REFOCUSING ENGINEERING CURRICULUM TO SERVE NIGERIAN INDUSTRIAL NEEDS: THE ROLE OF COREN

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1.0 INTRODUCTION

Engineering education literature has suggested that the capability of engineering graduates does not meet the expectations of industry employers. Engineering graduates from the current Nigerian University System leave school expecting to be well equipped for engineering practice. However, for some time, experience has suggested that employers find engineering graduates to be "weak in the field of engineering design, innovation, communication, and associated professional skills". It has been suggested that the fault lies in many factors: engineering curricula in Nigerian higher institutions, equipment inadequacy, standards/qualifications of staff teaching engineering courses and students' understanding of engineering. Industry feedback also suggests that changes are required in engineering training. For our engineering graduates to compete successfully in a globally competitive employment market, it is critical that this gap in knowledge and skills be clearly understood in order for engineering education to respond accordingly.

Modern nations show great concern for education, especially education in science, engineering and technology for obvious reasons. Education provides the great needs of a nation through the development of the social and economic infrastructure necessary for the growth of enterprise (Gemade, 2009); it is an antidote to poverty and leveler in the knowledge emerging society (Ajimotokan et al., 2009). Today, education has evolved as the primary agent of transformation towards sustainable development, increasing human's capacities to transform their visions for society into reality (Oloyede, 2008; UNESCO, 2005).

Depending on philosophy of life, disciplines, past experiences, circumstances and the environment among others, **Education can be defined as "the aggregate of all process by which an individual develops values, attitudes, abilities and other forms of behavior that is of positive value to the society"**(Fafunwa, 1974). Education provides the theoretical knowledge in both basic and applied sciences, acquired through formal method designed for human capital development meant to serve national interest (Ibidapo-Obe, 2009). It implies that **engineering education can be defined as education in science, engineering and technology for capacity building in engineering towards sustainable development**. Thus, the aim of **engineering education** should be the integration of knowledge, skills, understanding and experience (Padmanabhan, 2000).

The Nigerian government has made frantic efforts to encourage engineering education. From the mid 1980s, the first remedy introduced was diversification and specialization of the universities with a view to increasing their scientific, technological and agricultural contribution to the transformation of the country (Ajimotokan et al., 2009; Ekeh, 2009). The development of a viable **engineering education** is an indispensable tool in the various sectors of the economy if the nation hopes to develop and sustain development to attain its national vision and goals, be it Millennium Development Goals (MDGs), National Economic Empowerment and Development Strategy (NEEDS), Vision 20:2020 or National Sustainable Development Goals (SDGs)(Adisa, 2012).

It is within this context that the factors of access, resources, quality assurance and relevance, reassessment of academic degrees and globalization of higher education teaching, training and research predict the economies of scale of sustainable development.

2.0 OBJECTIVES AND VALUES OF ENGINEERING EDUCATION

One's success in engineering largely depends on one's attitude, self-improvement and skills developed on factual knowledge. An engineering education is designed to make a major contribution to one's development in these areas. Each field of specialization requires some knowledge of other fields. As a result, all Engineers are required to work hand in hand, not only with other Engineers and other engineering fields but much beyond this. It is therefore very important to stress that the main objectives of an engineering education among others are:

(i) To impart factual knowledge required. This is subdivided into:

a) Basic physical sciences such as chemistry, physics, mathematics, etc.

b) Applied physical sciences such as basic electrical circuits, mechanics of soils, thermodynamics, etc.

c) Codified empirical knowledge.

d) Other knowledge, which I refer to 'external knowledge' such as sociology, literature, history, law, psychology, humanities, etc.

(ii) To give a reasonable start in development of engineering skills such as: Design, inventiveness, judgment, experimentation, reaching reasonable conclusions, optimisation, thought, communication and most of all working with others.

(iii) To help shape one's attitude in his ability to inquire, able to accept or reject proposals and be open-minded.

(iv) To equip and motivate for a continuing self-improvement.

These qualities distinguish engineering from other professions such that the Engineer is often referred to as a problem-solver. One's success in acquiring these characteristics determines his effectiveness as an Engineer.

3.0 WHAT INDUSTRY WANTS VS WHAT EDUCATION GIVES

"It is sometimes forgotten that industry is an important customer of engineering education. Ignoring this relationship has produced graduates that often fail to meet the changing needs of industry in today's competitive environment." Industry has a set of given needs that it requires of new engineering graduates to fulfill. (Todd *et al*, 1993) Industry and engineering have certainly undergone significant evolution in the past 40 to 50 years; it is therefore appropriate that engineering education must do the same in order to maintain an efficient and effective pace.

In an industry survey conducted about two decades ago in Canada, a number of significant weaknesses in engineering graduates were pinpointed by industry. Engineering graduates were found to: be technically arrogant; lack understanding of manufacturing processes; desire complicated and "hightech" solutions; lack in design capability and creativity; lack in appreciation for considering alternatives; have a poor perception of the overall project engineering process; have a narrow view of engineering and related disciplines; have weak communication skills; and have little skill or experience working in teams. These weaknesses are significantly still with us in the developing countries today.

In another survey conducted by Frise et al (2002), in some Canadian companies and academic institutions, it was found that the most used skills in industry, as determined by industry, were, within the communication skill set; oral communication with clients, internal written workplace communication, and oral communication with colleagues. In the design skill set, the most used skills were determined to be creative thinking, design for cost, design for reliability, and design for performance. Within the people skills set; the key skills were found to be attitude, adaptability, leadership, and teamwork – part of what might be considered the "soft" skill set.

Wissey (2000) reported that the value of "soft skills" in addition to technical prowess, should be a priority for future engineers. To be successful, engineers must be team players. Engineers of today's generation can no longer be the "isolated innovators"; they must consider also what personal skills are involved in the position, from working with others to communicating ideas to environmental and social sensitivity.

It has been found that there is a supply gap in academia's coverage of creativity methods, project management, design for manufacture, design for assembly and product testing. Industry was also found to have a higher demand for individual design projects and interdisciplinary design projects than is currently being taught (May and Strong, 2006). Tables 1 and 2 below shows the summary of findings for industry demanded topics and activities.

Table 1: Top 10 Industry Demanded Topics

1	Teamwork
2	Engineering design specifications
3	Design for manufacture
4	Overall design process
5	Design for assembly
6	Creativity methods
7	Project management
8	Product testing
9	Tolerancing
10	Solid modeling

Source: May and Strong, 2006

Table 2: Top 5 Industry Demanded Activities

1	Team design projects
2	Open ended problem solving
3	CAD – Solid Modeling
4	Interdisciplinary design projects
5	Design reports (written)

Source: May and Strong, 2006

From perusing the past decade of engineering education literature, it appears that very little research has been done in effectively determining what industry really needs from all engineering graduates with respect to design – and what engineering education is currently providing.

4.0 ENGINEERING TRAINING IN THE 21ST CENTURY

Today's engineer will need to learn much new technical information and techniques and be conversant with and embrace a whole realm of new technologies, but some old problems will still need to be tackled. They will demand new attention and perhaps, new technologies (National Academy of Engineering, 2005). We are most certainly going to witness a situation where some of the present preoccupations of the engineer cadre must have to be passed on to the technologist cadre. This trend has been peculiar with the development and evolutions of the engineering profession over time, and the reason has always been to enable the engineer focus on the more challenging issues of the job. This of course has implications for the trainings of technologists and technicians which have to be updated to comply with the trend.

In order to address the challenges of the 21st century, it is essential that our undergraduate programmes be reformed. Nigerian universities have been tasked with developing high level manpower required for the country's development (Federal Government of Nigeria, 2004; Obadara, 2010). The country achieves middle level manpower trainings at Technical Colleges, Monotechnics and Polytechnics. The Federal Government of Nigeria in various National Development Plans placed emphasis on engineering manpower training (Ajimotokan et al., 2010). It was not until the 3rd national development plan that specific demand was made with regard to enrolment into engineering programmes, and this was helped with the establishment of more Universities. The establishment of Universities of Technology during the 4th national development plan reflected government interest and concerted effort at generating sufficient technical manpower to drive industrialization.

Long term brain drain, combined with insufficient output from national postgraduate programmes, in the face of rising student enrolments has left the Federal Universities system with a little less than 50% of its staffing need filled. Staffing scarcity is most acute in engineering, science and business disciplines.

Enrolment alone cannot be the main index for manpower generation in engineering. Other indices include ‘wastages’ in the course of the engineering programmes (i.e., dropout rates); absorption of graduate engineers into non-engineering jobs with associated subsequent loss of interest in the profession and non-availability of jobs for the graduate engineers.

As at October 2016, the Council for the Regulation of Engineering in Nigeria (COREN) had on its registers 2,392 engineering craftsmen, 670 engineering technicians, 3,474 engineering technologists, 35,606 engineers, 1,420 expatriate engineers, and 1,395 consulting firms. (COREN Registry, 2016)

Whereas these cannot be said to be true figures of available engineering manpower in the country, it does reflect the state of professionalism and the practice of engineering in the country and buttresses the point for urgent and concerted efforts on manpower generation and capacity development. The uneven distribution of the engineering family members is skewed towards the engineer and this is a concern for the country.

4.1 Capacity Building

There is however, more to our capacity building needs. Major deficiencies in our industrialization policies and economic development are the absence of capacity to produce a better trained population and strong institutional framework within which development can take place (World Bank, 1989; Bamiro, 2007; Alaibe, 2007; Ilaboya and Wara, 2008). Our technological base is weak. Wara, et al (2010) opined that competitive advantage is essential to growth of 21st century industries. Presently, the world is on the threshold of a new technological age – driven by rapid advances; new products will emerge that may quickly make conventional processes and products in Africa obsolete (Bamiro, 2007).

The world is knowledge intensive and increasingly dominated by emerging technologies. Mere possession of capital or natural resources is no longer pre-condition for national development; future developments will be more and more technologically based. Science is man's attempt at comprehending the workings of our systems. ***Scientific capability or "know-why"*** is acquired through research and its acquisition can take place meaningfully only if there exists a critical mass of scientific manpower in the country – within our firms and in our national R&D institutions. ***Technology or "know-how"*** however refers to ways of doing things and technological capability has always existed in any human society. ***Technology*** affects human development through innovation, by increasing functionality of existing means and increasing human capabilities, and through enhanced productivity, as seen in increased outputs, heightened efficiency of services and higher incomes. However, ***Engineering*** is the package of actions we take to put technology to work in the production of goods and services. Engineering capability is utilized for the translation of new technologies or processes into plants and process machineries.

Innovation refers to the application of knowledge in production; knowledge acquired through learning, research, training or experience is not innovation until it is applied in the production of goods and services. A Scientific, Engineering and Technological capacity underlies innovation and technical change, which are the drivers of economic development (Bamiro, 2007). Creating and sustaining a knowledge-based economy requires an innovative system of policy making which is different from our traditional centralized and rigidly regulated economic decision making. The key to this is partnership between Science, Engineering, Technology, Economics and Public Policy and between Tertiary Institutions, the Private Sector and Government. The institutions for capacity building in Science, Engineering, Technology and Innovation (SETI) includes the Education, Training and Research and Development System. The emphasis areas are (Bamiro, 2007):

(i) Entrepreneurship Development
(ii) Management for production
(iii) Professional and skilled manpower development
(iv) Basic and Applied Science
(v) Engineering for Production
(vi) Technology (including ICT)

Key stakeholders that should constitute a national innovation system for SETI capacity buildup should include: Firms/Enterprises (particularly the manufacturing sector), Government, Research and Development institutions, Educational and Training institutions, Engineering Consultancy Firms, Financial Institutions, Foreign firms, and International Agencies.

5.0 THE ROLE OF COREN

5.1 History of COREN

The Council for the Regulation of Engineering in Nigeria, COREN, was established by decree 55 of 1970 and amended by Decree 27 of 1992, now the "Engineers (Registration, etc) Act, CAP E11 of 2004" Law of the Federal Republic of Nigeria. The Act establishes COREN as a statutory body of the Federal Government empowered to regulate the Practice of Engineering in all aspects and ramifications in Nigeria.

5.2 Mandate of COREN

The Decrees setting up COREN empowered the Council to regulate and control the training and practice of engineering in Nigeria and to ensure and enforce the registration of all engineering personnel (i.e. Engineers, Engineering Technologists, Engineering Technicians, and Engineering Craftsmen) and consulting firms wishing to practice or engage in the practice of engineering. Council carries out this mandate through Accreditation of Engineering Programmes, Registration of Engineering Personnel and Firms and Regulation and Control through Engineering Regulation Monitoring and other mechanisms.

5.3 Accreditation of Engineering Programmes

The law empowers COREN to accredit all Engineering Programmes in Universities, Polytechnics and Technical Colleges to ensure that these institutions have adequate facilities for the production of Engineering graduates at all levels. Accreditation is COREN's quality assurance mechanism for the teaching and learning of Engineering courses.

Section (1) (b) of Decrees 55 of 1970 and 27 of 1992 (amendment), now the Engineers (Registration, etc) Act CAP E11, 2004, empowers COREN to "determine what standards of knowledge and skills are to be attained by persons seeking to become registered as engineering personnel and to raise those standards from time to time as circumstances may permit. For this purpose, these Decrees provide that COREN shall conduct visitation to Engineering Institutions in Nigeria for the purpose of:

(a) Accrediting their courses (sections 7 and 8 of the Decrees);

(b) Withdrawing any previous approvals, if so warranted and as prescribed in sub-sections (3) – (5) of section 7''

Similarly section 9 sub section 6 of the Act provides:

"An educational institution for the training of persons in the engineering profession shall submit syllabus of its programme, content and minimum facilities to the Council for approval before a course approved by the National Universities Commission (NUC) or the National Board for Technical Education (NBTE), or any other engineering body, is commenced"

5.4 Current State of Engineering Programmes in Nigeria

As at 2012, there were, thirty eight (38) Federal Universities, thirty seven (37) State Universities and fifty (50) Private Universities in Nigeria (NUC, 2012). Currently, in 2016, there are Forty (40) Federal Universities, forty four (44) State Universities and sixty eight (68) Private Universities. There are eight (8) approved Distance Learning Centres and fifteen (15) approved affiliations (NUC, 2016).

As at 2011, there were thirty four (34) Universities offering the B. Eng/B. Sc/B. Tech in 162 Engineering disciplines. Of these, 77.8% were fully accredited, 16.7% had interim accreditation and 5.6% were denied accreditation. Accreditation of twenty engineering programmes was being awaited. There were seventy eight

(78) engineering programmes, which was 46.3% of the total, whose status had lapsed. (Ref. Table 3)

Five years after, in 2016, there are forty seven (47) universities offering the B. Eng/B. Sc/B. Tech in 273 Engineering disciplines. Of these, 82.8% are fully accredited, 9.2% have interim accreditation, 0.3% were denied accreditation and 7.7% had passed pre-accreditation. There are twenty eight (28) engineering programmes, which is 10.3% of the total, whose status had lapsed. (Ref. Table 4)

There were **thirteen universities offering forty eight (48) postgraduate diploma courses in Engineering. Of these, 77% were fully accredited and 23% had interim accreditation. There were fourteen engineering programmes (29.2% of total) whose status had lapsed as at 2011** (Ref. Table 5)

In contrast to the above, **in 2016. There are nineteen (19) universities offering sixty six (66) postgraduate diploma courses in Engineering. Of these, 92.4% are fully accredited, 6.1% have interim accreditation and 1.5% were denied accreditation. There are ten engineering programmes (15.2% of total) whose status had lapsed** (Ref. Table 6).

These figures are disturbing and hence not apt for a nation's thirst for development to surmount its present technological and scientific dependence. However, engineering education in Nigeria has great promises; it also has a lot of challenges. Some of these challenges and thus the "dismal state" of engineering education can be traced to the following:

(i) Ill equipped laboratories and workshops,
(ii) Poor funding and thus poor educational infrastructures,
(iii) Deficiency in teaching and research equipment,
(iv) Paucity of quality teachers and poor learning environment,
(v) Paucity of ideas, scarcity and prohibitive cost of books,

(vi) Challenges of relating the curricula to national manpower needs.

(vii) Incessant interruptions of academic calendar,

(viii) Epileptic power supply, deficiency in ICT,

(ix) Very low industrial base,

(x) Little or no industrial – universities collaborations,

(xi) Existing monolithic training programmes, etc. (Bako, 2005; Oloyede, 2008; Ekeh, 2008; Adetokunbo, 2009; Ekeh, 2009 Adisa, 2012).

Table 3: COREN 2011 Accreditation Status of Existing Bachelor of Engineering Programmes in Nigerian Universities

S. No.	Engineering Disciplines	Number of Universities	Accreditation Status			
			Full	Interim	Denied	Awaiting
1	Agricultural Engineering	18	16	2	-	3
2	Chemical Engineering	18	13	5	-	1
3	Civil Engineering	28	22	4	2	3
4	Computer Engineering	10	6	3	1	1
5	Electrical / Electronics Engineering	23	18	4	1	4
6	Electrical Engineering	6	5	1	-	-
7	Electronics Engineering	1	1	-	-	-
8	Food Engineering	3	2	1	-	-
9	Industrial Engineering	1	1	-	-	-
10	Information/Communication Engineering	1	1	-	-	-
11	Marine Engineering	1	1	-	-	1
12	Mechanical Engineering	29	23	4	2	5
13	Metallurgical /Material Engineering	6	6	-	-	-
14	Mining Engineering	1	1	-	-	-
15	Petroleum Engineering	9	4	3	2	1
16	Polymer and Textile Engineering	1	1	-	-	-
17	Production Engineering	2	2	-	-	-
18	System Engineering	1	-	-	1	-
19	Water Resources Engineering	2	2	-	-	-
20	Wood Products Engineering	1	1	-	-	1
	Total	**162** **100%**	**126** **77.8%**	**27** **16.7%**	**9** **5.6%**	**20**

Source: Adisa, 2012

Table 4: COREN 2016 Accreditation Status of Existing Bachelor of Engineering Programmes in Nigerian Universities

S. No.	Engineering Disciplines	Number of Universities	Accreditation Status			
			Full	Interim	Denied	**Passed Pre Accreditation**
1	Agricultural Engineering	27	24	2	-	1
2	Chemical Engineering	28	23	3	-	2
3	Civil Engineering	41	38	2	-	1
4	Computer Engineering	22	16	2	-	3
5	Electrical / Electronics Engineering	44	37	4	-	3
6	Electrical Engineering	3	1	2	-	-
7	Electronics Engineering	2	1	1	-	-
8	Food Engineering	4	4	-	-	-
9	Industrial Engineering	2	1	1	-	-
10	Information/Communication Engineering	3	1	-	-	2
11	Marine Engineering	4	3	-	-	1
12	Mechanical Engineering	45	37	5	-	3
13	Metallurgical /Material Engineering	11	9	1	-	1
14	Mining Engineering	1	1	-	-	-
15	Petroleum Engineering	14	13	-	-	1
16	Polymer and Textile Engineering	2	1	1	-	-
17	Production Engineering	2	2	-	-	-
18	System Engineering	1	1	-	-	-
19	Water Resources Engineering	2	2	-	-	-
20	Wood Products Engineering	2	1	1	-	-
21	**Biomedical Engineering**	2	2	-	-	-
22	**Structural Engineering**	1	1	-	-	-
23	**Mechatronics Engineering**	6	3	-	-	3
24	**Telecommunications Engineering**	2	2	-	-	-
25	**Aeronautics/Astronautics Engineering**	1	1	-	-	-
26	**Automobile Engineering**	1	1	-	-	-
	Total	**273** **100%**	**226** **82.8%**	**25** **9.2%**	**1** **0.3%**	**21** **7.7%**

Table 5: COREN 2011 Accreditation Status of Existing **PGD** Engineering Programmes in Nigerian Universities

S. No.	Engineering Disciplines	Number of Universities	Accreditation Status			
			Full	Interim	Denied	Awaiting
1	Agricultural Engineering	4	2	2	-	-
2	Chemical Engineering	6	4	2	-	-
3	Civil Engineering	8	8	-	-	-
4	Computer Engineering	2	2	-	-	-
5	Electrical / Electronics Engineering	8	6	2	-	-
6	Electronics Engineering	1	1	-	-	-
7	Food Engineering	1	1	-	-	-
8	Marine Engineering	1	1	-	-	-
9	Mechanical Engineering	11	9	2	-	-
10	Metallurgical /Material Engineering	3	3	-	-	-
11	Petroleum Engineering	2	1	1	-	-
12	Production Engineering	1	-	1	-	-
	Total	**48** **100%**	**37** **77%**	**11** **23%**	**-**	**-**

Source: Adisa, 2012

Table 6: COREN 2016 Accreditation Status of Existing **PGD** Engineering Programmes in Nigerian Universities

S. No.	Engineering Disciplines	Number of Universities	Accreditation Status			
			Full	Interim	Denied	Awaiting
1	Agricultural Engineering	6	6		-	-
2	Chemical Engineering	9	8	1	-	-
3	Civil Engineering	12	12		-	-
4	Computer Engineering	1	1		-	-
5	Electrical / Electronics Engineering	13	10	2	1	-
6	Electronics Engineering	-	-	-	-	-
7	Food Engineering	-	-	-	-	-
6	Marine Engineering	2	2	-	-	-
7	Mechanical Engineering	13	13	-	-	-
8	Metallurgical /Material Engineering	2	2	-	-	-
9	Petroleum Engineering	2	1	1	-	-
10	Production Engineering	2	2	-	-	-
11	**Mining Engineering**	**1**	**1**	**-**	**-**	**-**
12	**Aerospace Engineering**	**1**	**1**	**-**	**-**	**-**
13	**Polymer/Textile engineering**	**1**	**1**	**-**	**-**	**-**
14	**Water Resources and Environmental Engineering**	**1**	**1**	**-**	**-**	**-**
	Total	**66** **100%**	**61** **92.4%**	**4** **6.1%**	**1** **1.5%**	**-**

5.5 Benchmark Minimum Academic Standards (BMAS)

There existed guidelines for accreditation of engineering programmes in Nigerian Universities and after years of use, guidelines needed to be reviewed to bring it in line with global practices. So the Benchmark Minimum Academic Standards (BMAS) was developed for Undergraduate programmes in Nigerian Universities.

The COREN Council put together various practitioners from Industry and Academia to hold a workshop in May 2013 to develop the BMAS and a new Accreditation Scoring Criteria. The participants included the President and Members of COREN Council, Deans and Heads of Engineering Departments in Nigerian Universities, Senior Engineers in the Industry, Past Registrars of COREN and many others. Of great importance during the compilation of the document was the BMAS of the National Universities Commission (NUC) for Engineering and Technology programmes. This document was compared to the one developed to avoid incidences of divergence in results of Accreditation exercise by NUC and COREN. This will also ensure that COREN and NUC complement each other in raising the standard of Engineering Education in Nigeria. The BMAS has been adopted and put to use for accreditation purposes since. This has given a good level of uniformity in the accreditation exercises carried out in the country.

5.6 Mobility of Certified Engineering Personnel

A forum was organised on Engineering Accreditation and Mobility in Africa with the aim of forging intra and inter-regional cooperation for Engineering Accreditation and mobility of certified Engineering Personnel within Africa and between Africa and Asia and the Pacific. This is with a view to transforming engineering education, standardizing curricula and teaching methods to emphasize relevance and problem-solving approach to engineering for effective infrastructural development and maintenance.

The High Level Policy Forum event was organised by COREN (17th – 22nd July, 2016) to fulfil the great desire for strengthening South – South Cooperation for the improvement of Engineering Standards in Asia and the Pacific and in Africa. Issues such as challenges of engineering education in developing countries, the need to have recognised standards, the difficulties for engineers from developing countries to be recognised at the international level, the brain drain and poor opportunities for engineers and professionals from the South of Asia and Africa, etc., were discussed.

As part of the event, two faculties of Engineering, namely Federal University of Technology Minna and Bayero University Kano were visited. During these two visits, discussions were held with the management of the Universities as well as staff and students from the faculties of Engineering. The technical sessions also focused on establishing cooperation and mobility program that supports joint postgraduate programs, researchers and university staff as well as joint projects to enhance higher education worldwide.

The Forum was made up of engineering experts, academicians and representatives of local, national and international organisations from Jakarta, Malaysia, Kenya, Tanzania, Ghana, Sudan and Cameroon. Deans of faculties of Engineering and Technology of Nigerian Universities, CODET and COREN Council Members.

Though the BMAS of COREN does suggest learning outcomes of the engineering programmes, it was opined that Outcome Based Engineering Education should be clearly spelt out for full understanding by the Faculty administration, Academic and Technical staff and students. The benefits of the forum to **Nigerian Engineers include standardization of Nigerian Engineering Qualifications and mobility of Engineering Personnel among member countries.**

It is worthy of note that at the recently concluded General Assembly of Federation of Engineering Institutions of Asia and the Pacific (FEIAP) in Malaysia, Council for the Regulation of Engineering in Nigeria (COREN) was officially accepted as a full member of FEIAP. The benefits accruable from this membership are certainly enormous.

7. CONCLUDING REMARKS

- The input from industry for continuous improvement should not be just limited to employer survey. There should be engagement such as industry advisory system where industry players are invited to give input regularly to Engineering programmes. Such input should be properly documented and implemented.

- Regional and international bench-marking by the university should further be strengthened with international external examiner system or with regular workshops where experts from other countries are invited to share experiences with the faculty staff.

- Engineering education is so momentous and should be spiritedly pursued, to fully exploit the available possibilities for promoting sound engineering education and sustain development. Therefore there is need for African Governments and relevant stakeholders to key into the initiative of ensuring mobility of Engineers by being supportive of this initiative of COREN

- The initiative to internationalize Nigerian Engineering Qualifications clearly demonstrates the determination of COREN to align with current trends and development in Engineering across the globe and to provide a framework for other African countries in meeting international engineering education qualification standards. Therefore there is need to periodically review and update the BMAS in view of increasing knowledge and changing technologies in the world.

- The challenges to guarantee quality engineering education seem overwhelming, however, they are attainable. Undoubtedly, the major obstacle to sustainable development is the lack of viable engineering education and training. Thus, the quest for the sustainable national development and growth as envisaged is dependent on the extent to which engineering education is revamped and transformed to compete globally.

- Concerted efforts are needed for harnessing available scientific, engineering, and technological capability, within right policy frame works to guarantee our vision for development through innovativeness.

- Our society must transit to a knowledge – based society, capable of meeting the challenges of the 21st century with regard to rapidly changing needs subject to increasingly complex constraints.

- Specific reforms are needed to achieve manpower/capacity development, deployment and coordination of technological, industrial and Research and Development (R & D) capabilities, as well as Education and Training.

8.0 RECOMMENDATIONS

- ✓ To continue to adequately serve the stakeholders of engineering education, it is imperative that engineering programs evolve. Educators must take a look not only at *what* is being taught, but also at *how* it is being taught. Current student's perception of engineering contrasted with the evident unfulfilled needs and wants of industry shows that there is a significant disconnect between stakeholders. A structured program to enhance learning in the identified areas of need must be implemented in order to achieve acceptable outcomes in engineering education.

- ✓ The National Universities Commission and the Council for the Regulation of Engineering in Nigeria, as well as the National Board for Technical Education, should work together at refocusing our engineering curricula in higher institutions to meet the challenges posed by sustainability and world technology development trends.

- ✓ For the nation to benefit substantially from the contributions of the engineering family in transiting our nation from a consumer to productive economy there is need for a complete overhaul of our perceptional system with regard to engineering and our expectations from the engineer.

- ✓ Professionalism in practice must be emphasized. The roles of the engineer, engineering societies and COREN with regard to ensuring strict compliance to requisite details cannot be overemphasized.

- ✓ Engineering societies and COREN should work at updating our codes of ethics and practice guidelines for conformity with requirements for sustainability.

- ✓ Appropriate policy framework must be established and followed through, for human and institutional capacity building in Science, Engineering, Technology and Innovativeness for National Development through society.

- ✓ Research and Development must be a top priority and commitment of governments and the private sector at all levels to ensure growth in a competitive knowledge based society is imperative.

- ✓ Engineers must be involved as **stakeholders** at the planning and implementation stages of all projects in order to ensure that crucial decisions with regard to the project are not neglected.

- ✓ Government and private concerns must encourage and drive indigenous practice of engineering in Nigeria which in turn promotes job creation. Requirements for this from the government are; opportunities, enabling environment, support for acquisition of technical facilities, special tax waivers on productive engineering activities, etc.

REFERENCES

Adetokunbo, K. (2009) Bridging the Skills Gap: Framework for dialogue between Universities and employers of Laabour, Keynote Address at the 24th Conference of the Association of Vice Chancellors of Nigerian Universities (AVCNU) Ilorin, Nigeria: 2nd June 2009

Adisa, A. Bello (2012) Engineering Education and Training in Nigeria for Sustainable National Development. Keynote Address presented at The Nigerian Society of Engineers, Jos Branch, First Engineering Conference/AGM. Theme: **ENGINEERING TRAINING RESEARCH AND DEVELOPMENT: A catalyst for the attainment of the transformation Agenda. Jos, Nigeria:** July 4, 2012

Ajimotokan, H.A., Ajao, K.R., Adebiyi, K.A. and Dainkeh, A. (2009). "Challenges of Sustainable Development in Nigeria: Need for Effective Engineering Education and Training" Paper Presented at the 1st Joint International Conference of the University of Cape Coast, Ghana and the University of Ilorin, Nigeria; Ghana: 28th-30th September, 2009.

Ajimotokan, H.A., Ajao, K.R., Adebiyi, K.A. and Dainkeh, A. and Oloyede A. A. (2010). USEP:Journal of Research Information in Civil Engineering 7(1) pp 93 – 98.

Alaibe, T. (2007): Sustainable development and the challenge of good governance in the Niger Delta region. *Convocation Lecture, Igbinedion University*, Okada. November 23.

Bako, S (2005) Universities Research and Development in Nigeria: Time for a Paradigmatic Shift. Paper presented at the 11th General Assembly of CODESRIA on Rethinking African Development: Beyond Impasse: Towards Alternatives. Maputo, Mozambique. 6th – 8th December, 2005

Bamiro, A. O. (2007): Millennium Development Goals: prospect and challenges to the engineering profession in Nigerian. *In: Proceedings of 16th COREN the Engineering Assembly*, 1 – 30. Abuja, August 28 – 29.

Eggert, R.J. (2002). Engineering design education: Surveys of demand and supply. *2003 ASEE Annual Conference and Exposition: June 2003 Staying in Tune with Engineering Education* (pp.1901-1912).

Ekeh, J.C. (2009). Reinvigorating Engineering Education in Nigeria for Sustainable Development, Proceedings of the 18th COREN Engineering Assembly, Abuja, Nigeria, pp. 7-21.

Ekeh, J.C. (2008). Redefining Engineering Education to meet the Need of Developing Countries, Presentation at the Covenant University Friday Fellowship on Achieving and Driving Teaching Quality in 21st Century African Universities, 18th April, 2008.

Fafunwa, A.B. (1974). History of Education in Nigeria, George Allen and Unwin Ltd., London, UK.

Federal Government of Nigeria. (1992): *Engineers (Registration, etc.) (Amendment) Act*. Lagos, Federal Government of Nigeria.

Federal Government of Nigeria (2004): National policy on education. Lagos, Government Press.

Frise, P.R., Sirizzotti, M.D., Gaspar, R.G., and Reader, G.T. (2002). *Mechanical engineering skills needs in Canadian industry*. Paper presented at the CSME Annual Conference, Queen's University, Kingston, Ontario.

Gemade, B.A.I. (2009). Quality of Engineering Education and Training – Key to Infrastructural Development, Proceedings of 18th COREN Engineering Assembly, Abuja, Nigeria, pp. 1-6.

Ibidapo-Obe, O. (2009). Reconstructing the Nigerian Education Landscape: Road Maps for Driving Innovations and Developments in Universities, 4th Distinguished Convocation Ceremony Lecture Series of Covenant University, Nigeria: 16th June, 2009.

Ilaboya, I. R. and Wara, S. T. (2008): Towards and effective capacity building for sustainable development. In: *Proceedings of the 6th Interanational Conference on the Role of Engineers in meeting the Millenium Development Goals in Lesser Economies,* 240 – 245. Arusha, December 10 – 12.

May, E and Strong, D. S. (2006): Is Engineering Education Delivering what Industry Requires? In: Proceedings of the Canadian Design Engineering Network (CDEN) Conference, Toronto, Canada, July 24 - 26, 2006, 204 – 212, Accessed 15th November, 2006 available at: http://ojs.library.queensu.ca/index.php/PCEEA/issue/view/396

National Academy of Engineering. (2005): *Educating the engineer of 2020: Adapting engineering education to the new century*. Washington, DC. The National Academies Press. pp4.

National Universities Commission (2002): Academic staff profiles, student enrolment, dropout and graduation rates at Nigerian universities during 1995/96 to 1999/2000 academic years. Abuja, Department of Academic Planning, National Universities Commission.

National University Commission. (2002). Ranking of University According to Performance in their Academic Programme in the 1999 and 2000 Accreditation Exercise, Quality Assurance in Nigeria Universities, Vol. 1, Abuja, Nigeria.

Obadara, O. E. (2010): The evolution and management of higher education in Nigeria: a review of private initiatives. *Academic Leadership*, vol. 8, issue 3.

Oloyede, I.O. (2008). Promoting Quality Geoscience Education in Nigeria - Challenges and Possibilities: Possible Areas of Collaboration with Oil and Gas Industry, Paper Presented at the 8th Conference of the Nigerian Association of Petroleum Explorationists (NAPE), Lagos, Nigeria: 21st - 23rd February, 2008.

Padmanabhan, K.A. (2000). Engineering Education and Practice: Need for Restructuring, Accessed 21st June 2012, available at:
http://www.iitk.ac.in/infocell/Archive/dirjan2/cover_story.html,

Todd, R.H., Sorenson, C.D., and Magleby, S.P. (1993). Designing a senior capstone course to satisfy industrial customers. *Journal of Engineering Education*, 82(2), 92100.

UNESCO (2005). Education for Sustainable Development, Accessed on 21st June 2012, available at http://portal.unesco.org/education/en/ev.php

Wara, S. T., Ngubi, F. W., Ilaboya, I. R., Njoya, H. K., Okwuonu, U. C., Collins, S. and Burnett, S. (2010): New frontier in cooking technology – 'cooking green'. *The Nigerian Engineer,* 49 (3): 42 – 50.

Wissey, T.W. (2000). Enhanced skills for engineers. Proceedings of the IEEE: Vol. 88, No. 8.

The Nigerian Society of Engineers: http://www.nse.org.ng/

The Council for the Regulation of Engineering in Nigeria: http://www.coren.gov.ng/

The National Universities Commission: http://nuc.edu.ng/