Global J. of Engng. Educ., Vol.8, No.1
Published in Australia

African Centre for Engineering and Technology Education (ACETE)

Silas Lwakabamba
Francis Mbuza
Kigali Institute of Science, Technology and Management
Avenue de l'Armée, BP 3900, Kigali, Rwanda

The article describes the establishment of the African Centre for Engineering and Technology Education (ACETE) at the Kigali Institute of Science, Technology and Management (KIST) in Kigali Rwanda. In the article, the authors discuss the organisational and functional structure of the ACETE as a satellite centre of the UNESCO International Centre for Engineering Education (UICEE), based at Monash University, Melbourne, Australia. The authors further highlight the achievements so far, showing the constraints and challenges that have been encountered on the way. It is concluded that, despite a number of constraints and challenges, the ACETE has travelled some distance in accomplishing the missions and objectives of the UICEE. With continued good leadership, regional and international collaboration, the ACETE will achieve more.

KIGALI INSTITUTE OF SCIENCE, TECHNOLOGY AND MANAGEMENT

Kigali Institute of Science, Technology and Management (KIST), Kigali, is the first technological institute of higher learning set by the government of Rwanda. Since its inception in 1997, the KIST has been able to respond to the crucial needs of high quality technical and professional workforce to support the development of Rwanda, which has been going through difficult years of economic decline and later, war and genocide of 1990-1994. The skilled personnel got either killed or had to run out of the country, leaving voids, which have been difficult to fill. This tragedy considerably increased the number of vulnerable groups, such as orphans, the physically disabled, widows and the destitute. In addition, there was a massive return of refugees who had left the country in 1959 and 1973.

The KIST began with only three departments in 1997: Engineering, Computer Science and Management. The School for Languages, which fosters bilingualism, and the Centre for Continuing Education, which administers part-time programmes, were later established in 1998. To date, the academic structure at the KIST has expanded to include three full operational faculties: the Faculty of Technology, the Faculty of Science and the Faculty of Management.

The Faculty of Technology has six academic departments and two service departments. The academic departments are as follows:

- Electrical Engineering;
- Electronics and Communications Engineering;
- Mechanical Engineering;
- Civil Engineering and Environmental Technologies;
- Computer Engineering and Information Technology;
- Food Science and Technology.

The two service departments are:

- Workshop Technology, which aims at imparting hands-on skills to the students in various trades, such as electrical installation, welding, masonry, carpentry, etc.
- Cottage Industry, which facilitates entrepreneurships and small-scale business development.

PROGRAMMES AT THE KIST

The KIST's unique programmes place a strong emphasis on the practical-oriented curriculum, which is in contrast to the theoretical or academic models. The full-time academic programmes in the Faculty of Technology have been designed to provide to the students

with the need-based market sensitive skills at the levels of craft, technician and engineers. The structure of the academic programmes is demand driven in the sense that different levels of skilled technicians would annually be availed to the labour market as a short-term measure parallel to the training of engineers as medium- and long-term measures, since their programmes are relatively longer and more demanding. The number of exit students at the certificate and diploma levels would largely depend on the requirements and the performance of the students enrolled.

The Institute is implementing a continuing education programme that covers a variety of courses, such as computer applications, masonry, carpentry, electronics and telecommunication, radio and television repair, etc. These programmes are normally short courses ranging between six months and one year. The main objective is to impart and update knowledge and increase efficiency of the working population from the private and public sectors. The KIST derives its validity through its active role it has taken in training to fulfil its objective and provide an impact to the economy as soon as possible.

The KIST also focuses on the following key aspects:

- Curriculum development with the advice from international bodies;
- Institute-industry partnerships, which includes community attachment for four weeks and industry placement for eight weeks;
- Income generation activities for the sustainability of programmes;
- Appropriate technology and innovation, particularly in the context of Rwanda [1];
- Increase in the number of female enrolments;
- Democratic education [2];
- Enhancement of ethics in student education with the recent introduction of a full course on engineering ethics and professional conduct.

Other notable aspects of the KIST's technical curricula include a common first year of study, as well as compulsory language study (English and French) [2].

ICT EDUCATION AT THE KIST

The KIST's ICT curricula and programmes are practical in orientation and market driven to address the requirements of all stakeholders, including even the provision of a workforce that will attract foreign investors. The curriculum is reviewed on a yearly basis in order to match the rapid changes in technology in the ICT sector.

The Institute offers full-time programmes in computer engineering, Information Technology (IT) and in electronics and telecommunication engineering. These programmes lead to the award of a diploma or degree. The Institute also offers basic computer courses to all students who are registered by the Institute.

The Institute is currently implementing a continuing education programme that covers a wide range of ICT courses such as: computer applications, networking, programming, etc. Some of these courses are tailor-made to suit the needs of particular customers. Most of the courses are offered in the evening for the convenience of students. Payment of course fees is done in instalments and a moderate amount is charged for the purpose of sustaining these programmes. This has enabled low-income earners to afford the costs involved.

Intensive Programme to Train ICT Technicians

In collaboration with the Department for International Development (DFID) UK, the KIST is running an intensive programme to train ICT technicians to maintain computing hardware, software and networks. The problem being addressed is the shortage of skilled technicians in order to maintain and repair the growing stock of ICT equipment.

The courses are provided in three modules, each of four months' full-time study. The focus of the training is on hardware maintenance engineering, software maintenance and management, and computer networking and administration. The programme is geared towards the enhancement of the local capacity to maintain the ICT infrastructure through rapid upgrading of staff at post. This benefit will be sustained by utilising facilities created for a regular training programme for school leavers and other unskilled people already in the labour market.

The KIST will need to generate a sustainable ICT infrastructure and human resource development. There is no doubt whatsoever that, at the moment, the ICT sector is fast growing and the situation is likely to remain the same over the next few decades. With this growth, and the economy as a whole, there are unlimited opportunities for ICT-trained personnel.

Distance Learning Programmes

The KIST utilises Internet resources to offer quality distance learning education through the African

Virtual University (AVU) with the minimum human resources. This has made the programmes more affordable.

Students interact with instructors through e-mail, telephone or fax. In this way, quality distance learning to KIST students and the general public is facilitated. The KIST is among the five selected universities in Africa to offer computer science degrees and diploma courses in conjunction with the RMIT University, Melbourne, Australia through distance learning under the AVU cooperation [3].

The KIST has also developed mechanisms that can assist some national members of staff to advance their knowledge without necessarily having to leave the country. For example, through such on-campus distant learning facilities like the Internet and the AVU, the KIST has encouraged, and is assisting, some staff members to upgrade their qualifications. One of the KIST's management priorities is thus to pursue staff development programmes within the context of capacity building so as to ensure that, in future, the Institute will have sufficiently qualified Rwandans to run it.

Clearly, the KIST is set to play a leading role, not only in the development of science, technology, and management, but also in the production of the much needed well-qualified personnel [4].

School Internet Connectivity

The KIST is working with World Links to support school Internet connectivity in rural schools in Rwanda located at regional centres. Twelve secondary schools have already been identified. The objective of this programme is to provide technical solutions in order to promote educational access to computers and the Internet, including the utilisation of a combination of new and refurbished technology, land-line, wireless and mobile tele-centres.

The availability of computers at regional centres will also be available to neighbourhood communities. This means an agricultural extension officer, for example, who lives near the Centre can use the ICT facilities to receive information from, and send information to, diverse sources for the benefit of the community.

CISCO Academy Programme

The KIST has introduced the CISCO Network Academy Programme and the Microsoft Certification Programme. These programmes will allow students to gain hands-on experience with state-of-the-art networking equipment.

The KIST and RwEdNet Project

The KIST is actively involved in extending ICT services to connect remote areas on the Internet under the Rwanda Education Network (RwEdNet) project. The immediate projection is to establish and connect 12 tele-centres and research centres scattered all over the country, each with its own gateway. All of these centres will be independently connected to the Internet and within themselves [3].

UICEE SATELLITE CENTRE AT THE KIST

In July 2002, the KIST signed a Memorandum of Understanding with the UNESCO International Centre for Engineering Education (UICEE), seeking to establish a UICEE satellite centre called the *Central Africa Centre for Engineering and Technology Education* (CACETE).

However, it was later realised that a satellite centre focusing on only Central Africa would be very restrictive and counterproductive in the long run, primarily because of the peculiar nature of this region. As such, it was found reasonable to expand the geographical coverage of the Centre to include other countries outside the Central African region. The Centre is currently known as the *African Centre for Engineering and Technology Education* (ACETE). The target countries include Rwanda, Burundi, DRC, Kenya, Uganda, Tanzania, Uganda, Ethiopia, the Sudan, Somalia, and others.

Objectives

The main purpose of the ACETE is to further the mission, aims and objectives of the UICEE. Special emphasis is being placed on facilitating research, development and the dissemination of information on engineering and technology education in Rwanda and neighbouring countries. This is in line with the mission of the UICEE, which is as follows:

> *To facilitate the transfer of information, expertise and research on engineering education and to act as clearing house for the transfer of information on textbooks, engineering teaching courseware, software and equipment, in particular from developed to developing countries.*

Location

The ACETE is located within the Faculty of Technology, KIST, Kigali, Rwanda.

ACETE MEMBERSHIP

It is envisaged that the African Centre for Engineering and Technology Education (ACETE) will provide leadership in engineering and technology education in the region. This regionalisation of engineering and technology education is expected to be of immense benefit to students, academic and research institutions, industries, funding agencies, as well as individuals.

Therefore, it is considered of paramount importance and urgency that the ACETE enlist the partnership, cooperation and rapport of as many stakeholders in the region as possible.

In line with the UICEE's method of work, five categories of membership have been proposed. These are summarised below.

Partners

Partners are to be drawn from large industrial and academic organisations (ie with more than 20 employees/members). These are to be represented on the ACETE Academic Advisory Committee and, in addition, will receive all of the benefits of membership to the ACETE.

Sponsors

Sponsors will receive all ACETE publications and have access to the database on international engineering academics and institutions. Sponsors are eligible for all membership benefits.

Supporters

Supporters shall be individuals, small academic or industrial organisations with up to 20 employees/ members, which will be represented on the ACETE Academic Advisory Committee.

Supporters are expected to closely cooperate with the ACETE in Research and Development (R&D) work in engineering and technology education. Members in this classification are eligible for all other benefits of membership to the ACETE.

Contributing Members

Contributing members shall preferably be individuals, academic institutions and industrial organisations who will be able to contribute to particular areas/activities of the ACETE that are of interest to them. They are eligible to all of the benefits of membership to the ACETE.

Individual Members

Individual members will have access to a database on textbooks, engineering teaching courseware, software, equipment and methodologies that will be available to the ACETE. They will have access to a forum for promotion of their own research and development activities in engineering education. Individual members will also have the chance to participate in seeking funds from funding agencies.

INTERIM STRUCTURE OF THE ACETE

Academic Advisory Committee

There is an Academic Advisory Committee (AAC) as the policy body of the ACETE. Initially, this is comprised of members of the KIST and will expand gradually to include membership from identified partners nationally, regionally and internationally.

The structure is as follows:

- Prof. Silas Lwakabamba, Rector of the KIST, is the Chairman of the ACETE Academic Advisory Committee.
- Prof. Albert Butare, Vice-Rector of the KIST, is the Vice-Chairman of the ACETE in charge of research and development.
- Prof. J.G. Monney, Dean of the Faculty of Technology, is the ACETE facilitator for academic affairs.
- Dr Francis Mbuza, Vice-Dean of the Faculty of Technology, is the KIST representative/coordinator in charge of the cooperative programme between the UICEE and the ACETE.

Other members of the AAC from the KIST include:

- Two elected representatives from the Faculty of Technology;
- The Director of the Centre for Continuing Education (CCE);
- The Director of the Information and Communication Technology (ICT) training centre;
- The Director of Research and Consultancy;
- The Director of the Centre for Innovations and Technology Transfer (CITT).

Roles and Functions of the AAC

The main roles and functions of the AAC are as follows:

- To advise on the future general goals and aspirations of engineering and technological education in the region;
- To propose improvements in curricula and adapt educational processes to changing conditions;
- To provide guidance for the development of effective teachers and educational administrators;
- To ensure enhancements in professional ethics, ideals and standards;
- To advise on appropriate approaches to ensure that research complements teaching;
- To advise on achieving effective linkages between technical institutions, industry and society;
- To recommend awards, fellowships, prizes, scholarships and stipends in engineering and technological education to the UICEE;
- To solicit assistance for short and long-term courses for engineering teachers and practicing engineers;
- To facilitate the preparation of teaching manuals and course materials;
- To facilitate the preparation of directories on technical education facilities and expertise in the region;
- To facilitate the publication of a bi-annual journal of the ACETE;
- To promote the usage of ICT in engineering and technological education;
- Any other roles and functions as may be agreed upon by the AAC.

Conduct of Activities of the AAC

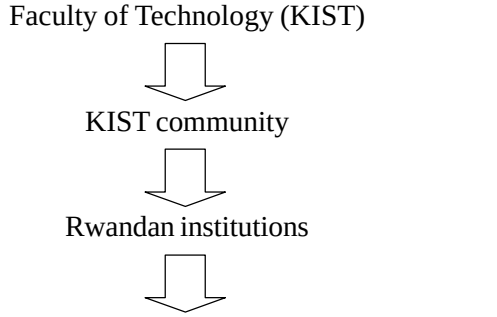
The activities of the AAC shall be carried out by correspondence and in meetings where scientific developments and documents to be published, as well as matters that relate to the planning of future activities, shall be discussed. The AAC shall convene the regional forum at least once every year. The AAC shall hold regular scheduled meetings quarterly.

Other important aspects in the conduct of the AAC include:

- The inaugural forum shall be held at the KIST, with subsequent fora to be decided at AAC meetings;
- The official language of the AAC shall be English and French;
- The AAC can recommend and convene conferences, symposia, seminars of experts on topics of relevance in order to achieve its objectives;
- The ACETE Secretariat shall facilitate AAC meetings and implement the agreed activities;
- The quorum of AAC meetings shall be two thirds of the active members;
- All of the members shall be informed of the schedule and agenda for the meetings by the Secretariat at least one month in advance of the meetings;
- 30% of the active members shall be required to call for an Extraordinary Meeting of the AAC.

INITIAL ROLLING PLAN FOR THE ACETE

The progression of involvement is expected to be as follows:



PROGRESS TO DATE

Progress to date can be characterised by the following activities and achievements:

- Establishing and strengthening the ACETE Secretariat at the KIST: This included the acquisition of office space, equipment and secretarial staff. In addition, there is an *ad hoc* committee that is charged with ensuring the effective implementation of ACETE activities, which includes the convening of the first seminar.
- Posting the ACETE on the KIST Web site.
- Establishing an Editorial Board of the ACETE bi-annual Newsletter; the first issue of this Newsletter was expected to be published in December 2003.
- Developing the ACETE five-year action plan.
- Initiating an exchange of scholars between the KIST and Hochschule Wismar - University of Technology, Business and Design, Wismar, Germany, a Partner institution of the UICEE. At the moment, two PhD scholars are at Hochschule Wismar on attachment.
- Initiating home-based higher professional degree programmes with Glasgow Caledonian University, Glasgow, Scotland, UK, another Partner member of the UICEE. So far, one senior staff

has enrolled for a PhD programme in engineering under this arrangement and five more staff are currently processing their applications.

CURRENT AND FUTURE ACTIVITIES

The ACETE's current and future activities include the following:

- Identification of potential partners and stakeholders in Rwanda and in the region;
- Sensitisation of all of the potential stakeholders;
- Convening the inaugural ACETE regional forum, which is expected to be held in July 2004;
- Expanding the ACETE Academic Advisory Committee to be effected at the regional forum;
- Sourcing funding, especially under the higher educational links of the DFID.

IDENTIFIED AREAS OF FOCUS FOR THE ACETE

The short-term goals of the ACETE include the following:

- The harmonisation of engineering curricula in consultation with industry;
- The development and implementation of sister university programmes;
- The development of a database on engineering education;
- Establishing communications networks and associations, eg a regional electronic mailing list.

The medium-term objectives of the ACETE cover the following:

- The development of a regional electronic database on activities and academics involved in engineering education and research;
- The promotion of twinning and networking between universities, eg the Central African Higher Education Network (CEAHEN).

The long-term targets of the ACETE include the following:

- Developing pedagogy through research and the development of courseware, software and teaching methodologies;
- Enhancing university-industry cooperation;
- Ensuring the equivalency of engineering education standards.
- Facilitating the exchange between individuals and institutions of information regarding expertise and research;
- Developing a database on engineering education;
- Promoting the participation of women in engineering education;
- Producing publications, such as the Newsletter, scientific journals, etc;
- Organising functions, seminars, training courses and symposia;
- Exchanging staff for academic development;
- Facilitating student exchanges;
- Encouraging the formation of industry working parties on engineering education.

CHALLENGES FACING THE ACETE

Geographical Coverage

The ACETE covers part of the famous great lakes region, which is characterised by not only political instability, but a unique colonial legacy and a divergence of economic progress. Many countries are still involved in civil wars. Some countries are Anglophone while others are Francophone. Some countries are relatively more prosperous than others. The implication is that different approaches are needed in different countries, which may, at times, slow down the speed of progress.

Expertise in Engineering and Technology

Rwanda, which is the host country of ACETE, has very few qualified personnel in the field of engineering and technology. It still relies heavily on expatriates in the teaching and advancement of engineering and technology. This implies that the establishment of the ACETE is timely, as it will assist Rwanda to advance in this area.

However, it also means that there is a distinct need for a great deal of mobilisation of the potential stakeholders who are not only few, but also scattered. In addition, there are very few manufacturing industries to foster university-industry linkages and to support some of the activities of the ACETE.

Legal Framework

The ACETE is not a body corporate but is expected to be administered within the legal framework of the KIST statute (2001), which provides for the setting up of Departments, Faculties, Centres and Schools. As to how much flexibility such an arrangement is to confer to the ACETE is yet to be established, after which a review can be made.

Mainstreaming

For effectiveness, it is better that the ACETE be mainstreamed into the programmes and activities of all of the stakeholders, so that it ceases to be seen in isolation. This calls for change of attitude and behaviour of the various stakeholders, which may be a daunting exercise given the common inertia in institutions and individuals. This effort calls for a concerted effort of stakeholder sensitisation and education through symposia and seminars that require funding.

Funding

This may probably be the main challenge facing the ACETE. The Memorandum of Understanding with UICEE does not elaborate on the funding mechanism to sustain ACETE activities. This leaves the ACETE with three possible alternatives, namely:

- Public funding, which is problematic given the ever-diminishing resource basket of developing countries like Rwanda;
- Private sector support, which is also not readily forthcoming given the small size of the private sector in Rwanda and the economic hardships it may be facing;
- Donor support, which is also not reliable, as there is no guarantee about its availability, nor can one dispel possible donor fatigue. Currently, the ACETE is trying to solicit some seed money from the DFID to kick start some of its activities. But, as expected, donor funding takes some time to be accessed. As of now, the ACETE has no funds to talk of. Efforts to recruit partners, supporters and sponsors have not yet yielded any fruits so far. In these circumstances, the initial thrust has been to concentrate on those activities that require no, or minimal, funding, such as fostering university-university linkages.

CONCLUSION

Despite a multitude of challenges and financial constraints, the ACETE has strived to gain ground. Given the goodwill of the UICEE, partner institutions and other stakeholders, the ACETE will continue to grow, expand and consolidate achievements at all levels.

UICEE PUBLICATIONS BY THE ACETE

1. Lwakabamba, S., Mushule, N. and Lujara, N., Professional ethics curricula in engineering education: the case of East and Central Africa. *Proc. 7th UICEE Annual Conf. on Engng. Educ.*, Mumbai, India, 21-23 (2004).
2. Lwakabamba, S. and Lujara, N.K., Effective engineering training: the case of Kigali Institute of Science, Technology and Management. *Global J. of Engng. and Technology Educ.*, 7, **1**, 71-76 (2003).
3. Lwakabamba, S., The challenges of promoting engineering education in developing countries: the case of Rwanda. *Proc. North-East Asia Inter. Conf. on Engng. and Technology Educ.*, Changhua, Taiwan, 8-13 (2003).
4. Lwakabamba, S. and Lujara, N.K., ICT education and employment in Rwanda: the role of KIST. *Proc. 6th UICEE Annual Conf. on Engng. Educ.*, Cairns, Australia, 49-52 (2003).
5. Butare, A. and Kimaro, A., Anaerobic technology for toilet wastes management: the case study of the Cyangugu pilot project. *World Trans. on Engng. and Technology Educ.*, 1, **1**, 147-151 (2002).
6. Lwakabamba, S. and Lujara, N., Teaching professional ethics to engineering students in East and Central Africa. *Proc. 6th Baltic Region Seminar on Engng. Educ.*, Wismar/Warnemünde, Germany, 45-48 (2002).
7. Lwakabamba, S., Effective engineering training: the case of Kigali Institute of Science, Technology and Management. *Proc. 3rd Global Congress on Engng. Educ.*, Glasgow, Scotland, UK, 79-82 (2002).
8. Lwakabamba, S. and Murray, P., Innovative technical education in Rwanda: a case study of the Kigali Institute of Science, Technology and Management (KIST). *Proc. 3rd Baltic Region Seminar on Engng. Educ.*, Göteborg, Sweden, 166-169 (1999).

CONTACT

Dr Francis Mbuza
African Centre for Engineering and Technology Education
Faculty of Technology
Kigali Institute of Science, Technology and Management (KIST)
Avenue de l'Armée, B.P. 3900
Kigali, Rwanda
E-mail: acete@kist.ac.rw

REFERENCES

1. Lwakabamba, S. and Lujara, N.K., Effective engineering training: the case of Kigali Institute

of Science, Technology and Management. *Global J. of Engng. and Technology Educ.*, 7, **1**, 71-76 (2003).
2. Lwakabamba, S. and Murray, P., Innovative technical education in Rwanda: a case study of the Kigali Institute of Science, Technology and Management (KIST). *Proc. 3rd Baltic Region Seminar on Engng. Educ.*, Göteborg, Sweden, 166-169 (1999).
3. Lwakabamba, S. and Lujara, N.K., ICT education and employment in Rwanda: the role of KIST. *Proc. 6th UICEE Annual Conf. on Engng. Educ.*, Cairns, Australia, 49-52 (2003).
4. http://www.kist.ac.rw/

BIOGRAPHIES

Prof. Silas Lwakabamba graduated with BSc (1971) and PhD (1975) in mechanical engineering from the University of Leeds, UK. He then joined the Faculty of Engineering at the University of Dar-es-Salaam, Tanzania, and progressed to the rank of Professor in 1981.

From 1985-1997, he was the Founding Director of Training and Extension Services at the UN-sponsored African Regional Centre for Engineering Design and Manufacturing (ARCEDEM) in Nigeria. Prof. Lwakabamba is currently the Founding Rector of the Kigali Institute of Science, Technology and Management (KIST), Kigalia, Rwanda, since 1997.

At the international level, Prof. Lwakabamba is a member of the Executive Board of UNESCO, a member of the Executive Board of the African Virtual University (AVU), a member of the African Technical Advisory Committee (ATAC) of the UN Economic Commission for Africa on the development of ICT in Africa and Fellow of the World Innovation Foundation based in the UK. In February 2003, he was awarded the UICEE's Silver Badge of Honour at the *6th UICEE Annual Conference on Engineering Education.* He is also a Deputy Chairman of the UICEE Academic Advisory Committee (AAC).

At a national level, Prof. Lwakabamba is the President of the Institution of Engineers of Rwanda and the Chairman of the Board of Director of the Parastatal Telephone Company (RwandaTel). He is also a member of various national commissions and steering committees on economic affairs, information and communication technology, human resources development and higher education.

He has over 30 publications in the areas of combustion, higher education, science and technology, energy and power production.

Dr Francis Mbuza, born in 1960 in Uganda, holds a Bachelor of Veterinary Medicine degree from Makerere University Kampala, and a PhD from Melbourne University, Australia. He has been involved in academia since 1984, initially as an assistant lecturer to the current status as the Vice-Dean of the Faculty of Technology at Kigali Institute of Science, Technology and Management (KIST), Kigali Rwanda. His academic pursuit has been in processing technologies of animal products, namely meat and milk.

He has special research interests in reproductive biotechnologies and the use of biotechnology in enhancing the quantity and quality of animal products. Dr Mbuza is currently the Chairman of the Department of Food Science and Technology in the Faculty of Technology at the KIST, as well as the Vice-Dean of the Faculty. He has served in many capacities in the public and academic arena and has published over 10 articles in international journals and proceedings of conferences and symposia.

Dr Mbuza is the Coordinator of the African Centre for Engineering and Technology Education (ACETE) located at the KIST. The ACETE is a satellite centre of the UNESCO International Centre for Engineering Education (UICEE).