

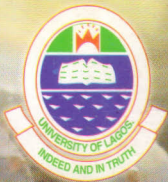
# CONFERENCE PROCEEDINGS



CP 357

## **AFRICAN REGIONAL CONFERENCE ON ENGINEERING EDUCATION AND SUB-REGIONAL WORKSHOP ON NEW ENGINEERING CURRICULUM**

CONFERENCE PAPER



*in partnership with UNESCO*



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# ENGINEERING EDUCATION FOR NATIONAL DEVELOPMENT.

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## ABSTRACT

The National Policy on Science and Technology arose from the understanding that Engineering and Technology are a source of strength to the nations. The very poor funding of science and technology activities and the high level of poverty in the Nigerian society are indices to the low level of technology development. The policy sought to use the nation's natural resources to integrate foreign technologies and upgrade indigenous technologies. There is need for a clear vision of what needs to be done to develop local human and material resources through Engineering Training and Research so as to create wealth and improve the quality of life of the citizens. Attempt is made in this paper to fill this gap through consideration of various inputs required for a new culture of Engineering and Technology for National Development.

## 1. INTRODUCTION:

The economic health of any nation depends increasingly on the fruits of engineering technology [5]. This axiom appeared to be the motivation for those who enunciated the National Policy on Science and Technology [1]. Today, there is little evidence that the Policy has been systematically implemented since the Ministry of Science and Technology was created in 1979.

The educational system that produces engineers had many problems to contend with: The level of funding for engineering faculties and for Research and Development in Engineering is dismally low.

- Academic and Professional careers in engineering were made unattractive through very poor salaries and lack of incentives.
- Engineering subjects taught are not often aimed at meeting the demands of society.
- Facilities for engineering training and education are presently obsolete. Engineering as a career has been made unattractive by deliberate corporate policies.
- Many engineering graduates find careers in accounting, banking, and insurance more attractive.



- The policy to develop local material and technologies and engender some self reliance through technology has not been encouraged. Consequently, there is poor maintenance culture of imported machinery and equipment.

In the light of the above, there is need to review the implementation of the National Policy on Science and Technology vis-à-vis Engineering Education in developing countries. It is possible that during the training process of engineers, a number of problems of the environment [solid waste treatment and disposal, traffic lights, drainage, highway failures and seasonal roads, traffic muddles, high cost of building projects, materials for road construction, gully erosion, desertification etc] shall be the focus of training and research. National and state policies, project conceptualization and planning can therefore be guided by the results of research from such training Institutions. A consistent programme of collaboration and liaison needs to be established between the users of Engineering graduates and the educational institutions that produce the engineers. The Federal and State governments should support the National Science and Technology Fund to ensure a steady input into the development of local capabilities in science and technology.

## **2. NATIONAL POLICY ON SCIENCE AND TECHNOLOGY.**

Science and technology were described in the Policy [1] as constituting a veritable arterial system through which intellectual activity can bring nourishment to every area of national development. The Policy was conceived at the early days of the Ministry of Science and Technology to:

- Encourage scientific and technological research and development
- Bring about technological innovations so as to integrate foreign technologies and upgrade indigenous technologies
- Encourage human resource development
- Ensure wealth creation through science and technology
- Promote international co-operation in science and technology.

If the above goals were truly sought, knowledge and understanding of the environment could be obtained through research to improve the quality of life of the citizens. Systematic exploration and exploitation of the natural resources of the country should lead to development. Effective mobilization of the scientific and technological community through provision of incentives and adequate funding of activities in this sector was expected to be the catalyst to continually encourage science and technology activities in public and private sectors of the economy and ensure the inculcation of such in the thinking and working process of Nigerians. Poor implementation of this policy can be seen in the poor funding of Research and other problems in the Universities and Research Institutes where new ideas in technology could be incubated.

## **3. FUNDING OF ENGINEERING EDUCATION.**

It has been widely reported that UNESCO recommends that 26% of national budgets be set aside for Education. However, the recent negotiated improvement in funding of Education in Nigeria achieved a level of funding of only 6% of National budget.

The faculties of Engineering in the country are poorly funded. Despite the high demand for consumables for Engineering Education no special allocation is made for updating



existing equipment and purchasing materials and components for laboratories and projects. This explains why prototypes of engineering systems designed and built in the universities are not encouraged. Such needs of engineering faculties should be considered in sharing the resources in the universities.

Figs 1-3 show the provision of funds for the Faculty of Engineering, University of Lagos over a period of twenty years. It is clear that no pattern can be said to exist in the allocation of those funds. However it is encouraging to find that some funds were sometimes set aside for Research and teaching equipment in the Capital expenditure. The budget allowed the faculty each year is so small that very little could be achieved through it.

The National, Science and Technology Policy sought to establish a National Science and Technology Fund with contributions from the Federal and State Governments and the public and private sectors. Such funds, if they exist, can assist in funding Engineering Education for therein lies the foundation of the technology based society of tomorrow.

#### **4. LATENT DRAGS ON THE IVORY TOWER.**

A university school of engineering is established to continually seek to strengthen the engineering and technology capacities of the country through study of the existing patterns of technology and striving to integrate the foreign technologies with some indigenous concepts. Through research and development, the faculty seeks to create new knowledge, extend old knowledge as well as disseminate and preserve knowledge [11]. The size of the academic staff of the school, the quality of postgraduate programmes, funding for research and the training facilities influence the output from the school. The strength of such a school of Engineering in research may be measured by the number of successful Doctoral theses, the number of staff publications in scholarly journals, the number of prizes won by the staff and the amount of research funds that the school can attract. A school of Engineering should also seek to solve the problems of technological advancement particularly in developing countries. It is specially staffed and equipped to enable it perform these roles. In Nigeria a number of problems are faced by these schools of engineering which prevent them from playing these roles, viz:

- Decline in academic environments as a result of poor salaries
- Use of obsolete equipment and research laboratories
- Isolation of university research community by industry and research institutes
- Apparent lack of national goals or objectives to which researchers can apply their drive and commitment
- Lack of up-to-date reference libraries
- Lack of funding for research
- Lack of scholarships for post graduate work
- Lack of committed post graduate students
- Increasing extinction of well trained and experienced academics in some engineering disciplines.
- Overwork of academic staff in spite of poor salaries
- Lack of clear national policy on research backed by adequate funding



If a nation needs universities for its economic vitality and national survival it must give their activities (research and education) a sense of direction.

## 5. ENGINEERING RESEARCH FOR NATIONAL DEVELOPMENT.

The need for engineering research that can impact on society has not been appreciated in developing countries like Nigeria. This is why engineering indices and data for planning and policy formulation are grossly lacking in developing economies. The state of roads in a country, the problems of the electricity supply industry, the drainage problems of a city like Lagos, the solution of problems of erosion and desertification data on implementation of major government contracts, local inputs in selected engineering projects, local sourcing of raw materials for technology related applications, local standards for engineering practice are data that can be obtained from engineering research. Such research, which can be useful for decision making in developing economies, should be carried out by the universities, government research institutes and professional bodies. These three arms should provide in the same country a body of research scholars who influence one another and whose co-operative and competitive efforts set standards of achievement for the nation.

Despite the many research institutes and universities in Nigeria, there is low productivity in engineering research. Majority of the population live in poverty due to lack of appropriate technology that can improve their productivity. This dismal situation can be attributed to:

- The latent drags on the ivory tower
- The isolation of Universities' Research Institutes and Industry from one another removing the interactive environment needed for brilliant research
- Absence of clearly defined National problems, goals and priorities for research.
- Very low funding for research and development efforts of the Universities.
- Lack of interest in research in local industries.

Many companies in Nigeria today are experiencing low capacity utilization as a result of dependence on imported raw materials, equipment failures, high cost of spares occasioned by high cost of foreign exchange. The Federal Government policy of self reliance should have spurred these companies to search for local substitutes for raw materials and local production of spare parts. Engineers are trained to seek new and more efficient processes leading to improved and high quality products which ultimately should lead to increased revenue. It has been reported by Adedeji et al ( 1988) [12] that Delta Steel Company with consumable items numbering about 70,000 and with 80% of them imported had made some progress in the search for local substitutes for some of the raw materials imported by the company. Engineering Research should brighten the prospects and options for industrial development. Through such efforts, upstream and downstream industries in the petroleum and steel development sectors can be technically supported. The contributions of the research institutes and Universities can impact National development if government provides the enabling environment for them.

Federal Ministries like Industries, Science and Technology, Power and Steel, Works and Housing, Communications, Solid Minerals, Agriculture, which are employers of engineering



manpower often have policies and programmes which overlap. There is need for inter-ministerial collaboration in Engineering Research. They can benefit from the results of engineering research for appropriate technology. They should fund projects in the Universities and research institutes that tackle identified environmental problems. Professional bodies in engineering disciplines should assist to ensure that there is some national interest in results from engineering research. This could catalyse the search for goals and objectives for engineering research in Nigeria. There should be adequate funds provided to support Engineering Research in Nigeria.

## 6. ENGINEERING EDUCATION

Education is the creation of awareness on which a job-training can be built. Consequently engineers receive from the Universities, basic scientific and general knowledge that enable them train for future responsibilities. Every engineering job has a requirement for training and acquisition of professional skills. Engineering education involves academic and practical training of the prospective professionals.

Education prepares its benefactor for usefulness to the society. Engineering education imparts some of the practical knowledge that assists the graduates to find solutions to the developmental problems of society. Engineering faculties should therefore:

- Have well equipped laboratories to ensure that the graduates meet some minimum training requirements.
- Review curriculum regularly to meet the changing needs of society.

Non-provision of funds for updating teaching equipments and students projects has led to some loss of interest in practical work in some engineering faculties. Graduates with little experience from University laboratories cannot improve the poor maintenance culture in developing countries nor be in the vanguard for acquisition or development of appropriate technology.

Inadequate training facilities has led to graduates of some engineering faculties in developing countries being found deficient to meet needs of industries. It has also led to retraining of engineering graduates by some conglomerates in these countries. It is difficult to explain this development since the universities train the graduates for the same companies. Why is it that the companies cannot provide funds for the Universities to be better equipped to produce graduates that meet the needs of industry? Such training further extends the time required to produce useful engineering graduates. The Universities and Industry should work together to ensure that present limitations of the engineering faculties are eliminated.

Curricula should be fashioned not only to be IT friendly, but should be applied to system models that form the core engineering systems of some industries [NEPA, NITEL, etc]. A University faculty of engineering can be engaged in projects to solve some local problems as part of its community service e.g. rural electrification, provision of traffic lights, drainage improvement etc. Staff and students of the University of Lagos have been involved in projects within the University in electrical power, computer assembly, electronics and communications [8]. Participation in such projects would rekindle the interest of the graduates to participate in finding solution to problems of modern society.



## 7. NATIONAL SCIENCE AND ENGINEERING INFRASTRUCTURE (NASENI)

The recommendations of a National Committee on Engineering Infrastructure (1990) led to the establishment of a National Agency for Science and Engineering Infrastructure (NASENI) in 1992. This Agency was charged with the responsibility of implementing science and engineering infrastructure development programme. It was believed that a well developed science and engineering infrastructure is strategic to national development and contributes to a virile and resilient economy. This programme required NASENI to catalyse the emergence of endogenous capacity for efficient production of goods and services through:

- Establishment of a system of science and engineering infrastructure development complexes capable of providing delivery systems, training and technical assistance to satellite industries.
- Assistance to local entrepreneurs to invest in indigenously tooled small scale industries and incubation of such delivery systems.
- Support of research and development towards achievement of objectives.
- Attract foreign investment for achievement of the industrial development programs.

About twelve science and engineering industrial development complexes were proposed to be built as enabling environment for technological development with associated capability for employment generation. Ten years after creation of NASENI the national will to commence the programme in earnest has not yet been mustered.

## 8. STANDARDS FOR ENGINEERING PRACTICE: ROLE OF UNIVERSITIES.

The culture of using codes and standards in engineering design and construction is inculcated in engineers during university education and subsequent training requirements. In developed countries, codes and standards evolved over the years from the work of both governmental and private sector organizations set up to provide them. The enforcement of such standards is also done by government and non-governmental agencies. Engineering codes and standards are subject to continuous evaluation and review which are only possible in standard laboratories. Adoption of national standards is often preceded by professional workshops and production of relevant literature. Engineers in Nigeria have relied mostly on standards from the British Standards Institute, the American National Standards Institute and the International Electro-technical Commission for Professional Practice. The Standards Organization of Nigeria has provided standards for quality of mostly commercial products.

Although engineering profession is international in outlook and may rely on the same tested standards, some of the important standards are dependent on environmental factors such as temperature, humidity, pressure and atmospheric particle density. There is therefore the need to develop codes and standards that are influenced by the environment of developing countries. Engineering faculties with laboratory facilities in every discipline can assist in developing and popularizing codes and standards for engineering practice. They have the experts that can provide literature and organize the workshops that should precede adoption of such standards. They should liaise with the Standards Organisation of Nigeria to recreate the past rather than always inherit it.



## 9. ROLE OF PROFESSIONAL BODIES.

The engineering profession is dynamic in the sense that an active professional must continue to embrace new developments in the discipline in order to remain current. Professional development is an aspect of engineering education that is of interest to professional bodies. The professional bodies can therefore be said to be partners with universities in engineering education. Leaders of professional bodies in developing countries have not yet recognized this partnership. Most academic staff of engineering faculties are required to be members of professional bodies and the relationship is symbiotic. Professional bodies like the Nigerian Society of Engineers and the Academy of Engineering can support engineering education through:

- Engineering research grants
- Engineering Information and Documentation Library at Engineering House
- Encourage excellence and achievement through prizes and awards to deserving engineers.
- Encourage academic scholarships to deserving engineering students
- Support international exchange programmes.
- Support publication of learned papers and research findings.
- Funding of inventions and innovations within the engineering family.
- Funding of professional chairs in engineering faculties.

A common characteristic of developing countries is the dearth of data for planning. Many policies which can catalyse acquisition of technology such as science and technology policy, construction policy, education policy etc have been put in place but there is no information as to how they are being implemented. Such data can be used in any lobbying of Government to achieve desired improvement in future. Engineers, by their training should be able to monitor government development projects in precise terms and generate data that can be useful for planning. Professional bodies and engineering faculties can collaborate in this kind of study. Such effort can help reduce the number of abandoned projects and wastage of resources in developing countries.

## III. CONCLUSIONS.

Engineering and technology development has been shown to be the responsibility of engineering faculties, research institutes, corporate bodies employing engineers and professional bodies. The various bodies should have adequate funds for research and development and maintain collaboration with one another. The setting of national goals for research and the focus on environmental problems during engineering training should produce manpower that meets the needs of society. The National Science and Technology fund should be sustained to ensure consistent funding of research and development activities. Professional bodies should assist in monitoring development projects so that the public may be informed of the progress being made vis-a-vis public funds being expended.



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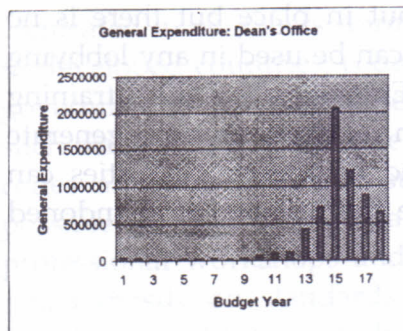


Fig 1(a)

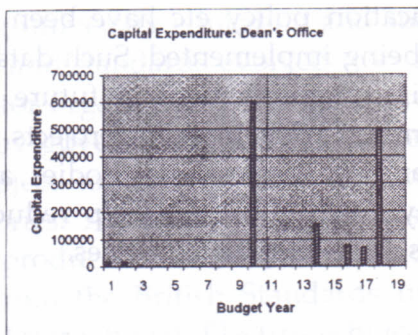


Fig 1(b)

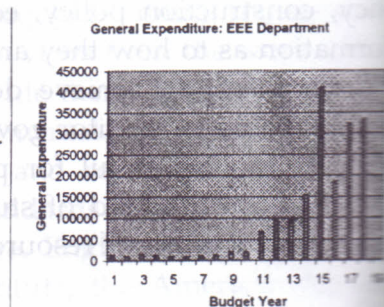


Fig 2(a)

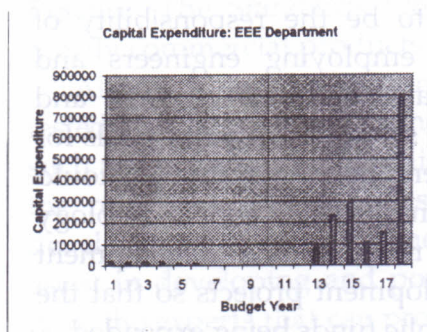


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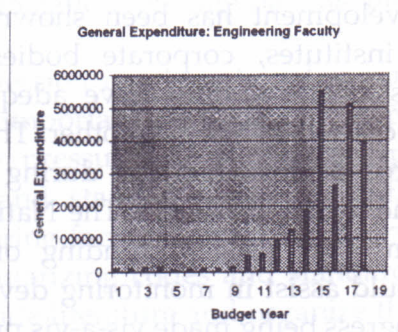


Fig 3(a)

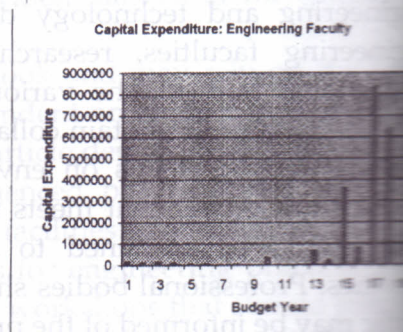


Fig 3(b)