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REVIEW ARTICLE

Challenges in engineering education in addressing industry needs in Kenya

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ABSTRACT

Engineering education in Kenya started in the 1950s. The curricula offered were Civil, Electrical and Mechanical Engineering. Later, other disciplines were introduced, including: Agricultural/Bio-systems, Chemical, Mechatronics, Marine, Mining, Petroleum, software, Aerospace, Aeronautical, Geomatic, Medical and Textile Engineering. From the 2000's onwards, Kenya experienced a steep rise in the number of universities offering engineering programmes. However, the requisite growth of the human resource and infrastructure did not match that growth. For purposes of maintaining quality and regulating engineering practice in Kenya, The Engineers Board of Kenya (EBK) was established. The Engineers Act 2012 gives EBK the mandate to register engineers and engineering consulting firms, regulate engineering professional services, accredit engineering degree programmes, set standards and develop the general practice of engineering. It was also mandated to evaluate for purposes of recognizing equivalent engineering degrees obtained from foreign jurisdictions, so that holders of such degrees may be licensed to practice in Kenya. On the other hand, the Commission for University Education (CUE) was established and mandated to accredit all degree programmes, including engineering. The expansion of university education created the following challenges: low staffing levels, inadequate infrastructure, limitations in curricula content, little financial support for research and innovation, limited university-industry opportunities and low subscription into postgraduate programmes. In order to graduate engineers who meet the industry needs stakeholders have taken a number of measures. The university are deliberately involving the industry in the development of the curriculum. However, due to the long review circle, this is not addressing the relevance fully. Other measures being undertaken to have engineers' training address industry needs are: providing internship placement for academic staff, nurturing meaningful university industry linkages, development of new programmes in emerging areas and encouraging innovation and entrepreneurship through establishing innovation centres at the universities. All the mitigation measures are still facing huge challenges.

Key words: engineering education, challenges, industry needs

INTRODUCTION

Engineering education in Kenya started at the University of Nairobi (UoN) in 1956 when the Royal Technical College was established to offer technical courses.[1] The Royal Technical College was transformed into the second university college in East Africa on 25 June 1961 and changed its name to Royal College of Nairobi. It awarded engineering degrees of University of London. In 1964, the Royal College of Nairobi was renamed University College Nairobi as a constituent college of the Federal University of East Africa. During this time, enrolled students studied for college degrees awarded by the University of East Africa instead of the University of London. In 1970, it transformed into the first national university in Kenya and was renamed the University of

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Nairobi. The curricula taught at the University heavily borrowed from the British education system. At that time, engineering programmes offered at the UoN, were Civil Engineering, Electrical Engineering and Mechanical Engineering. Engineering graduates in the country were therefore predominantly from the three disciplines.

From the year 2000 onwards, Kenya experienced a steep rise in the number of universities offering (or intending to offer) engineering programmes. In the quest to address industry needs, the following other disciplines were introduced: Agricultural/Biosystems, Chemical, Mechatronics, Marine, Mining, Petroleum, software, Aerospace, Aeronautical, Geomatic, Medical and Textile Engineering. Currently sixty-nine undergraduate engineering programmes from fifteen universities are recognized by Engineers Board of Kenya (EBK).[2] The universities and accredited programs offered are shown in Table 1 below.

Some universities have submitted applications to EBK for review of their newly developed programmes, and a verdict will be known in due course.

As per the University Statistics compiled by the Commission for University Education (CUE) in the 2017/2018 Academic year, the total number of registered students in the Engineering, manufacturing, and construction disciplines across all the public and private universities stood at 27, 911. This was a slight increase from the previous year when the number stood at 27, 711 of whom 20, 932 were Engineering students. According to a tracer study conducted for the Ministry of Education [3] and report released in November 2023, currently the Kenyan Universities graduate an average of 2500 engineers per year. The Academic staff numbers were 1476 in the 2017/2018 Academic year a slight increase from the 2016/2017 academic year when they were 1315 of whom 1035 were Engineering Staff.

For the purpose of maintaining quality and regulating engineering practice in Kenya, the Engineers Registration Board (ERB) was established under Engineers Registration Act (Cap 530) of 1969.[4] ERB licensed engineering graduates to practice in Kenya. In order to be licensed as a graduate engineer, one needed to have graduated from an accredited engineering programme recognized by ERB. Cap 530, however, had its inadequacies, which necessitated its repeal to enable the Board to effectively regulate the entire value chain of engineering, *i. e.*, engineering education, engineering training and engineering practice. In the year 2011, Parliament enacted the Engineers Act No. 43 of 2011 of the Laws of Kenya, which repealed Cap 530, effectively replacing ERB with EBK.[5] This new Act gave EBK mandate to register engineers and engineering consulting firms, regulate engineering professional services, set standards, and develop the general practice of engineering. EBK was further mandated to accredit engineering degree programmes in Kenya, It was also mandated to evaluate for purposes of recognizing engineering degrees obtained from foreign jurisdictions, so that holders of these degrees could be licensed to practice in Kenya. A sample list of such universities recognized by EBK is found on the EBK website.[6]

According to EBK, each engineering degree programme should have at least three thematic leaders. The thematic leaders should be at the level of Associate Professor and above and be a registered professional engineer. Universities are expected to engage lecturers that are licensed by EBK. Unfortunately, the number of professional engineers in Kenya is quite low as portrayed by the statistics in Table 2 from EBK 2023.

The recommended United Nations Educational, Scientific and Cultural Organization (UNESCO) ratio of professional engineers to a middle-income country's population is 1: 5, 000 persons. Going with the data in Table 2, for a population of about fifty-five million, Kenya has a shortage of over 7, 000 professional engineers across the various engineering disciplines to meet this threshold. In comparison, the ratio is 1: 170 in Malaysia, South Africa, 3, 166; Korea, 285; UK, 311; Brazil, 227; China, 130. India the ratio stands at 1: 130, while in Germany and France it is 1: 100.

In the year 2012, the Kenya Parliament legislated the Universities Act 2012 that gave birth to the CUE.[7] This Act mandated CUE to accredit all degree programmes in the country, including engineering. This meant that engineering degree programmes faced double accreditation, one by EBK and secondly, by CUE. Being accredited twice also meant that institutions were to pay twice for the same programme. It is worth noting that both CUE and EBK have their own sets of standards that must be satisfied for a programme to be accredited. Several programmes in various universities got accredited by both regulatory bodies. However, there are several programmes which were accredited by CUE but declined by EBK.

On 11th June 2020, the High Court of Kenya, through the judgment issued in Nairobi High Court, Petition No. 37, 49 and 106 of 2017, ruled that CUE is the only body mandated by law to accredit programmes. Further to this, the Universities Act 2012 was revised.[8] This new dispensation has thrown the professional bodies, among them EBK, into confusion on how to handle graduates from programmes they have not positively evaluated. There is, however, a window for collaboration under Section 5A (3) "*The Commission may, before approving any academic programme consult with any relevant body established by*

Table 1: Engineers Board of Kenya accredited Engineering Programs in Universities in Kenya

No.	Engineering program/University	*P*	C	A/B	M/M	E/E	I/T	C&*P*	Ma	Mi
1	University of Nairobi		*	*	*	*				
2	Moi University	*	*	*	*	*	*	*		
3	Jomo Kenyatta University of Agriculture& Technology		*	*	*	*			*	*
4	Egerton University			*	*					
5	Dedan Kimathi University of Technology		*		*	*				
6	Kenyatta University		*		*	*				
7	Technical University of Mombasa		*		*	*				
8	Masinde Muliro University of Science& Technology		*		*	*				
9	Multimedia University of Kenya				*	*				
10	Technical University of Kenya		*	*	*	*		*		
11	University of Eldoret		*	*	*					
12	Machakos University		*		*	*				
13	Strathmore University					*				
14	Murang'a University of Technology					*				
15	South Eastern Kenya University		*	*	*					

Adapted from https://ebk.go.ke 27/09/2023. * means the courses the University is offering. P, Production Engineering; C, Civil Engineering; A/B, Agricultural/ Biosystems Engineering; M/M, Mechanical/Mechatronic/Manufacturing Engineering; E/E, Electrical/Electronic Engineering; I/T, Industrial/Textile Engineering; C& P, Chemical& Processing Engineering; Ma, Marine Engineering; Mi Mining Engineering.

Table 2: Profile of engineers in Kenya according to the Engineers Board of Kenya

	Engineer category	Number
1.	Consulting Engineers	547
2.	Professional Engineers	2830
3.	Temporary Professional Engineers	208
4.	Graduate Engineers	21, 308
	TOTAL	24, 893

written law to regulate the profession to which the academic programme relates where such law empowers the professional body to approve or accredit courses offered at any university or colleges". Following these developments, discussions and consultations between CUE and EBK are ongoing to harmoniously solve any disharmony that may arise. Engineering postgraduate programmes are accredited by the CUE only, EBK does not, but recognizes the achievements through its continuing professional development (CPD) points programme.

CURRICULUM DEVELOPMENT AND DELIVERY

CUE has developed standards and guidelines[9] that govern the development and assessment of university programmes. EBK, likewise, has developed standards that are used to assess engineering undergraduate programmes. In assessing the programmes CUE lays emphasis on the following aspects [7]: (1) learning content of a programme; (2) purpose and objectives of a programme; (3) structure of a programme; (4) delivery mode of a programme; (5) availability of academic resources to implement a programme; (6) mode of assessment of the programme; (7) learning environment of a university; (8) learning facilities of a university; and (9) extra-curricular activities offered by a university.

Likewise, the EBK standards lay particular emphasis on programme design; programme curriculum content, faculty staff establishment and; training facilities and infrastructure.

It is a requirement that, when developing a curriculum, the universities must conduct a needs assessment to inform the kind of curriculum to develop. Stakeholders (alumni, industry, students, policy makers, *etc.*) are engaged to give their views, identify the gaps and make recommendations. A draft curriculum is thus written and subjected to further review by stakeholders before realizing a final draft. In some engineering professions, like electrical engineering, the industry is quite diverse and dynamic. Including all important aspects required in the industry, and having the right depth and breadth in one programme is near impossible. There must be some give-and-take at the end to ensure that implementable content is available.

The draft curriculum is consequently passed through the university machinery (from Departmental Board to Faculty/School Board all the way to Senate) and regulatory bodies to get the necessary approvals before it is launched. Review of an approved programme is done after one cycle of implementation of the programme. For engineering programmes in Kenya, the cycle is five

years.

The downside of the process of developing a curriculum is that it takes a lot of time and resources before it is launched. By the time it is being launched (3 to 4 years on average), it is nearly obsolete, or many aspects require revision.

INDUSTRY NEEDS

Universities and technical institutions are charged with the responsibility of producing a competent workforce for the country. Engineering graduates, among other graduates, are employed in various and varied industries and sectors of the economy. The students expect that, upon graduation, they will have been equipped with the appropriate and requisite knowledge and skills to enable them to easily get employed in the industry or start their own enterprises. On the other hand, the industry expects that the graduates coming from the university are adequately equipped with both hard and soft skills and can fit into the job market quickly. According to the tracer study conducted on behalf of the Ministry of Education, the employers rate the readiness of engineering graduates at 5.7 on the scale of 10.[3] Since the industry is so varied, and the desired skills-sets are so diverse, it has not been possible for the university to embed all the industry requirements in one programme.

The University expects the industry to collaborate closely with academia through offering opportunities for internship and attachments to both staff and students, conduct joint research, participate in development and/or review of programmes, identify and communicate the challenges faced in the industry (to spur innovation and/or inventions) and provide financial support.

To come up with degree programmes that address the industry needs, universities evaluate the needs of the industry and the feasibility and sustainability of mounting such programmes. Apart from solving specific technical challenges in the industry, the universities aim to launch self-sustainable programmes. There should be enough number of students to enrol in a programme and job opportunities to justify investing capital/resources in developing new programmes. It can therefore be seen that the level of a country's economic status (operational industries) plays a big role in the choice of programmes to be developed.

In the last ten years, technological advancements, especially in the telecommunication and computing areas, have been extremely fast. This has posed challenges to the universities, since academic programmes cannot move in tandem with the changes in the industry. The fact that engineering programmes are accredited for a period of five years before the next mandatory review, the curricula thus cannot change mid-steam. Moreover, any substantial change in content must undergo fresh evaluation by the regulatory bodies prior to implementation. From the foregoing, it is evident that the industry needs may not be fully met on a timely basis.

The rapidly changing technological and societal needs have led to universities acknowledging that there are gaps in skills-sets and are developing programmes in non-traditional specializations beyond the electrical, civil and mechanical domains. Example of these engineering areas are: aerospace, industrial, marine, biomedical, computer, software engineering, *etc.* The development of such programmes in these new areas is posing new challenges, like: (1) The universities do not have appropriate/sufficient in-house faculty to develop these new programmes, (2) The industry, also, does not have personnel with the right qualifications to develop university programmes, (3) The regulatory bodies do not have the appropriate people within the country to evaluate the programmes, and (4) Universities do not have adequate financial resources to develop the human resource, curricula and infrastructure for the programmes.

The low numbers of professionals in the emerging areas has compelled industries to set aside resources for re-training and or hiring beyond the borders. It has been recognized that, for the country to develop the appropriate human resource, good university-industry linkages must be developed and fostered. There are various efforts to develop and sustain these linkages. In the Government paper published in 1965 dubbed "*African Socialism and its Application to Planning in Kenya",*[10] the Government recognized the fact that the shortage of skilled manpower cannot be cured by general education alone. Trades must also be taught and industries must co-operate in providing in-service training and apprenticeship programmes. According to the policy paper of 2012,[11] a large number of youths graduating from the formal education system are unemployed despite the fact that opportunities for high technology skilled workforce exist. This situation has been attributed to a mismatch between delivered skills from training institutions and the skills demanded in the labour market, which could be due to limited input from industry players into curriculum design, development and implementation in universities, technical, industrial, vocational and entrepreneurship training (TIVET) institutions and middle level colleges.[3,11]

EFFORTS TO BRIDGE THE GAP

There are a number of initiatives being undertaken to

have universities produce industry ready graduates. Some of these initiatives include improving University-industry linkages, subscribing to international accreditation bodies, enhancing research activities, involving faculty in outreach activities and encouraging university community to innovate.

University industry linkages

There are concerted efforts by the government arms to incorporate the academia in the government projects. Some of the projects are: (1) The digital literacy programme, where Moi University and Jomo Kenyatta University were contracted by the Government of Kenya to assemble, supply and install digital devices in primary schools in the whole country.[12] (2) Consultancy tender, exclusively for universities to offer consultancy services to Konza Technopolis Development Authority in operationalization of data centre, smart city, development of virtual desktop infrastructure and knowledge economy. While these are examples of government driven initiatives, the picture from the private sector is different.

Accreditation of programmes

In order to offer degree and diploma programmes at Universities in Kenya, the programmes must be approved by CUE.[8] For the graduates from Engineering programmes to compete globally, it is necessary for universities to accredit their programmes both by national and international regulatory bodies.

The Institution of Engineers of Kenya (IEK) is a National member of the World Federation of Engineering Organization (WFEO), while the EBK is an affiliate member of WFEO.[13] To enhance the engineering education in Kenya to international level and also meet the industry needs, EBK is being mentored by the Engineers Board of Malaysia and Pakistan Engineering Council to have Kenyan University Engineering programmes accede to the Washington Accord.

The accreditation offers the graduates better chances to exercise their acquired skills and competences in member countries, thus opening more opportunities.

Research funding and scholarships

In recognition of the gaps within the engineering faculty, the Ministry of Education in Kenya in collaboration with the World Bank under the African Centre of Excellence 2 (ACE II) developed a scheme to support various postgraduate programmes in Sub-Saharan Africa. Three Kenyan Universities, namely, Moi University, Egerton University and Jaramogi Oginga Odinga University of Science and Technology were beneficiaries.[14] Among the disciplines that benefited from this sponsorship are engineering programmes.

Further, the African Development Bank (AfDB) has also funded a number of postgraduate programmes in various Universities, some of which include: Moi University, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Dedan Kimathi University of Technology, Egerton University, *etc.* [15–17]

Other grants and scholarships that have been realized include: Twenty Masters and Thirteen PhD scholarships from AfDB/Kenya Government to Moi University; Master's and PhD Scholarships in Renewable Energy and Textile Engineering at Moi University to ACE II World Bank project to Moi University; Mobility to Enhance Training of Engineering Graduates in Africa (METEGA),[18] Mobility for Innovative Renewable Energy Technologies (MIRET),[19] Transforming Energy Access – Learning Partnership (TEA-LP),[20] among others.

While most of the funding is international, the capacity built in the process (human and infrastructural) will be maximally exploited to ensure sustainability to strengthen local enterprise. Creation of new centres of excellence will help further the sustainability of innovation and technologies developed.

An important cadre of support for capacity building and sustainability can be harnessed from alumni. These are people that understand both sides of the coin and can offer the most natural linkage to the implementation of collaboration activities. In many cases, those who have succeeded offer scholarships and training opportunities as a way of giving back to the society.

Faculty internships to the industry

As part of the efforts to have relevant training and curriculum development and delivery, the engineering faculty requires constant exposure to the industry to update knowledge and skills. The Royal Academy of Engineering identified a gap in knowledge and skills transfer and rolled out a project called "Higher Education Partnerships for sub-Saharan Africa (HEP SSA).[21] The HEP SSA programme aims to ensure that the higher education system in sub-Saharan Africa produces engineers with the skills and knowledge required to meet the needs of industry and tackle local and global challenges. Grants are awarded to universities in sub-Saharan Africa for projects ranging from six months to two years. The programme funds knowledge creation and dissemination activities such as: Curriculum review and development; Joint-research projects; Academia-industry secondments; Training and workshops; Innovation and entrepreneurship initiatives.

Moi University, Technical University of Kenya, Masinde

Muliro University of Science and Technology, Murang'a University of Technology, Dedan Kimathi University of Technology, Technical University of Mombasa and Egerton University have benefited from the programme, either as Hub or Spoke Universities. Twenty seven faculty members from Moi University and Spoke Universities were sponsored for internships in the industry. Feedback from the HEP SSA beneficiaries indicate that the internships gave them exposure, which enhanced their knowledge and skills and subsequently, enhanced the quality of curriculum delivery of the courses. They recommended that internships should be done on a regular basis.

During staff internships, unique opportunities arise whereby some industries while modernizing are generally willing to offload their 'old' equipment to academia. These provide excellent student training chances, whereby dismantling and re-assembling of donated gadgets and equipment enhance practical skills to students. Such opportunities should always be scouted for by staff.

While it is appreciated that internships for faculty staff are beneficial, sustainability of the programmes is still a challenge due to lack of dedicated funding.

Within the same HEP SSA programme, industry partners were invited to share their knowledge, skills and experiences to the university fraternity. Given that the staffing levels in the industry have always been lean, availability of the industry personnel was challenging. It is desirable that industry personnel participate in the University activities, such as seminars, project supervision, and mentorship programmes.

Industrial attachments for students

To sharpen the skills of graduates, a number of universities have incorporated industrial attachment in the undergraduate degree programmes. There are efforts to enhance complementary studies in the curricula. The industry encourages more students to undertake postgraduate studies in the core areas of engineering. The industry is however not committal in financing the attachments, research and scholarship. To enhance the attachment component, the National Industrial Training Authority (NITA) was formed. NITA is a state corporation under the Ministry of Labour and Social Security whose mandate, according to the Industrial Training Act, includes: industrial training and attachment (both regulation and provision); curriculum development for industrial training; administration of Industrial Training Levy. All employers are required to pay a levy for every employee in the organization per month (kshs 50) for the purpose of developing staff capacity. Any training sponsored by an employer is refundable by NITA as long as the training provider used is accredited by NITA.

Working closely with NITA helps to effortlessly bring academia-industry together. This leads to better understanding and confidence building among partners, important ingredients for collaboration. Academia should exploit such opportunities to improve their industry relationships.

Many institutions have adopted the model of attaching students from all disciplines. This has created a big competition for the limited attachment opportunities. Since attachment placing is not necessarily at the university or closer to students' homes, these causes some strain to the students, both socially and financially.

Establishment of incubation centres

There is a push to convert the vast number of generated ideas into viable products. To realize this, a number of Universities have established innovation centres. Such centres are phytochemicals textile and renewable energy (PTRE) Incubation centre[22] established at the African Centre of Excellence II - Phytochemical, Textiles and Renewable Energy (ACE II- PTRE) - Moi University, The Chandaria Business Innovation and Incubation Centre at Kenyatta University [23] Mount Kenya University's MKU Innovation and incubation Centre,[24] IIEC-Meru University of Science and Technology Innovation, Incubation and Entrepreneurship Centre,[25] among others. It is hoped that the inventions and/or innovations from these hubs will be the heart of University-Industry linkages. Business start-ups from the hubs will enhance local products, generate employment opportunities, and spur economic growth.

CHALLENGES AND POSSIBLE MITIGATION MEASURES

The challenges in engineering education in addressing industry needs in Kenya can be attributed to inadequacies in curriculum design, weak industry-university collaboration and insufficient financial and human resources. All is not lost. The universities, industries and the Government have invested a lot in enhancing University-Industry linkages. There are however, still many challenges to overcome to have substantial impact and sustainability. The following are the challenges affecting university training and recommendations:

(1) As a tradition, universities retain their best students for postgraduate studies and eventually absorb them into their faculty. Without proper university-industrial collaborations, this process denies these good graduates a chance to gain industrial experience. Secondly, many engineering faculty do not have pedagogical qualific-

ations, since it is not a requirement for teaching and/or lecturing and conducting research in an engineering school. Inadequate pedagogical knowledge and industrial experience affect the quality of curriculum development and delivery. Internship programmes and pedagogical training will ensure regular industrial exposure and improved curriculum delivery.

(2) As mentioned earlier, starting in the year 2000, many new universities in Kenya launched programmes in engineering. Young Universities duplicated programmes found in the older universities. As a consequence, the number of qualified available lecturers in the country were not sufficient to service the existing and newly established programmes. As a result, the expansion of programmes caused a huge shortage of qualified full-time lecturers. To overcome staff shortage, staff development programmes by the government should be enhanced. Secondly, staff incentives should be introduced to ensure attraction and retention.

(3) Engineering programmes require a heavy investment in terms of equipment and buildings (infrastructure). A number of universities do not have the requisite laboratory spaces and equipment. The good news is that sharing of resources among universities has helped bridge this hurdle temporarily. However, this kind of arrangement has its logistical and financial challenges. The Government programme of equipping Engineering Schools should be fast-tracked.

(4) Some universities launched programmes before they were approved. This brought a big challenge to the stakeholders.

(5) New programmes in the emerging specializations could not find qualified staff within the borders. Universities did not have enough financial resources to purchase equipment and hire expatriates for the programmes. Since the programmes are important for the growth of the economy, the Government should set aside resources to provide scholarships in these niche areas.

(6) Regulatory bodies do not have local experts to evaluate programmes in the emerging areas.

(7) There is constant internal and external brain drain. Internal brain drain happens as a result of highly trained experts taking up other duties, which do not require their acquired technical knowledge, or are simply disillusioned to do more. External brain drain is happening when the experts relocate to other countries. Incentives should be given to ensure retention.

(8) Industry experts are very busy, such that they are not available to share their knowledge and experiences with the faculty and students. They don't have time for collaborative research either.

(9) Very few engineering graduates venture into postgraduate studies that may lead to higher qualifications in the engineering discipline. It is expensive to sponsor oneself. Due to the cost and opportunites after graduation, many opt to take courses that will better their soft and/or complementary skills. Government and industry scholarships will encourage more enrolment into engineering postgraduate programmes.

(10) Limited scholarships for postgraduate studies have hampered enrolment into engineering programmes. This consequently has slowed down research, which would otherwise have enhanced bankable industrial solutions.

(11) The working cultures of academia and industry are so different. Secondly, there is little trust between the two. Therefore, developing a working culture and trust is essential for productive collaboration.

(12) Alumni linkages are weak and therefore need to be enhanced.

CONCLUSION AND RECOMMENDATIONS

Industry is constantly growing. The growth and advancements come with new demands on the engineering profession. The engineering education has to evolve quickly to keep pace with the changes. However, the engineering education in Kenya faces the following challenges: low staffing levels, inadequate infrastructure, limitations in curricula content, little financial support for research and innovation, limited university-industry linkages and low subscription into postgraduate programmes. Though various stakeholders have contributed immensely towards improvement of the engineering education in Kenya, more efforts and support from stakeholders is required. An innovative way of sustaining University-Industry linkages has to be devised. The significance of industry – academia collaboration driven by both industry and academia is paramount. These collaborations benefit both parties: the industry obtains skilled workers with practical training and specialised expertise, while universities have the chance to work on pertinent technologies and problems. While there are challenges, once the two realize their complementarity, a sustainable symbiotic relationship that would promote technological advancement and innovation will develop based on their common needs.

Some industries still fear disclosing information about their operations even in areas where the internet and social networks have broken the iron walls. The culture gaps are effectively closed *via* collaboration, each party

improving on reducing their respective weakness while bringing distinct perspectives and skill sets to the table, offering a seamless fusion of two endeavours with related common goals that ensure sustainability.

A valuable resource in the academia-industry collaboration are the alumni of the institutions. University graduates that have progressed in their professional careers in the industry will always have a listening ear to academia requests. The same is true for industry staff that join academia – they are always handy while relating to their former colleagues.

Efforts to have programmes accede to Washington Accord need to be supported and the process accelerated. The international accreditation of the programmes to international standards will give an edge to the graduates from these programmes and will be able to compete internationally.

DECLARATION

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REFERENCES

1. University of Nairobi. Accessed January 11, 2024. https://en.wikipedia.org/wiki/University_of_Nairobi
2. Accredited engineering programmes. https://ebk.go.ke/accredited-engineering-programs-in-kenya/. Accessed January 11, 2024
3. Tracer study on destination of engineering graduates from public and private universities in kenya. A Study Contracted by Ministry of Education, State Department of University Education and Research and funded by The Africa Development Bank. Accessed January 11, 2024. https://geospatial.uonbi.ac.ke/latest-news/tracer-study-report.
4. Laws of Kenya. The Engineers Registration Act (Chapter 530). Published by the National Council for Law Reporting, with the Authority of the Attorney General. Accessed January 11, 2024. http://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/EngineersRegistrationActCap530.pdf
5. Laws of Kenya, engineers act no. 43 of 2011. Revised Edition 2012 [2011]. Published by the National Council for Law Reporting, with the Authority of the Attorney-General. www.kenyalaw.org. https://www.ebk.go.ke/resource/engineers-act-43-of-2011. Accessed January 11, 2024.
6. List of approved foreign engineering programmes by EBK. https://ebk.go.ke/resource/approved-foreign-engineering-programmes/?tk=1696708972. Accessed January 11, 2024.
7. Laws of Kenya. Universities act chapter 210B. Revised Edition 2012 [1986]. Published by the National Council for Law Reporting with the Authority of the Attorney-General. www.kenyalaw.org. http://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/UniversitiesAct_Cap210B.pdf. Accessed January 11, 2024
8. The universities act No. 42 of 2012. Revised Edition 2020 [2012]. Accessed January 11, 2024. Published by the National Council for Law Reporting with the Authority of the Attorney-General. www.kenyalaw.org.
9. UNIVERSITIES_STANDARDS_AND_GUIDELINES_June_2014. Commission for University Education - University Standards & Guidelines - CUE Regulations & Standards for University Education. Accessed January 11, 2024. https://www.cue.or.ke/index.php?option=com_phocadownload&view=category&id=20:cue-regulations-standards-for-university-education&Itemid=494.
10. African Socialism and its Application to Planning in Kenya. African Socialism and its Application to Planning in Kenya.pdf (spu.ac.ke). https://repository.spu.ac.ke/xmlui/bitstream/handle/123456789/3573/African%20Socialism%20and%20its%20Application%20to%20Planning%20in%20Kenya.pdf?sequence=1&isAllowed=y. Accessed January 11, 2024.
11. Ministry of Education. Republic of Kenya. A Policy Framework for Education. Aligning Education and Training to the Constitution of Kenya (2010) and Kenya Vision 2030 and beyond. April 2012. Accessed January 11, 2024. https://www.knqa.go.ke/wp-content/uploads/2018/10/Policy-Framework-For-Education-Paper-Kenya-School-Libraries.pdf
12. The Ministry of Information, Communications and the Digital Economy. Government Officially Rolls out the Digital Literacy Programme in Schools, 2016. https://ict.go.ke/government-starts-distribution-of-1–2-digischool-devices-to-over-22–000-public-primary-schools/. Accessed January 11, 2024.
13. WFEO National and Affiliate members. https://www.wfeo.org/nationals/. Accessed January 11, 2024.
14. List of Approved Eastern and Southern Africa Higher Education Centers Of Excellence. Accessed January 11, 2024. https://ace2.iucea.org/.
15. Disbursement/winning of a grant from the African Development Bank (AfDB) of KShs 39 million shillings to train lecturers at postgraduate level at Egerton University. Accessed January 11, 2024. https://nation.africa/kenya/news/education/sh39m-afdb-programme-to-train-engineering-lecturers-3494264.
16. African Development Fund Country: Kenya Support to The Enhancement of Quality and Relevance in Higher Education, Science and Technology Project. Project Appraisal Report – October 2012. Accessed January 11, 2024. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Kenya%20-%20Support%20to%20the%20Enhancement%20of%20Quality%20and%20Relevance%20in%20Higher%20Education%20Science%20and%20Technology%20Project%20-%20Appraisal%20Report.pdf

17. Master's and PhD scholarships tenable at JKUAT and sponsored by Kenya Government and AfDB. Accessed January 11, 2024. https://jkuat.ac.ke/wp-content/uploads/2017/07/African-Development-Bank-Post-Graduate-Scholarship.pdf
18. Mobility to Enhance Training of Engineering Graduates in Africa (METEGA). Accessed January 11, 2024. http://econsortprd.ugent.be/index.asp?p=2585&a=2286.
19. The Mobility for Innovative Renewable Energy Technologies. Accessed January 11, 2024. https://miret.mu.ac.ke/index.php/fr/miret-media/news-events/97-launch-of-miret-project.
20. Transforming Energy Access – Learning Partnership. Accessed January 11, 2024. https://engineering.mu.ac.ke/index.php/projects/tea-lp-project
21. Higher Education Partnerships in sub-Saharan Africa (HEP SSA). Accessed January 11, 2024. https://raeng.org.uk/hepssa.
22. PTRE Incubation centre. Accessed January 11, 2024. https://ptre-ic.mu.ac.ke/index.php/about/ptre-ic.
23. Kenyatta University. Chandaria Business Innovation Incubation Centre. Accessed January 11, 2024. https://www.ku.ac.ke/iiuil/chandaria-business-innovation-incubation-centre
24. MKU Innovation and Incubation Centre. Accessed January 11, 2024. https://www.mku.ac.ke/mku-officially-launch-innovation-and-incubation-center/
25. IIEC- Meru University of Science and Technology Innovation, Incubation and Entrepreneurship Centre. Accessed January 11, 2024. https://www.must.ac.ke/iiec/