Science, Technology & Innovation Policy Research Organisation (STIPRO)

Research Workshop:

Engineering Education Capacities: How Engineering Ecosystems are Preparing Students in Africa for Employment

1-2 December 2021

Supply and Demand of Engineers in Sub-Saharan Africa

"Engineering Practitioners in Sub-Saharan Africa: Demand, Supply, Capacity and Quality"

Goolam Mohamedbhai
Former Vice-Chancellor, University of Mauritius
Former Secretary-General, Association of African Universities

DEMAND

Demand for Engineering Practitioners

Two strategies, one global, the other continental, both launched in 2015, will largely determine requirement of engineering practitioners in Africa over the next decades:

1. Achieving the UN Sustainable Development Goals: "Transforming our World: The 2030 Agenda for Sustainable Development"

2. Implementing "African Union's Agenda 2063: The Africa We Want"

17 SDGs (169 Targets)

1. No Poverty	2. No Hunger	3.Good Health & Wellbeing	4. Quality Education
5. Gender Equality	6. Clean Water & Sanitation	7. Renewable Energy	8. Good Jobs & Economic Growth
9. Industry, Innovation & Infrastructure	10. Reduced Inequalities	11. Sustainable Cities & Communities	12. Responsible Consumption & Production
13. Climate Action	14. Life Below Water	15. Life on Land	16. Peace & Justice & Strong Institutions
	17. Partnerships for the Goals		

9 of the SDGs require <u>direct</u> engineering intervention
6 of the SDGs require <u>indirect</u> engineering intervention

- ➤ *Poor performance of most African countries in 2020: 13/17 SDGs not on track for 2030*
- ➤ *SDGs 3, 9 & 16 facing greatest challenges*

Agenda 2063: The Africa We Want

7 Aspirations (with 20 Goals):

1. Prosperity based on inclusive growth & sustainable development

2. Integrated continent, politically united

3. Good governance, democracy, respect for human rights, justice & rule of law

4. Peace & security

5. Strong cultural identity - common heritage, values & ethics

6. People-driven development, especially women & youth

7. Strong, resilient & influential global player

Engineering requirements are embedded in Goals, not easy to identify them as in SDGs. Monitoring and reporting progress at country level has faced challenges.

Increasing Demand for EPs with Economic Growth

- Available data suggest a direct correlation between countries' GDP/capita and engineering practitioners (EPs) per 100,000 population: the higher the GDP, the larger the number of EPs

- As all African countries are expected to increase their growth over the next decades, their demand for EPs will invariably grow

Country	Approx. GDP/capita US$	Approx. EPs/100,000 pop
Mauritius	11,000	400
Botswana	7,500	275
South Africa	6,000	200
Eswatini	3,500	140
Zambia	1,700	75
Tanzania	1,000	70

2016 values estimated from *Engineering Numbers and Needs in the SADC Region* (2018)

Sectoral Demand for Engineering Practitioners

- **Agriculture**: Improve rural agricultural production through mechanisation, facilitate post-harvest processing & ensure food security

- **Mining & Quarrying**: Take control of mining Africa's rich natural resources (minerals, oil, gas) and promote refining of resources before export

- **Manufacturing**: Accelerate industrial development to enable Africa to become a net exporter rather than importer of manufactured goods

- **Construction**: Promote infrastructural development to accompany growth: roads, bridges, buildings, airports, railways, harbours, etc.

- **Utilities**: Meet increasing needs for water, electricity, gas; and ensure proper sewage disposal and sanitation

- **ICT**: Assist in transitioning to information and knowledge societies, and participate as equal partners in global information-based society

Supply and Capacity

Education, Training & Employment in Engineering

Institutions
Universities
Polytechnics & Technical Colleges
Vocational Training Institutions
Engineering Regulatory body
Professional Engineering bodies
Ministries of Infrastructure & Public Utilities
Municipalities/District Councils
Industry (local & global private firms)
Small, Micro & Medium Enterprises (SMMEs)
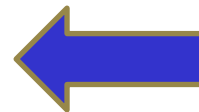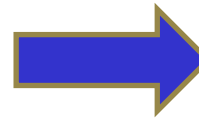
Practitioners
Engineering Graduates
Trainee Engineers
Professional Engineers
Entrepreneurs
Technologists
Technicians
Craftsmen, Artisans

Reports on Engineering in Africa

- Several reports published to diagnose challenges related to engineering supply and capacity in Africa:

  1. UNESCO (2010). *Engineering: Issues, Challenges and Opportunities.* 1st UNESCO report specifically on engineering. Has a special section on Africa.

  2. Royal Academy of Engineering, UK (2012). *Engineers for Africa: Identifying Engineering Capacity Needs in Sub-Saharan Africa.*

  3. SADC (2018). *Engineering Numbers and Needs in the SADC Region.*

  4. UNESCO (2021). *Engineering for Sustainable Development.* 2nd UNESCO report, has a special section on Africa.

- Most of the reports mention lack of reliable data in Africa (but also in other parts of the world).

Supply and Capacity Challenges

- The reports on Engineering in Africa highlight:
  - Acute shortage of engineers for supporting development & industry – countries have to rely on imported expertise
  - Notable levels of unemployment among engineering graduates
- Causes for these 2 contradictory findings:
  - Insufficient output of quality engineering graduates
  - Poor quality of engineering education, lack of employability skills among engineering graduates
  - Inadequate opportunities for students to get experience in local firms, both as internship while studying or after graduation – under-developed industrial environment
  - Limited opportunities for employment in public sector
  - Major foreign companies prefer to import their own professionals
  - Poor salaries of professional engineers, hence brain drain to other sectors or countries
  - Reluctance of graduates to take up posts in rural areas

Lack of Engineering Technologists & Technicians

- For effective operation of engineering industry, ratio of professional engineers to technologists/technicians should be 1:5 or 1:6

- In SADC in 2015, almost equal number of engineers as technologists/technicians (about 115,000), giving a ratio of 1:1. Similar situation in most other African countries

- In many countries, polytechnics have been converted to universities because of low status of technicians.

- Outcome: many engineers are underemployed (as technicians)

- Technologists/technicians are vital to support work of engineers, to service SMEEs and to work in rural areas

- Several countries (Germany, South Korea) have achieved industrial success because of good support from technologists and technicians

QUALITY

1. Engineering Education
2. University-Industry Linkages
3. Accreditation

Engineering Education

- Poor quality of pipeline from secondary schools – inadequate science teaching in schools
- Poor & ill-maintained infrastructure of institutions (labs, libraries, ICT, etc.)
- Outdated curricula, mostly imported from the North and not relevant to Africa
- Poor teaching methodology – magisterial mode, Problem-Based Learning (PBL) hardly used
- No pedagogical training of lecturers – hardly any have industrial training
- The insistence that all lecturers should have a PhD not entirely relevant to engineering field - a Masters in a specialised field + relevant industrial experience more appropriate for the majority

University-Industry Linkages

- Strong university-industry linkages vital for quality engineering education

- Industrial environment in Africa different from industrialized countries – direct comparison not justified

- Universities need to involve local industries in designing their curricula according to their needs

- In-course internships produce the best graduates, but finding adequate placement poses challenges, and internships often abandoned. Posting students in rural areas for internship help to expose them to problems of rural development

- Post-graduation supervised training essential for practicing as professional engineer – proper supervision not always available

- Major infrastructural projects undertaken by foreign firms – they hardly employ African engineers or offer internship or training

Accreditation

- Just like medicine & law, the engineering profession needs to be regulated.

- In most African countries, engineering degrees are accredited by a dedicated statutory body (in addition to QA requirements):

  ➢ Nigeria: Council for the Regulation of Engineering in Nigeria (COREN)

  ➢ Kenya/Tanzania/Uganda: Engineers Registration Board (ERB)

  ➢ South Africa: Engineering Council of South Africa (ECSA)

- In some African countries, recognition of engineering qualifications done by professional engineering body e.g. The Ghana Institution of Engineers

- In Francophone African countries, recognition & equivalence of engineering diplomas done by CAMES (African & Malagasy Council for Higher Education), a regional body.

International Accreditation

- Washington Accord (WA) is an international agreement among countries for accreditation and mutual recognition of engineering degrees.

- Countries must become signatories of WA – some 20 signatories currently

- South Africa (ECSA) is the only African signatory

- A signatory can assist other countries to gain signatory status – ECSA is assisting Botswana, Namibia & Mauritius

- Achieving signatory status is a complex, long and costly process – all costs to be borne by the requesting country

Conclusions & Recommendations

- There will be an increasing demand of EPs in Africa to support the continent's growth & development.

- Planning the supply requires concerted efforts by relevant Ministries (Education, Labour, Works, Industry, Economic Development, Finance). Statistics on engineering education, training & employment must be collected by all relevant institutions to assist the planning

- The quality of engineering education must be improved and made relevant to Africa's development needs and industrial environment

- Rural areas, where development challenges are greatest, have specific engineering requirements and EPs must be encouraged to serve in those areas

- Polytechnics must no be converted to universities and the status of technicians must be valorised

- Regulatory laws must be introduced to ensure that foreign companies employ local engineers and provide internship & training

- African countries should aim at regional accreditation of engineering qualifications. Sub-regional initiatives could be led by COREN (West Africa), ERBs (East Africa) & ECSA (Southern Africa)

Impact of COVID-19

- Reduced enrolment in engineering programmes in HEIs:

  ➢ Lower output from secondary schools because of frequent closure

  ➢ Parents cannot afford to send their children to HEIs

- Quality of engineering education will deteriorate because of online teaching & insufficient laboratory practicals

- Fewer opportunities for training & employment of engineers as several firms will either reduce their staff or even close down

Hence, supply, capacity and quality of EPs will probably all be negatively affected

THANK YOU