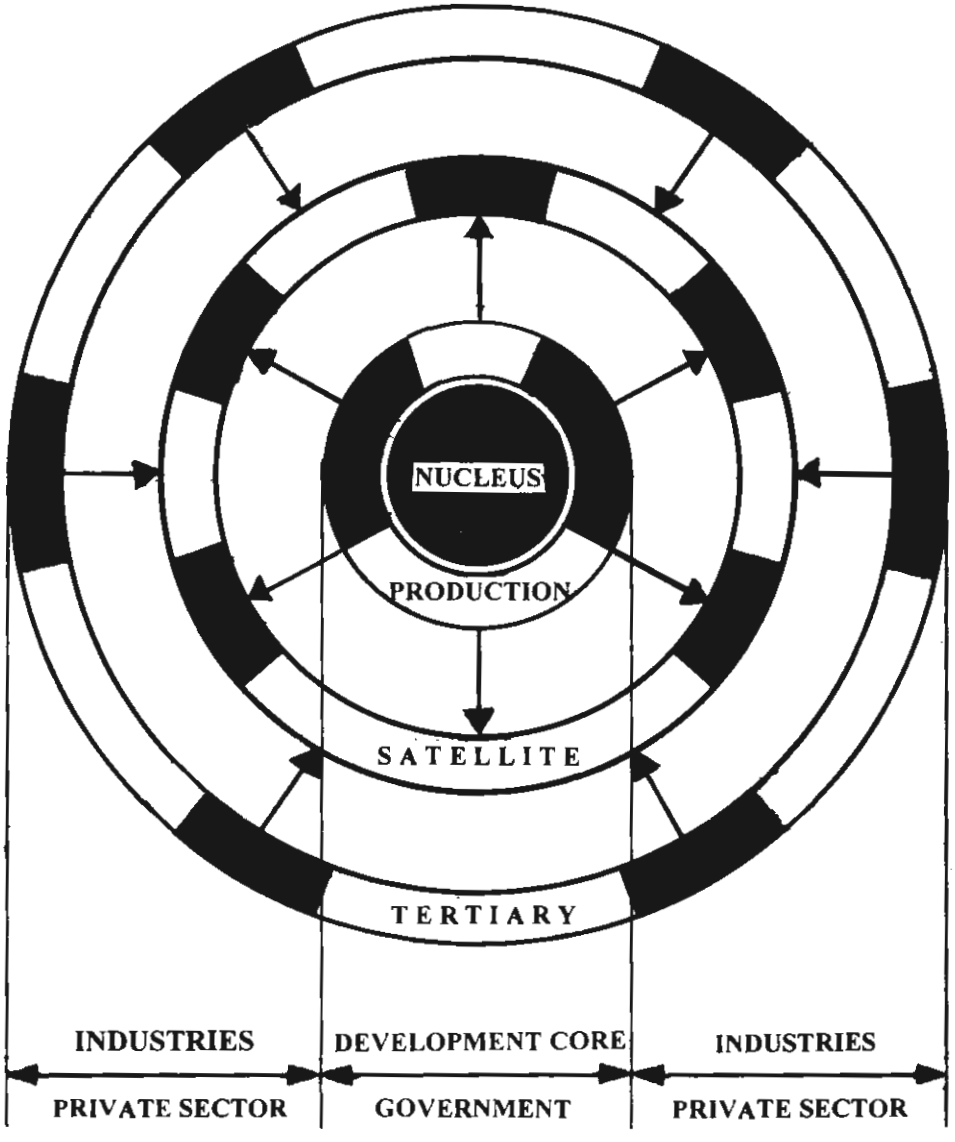

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TABLE 5

COMPARISON OF S&T FUNDING RATES

Country	Rates	Reference
Nigeria 1980-1992	0.1% GDP	
OAU Guideline	1.0% GDP	6
Malaysia	0.6-1.0% GNP	8
Tanzania	1.5-3.5% GNP	9
Taiwan	1.35-2.25% GNP	10
India	2% GNP	11
South Korea	2% GNP	12,
United Kingdom	2.3% GNP	12, 13
Germany (RG)	2.8% GNP	12, 13
United States	2.8% GNP	12, 13
Japan	2.8% GNP	12, 13
USSR	5% GNP	12,13

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