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Edited by
I.B. BELLO-IMAM
&
MIKE I. OBADAN

CENTRE FOR LOCAL GOVERNMENT AND RURAL DEVELOPMENT STUDIES, IBADAN.

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CHAPTER 15

SCIENCE, ENGINEERING AND TECHNOLOGY IN NIGERIA
PROBLEMS AND PROSPECTS

S.O. Isehunwa

Abstract

A general overview of the evolution and development of science, engineering and technology in Nigeria has been presented. Five phases of development were identified between 1960 and 2003. It was observed that while significant efforts have been made at establishing the institutions and infrastructure necessary for industrialization, the third important requirement, namely, a conducive and political climate has been largely missing. This has led to delay in achieving industrial revolution in the country. Other problems affecting science, engineering and technology were identified and some practical solutions have been recommended.

Introduction

Science is the acquisition of knowledge about the basic principles at work in nature and in the environment. Engineering and Technology on the other hand, is the acquisition and application of basic 'scientific intelligence' to practically produce and economically utilize the materials and needs of society. Thus, on a general note, 'pure' science provides (theoretical) insight and understanding of the forces of nature, while engineering and technology as 'applied' sciences provide the practical and applied skills required to exploit nature and produce materials and services needed by society. It is clear therefore that for society to derive maximum benefits, the advancement of science must go together with advancement of engineering and technology. Hence in recent times, the demarcation between 'pure' and 'applied' science is no longer very definite.

The benefits of science, engineering and technology (SET) are evident in industry and society in general. From the production and manufacturing sector, energy and power generation, to communication and information technology, the benefits of science and technology are clearly demonstrated. Science, engineering and technology can help reduce poverty, enhance international competitiveness and build social capability (Olayiwola, 2003). Science, engineering and technology are vital to national survival and security. They form the basis of industrialization and development hence, all countries try to develop and improve their SET base and potential. Africa's hope of breaking the cycle of poverty, disease, ignorance and excruciating debt lies with the exploitation of the full benefits of SET under good governance. Lord Sausbury of Turville, the UK Minister for science, noted that, "Science is a key driver for wealth creation, employment and improving the quality of life. We believe that the excellence of our science base is a great national asset". Commenting on UK's economy in the same vein, Tony Blair, British Prime Minister, noted, "The science base is the absolute bedrock of our economic performance".

It has been recognized that the application of scientific intelligence proceeds in particular situations and under specific combinations of circumstances. Thus, Science, Engineering and Technology (SET) cannot proceed effectively without consideration of the social, cultural and economic environment. SET develops faster when it has a close, compact relationship with the society. Under such conditions, the needs of the society

provide inspiration for scientific and technological creativity; while on the other hand, an understanding society is able to fully exploit the benefits of SET. A society that has not experienced such a proper 'marriage' with SET, such that there is a general absence of the culture and context of science and technology, is bound to remain under-developed longer than necessary. Such is the case of Nigeria.

The absence of an environment that encourages the inculcation of scientific knowledge in the citizenry right from the cradle, is the first major setback to SET development in Nigeria. It has led to a weak SET base. It is perhaps the factor that has led to a dearth of students who study mathematics, the basic sciences and engineering, and acute shortage of qualified science and technical instructors in all the tiers of technical education.

There cannot be significant success in SET development without a well conceived and coordinated development strategy. The absence of a national survey and database of available indigenous technology, the experiences with the "Crash technical training", "indigenisation or Nigerianisation" programmes, and the establishment of technical institutions and research institutes which lack even the very basic technical equipment suggest a rather haphazard, unarticulated development strategy. There are institutional inadequacies and lack of effective coordination of SET among all the stakeholders.

Inadequate funding is another problem that plagues SET development in Nigeria. Universities, research institutes and technical institutions are ill equipped because of lack of funds. The economic recession has also made it impossible for technical graduates to acquire the needed pre- and post-graduation industrial experiences as industries operate below capacity. This has led to a decline in qualitative science, engineering and technology education. It has led to "Brain drain" or drift overseas of highly qualified SET personnel. Furthermore, basic infrastructure that could facilitate SET development are absent or dilapidated. High level of poverty on the other hand, has led to absence of purchasing power of manufactured products and engineering services.

Other problems include the high cost of importing and maintaining foreign technologies as evidenced in the moribund steel complexes and steel rolling mills. There is also a general lack of adequate organizational, managerial and entrepreneurship skills among the country's scientists, engineers and technologists, such that they are unable to readily translate their ideas to sound economic ventures.

This paper reviews the development of science, engineering and technology in Nigeria. It identifies the problems and challenges. It concludes and offers recommendations on the way forward.

Historical Review

It is difficult to establish the exact origin of Science, Engineering and Technology (SET) in Nigeria. However, it is clear that in pre-colonial times, efforts were made to adapt materials and forces of nature to meet some pressing challenges. Thus for example, houses were built from local materials, trees were felled across streams to act as bridges and boats and ferries were constructed for marine transport. Similarly, furnaces were locally built and operated to produce simple farm implements like hoes and cutlasses and to make the famous Benin bronze works, while herbal medicines were formulated for healing. However, during the pre-colonial times, African education in Science, Engineering

and Technology focused on social responsibilities, job orientation, political participation, spiritual and normal values. Physical training was by imitation, based largely on the apprenticeship system. The scientific bases of most engineering and technology activities were lacking as the empirical basis of such activities were neither outlined nor established

During the colonial times, basic science education was introduced in schools and colleges, while education in engineering and technology was undertaken largely by various technical departments and corporations like the Posts and Telegraphs (P&T), Nigerian Railways and Nigerian Electricity Supply Company (NESCO), to meet their specific technical personnel needs. For obvious reasons, literary education was generally more popular in Nigeria.

The first attempt at formally producing middle-level technical manpower in Nigeria could be traced back to the establishment of the Government Surveys School in Lagos in 1908 to train survey technicians. The Yaba Higher College was established in 1934 and the survey school was affiliated to it. In the 50's, the Nigerian College of Arts, Science and Technology was established, with Colleges at Enugu, Ibadan and Zaria. The College at Enugu specialized in Surveying while that at Zaria specialized in Engineering. Since then, the number of Polytechnics or Colleges of Technology in the country have risen to over thirty, with courses offered ranging from Civil Engineering Technology to Power Engineering Technology, Mining and Printing Technology.

Although university education in Nigeria had its origin in the implementation of the Asquith and Elliot Commission's Reports of 1945, it was not until 1961, when the first set of indigenous universities were founded, that the first faculty of technology was established at Nsukka. Since then the Nigerian government has recognized SET education as a potent instrument of change and national development, as reflected in the national policy on education. Technical manpower development in particular is regarded as a tool for generating 'a great and dynamic economy, and growing into a united, strong and self-reliant nation'.

The initial focus of SET manpower development in the universities and polytechnics was the replacement of expatriate engineers and technicians in government and public technical departments. Thus, the Ashby Commission of 1961 estimated an annual requirement of 500 Engineers and about 3000 Technicians for the first few post independence years. The support craftsmen were estimated at about twelve times the total number of engineers and technicians. The National Manpower Board was subsequently established to undertake proper survey and planning needed to meet national manpower requirements. The National Universities Commission (NUC) was also established in 1962 to coordinate orderly development of University education in Nigeria. Again, it must be restated that the first generation graduates of the universities were mostly teachers and administrators.

The first major policy shift from training administrators to laying a foundation for technological development and industrialization started about 1966. Thus, the Nigerian Council for Scientific and Industrial Research (NCSIR) Decree of 1966 formed one of the earliest, boldest, post-independence efforts to create awareness in the development of science, engineering and technology in the country (Rai and Anyanta, 1999). The council was to:

(i) Encourage, support and coordinate scientific and industrial research;

(ii) Advise the Federal Government on science and technology policy and development;
(iii) Encourage the study of science and technology;
(iv) Coordinate research programmes related to national development in research institutes and universities;
(v) Record problem-solving research projects;
(vi) Disseminate information and recommend the establishment of new research institutes.

The NCSIR facilitated the establishment of the International Institute of Tropical Agriculture, Ibadan (IITA) in 1967, the Kaduna Polytechnic in 1968 and the Yaba College of Technology in 1969. In 1970, the implementation of research findings in SET was streamlined while the scope of the NCSIR was increased by the creation of the Nigerian Council for Science and Technology (NCST). The aims of the NCST were:

(i) The application of research to the development of agriculture and industry;
(ii) Coordination and cooperation between all the establishments involved in science, engineering and technology policy;
(iii) Advising the Nigerian government in SET policy review, formulation, planning, implementation and evaluation.
(iv) Advising government on research findings, technology transfer, technical manpower education, etc.

The Council for the regulation of engineering in Nigeria (COREN) was established by Decree 55 of 1970 and amended by Decree 27 of 1992. The council was established to control and regulate the practice of engineering in Nigeria.

The creation of the NCST facilitated the establishment of the Nigerian Steel Development Authority (NSDA) in 1971. Similarly, the Agricultural Research Council of Nigeria (ARCN) and the Industrial Research Council of Nigeria (IRCN) were also established in 1971. While the ARCN established agricultural research institutes in Umudike and other places in the country, the Industrial Research Council of Nigeria gave birth to industrial and engineering research institutes such as the Federal Institute of Industrial Research, Oshodi (FIIRO) and the Project Development Agency (PRODA). Enugu. The Industrial Training Fund (ITF) was also established in 1971 to promote and encourage acquisition of engineering and technological skills for industry and commerce. The Petroleum Technology Development Fund was created in 1973 for the purpose of promoting Technical Manpower Development for the petroleum industry. The Petroleum Training Institute, Warri was also born.

The Institute of Applied Science and Technology was established at the University of Ibadan in 1971 with assistance from the Canadian International Development Agency (CIDA). The Institute introduced new courses such as Agricultural Engineering, Wood Engineering, Food Technology, Petroleum Engineering, Machine Design and Production Engineering. The objectives of the Institute were to:

(a) upgrade academic activities by which more efficient and sophisticated use is made of woods, minerals, oils, foodstuffs and other natural resources with which Nigeria is endowed;
(b) link academic life and industrial enterprise more closely through the training of men and women scientists, particularly at the postgraduate level, so that their knowledge

may be broadened to include the design, adaptation, upkeep, and use of modern equipment and machines which are necessary for a fuller utilization of locally produced raw materials;

(c) develop and intensify research in the application of science and technology to development;

(d) generate technology relevant to Nigeria's resources and needs.

In 1977, the need to unify, coordinate and cater more effectively for the numerous SET development efforts and policies in the country led to the establishment of the National Science and Technology Development Agency (NSTDA). For the first time, the universities were finally included in the national policy on SET Development, through the NUC. The National Board for Technical Education (NBTE) was also established to coordinate and promote the training of technologists and craftsmen outside the universities. The Federal Polytechnics Decree of 1979 further expanded the training and education of such middle level technical manpower. It is pertinent to also mention here that earlier on, a "crash training program" was also designed, aimed at quickly training some scientists and engineers abroad to meet the local technical manpower needs.

Following Nigeria's involvement in 1979 of the UN-sponsored International Colloquium on Science, Technology and Society in Vienna, the Ministry of Science and Technology was established through the National Science and Technology Act of 1980, to take over the function of the NSTDA. Some Federal Universities of Technology and Universities of Agriculture were also established between 1980 and 1983 in Minna, Yola, Makurdi, Abeokuta, etc. to facilitate national development in technology and industrialization. During the same period, iron and steel complexes were established at Ajaokuta and Aladja with supporting steel rolling mills at Oshogbo, Jos and Katsina. The Metallurgical Training Institute, Onitsha was also established for training craftsmen for the nation's steel plants and allied industries.

The National Science and Technology Fund (NSTF) was established in 1987 to provide capital for activities in Science and Technology Development and Commercialisation of research and development results. The Raw Materials Research and Development Council (RMRDC) was established in 1988 to support industrial development through the use of local materials. Other notable developments that were designed to impact on science, engineering and technology development in Nigeria include the establishment of the Aluminum Smelting Company and the Petroleum complexes at Port Harcourt, Warri and Kaduna. There are also, the Energy Commission of Nigeria, National Mathematical Center, National Science Laboratory, National Space Research Development Agency, National Office on Technology Acquisition and Promotion (NOTAP), etc.

From the foregoing, it is clear that efforts have been made to promote the development of SET in post-independent Nigeria, first through science and technical education. Understandably, the British pattern has been followed by training scientists, engineers, technicians and craftsmen at different tiers:

(a) The Universities for Graduate Scientists and Engineers

(b) The Polytechnics for Technicians

(c) The Technical Colleges for Craftsmen

(d) The Vocational Centres as well as Apprenticeship Schemes for Craftsmen, Artisans and Operators
(e) The Research Institutes for the Training of Scientists and Technicians.

Furthermore, the second efforts were directed at establishing the infrastructure and institutional framework necessary for SET development and industrialization. This was done through the establishment of research councils and making massive investments in iron and steel complexes, rolling mills, aluminum smelting company and the petrochemical complexes.

However, there were missing links. First, there are three major essential ingredients for industrialization, namely, adequately trained SET personnel, necessary infrastructure and favourable economic and political environment. It is this last leg that is the bane of Nigeria's industrial revolution.

Secondly, there is always, difficulty in transferring research results to the production sector. Thus, the results of years of research in universities and research institutes have not been translated effectively to concrete engineering and technology feats. One of the ways this has been overcome in some countries is by organizing some research units in such a way as to combine researchers from universities, private industries, research institutes, government technical staff and some identified possible users. In Nigeria, the use of agricultural extension officers has helped to quickly transmit research efforts in the agricultural institutes to farmers. This has not been extended to engineering and technology.

Policy Framework and Conceptual Issues

Three issues are crucial for nursing science and technology, namely, ideas, innovation and investment. Science thrives where the spirit of enquiry is fostered. The environment must be conducive to creative thinking and research. However, the best ideas must be converted into products and services for the benefit of society. This is where engineering and technology comes in as means of industrial development and social well being of the society.

Technology can be acquired in three major ways, namely, by self-development efforts, by copying (or stealing) from others and through transfer by formal or informal instructions. (Ebuh, 1998). Technology acquired by self-development is relatively cheap and can be readily adapted. It also could enhance creative abilities and ingenuity. However, its impact and benefits could take a long time to see. Technology acquired through imitation or copying could have immediate impact. However, there are side effects and this approach is often considered as an unethical or unhealthy professional practice. It is believed that the most effective way of acquiring technology is by instruction. Its impact could be immediate too since one does not have to take a long time to 're-invent the wheel' through self-development. However, one disadvantage is that the cost of instruction could be marked up significantly to absorb the implied loss of patronage. Furthermore, only 'old' technology is thrown open in the market and the instructor or technology source may not give up every detail to make room for further consultation. The contemporary and advanced technologies are showcased and not sold. Most countries adopt all these strategies of technology acquisition in different degrees.

In order to achieve scientific and technological development, it is important to properly

define national needs, formulate appropriate policies and strategies, and ensure effective coordination and implementation to achieve the national objectives. The effective implementation of the objectives depends on several factors, the most crucial of which are adequate finance and adequate trained manpower. For a developing country such as Nigeria, what should be the focus of the Science, Engineering and Technology policy? Should SET be seen only as a means of empowering individuals or made to prepare people for specific tasks and functions which are essential to the national development and the transformation of the environment? In other words, should the implementation of the national policy on SET be government-driven or private sector-driven?

Other issues that must be addressed include what specific, measurable, achievable and real-time tangible (SMART) techniques can be deployed to enhance SET development and policy implementation? What are the implications of privatization and commercialization of government-owned companies on SET? Will increases in foreign direct investment (FDI) have any effects on national SET aspirations and development? What are the implications of globalization on SET? How can the national policy on SET be effectively monitored constantly evaluated? It is clear that in the present circumstances of underdevelopment, SET should be regarded as a 'capital good' that requires some minimum state intervention and forward planning geared towards national socio-economic objectives and development.

The objectives of a robust national policy on science, engineering and technology should cover the following broad areas:

* Balanced approach to SET development, taking into account culture, needs, indigenous technology and available manpower.
* Promoting a diversified economy and technology base.
* Promoting on short-term self-sufficiency in certain areas such as agriculture and food production, petroleum and energy.
* Reduction of imports while promoting exports of processed goods instead of raw materials.

A well-articulated SET development programme should lay a solid foundation by creating a 'technological base' through an environment conducive for the breeding of 'Scientific Intelligence' and creativity among the citizenry. It is common knowledge that in the developing countries most prospective scientists, engineers and technologists have less exposure to computers and other mechanical devices than elementary sophomores do in the developed countries. In a recent survey in the United Kingdom, 80% of Britons agreed that Science and Technology should be given priority in order to enhance its international competitiveness. In addition, two out of every three people agreed that science and technology are making their lives healthier, easier and more comfortable. The most important issues in establishing a strong scientific attitude and technology base in the country are the schools and basic technology infrastructure such as electricity, foundries, forges, presses and concerns for manufacturing simple tools. For schools, curriculum development and evaluation, laboratories and the training SET teachers are most crucial.

The next stage should be directed at identifying the appropriate technology necessary for national development. Science and Technology based survey aimed at identifying and harnessing indigenous technology for development should be undertaken as well as caring

operating and maintaining imported technologies, through the training of scientists and technical manpower at various levels. However, indigenous technology that can be refined and upgraded should be given priority.

In order to properly assess and enhance development in Science, Engineering and Technology, the country's stage of industrialization needs to be defined and manpower requirements linked to the development stage. Thus, of the three stages of industrialization that has been identified, a country at the first stage requires mostly technicians and "generally skilled" personnel, while the second stage requires the development of manpower in science and all technical categories but at an appropriate mix. An advanced technology planted in an environment that cannot sustain its maintenance will simply not survive. Moreover, SET development involves a process of collective, multidisciplinary and dynamic learning and the domestic capacity to explore technology lies in the particular mix of capabilities that it is able to generate for producing or using the technology (Freeman, 1987). It is in this vein that the Nigerian Society of Engineers has suggested a mix ratio ranging between 32:4:1 and 60:6:1 for craftsmen, technicians and engineers for optimal technological development.

Another important requirement for a robust policy is the ability to set (SMART) national targets in specific areas of science, engineering and technology. The financial implications for achieving the targets should be clearly estimated. For example, in the UK, the investment in school buildings in 1996-97 was ?683 million while estimated cost for 2002-2003, 2003-2004 and 2005-2006 were estimated at ?3 billion, ?3.8 billion and ?5 billion respectively. Stakeholders and expected contributions should be articulated.

The Federal Ministry of Science and Technology has tried over the years at formulating a robust national policy on Science and Technology. It is not clear if the policy has successfully addressed all the multi-dimensional issues involved. Such issues include promotion of SET among the citizenry, research and development (R&D) funding, technology acquisition and transfer, technical manpower development and the challenges of effective coordination of SET activities with the Education Ministry, National Universities Commission, National Board for Technical Education, Technical Institutions, the research institutes, other Federal Ministries like Agriculture and Industry, the Armed Forces and all other stakeholders.

Situation Analysis of SET in Nigeria

The overview and quick analysis of science, engineering and technology in post-independent Nigeria leads to a realization of five distinct phases:

* 1960-1965: Training of SET manpower as administrators to replace expatriates.
* 1966-1970: Establishment of institutions for R & D.
* 1971-1987: Establishment of basic infrastructure for industrialization.
* 1988-1999: Economic recession and dilapidating SET institutions and infrastructure.
* 2000-200?: Commercialization, privatization of SET institutions and infrastructure.

There are several ways by which the impact of SET on the national economy can be evaluated. On a broad basis, evaluation can be done:

(a) Objectively, by assessing the impact on the usual economic indicators: GDP, foreign trade, FDI, etc.

(b) Assessing how far SET has helped relieve the traditional obstacles to accelerated

growth and development.

A detailed evaluation of the national efforts in Science, Engineering and Technology should include the following areas:

(i) Science, Engineering and Technology base of the country
(ii) Science, Engineering and Technology personnel
(iii) Government expenditure in Science, Engineering and Technology
(iv) Government expenditure on Research and Development
(v) Private sector expenditure on research and development locally
(vi) International comparisons.

For example, between 1999 and 2000 in the United Kingdom, published SET statistics show that total funding for research and development was 4,149 million pounds of which 72% came from government, 13% from charities, 7% from overseas (including 4%) from the EU), and 6% from UK industry. Gross Domestic Expenditure on R&D was 1.83% of the GDP. Similarly, statistics of higher education between 1999-2000 in SET subjects indicated 128,270 first degrees, 32,950 Masters, 10,735 Doctorates and 11,540 other postgraduate qualifications in SET subjects. In Nigeria, it is generally known that up to 80% of reported expenditure are for salaries and imports. For example, the national remote sensory satellite was launched in September 2003 at Plesetsa, Russia. The project, which has application for national security, population surveys, pipelines surveillance, etc., was contracted in 2000 to the Russian Space Agency at a cost of $13m.

Another way of evaluating the impact of SET on national economy is to use the survey and projections of personnel actually involved in SET or related activities in the economy. Enrolment in engineering and technical programmes is also considered. Usually, the demand for scientists and technical manpower is expected to be a function of the investment in the economy, economic growth rate, current employment level and the rate of employment. Thus, for example, the projection for technical manpower in the economy has been expressed as:

$$R = (E + V)(1 + r)^n + PnE$$

Where,

R = Employment level in n year;
E = Current stock in the base year;
V = Current vacancy;
r = Annual growth rate of employment;
n = Number of years from the base year; and
P = Annual wastage due to death, retirement, etc.

However, one major problem in making such estimates and projections is the scarcity of reliable data. Projections by the National Manpower Board appear to be based on government ministries, parastatals and departments rather than on in-depth surveys and articulations, also, there is the prolonged economic recession with the attendant massive unemployment and distortions in the economy.

A methodological approach can also relate science, engineering and technology to economic development, based on an analysis of the national level of Infrastructure, Experience, Skills and Knowledge (INEXSK) complimented with Business Environment indicators (Olayiwola, 2003).

Table 1 shows a survey of Engineering and Technology Faculties in Nigerian

universities. It can be observed in the Table that all engineering and technology faculties were established after independence in 1960. In addition, majority of the universities were established during democratic rule in the country.

Table 2 gives a survey of information, communication and technology utilization in selected countries while Table 3 gives the electricity consumption in selected countries. The two tables demonstrate clearly, the poor state of science, engineering and technology in Nigeria compared to countries like South Korea, South Africa, Egypt, etc. Table [illegible] gives a scorecard of telecommunication infrastructure in Nigeria between 1999 and 2003 and shows remarkable improvement. It again confirms that modest gains are achieved in SET under democratic governance.

Conclusions and Recommendations

The historical review and the analysis of science, engineering and technology (SET) in Nigeria have highlighted a number of problems. Policies have been formulated, but have been largely ineffective at dealing with all the contending issues. What must be done to achieve faster growth in SET development?

1. There is a need to foster the spirit of enquiry and creativity in science [illegible] in the society at large. In schools, the 6-3-3-4 educational system needs to be [illegible] and remodelled to make science more exciting. All laboratories should be adequately equipped. State governments should establish ministries or department of science and technology just like the federal government.
2. There is need to redefine national priorities and relocate funds from the less productive sectors to education, basic research and SET infrastructure. For example, during their economic recession, India did not allow the education sector as well as R&D suffer the same deprivation like other sectors. Massive investment is needed in Nigeria to urgently restore glory to science, engineering and technology in the country. There is also need to stimulate increased funding from industry, state and local governments.
3. There is need to reform the institutional arrangements for SET research support and funding of inventions. SET-based research and development should be a definite budget item at all tiers of government and in industry. It has been observed that one of the major reasons for the success of US science and technology is the fact that its programs are built largely from bottom up. This is different from what obtain in many countries where science and technology budgets are established at high government level and then shared among different programs.
4. There is need for better coordination of SET efforts, and improvement in relations and communications among universities, research institutes, industrial scientists and engineers. Electronic networking is long overdue. There is a need for a deliberated national programme like the Sabbaticals, aimed at increasing the flow of university SET teachers and industrial scientists and engineers in and out of each others' institutions.
5. There is need to improve the interaction between the public and the universities and research institutes. There is also need for more public awareness and interest in science and technology through innovative measures such as science museums, science exhibitions, 'meet the scientist' programmes on radio and television, etc. For example, in the UK, there is the Science and Engineers Ambassadors programme, set up to enable successful, young SET professionals visit schools, stimulate interest in SET-based careers and act as role models to students.
6. Furthermore, sources available for funding research and inventions need to be made easily available. For example, Israel has over 300 technology incubators and facilities for new (technology) ventures funds spread across the country.

7. While we must continue to encourage foreign direct investment in the economy, we need to become better negotiators on technology acquisition when striking agreements in science and technology projects and programmes. The privatisation policy of government must be done in such a way that it does not compromise national objectives in science, engineering and technology.
8. There is a need to rebuild basic infrastructure that will enhance science, engineering and technology. Such infrastructures include the Iron and Steel Complexes, steel rolling mills, electricity, foundries, forges, presses and other concerns for manufacturing simple tools.
9 There is need to create greater incentives for basic research and SET development. For example, all Ph.D students in critical areas of science, engineering and technology should be given scholarships or grants. Meanwhile, such students should be given additional training in business skills, resource management and entrepreneurship so that can be encouraged to translate their best ideas to practical jobs.
10. There is the need to tackle the problem of how to easily transfer the results of research efforts in SET to the productive sectors. The Federal Ministry of Science and Technology should introduce engineering and technology extension services just as has been done in the agricultural sector.

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Table 1: Survey of Nigerian Universities with Engineering/Technology Faculties

University	Year of Establishment	Year Faculty/School of Engineering/Tech was Established
Ibadan	1984	1970/7 (inst. Applied S&T)
Lagos	1962	1964/65
Abeokuta	1982	1984/85
Nsukka	1960	1961
Zaria	1962	1962
Bauchi	1980	1983/84
Ife	1962	1970/71
Benin	1970	1971/72
Makurdi	1980	1981/82
Kano	1977 (1975)	1978/79
Maiduguri	1975	1984/85
Yola	1981	1988/89
Ilorin	1977 (1975)	1978/79
Port Harcourt	1977 (1975)	1979/80
Owerri	1980	1981
Akure	1981	1988/89
Minna	1983	1984/85
Anambra	1980	1980/81
Rivers	1979	1980
Imo	1981	1986/87
Edo	1980	1981/82
Ado-Ekiti	1981	1985/86
Lagos State	1983	1986
Military	1985/86	Not Available
Oghomosho	1990	1990

Source: National Universities Commission

Table 2: Communication, Information, Science and Technology Indicators Per 1000 Persons in Selected Countries

Countries	Telephone Mainlines 1998	Mobile Phone 1998	Personal Computers 1998	Internet Host 2000	Scientists and Engineers in R&D
USA	661	256	458.6	1937.97	3676
UK	557	252	263	321.39	2000
Indonesia	27	5	8.2	1	n.a
S. Korea	433	302	156.8	60.03	2492
S. Africa	115	56	47.4	39.17	1031
Nigeria	4	0	5.7	0.01	15
Cote d'voire	12	6	3.6	0.42	n.a
Senegal	16	2	11.4	0.32	3
Egypt	60	1	9.1	0.73	459

Source: World Development Reports (in Olayiwola, 2003)

Table 3: Electricity Power Indicators Per 1000 Persons in Selected Countries

Countries	Consumption per Capita Kilowatt-hrs		Electric Power Transmission and Distribution Loses % of Output	
	1990	1997	1990	1997
USA	10558	11822	90	6
UK	4768	5241	8	7
Indonesia	156	329	15	12
S. Korea	2202	4847	5	4
S. Africa	3676	3800	6	8
Nigeria	77	84	38	32
Cote d'voire	158	181	18	16
Senegal	94	107	14	17
Egypt	697	803	12	12

Source: World Development Reports (in Olayiwola, 2003)

Table 4: Nigerian Telecommunication Scorecard: 1999-2003

	December 1999	December 2002	December 2003 (Projected)
Connected Fixed Lines	450	702,000	1,200,000
Connected Digital Mobile Lines	0	1,594,179	2.900,000
No. of National Carriers	1	2	2
Operating ISPs	18	30	35
Active Licensed Fixed Line Operators	9	16	30
Licensed Mobile Operators	1	4	4
KM of Microwave Links (Est)	16,000	23,000	31,0000
Private Investment $m USD)	50	2,1000	3,800

Source: Nigerian Communications Commission