Quality management techniques in University Engineering Departments

By Michael Njogah

michaelnjogah@yahoo.com

Abstract

In recent years, the quality of trainings at university engineering workshops in Kenya and other facilities for the engineering graduates has come into question. Differences in concepts and ways of approach towards quality of the services are affecting workshops and facility performances and in turn low quality graduates. In the context of quality management, the concept of quality has extended from a mere focus on service to business processes Technologists have typically been responsible for the quality of care and training in university engineering workshops and other facilities. However, as it has become difficult to retain already-trained technologists and also source fresh, competent technologists to provide care and service for the engineering graduates in universities workshops and other facilities, there is also a pressing need to adopt measures to find, train, and retain skilled technologists. This study assesses the capacity of Kenya's public universities to meet the demand for their academic programmes in engineering in addition to finding out if these institutions are responding to the quality labour market requirements. The paper also proposes a quality management model to effectively manage engineering human resources and other facilities for the engineering graduates with an emphasis on improving the intellectual productivity of technologists in these workshops and other facilities. This model is centered mainly on information sharing to secure and develop skilled human resources in order to ensure the delivery of high quality trainings in these workshops and other facilities. Moreover, in this model, it is conditional that Customer Satisfaction, Employee Satisfaction, Stakeholder Satisfaction are met under stable management and environment that same quality and optimal trainings are offered. This paper adopts modernization and dependency theories to interrogate the Universities and intellectual interface and raise pertinent issues on the problem. The methodology is largely normative. Secondary data is used with deep and comprehensive primary insights into the operations of major university workshops in Kenya to sufficiently address potential efficacy and likelihood of failures of Universities as the possible hope in achieving the Vision 2030 in Kenya and identical programs including the accomplishment of the Millennium Development Goals. The possibilities of sustainable alternatives are also explored.

Key Words: Quality, Technologists, Public Universities, Kenya

INTRODUCTION

The unprecedented quantitative growth in Kenya's higher education sub-sector, coupled with inadequate government funding for public universities, has resulted in these institutions facing demand-related challenges, especially in terms of access, equity, relevance and quality. This raises a major concern regarding the capacity of these institutions to produce skilled manpower to meet the country's current and future development needs. This study assesses the capacity of Kenya's public universities to meet the demand for their academic programmes in engineering in addition to finding out if these institutions are responding to the quality labour market requirements.

Social and technological changes require constant updating of the general populations knowledge and skills. Developments in engineering and technology are tangible realities affecting any member of society. Engineering education has become so important that many consider it necessary to strengthen considerably engineering teaching in all educational systems and to allow scientific literacy to develop. It is particularly important for developing countries to develop their own capacity to evaluate, import, absorb and improve the scientific and technological knowledge that would be suitable and would contribute to their autonomous development.

The World Conference on Education for All, convened and sponsored by UNESCO, UNICEF, UNDP and the World Bank, charted in March 1990 a World Declaration on Education for All. The Conference stressed the need to respond to the impact of scientific discoveries and technological change on the content and process of education itself:

> *To be truly independent, a country should be able to ensure that all its citizens are given the opportunity, starting from the earliest stages of education, to gain*

an understanding of engineering and technology and the capacity to put them to appropriate use and to develop them to meet collective needs. Although the large majority of people do not necessarily work directly with new technology, they live in societies where technological innovation increasingly permeates almost every aspect of daily life. The need for basic scientific and technological knowledge and skills therefore becomes pervasive.

A country's engagement in the development and use of new technologies has profound implications for employment and skill requirements. Sound basic literacy and numeracy skills, middle-level technical and organizational skills and, to an increasing degree, problem solving and abstract reasoning abilities will be the cornerstones of scientific and technological advance. It is assumed that better understanding of engineering and technology leads not only to more informed decision-making in engineering and engineering, but also in many other areas. When the impact of the investments is less or slower than anticipated there may be a backlash against engineering education (Ware, 1992).

Educational reforms in developing countries are in many cases coupled with a substantial expansion of the educational system. The success of such reforms depends on many factors. For engineering education one of the important ones is provision of adequate workshop materials.

The study recommends the development of a framework for manpower planning in such a way that these institutions offer strategic programmes in line with the country's development needs. Otherwise, without a coherent strategy for developing skilled manpower, it is unclear how Kenya is to realise her stated development goals. The study recommends that the government should develop a framework for coordinating Human Resource Development (HRD) programmes in public universities to ensure that these institutions respond to labour market needs as well as future manpower requirements.

Practical activities in engineering education

According to some authors, the role and educational effectiveness of practical activities in engineering education are not clear. The arguments are summarized and discussed by Silvia Ware (1992). However, it is agreed on the World Conference on Education for All, that the most effective and relevant learning takes place through the process of solving problems, and that there is a fundamental need for 'doing' to be part of learning. These are the prerequisites if the learning is to be brought into effective action (Haggis, 1991).

The question of national and local relevance is again very much present in the establishment and evaluation of practical activities. There is a widespread belief that in the design of practical activities, local relevance and applicability to problem situation in the real world should be promoted together with the understanding of scientific concepts and the world of work (Badran, 1988).

There is a trend of change from traditional acquisition of knowledge to scientific inquiry, problem solving and application of engineering. Recent curricula in some developed countries place also practical activities on a new level. Traditional approaches can be summarized as teacher demonstrations to illustrate scientific principles, combined with students' work in laboratories following 'cookbook recipes'. The 'modem' approach is characterized by inquiry and discovery methods, decision making, 'learning by doing', and 'hands-on' teaching. These approaches were first widely adopted in smaller countries (Denmark, for example), but are now fast gaining ground in larger ones (Thulstrup, 1993).

Another successful way to motivate students is 'student projects'. Students carry out research appropriate for their level of understanding of engineering. Nevertheless, the results are in many cases quite impressive, particularly where state-wide competitions are organized.

The project has several components. One of the proposed objectives is building the inquiry skills includes:

- formulating questions,
- planning experiments,
- making systematic observations,
- interpreting and analyzing data,
- drawing conclusions,
- communicating, and
- Understanding of inquiry

Technical unsuitability of the equipment

Climatic conditions in some developing countries are very hard on equipment. High temperature and humidity cause corrosion of metallic parts and make particularly sensitive (and often expensive) electronic equipment unusable. Lack of or unreliable water, gas, and electricity supply are sometimes not taken into account. Precision electrical instrument's tolerance for current oscillations is in many cases lower than actual oscillations in public network, resulting in breakdown of the equipment.

In many countries, engineering education is suffering from a lack of appropriate facilities and supporting materials, including the equipment. Modern curricula and textbooks based on discovery learning are sometimes used, but in the absence of practical activities it is questionable if the students receive a better understanding of engineering then they did when books and curricula were based on lecturing and blackboard teacher demonstrations (Hakansson, 1983).

To improve the situation, many national, regional and international projects have been launched, emphasizing labs and equipment. However, their success was in many cases far below the expected.

Educational unsuitability of the equipment

The equipment is not always relevant to the curriculum. In other words, it is designed for experiments that do not suit the curriculum. Envisaged changes in the curriculum are sometimes not taken into account in connection with equipment purchase, even if they are supposed to happen in the near future. On the other hand, in practical implementations of the curriculum there is sometimes little or no time allocated for practical work. Another possibility is that the educational value of the experiments is low because they fail to demonstrate scientific concepts convincingly, or do not illustrate the connection between scientific principles and the real world. The reasons might be use of unfamiliar materials, practical work following 'cookbook recipes' without real understanding of the process, or use of 'black boxes' - unexplained and unfamiliar equipment where input and output do not have any apparent connection.

Procurement procedures

In many cases equipment lists are prepared by people unfamiliar with the curriculum. Lists are sometimes prepared on the basis of the suppliers' catalogs (in some cases even outdated catalogs) instead of the practical work as defined in university programs. Equipment lists are often based on out-of-date understanding of what a well-equipped engineering laboratory should contain. Long-range plans (more than five years) to support maintenance and replenishment are rarely included since procurement is usually considered to be a one-time operation.

Suppliers' warranties which promise spare parts and service, e.g. within the first year, are often not used.

Cost of equipments

Investments in equipment for all students at a given level are a heavy financial burden for a developing country. Essential follow-up procedures like teacher training in the pedagogical and technical use of the equipment, provision of maintenance, and replenishment, etc., are sometimes not accomplished because of the lack of funds.

There is another risk in connection with the high cost of equipment. It is sometimes safely locked up in the university (Dalgety, 1983; GTZ, 1983) and not used at all, because the teacher is afraid that he/she or the students might break it and that he/she will have pay for it from his/her own pocket.

Technician training

In pre-service training, technicians often get work experience with equipment they are not likely to use after graduation. They are not trained to work with the kind of equipment which is actually in use in universities, or to work with little or no equipment at all. They are seldom taught how to use and improvise with local materials. Maintenance and repair of the equipment are rarely included in pre-service technician training. The future teachers do not develop managerial skills in selecting and acquiring equipment and consumable materials, although they in some countries are responsible for that, using the university budget. Proper in-service training is often not available when new equipment is supplied to universities. Although well-prepared manuals and teachers' guides may be supplied, they are frequently not enough to ensure efficient use of the equipment. In-service training is particularly essential when new equipment is accompanied by changes in the curriculum.

Maintenance, repair and replenishment

Technicians (where available) are rarely trained properly in maintenance of the equipment, either in pre-service or in-service training programs (Lowe, 1983). If the equipment is in use, it will eventually break down. Technicians should be able to carry out simple repairs, but the necessary training is seldom provided. Centers for more complicated maintenance and repair are organized in some countries, but generally they are not available.

A missing or broken inexpensive part may render a whole equipment kit unusable unless it is replaced. Single items for replenishment are not always in stock and available for universities to acquire.

Technician support roles: problems of classification

The ‘highly skilled technician’ is a widely acknowledged but ill-defined concept, perhaps associated with inferred skill levels and perceived replicability. There is an assumption that these highly skilled roles are associated with research, though there is no simple way of distinguishing in existing data sources between those technicians who concentrate on research and those whose duties relate principally to teaching and demonstration.

Few criteria consistently distinguish the role of highly skilled technicians from that of other technical staff or research assistants. The extent to which different criteria illuminate the roles of such staff varies between institutions. For example, some HEIs employ staff with well-defined technical roles on research scales with a plethora of job titles. In other HEIs, staffs are intentionally appointed as research assistants to perform skilled technical support roles (These staff is not attached to the technicians' job grading and evaluation structure -the 'Blue Book'.)

Job title, grade or scales are no indicators of function or skill content. Nevertheless, customary demarcations between academic and technical roles persist. IT-related roles are an increasingly important element of skilled technical support performed by a range of staff.

Models of technicians' roles

There is need to develop a typology to accommodate and reflect new roles and links with highly specialised equipment. This should differentiate higher technical skill levels (in Models A and B) from more general skills (Model C):

- *Model A*: Process based roles, characteristic of medicine and life sciences. Research focused, with teaching responsibilities. Role requires the ability to draw on scientific theory and its relationship with empirical results. Typically, younger graduates, usually on fixed-term (one or two years) contracts on research grades.
- *Model B*: Equipment based roles, characteristic of physical and engineering sciences. Research support is predominantly development oriented. Role includes design, modification, development and operation of equipment. Typically experienced and mature with vocational and academic qualifications, on fixed-term (including rolling) contracts, on either technician or (in some cases) research grades.

Model C: General support across all fields, in larger numbers than more specialised Models A and B. Predominantly teaching/demonstration plus general e.g. health and safety, sample preparation. Less articulation between technician identity and academic organisation.

Recruitment and retention

There are signs of strain in recruiting and retaining skilled technical staff, although there is no *general* supply or retention crisis now or in the foreseeable future. These signs derive principally from the problem of career development for highly skilled technicians. While some HEIs are aware of the problem, there is no generally supported response or pro-active sector wide HR initiative that can address these issues.

HEIs 'cope' with resource cutbacks, often through ad hoc responses at research group level. These are local and individual approaches to local problems, influenced by a combination of university mission, the disciplinary area(s) involved and the opportunities presented by the local labour market. This responsive approach forestalls the catastrophic crisis, but we believe that it also hides continuing attrition and degradation of cutting edge research performance.

Such localised responses create tensions within an HE system more normally characterised by national arrangements for job evaluation, trades union representation and collective bargaining. Recruitment and retention can be summarised for two broad disciplinary groups:

- In bio-medicine/life sciences: units recruit young graduates to largely technical roles, though they may be on research scales. Research grants support only short-term contracts but there is no shortage of applicants. However, those with technical aptitude have no clear career path to follow.
- In physical sciences/engineering: there is a continuing need for 'traditional' technicians with experience and specialised knowledge essential to maintenance/design of research equipment. Such staffs have followed traditional technical careers and vocational training routes, in HE and outside.

Training and career development

Recognising quality in technicians' work, particularly at the higher skill end where it interfaces directly with research, is problematic. There is a changing context for highly skilled technical work. Much personal development takes place on the job and integrating formal training opportunities with these on-the job factors would require a shift from a cost to an investment training culture. The problem is that acquisition of experience and higher technical skills is neither easily accredited nor rewarded through career progression.

Technicians and their representative organisations share the view that the career track for technicians is inadequate. Many HEIs no longer recruit trainees, while for those in post there is only a tenuous link between career development (and reward) and training support mechanisms.

To reward and overcome development blockages for those practicing higher level technical skills some HEIs are switching staff to Academic Related scales. There is no clear or consistent reason why such grades, which exist in all institutions, are not more widely used. Technicians' trades unions acknowledge the problems with the Blue Book but favour retention of a single job structure for all technical staff.

LOW-COST AND/OR LOCALLY PRODUCED EQUIPMENT

Import of university engineering equipment to developing countries has a series of negative side effects. Foreign exchange is usually scarce, while the equipment is rather expensive, considering the large number of universities. This results in uneven and only partial supply of universities (Dalgety, 1983). Moreover, spare parts also have to be imported, as well as some (or almost all) consumables. If the equipment does not suit the existing curriculum, it may not be used in the teaching. If teachers' training is neglected, the equipment might not be used anyway. Even if the teacher knows what to do with the equipment, he/she might be reluctant to use it out of fear to damage expensive apparatus. In the best case he/she would use it for demonstrations, and would not allow students to work directly with it. Some universities have 'graveyards' of equipment that require minimal repairs (or only some maintenance) which the teacher or laboratory technicians have not been trained to carry out (Sane, 1984). When the necessary repairs are more complex or require a spare part, centralized repair and maintenances services re often not available .I n some cases equipment is not used because of lack of necessary consumables.

Foreign aid in the form of equipment sometimes has negative effects. It rarely meets more than a small part of the demand, and often a developing country may have a variety of equipment received from various donor countries, each in small quantities. This makes it difficult to equip all universities evenly with uniform equipment (Hakansson, 1983).

High cost and sophistication of the equipment do not necessarily mean high educational value. Commercial instruments are sometimes designed to cater for multi-purpose needs of industry and research, while an instrument to often can be significantly simplified, according to the educational needs. Sophisticated equipment is not always comprehensible to students, and often not even to teachers. Many sophisticated pieces of equipment come as completely enclosed units, and their function can usually not be understood by the user. Relying on the results without any understanding how they are obtained decreases the value of the practical work.

One of the approaches to overcome the problems in supply, maintenance and use of equipment for engineering education is development of **low-cost** and/or **locally produced** alternatives. It must be emphasized, that low-cost, simply designed equipment is not necessarily synonymous with second-rates Engineering education. It is possible to design low-cost equipment and experiments that are relevant to students and that lead to understanding (Tobon, 1988).

The main point in university engineering is to define the most appropriate equipment. Many types of equipment can be developed at a low cost and still retain the precision needed for university engineering. It is important to determine what precision range is actually needed for teaching. Too sophisticated equipment is sometimes used, producing data whose accuracy is incompatible with the other measurements taken during the experiment (Gardner et al, 1984).

THEORETICAL FRAMEWORK

The need for quality teaching and learning in higher education has been felt all over the world. The Kenya Higher Education Act brought with it increasing concerns about how universities perform and the quality of teaching and services they provide. The performance indicators focused on six broad aspects of institutional performance, namely; participation of under-represented groups; student progression; learning outcomes; efficiency of learning and teaching; research output and employment (Breakwell & Tytherleigh, 2010). These performance indictors reflected the political concerns of the time, which were with social equity, value for money, economic impact and international standing.

Chacha (2004) observed that globally, the environment of higher education is facing relentless and rapid change. The circumstances underscore the crucial role of leadership and management in maintaining morale, enhancing quality and productivity, and helping staff at all levels cope with momentous and rapid change. Those in higher education management and leadership positions are finding it essential that they understand shifting demographics, new technologies, and the commercialization of higher education, the changing relationships between institutions and governments and the move from an industrial to an information society. Current leaders must be trained, new leaders prepared and students identified who will both lead and study for the future.

ISO Standards

The adoption of Quality Management System has therefore been considered by some scholars, as a strategic decision by educational institutions to ensure delivery of quality service. This may take the form of ISO certification, structured specific training series for top management, section heads and customer care or a combination of the two approaches. Aruasa (2009) noted that the international standard specific requirements for quality management system include:

i. Need to demonstrate the ability to consistently provide a product/service that meets customer and applicable regulatory requirements and

ii. Enhancement of customer satisfaction through effective application of the system, including processes for continual improvement of the system and the assurance of conformity to customer and applicable regulatory requirements.

The ISO certification has fundamentally been a private sector affair, but it is becoming a public sector affair too, especially in Kenya. It is believed that ISO is a mark of quality and a step towards international standards. However, Singels, Ruel & van de Water (2001) in a survey of 950 organizations of North Holland noted a common misconception among the organizations that ISO would mandate higher levels of product quality. They were of the view that ISO certification gives no guarantee that the quality of products or services of an organization is better than the quality of other organizations. According to Dick (2000) the principal motivation for pursuing ISO certification among firms in the UK was the ability of the certificate to open customers' doors that were previously closed, or would close, if ISO certification were not achieved. Gunnlaugsdottir (2002) while conducting a study in Iceland concluded that ISO certification is a necessary entry ticket for an organization for selling its products abroad in new markets. A study by Staines (2000), in a Swiss hospital, concluded that ISO processes should be designed through consensus meetings, not through one or two individuals. This helps in implementing the redesigned processes and empowers people in the organisation. According to Magoha (2008), the process of ISO certification represents an international consensus on good management practices with the aim of ensuring quality service delivery to clients. ISO certification has become a widespread practice as organizations increasingly work to conform to the international standards. The standards place strong emphasis on process control and continuous improvement which are some of the key characteristics that an organization must possess to be recognized as a leading player. Some of the universities in Kenya that have so far been certified to this standard are Strathmore University (private - the first to be certified in the country) and two public universities Kenyatta University and University of Nairobi (Mang'eli, 2008).

The Vision 2030 Linkage

Universities are established to meet specific objectives. In the event that these objectives are not met, then they cannot justify huge public expenditure on them. Today Kenya Government is pursuing Vision 2030. *Kenya Vision 2030* is the country's new development blueprint covering the period 2008 to 2030. It aims to transform Kenya into a newly industrialising, "middle-income country providing a high quality life to all its citizens by the year 2030" (Republic of Kenya, 2007). Critical players in achieving Kenya Vision 2030 are the universities. This is because education and training at university level, according to the Government (Republic of Kenya, 1999), is expected to achieve the following:

- Imparting hands-on skills and capacity to perform multiple and specific national and international tasks.
- Creation of dependable and sustainable workforce in form of human resource capital for national growth and development.
- Creation of entrepreneurial capacity for empowering individuals to create self- employment and employment for others.
- Offering opportunities for advancement of learning beyond basic education with strong leaning towards scholarship and research.
- Creation of a strong national research base at various sectors of economic and national development.
- Bridging the gap between theory and practice in various disciplines of education and training.
- Creation of a strong sense of nationalistic and global development.
- Inculcation of a culture of precision, moral discipline and work ethic which are necessary in modern industrial and technological world.

A careful study of these objectives underscores the importance of the universities and justifies current concern that they provide the kind of education and training expected of them. The stakeholders need an assurance that there is quality in provision of university education in Kenya.

University Expansion vs the Double Intake

A study by Mwiria & Nyukuri (1994) on the management of double intakes describes the planning and implementation adjustments that were made to accommodate double intake of students in 1990 at Kenyatta University. According to this study a number of management changes took place at Kenyatta University to cope with the double intake. The first set of changes related to the expansion of tuition and boarding facilities. However, because resources to implement such changes fell far short of the demand, congestion in lecture theatres, science laboratories, libraries and dining halls remained a critical problem. The second set of changes related to the organization of the three semester year, which necessitated the use of available facilities throughout the year. Although commendable from the point of view of promoting a more efficient use of available resources, these measures also had some negative consequences; most notably the lowering of staff morale, the lengthening of the period it takes students to complete their degree courses as well as the lowering of academic standards. The third set of changes related to staff incentives. These have included accelerated recruitment of teaching staff, the application of relaxed promotion criteria, and the introduction of monetary incentives. The first two measures have tended to de-emphasize merit and the need for staff to research and publish and have had serious negative consequences on the quality of education offered by Kenyatta University. Finally, the double intakes necessitated changes in the administration of university examinations. The increased enrolments were accompanied by an increase in examination irregularities such as cheating while staff applied less rigorous criteria in grading examinations. Measures recommended by the Senate to curb such malpractices did not succeed mainly because of the unmanageable size of many classes. Other measures taken to improve on the efficiency of administering examinations such as the introduction of multiple choice tests only added to further dilute the quality of education offered at Kenyatta University.

Efficiency as an output of Quality

Quality assurance is a continuous process by which an institution can guarantee that standards and quality of its educational provisions are being maintained or enhanced (Standa 2008). A study that examined the problems of leadership within a university concluded that one of the most difficult challenges that leaders within universities face is that they must take responsibility for systems that provide assurance of quality teaching, research and Australian Journal of Business and Management Research Vol.1 No.2 | May-2011. Community services within rapidly changing environment, despite bureaucratic structural context dominated by process mentality (QUT 1994). As Ndeithu (2007) noted, learning outcomes for any institution are shaped by the determination of the university authorities more than the values of students, lecturers and availability of resources. The quality assurance regulatory body in Kenya (Commission of Higher Education) recognizes that quality assurance is primarily the responsibility of individual universities (Standa 2008).

A study conducted in Hong Kong, Pounder (1999), developed organizational effectiveness criteria, which reflected expectations from university management, applicable across higher educational institutions. The organizational effectiveness model comprised four effectiveness criteria, namely:

i. Productivity - efficiency. This refers to behaviour that reflects the extent to which leadership is concerned with the quantity of what it produces and the cost of production.
ii. Cohesion. This refers to behaviour that reflects the extent to which it is concerned with staff morale, interpersonal relationships, teamwork and sense of belonging.
iii. Information management – communication. This refers to ability of the leaders to distribute timely and accurate information needed by its stakeholders to do their jobs.
iv. Planning- goal setting: This aspect of an organization's performance has to do with behaviour that reflects the extent of its ability to set goals and objectives and systematically plan for the future.

What is the relationship between organizational effectiveness and quality assurance function of institutional managers? The effectiveness of employee behaviour within organizations and the effectiveness of their performance are referred to in this paper as organizational effectiveness. The studies by Weese (1996) and Lim and Cromartie (2001) recognized that a significant indirect relationship exists between leadership and organizational effectiveness. Changes in an organizational strategy bring about new management challenges which, in turn require new strategies to be successfully implemented. To guarantee that standards and quality of educational provisions are being maintained in the universities, will require that management understands the new challenges and effectively restructure the organizations to achieve the expected outcomes. Organizational effectiveness is therefore necessary for managers to guarantee provision of quality university education. Based on the four critical indicators of organizational effectiveness discussed above, this study sought to establish how effectively university managers in selected universities in Kenya have played their role in quality assurance. The null hypothesis of this study stated that, "There is no statistical difference in the management of quality education in private and public universities in Kenya".

ABBREVIATIONS

EO	Experimental Officer
FTE	Full-time equivalent
HE	Higher education
HEI	Higher education institution
HERA	Higher Education Role Analysis
ERB	Engineers Registration Board
IST	Institute of Science Technology
PGRA	Postgraduate research assistant
QR	Quality-related research funds
RAE	Research Assessment Exercise
SO	Scientific Officer

ISO	International Standards Organization
UNESCO	United Nations Education, Scientific, Cultural Organization.
UNDP	United Nation Development Progamme
UNICEF	United Nation Children Education Fund
CHE	Commission for Higher Education
DIT	Directorate of Industrial Training
ERS	Economic Recovery Strategy for Wealth and Employment Creation
FPE	Free Primary Education
GoK	Government of Kenya
HRD	Human Resource Development
ICT	Information and Communication Technology
IMF	International Monetary Fund
JAB	Joint Admissions Board
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KCSE	Kenya Certificate of Secondary Education
KU	Kenyatta University
MIS	Management Information System

CONCLUSION

University education is critical in providing skilled manpower for national development. The government should spearhead the expansion and improvement of public universities, which should play a key role in realizing the country's ambitious industrialization goal. However, there is lack of appropriate framework for coordinating the relevant government Ministries and Departments charged with the country's HRD and the public universities. Without a coherent strategy for developing high-level technical manpower, it was not clear how Kenya is to realise the envisaged economic development, technological transition and sustained growth. Characterised by excess capacity and excess demand, the pattern of engineering programmes offered in Kenya's public universities reveals a sense of competition among these institutions, which may imply inefficient use of scarce resources.

ACKNOWLEDGEMNT

I wish to express my sincere gratitude to Department of Mechanical Engineering of Jomo Kenyatta University of Agriculture and Technology for guidance and encouragement in writing out this paper. I also wish to express my gratitude to the Chairman and staff members of the Mechanical and Automotive Engineering Department of The Mombasa Polytechnic University College who rendered their help. Last but not least I wish to avail myself of this opportunity, express a sense of gratitude and love to my friends and my beloved parents for their manual support, strength, and help and for everything.

REFERENCES

1. APEID, 1981: Curriculum Development: Linking Science Education to Life. Report, Sub-regional Workshop on Designing and Developing Innovative Science Curricula and Instructional Materials, December 8-20, 1980, Bangkok, Thailand, UNESCO ROEAP, Bangkok, Thailand, 80 p.
2. Bengtsson, E., 1983: The development of school equipment production in Kenya. In: Lowe, N.K. (Ed.): New Trends in University Science Equipment, UNESCO, Paris, pp. 91-98.
3. Bromfield, K. (1998). *Preparing for the changing roles of university technicians*, UCoSDA Briefing paper 62.
4. Fox, R. and Guagnini, A. (eds.) (1993) *Education and Industrial Performance in Europe, 1850-1939.* (Cambridge: Cambridge University Press).
5. International Institute for Educational Planning, Paris, 138 p.
6. Lowe, N.KY (Ed.), 1985: Low Cost Equipment for science and technology education. Volume L UNESCO,
7. Kedney, B. (1995). *Reviewing the technician establishment. 3 New tasks and new roles?* 24/9, 799-811. Bristol, Further Education Development Agency. Coombe Lodge Report.
8. The Kenyan State and its capacity to realise Vision 2030. Tiberus Barasa and Justus I. Mwanje. 43p. ISBN No. 9966-948-22-8 (http://www.ipar.or.ke/ dp112 abstractpdf)
9. Montague, R, 1993: personal communication.
10. Mwiria, K. (2007).Kenyan Universities in the Coming Decade: The Policy Intention, in Kilemi Mwiria, Njuguna Ng'ethe, Charles Ngome, Douglas Ouma-Odero, Violet Wawire and Daniel Wesonga, *Public and Private Universities in Kenya.* Nairobi: East African Educational publishers.
11. Scarselletta, M. (1997). The infamous 'lab error': education, skill, and quality in medical technicians' work. In *Between craft and science: technical work in U.S. settings*, S.R. Barley and J.E. Orr, eds. (New York: ILR Press), pp. 187-209.
12. Layton, D. (Ed.), 1988: Innovations in Science and Technology Education, Vol. II, UNESCO, Paris,299p.