

**STRATEGIES FOR ENHANCING ENGINEERING PROFESSIONALISM AND STRENGTHENING  
TECHNOLOGY-BASED ORGANISATIONS THROUGH THE PROMOTION  
OF FUNCTIONAL EDUCATION IN NIGERIA**

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**ABSTRACT**

This article focuses on criteria to enhancing engineering professionalism through the promotion of functional and qualitative education and training in Nigeria. It examines the factors influencing the establishment of engineering standards and codes of conduct in Nigeria. It also discusses challenges affecting the low impact of functional and qualitative engineering education in Nigeria. The paper then recommends strategies for enhancing engineering professionalism and strengthening technology-based organisations in manufacturing, contracting / consulting, design, education and training among others in Nigeria.

**Keywords:** Engineering, Professionalism, Engineering standards, Codes of conduct, Functional and Qualitative Education, Nigeria.

## 1.0 INTRODUCTION

In Nigeria, we are aware of the existence of several professional organisations such as the Nigeria Medical Association, the Nigeria Bar Association, the Nigeria Society of Engineers, the Institute of Chartered Accountants of Nigeria, the Institute of Architects, Pharmaceutical Society of Nigeria, e.t.c. All these are concerned with problems of how to maintain high standards of professional practice in their area of specialisation. The professionals have become a dominant feature of modern area of life, requiring expertise, and that the regulation of practice in such areas is better left to the experts who operate with considerable autonomy within the laws of the land and the framework of society established by legislature, it is the responsibility of such professions to establish the criteria for training, and to screen qualification for admission to the practice of the profession [1]. They also lay down code of ethics that should guide the practice and have sanction to penalise infringement of such code. Because of our nations emphasis on development which to most people, consist largely engineering works in terms of electricity, water supply, roads, telecommunications, transportation by road, rail, sea or air, building, factories, machines etc.

The engineers insist that engineering is “the creative application of scientific principles to design or develop structures, machines, apparatus or manufacturing process” [2]. This definition has not succeeded in clarifying the distinction between engineering and technology, which implies the use of hand in practical action. It occupies an intermediate position between crafts, techniques and engineering [3]. Engineering is as old as man himself. This concept is based on the premise that engineering is technology put into action, where technology is defined [2] as “a flexible repertoire of skills, knowledge and methods for attaining desired results and avoiding failure under varying circumstances”. This is in line with Chambers Encyclopedia which describes engineering as “that branch of human endeavour by which the forces of nature are brought under human control and the properties of matter are made useful to man in structures and machines. Engineering is about problem solving, finding better and easier ways to do our work. Ultimately, engineering is about creating technology; technology being a collection of proven techniques that get things done. Thus every modern device such as cars, radios, telephone, aeroplanes, pepper grinder, camera, spaceships and everything that works is a collection of various pieces of technology. All of technology is a creation of engineering and the engineering process.

Professionalism is the conduct or aims or qualities that characterise or mark a professional person or profession. A profession is a group of persons wanting to cooperate in serving the same ideal better than they could if they did not cooperate. There are four main characteristics, which distinguish a profession from other less formally constituted occupations [1]: (i) expertise: command over a body of systemised and standardized knowledge, developed and updated on behalf of society, transmitted through recognised channels of training and examining of new recruit. In the case of engineering, the core of the training is that “the planning design, creating and economical operation of physical structures or engine”, should be based on the application of laws of mathematics, physics, and chemistry and the recruit be subjected to a period of practical pupillage; (ii) code of ethic: which governs the performance of the professional defines his relationship with his clients in particular and society in general. This can be enforced by the profession’s own institution which emphasize accountability and discourage mercenary service among its members; (iii) monopoly: granted by society through laws that reserve designed functions solely to members licensed by the profession’s own institution as possessing the requisite training and qualifications of expertise referred to above; (iv) autonomy: a measure of independence

granted by society though law to enable the profession to regulate itself, discipline its members, and control the practice of the professions, without undue interference from the employer, client or government.

Owing to the lack of poor understanding of an engineer or the engineering profession, the engineer identity is out of focus. Hence many people equate the engineer to his functions or trades. For instance, many view the motor mechanic as a mechanical or automobile engineer, electrician as an electrical engineer and a carpenter or bricklayer as civil engineer. Such viewpoints of the engineer influence the expectations of the society with respect to the functions of the engineer in the society. The engineering profession is pyramidal in structure. The trades with the skilled craftsmen form the base of the pyramid that gives its stability and the stem of the pyramid consists of the technical workforce. The professional engineer is at the apex of the pyramid. He directs and controls the professional pyramidal structure for effectiveness. The artisan and craftsman (products of the Technical colleges, Trades centres of old and Vocational schools) are specialists in the use of special tools, operation and maintenance of all sorts of special machinery like lathes, graders, dumpers, cranes, etc. The technologists and technician (products of the polytechnics, monotronics and Colleges of Technology) are trained in application and maintenance of existing technologies, and less about how to create or develop new technologies while the engineer (the products of University degree programmes) is trained and equipped with the theory and knowledge of the sciences, science of materials and tools of analysis of engineering problems to create new technologies (that is to create new solutions to engineering problems), and to extend the boundaries of application of existing technologies. All these member of the engineering family must work together to get the job at hand done. The real engineers unfortunately are the ones Nigeria would like to sideline and has been sidelining at great cost to her economy and development [4]. It has become necessary for the developing countries to get a clear picture of the engineering profession. The failure to do this has been the responsible for its poor development status. Its development plans have lacked the vital engineering inputs and as such run into execution problems or has become stalemates.

To sustain the practice of engineering in Nigeria, there is a need to educate new set of young people in engineering in the proper manner. How well an engineer performs his functions depends on the training he has received. Ezeh [5] outlined the foundation on which tertiary education has to be based. He described the foundation to be the basic science subjects and mathematics at the senior secondary school level. In the present day Nigeria, to study any of the engineering course in any tertiary institution, or the West African School Certificate (WASC) of the West African Examinations Council (WAEC).

The functional, effective, qualitative and well-structured engineering training is in three phases: educational, professional and continuous retraining. For anybody to go into engineering profession, he must be well groomed in the sciences and mathematics. He must also be adequately qualified in communications ability. With such background, the engineer acquires his basic education in university for five years and obtain a first degree that certifies him to be a potential future engineer. Somebody who attends Polytechnic can also move up the ladder to qualify as a professional engineer through two routes: a bridge course called a postgraduate diploma in the discipline of interest, or Graduateship examination.

After the basic education, the potential engineer starts his pupilage training under a professionally registered engineer in his own discipline. After four or six years of such training, he embarks on the registration procedure by being active in the Nigerian Society of Engineers (NSE). By application, examination and

interview, he obtain the corporate membership of the society which qualifies him for professional registration with the Council for Registration of Engineering in Nigeria (COREN). The engineering training and personal development does not end with registration. In fact, one may rightly say that registration is the starting point of the professional engineer career ladder. His development follows from attendance and participation in professional symposia, seminars and conferences. He keeps abreast of the profession by establishing a good technical library with the updated editions of textbooks, handbooks and journals in his discipline and allied fields. Eventually, the professional engineer becomes an experienced resources person in his field of specialisation. Mbanefo [6] concluded that engineering education in Nigeria should be a partnership between academic, professional practise and the student.

It is a health policy for many developing countries to train people in the engineering profession, a profession that crease wealth by adding value to materials, and converting them to precious consumable goods. The competitiveness of a nation depends on a whole range of factors including the macroeconomic environment, the commercial framework, the openness to trade and investment, the level of education and training of the work force, the ability to innovate the flexibility of the labour market and adequacy of the transport sector and communication infrastructure [7]. It is clear that business cannot function and therefore wealth creation cannot be achieved without engineers. One hopes that Nigeria will become fully awake to her critical need of the country for the improvement of the citizens' standard of living. No profession impinges on our daily life more than engineering. We should not be under the delusion that this country will be developed by foreigners. It will only be developed by Nigerian engineers and technocrats. What is needed is to provide appropriate education and training to impart the skills and professionalism needed for development. Thus this paper is motivated by this desire. The objectives of this paper are: (i) analyse the factors influencing the establishment of engineering standards and codes of conduct; (ii) examine the challenges affecting the low impact of functional engineering education and training and (iii) recommend the strategies that can enhance engineering professionalism and strengthen technology-based organisations in manufacturing, contracting / consulting, design, educating and training among others in Nigeria.

## **2.0 ANALYSIS OF THE FACTORS INFLUENCING THE ESTABLISHMENT OF ENGINEERING STANDARDS AND CODES OF CONDUCT IN NIGERIA**

Under normal circumstances, one is right to think that the system would not be circumvented. However, a critical analysis raises some following thought-provoking issues among others:

- **Policy Making Process:** Policy making and the process of developing infrastructural facilities are influenced majorly by government and interest of the officials in government. Professional advice is always secondary while taking decisions. Political consideration is a very great factor which most of the time negates professionalism. Many competent engineers are unable to assert professional independence by allowing political master to influence their professional judgement which usually lead to wrong decisions. The after effects of such decisions is that the engineer receive the blame and he is termed incompetence. The Nigerian society have bastardised engineering profession by patronising quarks and emergency contractors who desecrate with impunity, the engineers ethical codes that are supposed to be sacrosanct;

- **Foreign Ideas Imposition:** Some foreign engineering companies still manage to do business in the country in apparent disregard for its basic law [8]. Foreign companies propose and in certain cases impose their prescribed obsolete engineering design and send in managers with practically no engineering qualifications from their home countries. Well qualified local engineering staffs are then recruited as subordinates to such foreign staff. Design errors, obsolescence and discrepancies are discovered after series of reviews of project handled by these foreign companies. At times refurbished equipment are supplied as new for project in Nigeria. The sleight of hand of consultants plays an important role in penetrating the problem. With complete disregard for professional ethics, unscrupulous consultants and contractors collude to siphon off scarce international capital lent to Nigeria, leaving a legacy of perpetual indebtedness in the country;
- **Obsolete Codes and Standards:** In most cases, the codes and/ or standards used in our various industrial sectors are obsolete (in the least or are in conflict with one another) [9];
- **Ineffective Monitoring:** Engineering Regulation monitoring (ERM) programme of the COREN is partly to address problem faced by the Engineer in the discharge of his duties. ERM has not achieved much success as is evident all over the place, ERM programmes has been inaugurated in at least 20 NSE branches across the country. These branches include, Calabar, Uyo, Port-Harcourt, Benin, Aba, Warri, Umuahia, Owerri, Onitsha, Awka, Enugu, Asaba, Ibadan, Lagos, Akure, Ilorin, Abeokuta, Kaduna, Ajaokuta and Ado-Ekiti [10]. Even in place where ERM programmes were inaugurated;
- **Indiscriminate Posting of NYSC Members:** State governments have consistently influenced the NYSC directors in their state to post engineering corpors indiscriminately, without due consideration to the need to post them to engineering establishment where they could acquire practical experience relevant to their profession as it is done for doctors, lawyers, and accountants. SITSIE has so far not delivered the expected results mainly because the Organised Private Sector (OPS) did not 'buy' and support the scheme [11]. This observed un-complementing position of the OPS is not an indication that the OPS is not concerned with professional development of its young engineers-a state which the OPS are consciously propagating;
- **Discrimination within the Profession:** This is a major source of imbalance that has affected the so desired professional relationship among the various cadres in the engineering family in the country. The discrimination between holders of the HND and the B.Sc. in terms of remuneration should therefore be played down to meet the basic technological development in the country. The theoretical content in polytechnic engineering education should be 40 percent and practical content be 60 percent in order to solve production and mechanisation problems and thereby favour increased technological content;
- **Not Learning to Work Together:** The one man business syndrome has become the trade mark of the engineering industry in Nigeria. There are many roadside workshops, small and medium scale industries and engineering consultancies owned and managed as one- man outfits. The major reason is that many members of the engineering family have never learnt to work together as a result of mistrust and fear of losing control of their various businesses. The unfortunate aspect is that such single proprietors are unable to marshal enough resources, connections and managerial ability to ensure success of their operations [12];
- **Lack of Technical Specification for Engineering Materials:** Most engineering materials that are used by the companies, in manufacturing their product are imported. And some of the businessmen selling these engineering materials are not technically oriented. Therefore, they are not in position to know the material composition and the general (engineering) properties of their goods. This information is needed in design;

- **Lack of Sufficient Knowledge, Experience/Confidence to make Changes in their Codes and standards:** Local-partners generally do not have sufficient knowledge, experience or confidence to make changes on their own. In many cases, the terms or agreements prevent the Nigerian partners from doing so [9];
- **Lack of Development of Organisation Standardisation Activity:** The local partners may not have sufficient supporting data of their own to convince their overseas collaborators that valid reasons exist for seeking deviations from overseas standards which are not directly applicable to local conditions [9];
- **Existence of Multiplicity of Standards/ Codes:** Many practicing engineers who were trained overseas adopt the various codes and standards of the countries they were familiar with as their practicing codes and standards in Nigeria. This is evident in the avalanche of codes and standards existing in Nigeria e.g. BSI (British standards), DIN (Germany standards), AFNOR (French standards), ANSI (American standards), GOST (USSR standards), BIS (Indian standards), CNSI (Chinese standards), and others [9].
- **Lack of Nigerian Design Codes:** It is indefensible that local codes and standards have not been developed by Nigerian engineers for use in design of civil and structural engineering works [9 and 13]. We rather depend on foreign codes. This, in itself, is a tacit endorsement of foreign influence in Nigerian construction industry;
- **Engineering profession not Accorded its Rightful place by Government:** One indicator by this is that there is no key ministry in Nigeria public service where the leadership (Commissioner or Minister) is reserved solely for engineers or even engineering related professionals; The ministry which have high engineering content or technological bias are the Ministries of Works and Housing, Mines and Power, Transport, Communications, Industries and related parastatals. These ministries should be headed by professional engineers [13];
- **Non Patronage of the Indigenous Firms/Engineers by Government:** The level of patronage of indigenous consultants and contractors in construction projects is very low [13]. Preference is given to the multinational firms operating in Nigeria over the indigenous ones. As a result of non-patronage of local consulting and contracting firms, there are no job opportunities for many indigenous engineers and this lead to under employment of local engineers and non-development of indigenous expertise despite the large magnitude of construction works going on in the country;
- **Lack of Job Opportunities for Young graduate Engineers:** Many of the young engineers are unemployed for long after graduation. Some that got jobs are employed into government ministries and parastatals, for lack of opportunities, find themselves doing little or nothing and over the years get promoted into positions of higher responsibilities with little or no corresponding attainment of professional skill. Lack of job opportunities has discouraged interest of secondary school leavers in engineering education. The situation in Federal Capital Development Authority (FCDA) where embargo was placed on employment since 1990. This has resulted in more engineers on grade level 15 than grade level 8 with no engineers on certain levels [6]. The decline in activity of the industrial sector of the economy has resulted in fewer job opportunities and this has a negative effect on the willingness of young bright people to enter the engineering profession;
- **Lack of Exposure of Young Graduate Engineers to Necessary out-of College Training:** Young engineers are not getting the necessary out-of-college training. This is attributed to importation of foreign engineers. For that reason, our young engineers are not exposed and therefore not experienced and not

qualified for certain jobs [5]. Some that consider themselves lucky are employed into local government services where, invariably, most find themselves as the only engineer without the benefit of any exposure to required training under experienced senior engineers; and

- **Non-encouraging Attitude of Organisations Making use of the Services of Engineers to Continuous Professional Development:** Most of the organisations refuse to sponsor their engineers to attend workshops, seminars, and conferences. Journal and internet facilities are not provided. Some of the engineers that are sponsored to conferences are only in financial gains as they will not attend most of the technical sessions [6].

### **3.0 CHALLENGES AFFECTING THE LOW IMPACTING OF FUNCTIONAL AND QUALITATIVE ENGINEERING EDUCATION AND TRAINING IN NIGERIA**

An appraisal of the Nigerian engineering educational system reveals the following as challenges militating against the low impact of engineering education and training [14]:

- ***Non flexibility and Obsolete Curricula:*** The engineering education curriculum in Nigerian tertiary institutions can be said to be obsolete. Engineering curricula are too focused on engineering science and technical courses without providing sufficient integration of these topics or relating them to industrial practice. Programmes are content driven. Another problem hindering effective engineering education in Nigeria is the issue of curriculum design. This curriculum, uniform to most universities, has not been thoroughly reviewed since the British who established universities and assisted in their development [15]. Curriculum does not place emphasis on manufacturing. Students are not equipped with appropriate skills and knowledge for entrepreneurship. The present system of education cannot produce high technical skilled people that would turn to be entrepreneurs. Technical and vocational education have remained a window dressing for long if at all they are existing in the technical colleges. The Council for the Regulation of Engineering in Nigeria has the responsibility for accrediting engineering faculties in Nigerian tertiary institutions. Though it reports that curriculum is adequate, it is apparent that Nigerian engineering students are computer deficient. Computer based design packages (such as AutoCAD) are not taught in any Design programmes at any of our universities. Instead, where computers would be used in developed nations, our students continue to use drawing instruments. Even the instructors are not proficient in the use of computers. This is a deficiency in our education, which can be linked directly to the lack of adequate funds for university and also exposes the need for curriculum revision. Curriculum review and development are urgently needed, but cannot be done arbitrarily. Review must be done based on the requirements and expectations of the Nigerian society (Industry, economy, etc.) of engineers. One way to achieve this is to have practicing engineers serve on advisory committees for curriculum design on engineering education. The Council for Regulation of Engineering Education (COREN) and the Nigerian Society of Engineers (NSE) have been active in this area, but sadly, their efforts have not so far brought any major improvement to the state of engineering education;
- ***Student Insufficient Exposure to Industrial Practice:*** Existing faculty lack practical experience, hence are not able to adequately relate theory to practice or provide design experiences. Graduate still lack communication skills and teamwork experience and programmes need to incorporate more opportunities for

students to develop these. Programme also need to develop more awareness amongst students of the social, environmental, economic and legal issues that are part of the reality of modern engineering practice. The leading qualities of a good engineer are technical ability, imagination and solid judgement. Technical ability depends on technical knowledge [15]. Engineering education must impart technical skill as well as financial, communication and social/political skills. Early exposures of students to technical programme as well as developing their computer knowledge base will develop their creative thinking and technical skills, and help them understand easily what they are taught. In Nigeria, engineering practice through the student work experience programme (SWEP) and the student industrial work experience scheme (SIWES). These programmes constitute part of the requirements for the award of an engineering degree. The SWEP programme is usually conducted within the students' local University at the end of the second year and lasts for about a month. The SIWES is an exposure to industrial practice. It runs for three months at the end of the third year plus a minimum of four and maximum of six months after the first semester of the fourth year. Sadly, the tertiary institutions have not gained the cooperation of industries in the SIWES programme. Students still find it difficult to get positions for industrial attachment and when they do, they are not properly supervised to ensure that they actually acquire knowledge as well as technical skills. This is partly because the industrial manufacturing base in Nigeria is very low and also because of the reluctance of industries to allow their facilities to serve as training grounds;

- ***Inadequate Funding:*** Engineering schools in Nigeria are best by: inadequate number and quality of lecturers and instructors; poor library facilities; and inadequate (quality and quantity) training facilities. These problems are directly caused by inadequate funding of the academic sector. Funding for Nigerian Universities has traditionally been from grants by governments and international agencies, research donations and contracts usually tied to specific projects, consultancy and other services rendered by the university, and endowments [15]. Our first generation institutions, the ones that have existing facilities for teaching, are the most deeply affected by low funding [16]. Whilst engineering education in Nigeria cannot be described as substandard, it is nevertheless inadequate to completely equip students to cope with the challenges of modern day society. The government funding amount are grossly inadequate and facilities, much less embarking on new project which are capital intensive. Except, of course, such projects are funded by grants from international agencies;
- ***Lack of Exposure of Young Graduate Engineers to Professionalism Prior to their Employment:*** A review of the various academic programmes of engineering faculties in Nigerian tertiary institutions shows that there are no formal courses specifically assigned to teaching of ethics and professionalism and students get little exposure to engineering as it is practised in industry. Yet, the undergraduate education appears to be the level at which the foundation of professionalism and ethical conduct should be laid [17]. There is minimum contact of undergraduates with highly experienced practicing engineers while in school. An engineering educator who has not kept up with the trends of engineering practice in the country cannot truly motivate the students and young engineers towards proper ethical and professional conduct / practice in their career;
- ***Ineffective Transfer of Information:*** Obstacles to effective transfer of information are [18]: (i) lectures are usually delivered in the classroom environment with little or no practical back up; (ii) The involvement of industry in the training of engineers via industrial attachment is highly eroded because of poor quality



placement as a result of non-availability of challenging projects in the sector; (iii) seminar, workshops and conferences are rarely organised jointly by engineering educators and industry leaders, this hinders the transfer of knowledge from university to industry and vice versa;

- ***Over-enrollment of Students:*** Large student enrolment as a result of high demand of engineering education while necessary facilities are inadequate results in overloading of faculty members. Faculty members therefore have little time to spend on developing research goals. In order to alleviate this problem, enrolment should be matched with the available facilities. Faculties should also embark on recruitment drive and staff development scheme [19];
- ***Insufficient Design Experience to Students:*** Current programmes do not provide sufficient design experiences to students. Traditional methods of teaching design in the various disciplines have been largely mathematical. This has created the wrong impression that design is purely mathematical. Granted mathematical concepts, models and equations aid design procedures.
- ***Poor Background in Science and Mathematics of some of the intakes:*** Some of the intakes to the faculty of engineering in tertiary institutions are unteachable due to poor secondary school foundation in science and mathematics [20]. Since engineering is all about the application of the principles of nature to designing tools, machines, processes and plants, one who aspires to be an engineer must not only have a firm grasp of the natural sciences but must be taught to be imaginative, innovative and be a problem-solver. This is absent in most of our secondary school. Some other identified problems responsible for poor background are incessant strike by teachers, low morale of teachers resulting from poor funding, lack of essential textbooks, non-functional introductory technology and science laboratory equipment, lack of adequate parental guidance, lack of school counselors, less premium on talent or natural endowment etc.;
- ***Poor Teaching Resulting from The Infamous Publish or Perish Syndrome:*** The existing teaching and learning strategies or culture in engineering programmes is outdated and needs to become more student-centred. Present promotion systems reward research activities and not practical experience or teaching experience. In most tertiary institution, professional tenure promotion and status depend almost entirely upon publications, and usually, the research that leads to publication is typically quite separate from the teaching [21]. The result, of course, is that most university teaching is scandalously bad and lecturers tend to devote less time to teaching, and hence quality drops, with severe repercussions on the future fortunes of the nation; A better formulation of the situation would be make: professional tenure promotion, and status depend upon publications, and/ or teaching, and services;
- ***Inadequate and Obsolete Instructional Materials and Teaching Aids:*** There is an inadequate supply of instructional materials such as textbooks, writing materials, copies of approved curricular, manuals etc.;
- ***Weak link between Tertiary institutions and Industries:*** There is no discernable strong relationship between the schools/faculties of engineering and industries and other related establishments. This weak link is leading to existing lack of real technological development and mismatch between tertiary education and the needs of the labour market in Nigeria. Some factors responsible for this includes lack of training and development programmes, lack of planned industrial study visit, non availability of fund for lecturers to undertake industry based researches, non-engagement of practicing engineers as a visiting lecturers from the industries etc.;

- **Brain drain syndrome:** Most lecturers in engineering department (especially the young ones that went abroad for Ph.D. in United Kingdom and America) now prefer to seek greener pasture in oil, consultancy and construction companies in the country or overseas after completing their bond. This may spell doom for engineering education in the country if the trend is not quickly reversed as most of the committed older lecturers retire.
- **Non Implementation of Government Policies on Science and Technology:** Government policy on admitting on the basis of 60 percent into science and technology courses and 40 percent into the humanities in all the universities is not being implemented. More students are admitted to pursue careers in arts and humanities. This is sad and not healthy for developing country aspiring to attain industrialisation;
- **Lack of Training and Development Programmes for Academic Staff:** Neglect, inadequate funding and uncompetitive remuneration have made the lecturer incapable of participating in his professional activities including conferences, workshops and industrial research; and
- **Inadequacy and irregularity of electricity power supply:** The usual experience is that much idleness is caused by power failures. The result is that as power is restored, the backlog of administrative matters are first treated, leaving very little time for personal research on the computer and internet. Thus, adequacy and regularity of power supply must be ensued by the government and institutional authorities in universities.

#### **4.0 THE STRATEGIES FOR ENHANCING ENGINEERING PROFESSIONALISM AND STRENGTHENING TECHNOLOGY-BASED ORGANISATIONS IN NIGERIA**

The strategies for enhancing the Engineering professionalism and strengthening technology-based firms in Nigeria (at the following stages) among others are as follows:

##### **1) Manufacturing [22]:**

- ✓ **Development of Raw Materials:** Development of raw materials such as iron and steel, non-ferrous metals, plastics and ceramics. Government should encourage the private sector to invest in exploration and exploitation of local sources of raw materials. It could play a more pragmatic role by leading in this venture and within a specified time to privatise these companies. This should not be seen as negating the policy of government on privatisation but as a necessary intervention to develop the sector of the economy. As soon as this raw materials exploitation yields the desired result, Government should immediately ban importation of such from outside the country;
- ✓ **Construction of Basic Industries:** Construction of basic industries such as iron and steel plants, machine tools industries, heavy electrical, petrochemical, gas and bitumen industries. Government should as a matter of urgency conclude its programme on the full commissioning of Ajaokuta Steel Company, Delta Steel Company and Aluminium Smelting Company of Nigeria. Government should place total ban on the exportation of local scraps and ores that are needed to feed this exploitation companies.
- ✓ **Achieving Optimum Production Capacities:** Most Nigerian companies operate very much below installed capacities. This is due to the dull economic, lack of fund, scarcity of raw materials, lack of energy, lack of spare parts, lack of qualified manpower, low value of the naira, low demand of product, inflation, obsolete equipment poor maintenance, and low level of technology. To improve capacities, all of these problems must be given due attention; Government should provide enabling environment.

- ✓ **Research and Development:** R&D remain the road map to indigenisation of manufacturing technology. Government should establish a research institute for manufacturing research and equipment development, to initiate research into adapting new technologies and updating old ones and passing on their results to the existing companies for commercialisation. Government should encourage industry based research by our local companies;
- ✓ **Design and Development of Machinery:** There is the need to actively encourage the local manufacturing of machines, and equipment e.g. electric motors, petrol and diesel engines, compressors, water pump and the like, that would require components and spare parts produced locally in our industries. Government should provide enabling environment for the indigenous production of most manufacturing equipment needed for the productive operations etc. The development of the machineries through several methods such as copy technology, joint ventures and collaboration as well as basic R&D. This is called local content;
- ✓ **Overhauling of Infrastructural Facilities:** Overhaul of infrastructural facilities such as electricity, telephone and telecommunication services, road, air and seaport; Government should improve on its provision of necessary infrastructure.
- ✓ **Adequate Finance:** Adequate funding of organisations involved in development of appropriate technologies for the manufacturing industry should be done. Government through the Bank of Industry should make substantial credit available to the manufacturing industry; and
- ✓ **Training:** Engineer should improve his technical competence by attending short courses, training courses etc. Engineer-entrepreneur should take advantage of small business counselling on technical and management matters rights from appraisal stage. This should be in such areas as financial management, production planning and control, financial analysis and appraisal. Higher institutions, Small business associations, Non-Governmental Organisations adopted some approaches, which include seminars and workshops. These training and discussion sections are usually free or at a minimal cost.

## 2) Contracting/Consulting

- ✓ **Involvement of Nigerian Engineers in Project Execution in All Level:** Participation of Nigerian engineers in project execution at all levels will enhance their involvement in all facets of project execution. This will result in job creation for more Nigerians and as such reduce poverty;
- ✓ **Formation of Engineering and Multi-discipline consortia:** This lead to working together for mutual benefit: There are many small and medium scale engineering contracting and consultancies owned and managed as one-man outfits. The advantages of partnerships and consortiums are immense to warrant its encouragement. Partnerships and consortiums are able to marshal enough resources, connections and managerial ability to ensure success of their operations and capacity to bid for large projects[12];
- ✓ **Legal Matters on Partnership:** Members of engineering family must tidy up the legal angle of their partnerships so that the terms of partnerships must be clearly drawn up and strictly adhered to within a legal framework;
- ✓ **Technical Partnership and/or Strategic Alliances with Expatriates:** Indigenous engineers should enter technical partnership and/or strategic alliances with expatriates, with the latter having a financial stake in the enterprise, to ensure their loyalty;

- ✓ **Mentoring and motivation of young engineers:** Indigenous practitioners should grow local talent through apprenticeship scheme and vigorous effort should be made to expose and weed out 'quacks'; The best motivation for young engineers are the examples of our leaders, both in the engineering establishments, organisations and societies, and in the large society, in the way they carry out their private and public businesses. Some of the attributes of good leadership include: trust, honesty, integrity, vision, technical and management competence, reliability, friendship, team work, being a good teacher and communicator, interest in the welfare of their subordinates, concern for the society and many more [23]; NSE should encourage its branches and divisions not to relent in embarking on visiting engineering institutions to motivate students; also, NSE can encourage members to accept students who they can mentor on personal capacity, listen to their academic needs to advise them and occasionally take them along to fields for experience, if and only if it is safe to do that;
- ✓ **Indigenisation of Engineering Practice:** As a matter of fact, foreign engineers must be banned. Where they can come in, it has to be in strict collaboration with the local engineers [5]. Nigeria as a nation is endowed with abundant human resources and expertise to actualise the indigenisation of engineering practice. Establishment of a special postgraduate programme in project planning and construction management would strengthen the indigenous participation in the construction industry. Government should develop and maintain a database of engineering manpower in the country for available utilisation. This will be useful in the processing of application for expatriate quota so that unneeded foreign professionals would not be imported to displace available local experts. The greatest constraint to the indigenisation of engineering practices is the dearth of equipment for construction; Government should patronise indigenous consulting and contracting firms [24];
- ✓ **Setting up of Plant Hire Company:** Government should establish a plant hire company where local contractors can hire construction equipment at reasonable cost. Part of the fund realised from excess crude oil sales should be directed towards this viable venture. Also, indigenous firms should pool resources together to set up plant hire company to procure expensive construction equipment that are of mutual benefit to them;
- ✓ **Access to Finance:** Evolution of suitable fiscal policies by government to ensure that engineering projects particularly in the private sectors are well funded at interest rate comparatively lower than those of conventional projects; Government should give adequate support towards the sustenance of professionalism in engineering in order to continually realise her national development plans. Also government must support COREN with more funds to perform effectively and in ensuring proper regulation of engineering practice;
- ✓ **Involvement of Engineers in Industry Focused Research and Development Activities:** The engineer should carry out extra studies and research in other to improve their standard of knowledge. Research will expose an engineer to new developments and widen the scope of his reasoning. Engineer should put in place resources to creating new things for the benefit of mankind. Engineer should take part in research and development activities that can utilise our local materials as industrial inputs. Research and development will be required to get the material to certain level of quality and involving adaptation of existing processes and machinery to accept these materials [25];

- ✓ **Continuing Professional Development (CPD):** Engineering consulting and contracting firms should be encouraged to embrace CPD. This is the only way to remain relevant in our various field. Foreign firms continuously sharpen their expertise by regular attendance of their relevant staff at training workshop [17 and 26]. The professional societies should offer continue education type of courses, especially in the form of workshops and hands-on training. Technology-based firms should endeavour to provide the in-house type of training for their employees, which in certain circumstances may be made open to the public. Technology-based firms and professional institutions should promote industrial exchanges such as visits to project sites;
- ✓ **Lobbying:** Lobbying is part of politics, engineer should embrace the concept of “lobbying politics”. Nigerian Society of Engineers should lobby the President of Nigeria and Governors of states with a sole request that Minister of Works Portfolio/ State Ministries work should be allocated to engineer. In addition, NSE should also request for allocation of a limit of contract sum that should only be awarded to indigenous consultants and contractors in order to promote the development of the capacity of the local construction industry [13];
- ✓ **Establishment of Contracting/Consulting Council:** Government as a matter of urgency, establish council for contracting/consulting industry, as a coordinating organ for the professions in the built environment, with functions relating to national policy and legislation. This council will exercise leadership and foster the cooperation of industry stake holders to pursue development objectives, improved industry practices and procedures;
- ✓ **Involvement in Governance at various Levels:** Members of the engineering family were enjoined to henceforth show interest and participate actively and relentlessly at various levels of technology policy articulation and execution and to seek involvement in governance at various levels and tiers;
- ✓ **Employment Opportunities for Young Graduate Engineers:** There is need to provide jobs for young graduate engineers. The Supervised Industrial Training Scheme in Engineering (SITSE) programme should not only be on paper. The two years pupilage should be made compulsory. A programme should be put in place to make engineering companies in Nigeria take Industrial Training (IT) students. The embargo on employment should be lifted to allow for training of young engineers.
- ✓ **Development of Entrepreneurship and Computer Skills:** Companies and other institutions want engineers to have entrepreneurial skills. Society needs engineer who not only solve engineering problems but also who can participate in bringing ideas and products to market. The engineers need to develop necessary skills to make a living. However a lack of computer and entrepreneurship skills could condemn engineer to a life of poverty, or low earnings. With entrepreneurship skill, an engineer will be capable of integrating his engineering and technical competence with a sound knowledge of entrepreneurship in nurturing copy and endogenous technologies into small-scale industries. No matter how excellent you are technically, unless you have entrepreneurship and computer skills you will not realise your full business potential [27]. Your business can even go bankrupt because of your failure to sustain a profit. Four business/entrepreneurship skills are sales, accounting, investing, and leadership. If you sell you make money; engineers should be able to read numbers and understand income statement and balance sheet; Engineers must learn to make money work hard for them, acquire financial intelligence and do the right things at the right time;

- ✓ **Focus on Small and Medium enterprise:** The development of Small and Medium Enterprise consultants / contractors assures effective competition which will promote stability and sustainability at least cost to the society. Small scale enterprises offer a variety of advantages including making use of materials and resources that may otherwise not be drawn into the development process and creating jobs at relatively low capital cost than large contractors / consultants [27];
- ✓ **Focus on Productivity, Profitability and Creativity:** Engineer should play an effective role in the nation's economy and build Nigeria into an economic, technological and agricultural superpower, if to begin with observing the highest professional standards, keep ourselves professionally competent and up to date and also focus on productivity, profitability and creativity [27]. The engineers should create wealth by creative method not by competitive one (poverty thoughts);
- ✓ **Participating in Partisan Politics:** Engineer must participate in political activities so that the right persons can be placed in the right positions to carry out their professional duties/career. This will enhance their leadership role in industry and government institutions; NSE should encourage and support members to participate in political activities for both elective and political offices [28];
- ✓ **Rigorous Control of Engineering profession:** There should be rigorous control of the engineering profession. NSE must be involved in the development and enforcement of standard for engineering professional practice; NSE and COREN should ensure that engineers adhere strictly to the codes of practice, code of conduct and ethics;
- ✓ **Headship of Engineering Based Ministries:** All engineering based Ministries, Departments and Institutions must be headed by Nigerian Engineers of suitable competence not only technologically but also managerially; and COREN must see that at least an engineer is a member of board of directors of all companies carrying out engineering work in any form. Government should give adequate support towards the sustenance of professionalism in engineering in order to continually realise her national development plans;
- ✓ **Unethical Practises and Infiltrators:** Engineers should report unethical practises and infiltrators either to COREN directly or to ERM inspectors for appropriate action. Engineers should constitute themselves to formidable force to police the practice of the profession; and
- ✓ **Self-Education and Professional Development:** Engineer must be an active, aggressive, ambitious learner in order not to be out of business. Being engineer-entrepreneur requires far more study than being an employee. Personal-development draws you toward your destiny. As you read, apply what you read and results will start manifesting. An engineer should be a continual learner. An engineer should increase his financial intelligence to raise capital. Engineers are the captain of economic "vessel" and have to use their rightful role in turning ideas into products or services, build business using other people's money and other people's resources and create systems that run the business. Employers of engineers should be encouraged to sponsor attendance and participation of engineers at conferences, seminars and workshops. Engineers should pay attention to details and maintain momentum no matter how accomplished they are, how well they think they know their business, what they are managing. Even the best engineers need to be retrained regularly, to stay current on the latest research and procedures in order not to lose momentum;

### 3) Design:

- ✓ **Effective Methods of Training in Engineering Design:** Training in engineering design needs focused attention in our engineering institutions and our industry. Traditional methods of teaching design in the various disciplines have been largely mathematical. There is the strong need to devise effective methods of teaching design which will enable engineers and engineering students to practically acquire sound methods of designing machineries, equipment, processes, infrastructural facilities necessary for the Nation's development [29];
- ✓ **Opportunity to Participate in Design, Construction, and Maintenance of Infrastructure:** Engineers should acquire technical know-how and appropriate product design skills needed to prepare a good product design and participate in solving design problems in projects, products, processes, material handling etc.; Engineer must be accurate in all his doings. A slight mistake or misfit can cause a very heavy destruction of valuable resources and even death. Engineer must have their priorities right; the right material for the right job. Assumption is strictly prohibited. Governments in Nigeria should patronise Nigerian engineers in design contract or a construction contract. The abolition of quacks should be appropriately entrenched in the current "Due process" mechanism of awarding contracts by Federal, State and Local governments [24]; Engineers must test and use whatever they are creating or designing. Separating out the work would make engineers lose touch with its functionality. Models should not only depend on superior technology but also on the highest number of test runs, creating an optimal learning curve. This will revealed flaw to be worked on and give them a feel for the product that can never be have in abstract. Engineers should not look at the parts separately but at how they interact and experience what they produce as a whole.
- ✓ **Establishing Comprehensive Training Programme for Design Engineers and draughtsmen:** Using the facilities at African Regional Centre for Design and Engineering Manufacture (ARCEDEM), Ibadan and Engineering Design Centre of NASENI to mount comprehensive training programmes for design engineers and draughtsmen. Government should finance the training through NASENI as part of the development of our engineering infrastructure [30] and upgrade ARCEDEM to a fledgling research and postgraduate degree awarding institution in auto mechanics and electronics preferably under the Academy of Science and Engineering;
- ✓ **Involvement of Engineers in Buy and Selling of Engineering Components and materials:** Engineers should recognise that selling engineering components and materials is an engineering function. Engineering should introduce some form of training / programme for traders/supplier of engineering materials so that they know the type of information required when the engineer want to buy a component or material based on composition and engineering properties of the goods;
- ✓ **Developing High Potential for Machine Building and the Roles of NSE in Design and Manufacture:** NSE should: (i) recognise that engineering design and manufacture is a technological function that is extremely critical for the recovery and sustained survival of Nigeria; (ii) encourage more professional engineers to go into machine building as a field of practice; (iii) through Divisional activities organise technical sessions to enhance our national capabilities and set in motion the process of standards of design and manufacture in equipment and machinery; and (iv) sensitise Government on the urgent need to create the enabling environment for, and invest heavily in the development of our national capability and capacity in engineering design and manufacture [30];

- ✓ **Harmonisation Process of the Existing Codes and Standards:** For this country to advance technologically there is urgent need for Nigerian Society of Engineers to kick start the harmonisation process of these existing codes and standards. A desk under the Standards Directorate of Standard Organisation of Nigeria (SON) should continue providing the necessary service to manufacturers and other stakeholders to align their requirements on the basis of Nigerian standard; SON should continue to favourably disposed to all sectors /organisations in providing the secretariat that will coordinate the harmonisation of standards/codes existing in their various sectors [9];
  - ✓ **Creating Awareness about Design Codes and Standards:** In order to minimise the conflict of codes and / or standards with one another, SON should continue to work out an elaborate plan of creating standards consciousness in the country through periodic standards conferences, participating in trade fairs collaborating with other agencies of Government in workshops; holding annual walk-for-standards in major cities of Nigeria, launched a scratch card for downloading Nigerian standards/codes through SON Website- [www.sononline.ng.org](http://www.sononline.ng.org).
  - ✓ **Formulation of Design Codes and Standards:** There is an urgent need to develop codes and standards that are based on the local materials and environment; technical specification for engineering materials to be used in manufacturing product in our local manufacturing companies should be established and compiled; the university, industry and professional organisations should come together to formulate necessary codes and standards that reflect the characteristics of local materials and environment; local codes and standard should be developed by Nigerian engineers for use in design of civil and structural engineering works; and
  - ✓ **Establishment of National Codes of Practice:** National Codes of Practice forms the foundation for the Institutional framework required to achieve standardisation, good governance including the legal framework for practitioners. COREN and SON are in the right direction in putting effort to document these National code of Practice that work for our environment; in the area of data collection, the professional bodies and engineering faculties can collaborate to obtain data suitable for development of relevant codes of practice and standards.
- 4) **Education and Training:**
- ✓ **Total Overhaul of Engineering Education Curriculum:** Engineering education curricula should be made more dynamic through frequent reviews in line with technological development and our development needs; Overhaul of Engineering curriculum to reflect the real needs of local industry and Nigerian society which will ensure the development of basic skills and train graduates for self-reliance and self-employment. An engineering curriculum design should incorporate training in engineering ethics; Engineering graduates should be familiar with the engineering codes of ethics so that they can uphold and advance the integrity, honour and dignity of the profession. Also, engineering should be reviewed to reflect the impact of internet technology on the practice of engineering and training. Term papers and assignment should be given that would compel the students to visit the internet for reference sources [28];
  - ✓ **Practical Training and Development:** COREN should revitalise SITSIE which is most relevant to practical training and development of the engineering personnel. Engineering professional bodies should make sure that tertiary institutions with faculty of engineering and technology have reasonable facilities and modern day machines/equipment. Programme for the engineering students should stress practical and



entrepreneurship skills. COREN must insist on changing the current conventional methods of imparting engineering knowledge by reviewing the teaching and learning objectives of our education system to emphasize student competencies in original problem identification, formulation and solution in a multi-disciplinary atmosphere and under given constraints; engineering corpsers should be posted to only relevant engineering establishments for their National Youth Service. The Directorate of the National Youth Service Corps should comply with section 9A of Decree 27/92 by communicating the location of graduate engineers and technologists to COREN. Government policy must be directed towards removing obstacles such as the small industrial base and the unwillingness of industrialists to cooperate with the SIWES and SWEP programs [28]. Faculties of engineering in tertiary institutions should carry out proper monitoring and supervision of SWEP and SIWES students during the programmes in order to equip students in the needed skills for self-reliance. Engineering faculties need to further enhance practical aspect of industrial training by establishing real life industries within campuses. These prototype industries must be self-sustaining and simulate real life industrial environment. This way, engineering graduates armed with much needed confidence to tackle real life problems of development outside school;

- ✓ **Industrial Attachment and Sabbaticals for Engineering Staff:** Lecturers in Engineering faculties should be given approval on request for a short study leave of about three months to enable them to update their knowledge in modern technology in industry in order to effectively merge theories been taught in the class with practical/industrial application [31]. This arrangement should be formalised with industries and should involve all departments. Industrial sabbaticals for academics should be encouraged for engineering staff so that they acquire some industrial experience as well as proficiency with the latest engineering tools in order to train their students adequately;
- ✓ **Developing Staff Exchange/Training Schemes between Universities:** Tertiary institution must develop staff training schemes to upgrade the quality of teaching staff. This can be done through linkage programmes between sister universities in Nigeria and Nigerian universities and universities outside Nigeria;
- ✓ **Recruitment of Professional/Practising Engineers:** The Faculties of engineering in Nigerian tertiary institutions should recruit professional engineers to teach a few hours per week on part-time basis so as to instil professional/ethical attitude and impart knowledge of latest technology in industry to students. Interaction between academic and practising engineers helps to reduce the mismatch between tertiary education and the needs of the labour market as practising engineers would have the opportunity of contributing to curriculum development with the needs of the industry in mind [32]. The NSE and COREN can establish active participation of practising engineers in academic programmes;
- ✓ **Establishment of Computer and CAD sections:** Faculties of Engineering should establish computers and CAD section to enable the students to improve their knowledge in the use of computers and its application to solving engineering problems [33];
- ✓ **The use of AutoCAD and other Drafting packages:** Due to the inadequacy of computer resources, AutoCAD and other drafting packages are not being extensively utilised in Faculty of engineering in tertiary institution. Teaching of engineering drawing should be emphasised. Drawing should be preferably be taught by senior member of academic staff. Tertiary institution should collaborate with the industry, and

obtain necessary assistance to equip their computer laboratories. Thus, emphasis could then be placed on the use of drafting packages in the processing of engineering assignments and homework [33];

- ✓ **100% Computer Literate for Faculty/staff:** Since 100% computer literate lecturer is desirable, Tertiary institution should embark on train-the-trainers programme in order to increase computer literacy among engineering lecturers. This will indirectly affect lecturer' productivity and should impact on the students; performance also since many formula and mathematical approaches could now be given to students as assignments and supervised confidently [33];
- ✓ **Establishment of Online Libraries and Services for the Publication Results:** Tertiary institution should establish digital online libraries and services for the publication of research results. This is important so that more users would have access to such materials, thereby promoting scholarship and contributing to the extension of the frontier of knowledge [33];
- ✓ **Establishment of Industrial Advisory board:** Faculties of Engineering in higher institutions should establish industrial advisory board at which forum job opportunities could be made available to graduating students and possibly conduct interviews for possible employment immediately after successful completion of studies. At the same time, views should be exchanged on how to improve on the quality of engineering education;
- ✓ **Adoption of Unitary System of Education and Training:** Adoption of unitary system of education and training in engineering whereby engineers would have acquired craftsmanship and technician training as prerequisite for going to engineering degree programme [22];
- ✓ **Introduction of Formalised Programme of Extension Education:** Introduction of formalised programme of extension education for roadside artisans to improve their scientific, technical, business and civic abilities [22];
- ✓ **Commercialisation of Engineering Idle Facilities:** Commercialisation of engineering idle facilities as well as the development of Industrial villages within institutions as avenue for transmitting research and development into viable energy products and services and avenues to provide skills and experience to both students and lecturers alike; Engineering institutions in the country should engage in aggressive marketing for commercialisation of their research outputs in collaboration with industries and organizations in their catchment areas in order to make researches more useful for economic development; also, engineering institutions should ensure optimum utilisation of teaching and learning facilities;
- ✓ **Computer Skills:** Engineering programmes in Nigerian tertiary institutions must equip engineering students with necessary computer skills by making computers available at all levels for teaching, instruction and research; students should be educated on the efficient and productive use of the internet facilities;
- ✓ **Adequate Funding:** NSE should educate the federal, and state governments on the need to provide functional laboratories, libraries, teaching aids in our tertiary institutions; Government should make enough funds available to tertiary Institutions for updating their training equipment and for retraining of staff. Government must support Faculties of Engineering with more fund and adequate resources to establish and to run technological entrepreneurship programme. Government should pursue a policy that would make the creation of jobs for engineering graduates profitable and beneficial to small-scale enterprises. Industry should be encouraged to support research through funding;

- ✓ **Employing Diverse Set of Methods:** A diverse set of methods such as the case method, the discussion methods, active learning, cooperative learning, experimental learning, problem-based and project based learning should be employed to improve quality of education in faculty of engineering [34];
- ✓ **Learning to Work together:** Engineering concerns all over the world are operated under partnerships and here in Nigeria there are many small-scale one man outfits. We members of the engineering family must learn to work together for mutual benefit. Our engineering training schools should also emphasise this aspect of our profession [8]. Engineers need technologists, technicians, craftsmen and artisans to work with;
- ✓ **Harmonising between Universities and Polytechnics:** Presently there seems to be academic competition between universities and polytechnics in Nigeria. The mandates for universities and polytechnics in national manpower development should be clearly redefined. As Nigeria's summit on higher education recommended, there should be no salary barriers for graduates of either system during work. Graduates of polytechnics are allowed to seek admission into university engineering schools, if they desire. The theoretical content in polytechnic engineering education should be severely reduced in favour of increased technological content. The technical universities should draw the bulk of their admissions from qualified graduates of polytechnics for engineering and technology courses [35];
- ✓ **Improving Teaching methods and Engineering Profession:** The primary goal of engineering education institutions is to teach, it is better to allow some members of staff to focus on improving delivery of engineering education whilst others focus on improving the discipline. In this environment of partnership, colleagues share experiences through faculty/department seminars and in the end both teaching methods and disciplines are advanced [21].
- ✓ **Creating Awareness and Engineer's Education about Codes of Conduct:** Awareness programmes should be well intention and focus. Engineers should be educated about the codes of conduct; Engineering institution and industry should organise joint seminars, workshops and conferences; Engineer should think as a manager as well as engineer first; Managers are trained to handle people while engineers are trained to handle things; To think like a manager rather than an engineer is to focus on people rather than on things; What is to think like an engineer if not simply to use one's technical knowledge of engineering? Interestingly, that is a question engineers have been asking for almost a century. Answers have often been expressed as a code of ethics. So, it is seems, one way to begin to answer our question is to learn something about those code;
- ✓ **Incorporating Industrial Excursion Programme into the Curriculum:** The versatility and experience of the students could be broadened through properly tailored excursion programmes. Excursion programme should take place every semester with clearly defined objectives aimed at targeted industries relevant to their fields of study. It is wise to emphasis on visitation to small scale/cottage industries employing crude indigenous technology. This will empower our graduate engineer to think more as job creator than seeker [36]. Students should submit the report of their experience and what they see during the field trip in the departments for grading. Also, adequate funding should be provided to enable students visits industries frequently [37];
- ✓ **Adequacy and Regular Power Supply:** Adequacy and regular supply of power must be ensured by the government and authorities in tertiary institutions to reduce much idleness by power failures;

- ✓ **Encouraging Academic Engineers in Industry Focused Research and Development Activities:** There is a need to encourage more industry-focused research at graduate level by forming research partnerships with some of the major industries in the nation. Such partnerships not only improve the quality of engineering education, but also generate income for the institution [21];
- ✓ **Attractive Salary Structure:** Government should quickly address special salary package for engineering practitioners, like their contemporary in other profession like medicine as this will boost their morale and enhance their performance;
- ✓ **Advocating Faculty of Engineering and Technology Alumni:** The main purpose is to [31]: (i) maintain contacts among graduates and staff of the faculty; (ii) keep the graduates informed of various programmes and activities of the faculty; (iii) involve the graduates in various programmes / activities for individual and national development; (iv) act as a forum for exchange of ideas and experience and to get feedback on their performance at work; and (v) organise activities to raise funds for the development of faculty; and
- ✓ **Financially Viable Institution for the Production of Quality Engineers:** Engineering institutions have to engage in activities such as consultancy, short courses, fund raising and autonomous business ventures. The Faculties of engineering in Nigerian universities should offer short courses to industry; Consultancy work should be encouraged and developed in the Faculties of engineering in the Nigerian Universities. Departments should solicit consultancy work from industries and companies; Industry should consult researchers for solution to problems in the industry; the academic engineers will in this process is gaining practical experience and knowledge.

## 5.0 CONCLUSION

Promotion of functional and qualitative education will enhance engineering professionalism, open up new employment opportunities for engineers and teaming population, create wealth, reduce poverty, promote national development and sustain industrialisation as well as increase the participation of engineering practitioners in manufacturing, consulting, design and execution of various construction projects thereby leading to the increment in capacity, technological and socio-economic development of the nation. The factors influencing the establishment of engineering standards and codes of conduct in Nigeria were examined. The challenges affecting the low impacting of functional engineering education and training in Nigeria were also discussed. The strategies and measures for enhancing engineering professionalism and strengthening technology-based organisations in manufacturing, contracting/consulting, design, educating and training among others in Nigeria were suggested.

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