

ENGINEERS REGISTRATION BOARD CAPACITY BUILDING PROGRAMME FOR ENGINEERS AFTER GRADUATION

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Abstract

Young engineers graduating from higher learning institutions lack several technical and managerial skills not acquired during the academic training programmes. The missing technical engineering skills need to be harnessed before these graduate engineers can perform adequately and efficiently in their professional disciplines. Likewise, modern professional engineers need to have the ability to develop their skills and knowledge on a continuing basis in order to maintain and develop professional competence. This life-long education of engineers is necessitated by rapid developments in technology and changing work demands of the engineering profession. These attributes can be acquired through suitable programmes such as the Structured Engineers Apprenticeship Programme (SEAP) which is an internship programme for fresh graduates and the Continuing Professional Development (CPD) which is relevant for practicing professional Engineers.

In order to acquire professional and competent engineers within a minimum short period after graduation and thereafter continue with development of their competencies, the Engineers Registration Board has introduced the SEAP and CPD programs.

This paper briefly outlines the reasons why SEAP was introduced and its benefits to the nation. The paper also describes the Continuing Professional Development program of the Engineers Registration Board, which is mandatory for all practicing professional engineers in Tanzania. It highlights the objectives of the programme, its requirements, organization and operational modalities, impact of the two programmes that lie ahead and the challenges.

1.0 INTRODUCTION

1.1 Background

The number of engineers that are graduating from Tanzanian institutions of higher learning is increasing year after year. Currently, the country is producing more than 500 fresh graduates from various institutions of higher learning. These young graduates have to be employed in various engineering sectors throughout the country.

Experience has shown that quite a good number of young graduate engineers do not secure employment due to lack of professional exposure/experience/competence. Some potential employers have even gone to the extent of advising graduate engineers who seek employment to go back to them once they have acquired the requisite experience. This vicious cycle of **no experience-no employment-no experience** has made a number of graduate engineers to quit the profession and do other jobs.

It is known that the cost of training an engineer for four years is one of the highest as compared to other professionals; and therefore if graduate engineers are not assisted immediately after graduation to acquire the experience and employment, they will continue shifting to other jobs such as banking and vending instead of practicing engineering. This is a waste of the rare profession and human resources. As a result this can retard the development of the country, because a country without engineers cannot develop.

Thus, one of the major preoccupations of the Board has been to address the need for young graduate engineers to gain adequate professional experience to enable them become professional engineers within the minimum period possible, and therefore be able to contribute effectively towards the development of the country. This will assist the country to have a sustainable growth of the engineering profession.

In order to break the vicious circle, of no experience no job, and no job no experience, the Government in 2003, through the Engineers Registration Board introduced the Structured Engineers Apprenticeship Programme (SEAP) to help graduate engineers acquire the professional experience and competence necessary for registration as professional engineers. The study carried out by Lema and Eng. Kimambo [1] on the design and operationalization of SEP in 2003 revealed the importance of providing training to young graduate engineers so as to equip them with skills for competitive performance, employment and registration with the Board as professional engineers. The two consultants submitted the report in April 2003 and the SEAP programme became operational in the same year. To date a total of 1,050 Graduate engineers have benefited from the programme.

The Board realizes that Continuous Professional Development (CPD) is paramount for all practicing engineers for enabling them to keep abreast with changes in science and technology and thus be up to date with the current practices and therefore remain competitive. In the developed world participation in CPD is viewed as a professional obligation throughout ones working life. The Board introduced a CPD programme in 2004 and officially started to be operational in January 2006. CPD is obligatory for all practicing professional engineers in Tanzania.

1.2 Objectives of the Engineering Capacity Building Programs

The objectives of the programmes are as follows:

- Enable fresh graduate engineers to acquire professional competence and therefore qualify for registration as professional or technician engineers
- Enable local engineers (consultants, contractors) compete effectively with their foreign counterparts
- To improve the knowledge, skills and performance of practical engineers so as to enable them keep abreast of new developments in technology and changing demands of their environment.

- To enhance professional competence and competitiveness of both local engineers and local engineering firms.
- To reinforce the need for life-long learning for engineers;
- To provide a framework through which practicing engineers can systematically maintain and enhance their professional competences;
- To assist practicing engineers to increase capacity for learning so as to be more capable, confident and adaptable when faced with change; and
- To encourage practicing engineers to broaden their knowledge, skills and experience in order to improve work performance and enhance career prospects.

2.0 PRACTICE AND EXPERIENCE IN OTHER COUNTRIES

The study conducted by Mawenya [2] on the design and development of a structured Continuing Professional Development (CPD) revealed the significance of career development through continuous training so as to be update engineers with emerging knowledge and technologies. In his study he reviewed CPD requirements for engineers in eight countries in Europe, Africa and South Asia, representing a cross-section of both developed and developing countries. These countries are the United Kingdom, France, Germany, Nigeria and South Africa. Others are Singapore, Australia and Hong Kong.

2.1 United Kingdom

There is no formal requirement within the UK for an engineer of any discipline to register in order to practice (except for engineering technicians working on aircraft engines, and a small panel of qualified dam engineers). However, it is general practice within the engineering community, for all engineers to be on the register of the Engineering Council (UK) in order to gain recognition as engineers.

Registration with the Engineering Council and membership of its accredited professional engineering institutions such as the Institution of Electrical Engineers (IEE), Mechanical Engineers (IMechE), Civil Engineers (ICE), Chemical Engineers (ICChemE), the Institution of Acoustics, the Institution of Physics, etc places obligation on members to maintain and develop professional competence through CPD. A Code of Practice identifies explicit CPD standards that should be achieved, amounting to at least 5 days per year (equivalent to 30-35 contact hours per year). The Code emphasizes that individuals should be responsible for their own professional development at different stages of their carrier. It also places an obligation to the individuals to plan and record their CPD, to produce evidence of CPD chievement and to support the learning of others.

2.2 Germany

In Germany, the only qualification necessary for an engineer to work in industry is the academic title “Diplom-Ingenieur” which is awarded by universities and Fachhochschule. There is no formal registration or professional certification necessary after obtaining the “Diplom-Ingenieur”.

Continuing professional development is considered important for career development. Though not formally prescribed it is strongly supported by industry, the German Association of Engineers (VDI) and other reengineering institutions. These institutions require engineers to participate in CPD seminars, workshops and courses on technical and management aspects of their work.

The main providers of CPD courses for engineers are education and training institutions (notably Universities and Fachhochschule), but employers also play a central role. In fact every large enterprise develops its own CPD and, in consequence, elaborate CPD programmes exist for engineers in the chemical industry (developed by BASF), mechanical industry (developed by MAN) and the information and communication industry (developed by SIEMENS). Some of the large companies have specific departments for continuing education that organize in-house seminars and workshops for company employees. The companies regularly invite outside speakers, notably from universities, to address such seminars and workshops.

2.3 France

The practice of the engineering profession in France is neither controlled nor regulated by French laws. But the academic title “Ingenieur Diplom de...:” followed by the name of the school that has awarded it is legally protected by the Commission des Titres d’Ingenieur (CTI) – Accreditation Board for Engineers Titles. Like in Germany this is the only qualification necessary for an engineer to work in industry. This qualification also entitles one to have his or her name entered in the Repertoire Francais de Ingenieurs (Directory of French Engineers).

CPD is not a formal requirement for registration, but every engineer is expected to maintain and develop his competence through CPD. The French law obliges every enterprise to spend a minimum of 1.5 percent of their annual payroll on continuing education of their employees. But in fact the enterprises spend more; their overall expenditure on CPD averages 3.22 percent of the annual payroll (or euros 7 billion). Enterprises in IT and R & D spend much more on CPD (6-7 percent of the annual payroll).

Almost all the main engineering schools in France have centers for lifelong learning. Many large enterprises also have their own CPD centers.

2.3.1 Nigeria

Continuing engineering education is a statutory obligation for practice for the engineering profession in Nigeria. Under the Nigerian law, the Council for the Regulation of Engineering in Nigeria (COREN) requires all engineers to keep abreast of current trends in the profession by attending seminars, workshops, conferences, lectures, courses and subscribing to reputable engineering journals. The regulations stipulate that for any engineering practitioner to qualify to be on the register of COREN he or she must accumulate a total of 20 Professional Development Units (PDUs) annually, equivalent to 20 contact hours.

A defaulting engineer would have his or her name removed from the register. It is illegal for any person whose name is not in the register to practice as an engineer. The employer of such a person is also liable to penalty.

The requirements for registration are effectively met through membership of professional engineering institutions accredited by COREN, such as the Nigerian Society of Engineers, but the modalities of enforcing them are yet to be finalized.

The main providers of continuing engineering education in Nigeria are education and training institutions, professional engineering associations, industry (though in-house programmes) and independent private consultants.

2.4 South Africa

The law in South Africa requires professional engineers to register with the Engineering Council of South Africa (ECSA). This is typically achieved by possessing a qualification that is on the South Africa's National Qualifications Framework, such as the corporate membership of the South African Institution of Civil Engineers, or equivalent.

As of 1 January 2006, CPD for engineering practitioners is an obligatory in South Africa. CPD is used as the mechanism through which all registered engineering practitioners must have to renew their Registration with ECSA. In this regard section 22(1) of the Engineering Profession Act, 2000 (Act 46 of 2000) requires that a registered practitioner has to renew his or her Registration and has to "apply, in the prescribed manner, to the Council for the renewal of his or her Registration." A minimum of 4 credits (40 hrs) are required for renewal.

Apparently continuing engineering education in South Africa is a popular activity pioneered by tertiary training institutions (universities and tehnikons) professional engineering institutions and industry.

Universities are among the most active providers of continuing engineering education in the country with Universities of Witwatersrand, Pretoria, Cape Town and Stellenbosch leading. The overall level of continuing engineering education is likely to increase in the future following the new legislation concerning a skills training levy to be charged on companies to support continuing education.

2.5 Singapore

Legislation in Singapore requires all engineers to register with the Professional Engineering Board of Singapore in order to practice. In addition, Singapore registered professional engineers have to be in possession of an annually renewable practicing certificate.

CPD is a statutory requirement both for registration with the Professional Engineering Board and for renewing the practicing certificate. Every professional engineer who wishes to renew his or her practicing certificate is required to obtain 40 PDUs of CPD over the renewal qualifying period. This is equivalent to 40 contact hours of CPD activities approved by the Board. The 40 PDUs must comprise a minimum of 15 PDUs in structured activities and the remainder can be obtained from either structured or unstructured activities approved by the Board.

The Board has an elaborate organizational system for conducting, monitoring and evaluation of CPD activities.

2.6 Hong Kong

In order to practice as a professional engineer in Hong Kong an individual has to be a Registered Professional Engineer. Such registration requires membership of the Hong Kong Institution of Engineers (HKIE) or of another engineering body whose membership is accepted by the Engineers Registration Board of Hong Kong as being of a standard not less than that of a member of HKIE.

CPD is a mandatory requirement for membership of the HKIE. Corporate members of HKIE are required to undertake a minimum of 5 CPD days (30 contact hours) each year on a self-regulatory and voluntary basis. The requirement for no-corporate members who are working on their initial professional development is 45 contact hours per year.

Members are required to complete a declaration form every year that reflects their self assessment of CPD attainment.

2.7 Australia

Registration of engineers is not mandatory in Australia, although some states, e.g. Queensland, do have legislation governing the practice of engineering. The Australian government, both at the federal and state level, fears that having such legislation may be anti-competition or discriminatory.

However the Institution of Engineers Australia (IEAust) maintains a National professional Engineers Register (NPER) that is recognized as an authoritative database of engineers. In order to have his or her name entered on the register one has to have corporate membership of IEAust or other equivalent qualification.

CPD is a mandatory requirement for membership of IEAust. Corporate members are required to have a minimum of five CPD days (30 contact hours) each year on a voluntary and self-regulatory basis.

3.0 THE STRUCTURED ENGINEERS APPRENTICESHIP PROGRAMME (SEAP) IN TANZANIA

The Structured Engineers Apprenticeship Programme (SEAP) or the Initial Professional Development (IPD) is a three-year training programme. It has been instituted in order to enable fresh graduate engineers to acquire professional competence and skills in a structured and systematic manner and thereafter register as professional engineers thus enabling the engineers to enter the job market fully equipped to practice the profession with confidence and effectiveness. Implementation of the programme started in 2003 but the programme was conceived a decade earlier when the Board realized that the majority of fresh graduate engineers were not getting employment due to lack of professional experience. With liberalization of the economic sectors in the country, the majority of the new employers were reluctant to employ engineers who lacked professional experience. These employers therefore found this to be an excuse for employing foreign engineers. This led to the no-experience-no-employment-no-experience syndrome to the Tanzanian young engineers. The situation worsened as years went by while at the same time engineering training institutions released more graduate engineers into the labour market each year. Due to lack of professional competence and skills, the engineers also failed to qualify for registration as professional engineers. To address the situation, the Board and the Institution of Engineers Tanzania requested the Government to finance the program. Thus the Government started to finance the programme through the then Ministry of Works, in 2003 and the Board is the Program's implementing agency. Since its inception a total of **1,050** graduate engineers have benefited among which 441 secured employments after acquiring engineering competence. See Table 1 for details.

Table 1: SEAP Status for the Period 2002 - 2008

Intake	Total number of SEAP trainees admitted	Number of SEAP Trainees sponsored by the Government	Number of SEAP Trainees privately sponsored	Number of SEAP Trainees who have completed training	Number of SEAP Trainees Employed (many are employed even before completion of the program)
2002/03	120	110	10	-	60
2003/04	174	162	12	24	95
2004/05	212	195	17	35	120
2005/06	167	137	30	31	81
2006/07	218	113	105	49	85
2007/08	159	124	35	93	
Total	1050	841	209	232	441

Every year the Government sets aside funds which cater for training of about 150 graduate engineers. This fund caters for training allowances to the trainees and other costs pertaining to the program such as stationery, transport of trainees, and supervision costs. In order to complement the Government's effort, a total of **209** trainees have been sponsored by private employers since 2003, whereby the Government has financed a total of **841** trainees.

3.1 Benefits of Structured Engineers Apprenticeship Programme

The Structural Engineers Apprenticeship Programme (SEAP) has a number of benefits to various stakeholders including Trainees, Mentors, Providers and the Nation. The benefits are outlined in the proceeding text.

3.1.1 Trainees

The benefit of SEAP to the graduate engineers (trainees) include exposure to working procedures of different engineering companies, gaining experience, competence and employment after placement and completion of the professional training. The programme assists Graduate engineers to qualify for registration as professional engineers. To date a total of 441 SEAP trainees have been employed. (Table 1). Those who are employed before completing the programme are required to continue with the programme through sponsorship of the employer, working under supervision of professional engineers by submitting their quarterly reports until they complete and thereby be registered by the Board. The Board however, continues to monitor their professional training.

3.1.2 Mentors

The Mentors who supervises the SEAP trainees until they complete their professional training will gain points in the Structured Continuing Professional Development (CPD) which will be documented by the Board. CPD is compulsory to all practicing engineers, where one is required to get a minimum of 30 Professional Development Units (PDUs) in a year. Since learning is a continuous process, it is believed that while mentoring the mentors also gain new knowledge. Publicity of SEAP mentors' names into the ERB website is another benefit to mentors. This is very beneficial as all Mentors will be publicized worldwide.

3.4 Providers

The SEAP providers benefit during training by getting free manpower and professional training for future employee instead of employing fresh graduate from Universities. The Providers select among the trainees the good employees. Experience has shown that even before completion of the program, some trainees who demonstrate high performance secure employment by the providers. For example, as of March 2008, **441** trainees got employment after exhibiting competence and confidence during the SEAP training.

3.5 Nation

The graduate engineers, due to lack of experience after completing their studies find themselves in a difficult situation due to lack of employment opportunities. SEAP tends to give opportunity to graduate engineers to gain professional experience and expose them to their future employers. Therefore, SEAP help to reduce the unemployment problem of the engineers in the country.

The program also helps the prospective employees to recruit employees after reasonable time of scrutiny. Hence, this programme has a multiplier effect to the nation owing to the fact that all the key stakeholders of the engineering industry including the public and the private sectors are ultimately in a win-win situation they derive value for money for services provided by competent professionals.

4.0 STRUCTURED CONTINUING PROFESSIONAL DEVELOPMENT FOR ENGINEERS IN TANZANIA

4.1 Importance of Continuing Professional Development Programmes

It is not surprising to note that, there are several local engineers who have worked in their fields for several years but lack the necessary experience. In this case the issue of Continuing Professional Development (CPD) is necessary such engineers in order to make them internationally competitive and be able to practice within the country and across the national frontiers.

The Continuing training programs which are in the form of seminars, lectures, etc are aimed to keep all engineers updated with the current technologies and enhance them with the necessary technical skills. The Continuing Professional Development programme has been made mandatory to all practicing engineers in the country. Actual implementation of the Program started in January 2006. Prior to that the Board commissioned a Consultant to design and operationalize the program. The rationale for introducing the program emanates from the fact that the body of knowledge in science and technology is changing fast and growing, and unless engineers constantly update their engineering knowledge in order to keep abreast with the changes, they will cease to be innovative and creative. The program is therefore intended to redress obsolescence of engineering knowledge with time.

The purpose of the Board's CPD Program is twofold: to reinforce the need for life-long learning and to provide a framework within which practicing engineers in Tanzania can systematically maintain and enhance their professional competence. As a result, practicing engineers of all categories need to participate in CPD in order to.

- Maintain, improve and expand technical skills and knowledge
- Keep abreast of changing procedures and standards
- Understand and apply advances in technology
- Better serve the engineering profession, community and environment
- Broaden into related fields, such as management, finance and law.

The Board's CPD Program has four main objectives, namely:

- To reinforce the need for life-long learning among engineers through CPD;
- To provide a framework through which practicing engineers can systematically maintain and enhance their professional competence;
- To assist practicing engineers to increase capacity for learning so as to be more capable, confident and adaptable when faced with change; and
- To encourage practicing engineers to broaden knowledge, skills and experience in order to improve work performance and enhance career prospects.

4.2 Types of Continuing Professional Development Programmes

The Board recognizes a wide range of continuing engineering education activities as contributing to Continuing Professional Development (CPD). These activities are:

- Formal postgraduate courses leading to a higher degree, postgraduate diploma or certificate
- Participation in short courses, lectures, conferences, seminars, workshops, symposia, study visits, organized exhibitions and other related professional activities
- Contribution to knowledge through publications, patents, etc
- Participation in boards, committees and professional societies
- Self-study and development

For the purposes of assessment, the Board classifies into two groups: *structured* and *unstructured* CPD activities. The former refers to a course or activity that has a specific objective and measurable outcome and has been accredited as such by the Board. A CPD activity that involves self-directed learning, reading, discussion, participation or that is otherwise not accredited by the Board is referred to as an "*unstructured CPD activity*".

The "*Professional Development Unit*" or "*PDU*" is the unit of measure for effort invested in continuing professional development. One PDU is equivalent to one contact hour of attendance or involvement in a *structured CPD activity* [4]. In order to reflect the relative importance of various CPD activities, both structured and unstructured, the Board has assigned different PDUs to these activities. The assigned PDUs are given separately in other Guidelines of the Board's CPD Programme. Individual engineers and organizers of CPD activities are advised to consult these guidelines when planning their CPD programme.

4.3 Requirements for Continuing Professional Development Programmes

The CPD Program of the Board requires the following:

- Every practicing engineer must achieve a minimum of thirty (30) PDUs per year. This is equivalent to five days of continuing professional development involving not less than six hours of structured activity per year. The 30 PDUs shall comprise a minimum of 20 PDUs in structured activities and the remainder can be obtained from either structured or non-structured activities.
- If an engineer exceeds the annual requirements of 30 PDUs in the year under review, a maximum of 30 PDUs obtained from structured activities may be carried forward into the following year.
- An engineer who has not obtained sufficient PDUs in the year under review will be allowed to carry over the shortfall into the following year, provided that he or she has accumulated a minimum of 70 PDUs in the past three consecutive years.
- If an engineer fails to meet the prescribed PDU requirements for three consecutive years, the Board may lapse his or her registration. The same will apply to an engineer who, for whatever reason, has not submitted his or her CPD returns for a period of three consecutive years.
- An engineer whose registration has lapsed is required to obtain 60 PDUs within one year before he or she can be reinstated. These 60 PDUs must comprise at least 40 PDUs obtained from structured activities.
- An engineer may be exempted, subject to review and approval of the Board, from CPD requirements if he or she experiences physical disabilities, prolonged illness or other extenuating circumstances.

The above requirements apply to three categories of practicing engineers, namely professional engineers, consulting engineers and technician engineers. They do not apply to graduate engineers and graduate technician engineers who are engaged in professional training in order to acquire competence and commitment and, in particular, to qualify for professional registration with the ERB. To date, the Board has received **34** duly filled CPD-logbooks, and a more have been collected by engineers. At the end of 2009, an assessment will be done and engineers who will not secured the required total of 90 PDUs for the last 3 year, may not get their practicing licenses renewed. Therefore it is advised that every CPD activity done by practicing engineer must be documented and reported to the Board for recording.

5.0 IMPACT OF THE PROGRAMS

5.1 Impact

Since the introduction of the two programs, significant impact has been recorded in the registration of engineers and the capacity building. The impact covers the following:

- The registration of all categories of engineers, including engineering consulting firms. As of May 2008 the Board has in its register more than 8000 Engineers and 152 Engineering Consulting Firms. Under the amendment of Act, the Board will soon start registering all engineering technicians.
- Professional development of engineers, covering professional training of fresh graduate engineers and continuing professional development (CPD) for engineers.
- Introduction into the Board's Annual Calendar of activities events that have a bearing on professional development/capacity building such as the Annual Engineers' Day, Annual Consultants Learned Discourses, Public and Professional Lectures, etc.
- Introduced Professional Examinations for technician engineers whereby more than 200 technician engineers have passed the examinations and upgraded to professional engineers.
- Innovativeness among local engineers have been enhanced
- Enrolment of fresh to SEAP program has gone up and a total of 1050 trainees have benefited from the programme
- More than 120 Engineers who pursued the SEAP have been registered as professional engineers and more than 400 have been employed some even before completion of the training
- Enhanced employability of Tanzanian engineers
- Enhanced competitiveness of Tanzanian engineers
- Improved confidence in the professional careers of the engineers
- Increased individual engineering capability as a contribution to national development
- Enhanced development and career prospects
- Ability of Tanzanian engineers to meet international professional standards and therefore gain international recognition

5.2 Challenges

The key challenges that lie ahead for the Board in implementing the SEAP are as outlined below:

- Limited finances to run the program. Currently, the SEAP program is financed only by the government
- Some of the trainees who obtain employment even before end of the program stop from continuing with the programme
- Some trainees after completing the training without prior informing the Board, run out of the country to seek green pastures even before effectively contributing to the socio-economic development of the country and thus deprive the country of professionally qualified engineers who are require to undertake specialized engineering assignments

6.0 CONCLUSION

- Rapid developments in technology and changing work demands of the engineering profession reinforce the need for life-long education of engineers through SEAP and CPD. Practicing engineers in Tanzania need to develop their skills and knowledge as well as the skills and knowledge of other members of the profession on a continuing basis in order to maintain and develop professional competence. This is a professional obligation.
- Given this necessity and the high potential demand for SEAP and CPD by practicing engineers in Tanzania the establishment of the two structured programs by ERB for engineers is fully justified and need to be supported by various stakeholders of these programs including the individual engineers, employers, training institutions, regulatory Boards and professional institutions. Each of these stakeholders has a unique role to play in promoting the two programmes.
- The role of ERB, in this context, is crucial. The Board has several responsibilities including the setting of standards of attainment, prescribing and enforcing the necessary required standards, coordinating the efforts of various stakeholders and setting policies and procedures to facilitate implementation of the programme.
- Capacity building for engineers in the developing world should be taken as a necessity. This will enable them to effectively offer services that meet international standards and therefore be able to effectively respond to the challenges of globalization.

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