How can the engineering field be made more responsive to the needs of the industrial sector?

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Discussant – Dr Nyemba's presentation

- Engineering Lecturer (senior) – engaged in engineering education
- Engineering Secondments fo faculty
- Publishing Engineering Education work

Bigger picture: The need to develop engineering capacity in Africa

- Africa is a growing economy – discoveries of minerals, oil and gas
- Government policies – towards industrialisation
- Advancements in Science and technology
- The need to build infrastructure to accelerate industrial development
- High demand of engineers to build local capacity for sustainable development
- The need to invest in producing engineering human capacity to match the large investments in infrastructure

Engineering education transformation – motivated by economic development

"The contribution of engineers to society is critical to sustainable development, to responsible wealth creation and to international competitiveness."

(Engineers Australia, 1996, p. 6).

- In the Global North, major transformations in engineering education occurred in the 1990s after industrial revolutions of the 1980s.

  (Brown, 1998; Engineers Australia, 1996; Wulf, 1998; Yeargan & Hernaut, 2001)

- The efforts were motivated by industrial pressures in order to prepare for the competition in the 21st century, to meet "increasing demands on the education systems for the skilled people it needs to compete in global markets in the 21st century" (Mackenzie, 1999, p. 270)

African Engineering education relevance to industry

- In the 1990s, when major engineering education transformations were happening in the Global North, most of the African region was burdened with disabling economic stagnation.
- The situation led to an alarming decline of established manufacturing industries, particularly those dependent on imported raw materials and spare parts.
- Coupled with restrictions on long-term lending by financial institutions affected expansion of small scale industries.
- Production levels of certain ore and mineral extracting industries dropped as world demand for them shrunk. (Zymelman, 1993)

African engineering industry as well as engineering education have not developing at the same pace with the Global North.

What do we need to do to ensure that engineering education responds to Industry needs?

- Collect and share data – there is lack of data in Africa (Mohamedbhai, Today)
- Treat engineering education as an area of research in addition to disciplinary areas.
- Connect to relevant literature and discussions in the area

  For example connecting secondments to Work Integrated Learning. Other models that have connect engineering education to authentic practice are PBL, EE
- Get faculty involved in innovation of teaching and learning
- From Teaching and Learning practice to education Research

Lessons from Tanzania Early engineers (Matemba, 2020)

- 3 focus groups (n= 20)
- Research study conducted between 2015 and 2016
- The years in industry between 1 and 10.
- Different fields, Public employees, private employees and self employed.
- Only 3 were female engineers

Gap in Professional practice confidence

- When asked in the pilot focus group how their education had prepared them for their current role, early career engineers revealed a common experience that:

"Tanzanian graduate engineers needed at least "two to three years", "to get the necessary skills in the industry" so they "can be confident" to practice

Early career engineers claimed that they entered the industry with "appropriate knowledge" but not enough "skill to immediately get into the industry and be compatible in the

Technical Engineering Practice competence

"… in the university you learn say the importance of moisture in compaction of granular material, you learn and you know it is important and you need this much of moisture content. In the lab you can do it, but when you get into the field, mixing huge amount of material, trying to acquire that moisture, that you cannot measure, you need to see and do some visual tests and you need some experience to know if this material behaves …" (ECE FG, 2015)

- There is a gap in technical engineering competence that results from the differences in terms of the scale and nature of work between the training environment and the industry environment.
- They explain for instance that it is difficult for the existing education environment, for instance laboratory experiments, to comprehend the practical tasks in the real-world engineering role.

Engineering education Focus – Marks

- Evidence shows that their loaded curriculum leaves the students with impulse to only strive for marks, which in turn negatively affect students' development of important technical skills for industry practice
- The engineering education is focused around attaining marks or passing exams - Instead of developing competencies for practice

This is problematic when it comes to developing creativity and critical thinking skills

"bombarded with a lot of things, a lot of modules […] like eight, nine modules a semester."

"So a person is not really, does not really get time to concentrate on a single or a few things, but rather just touching here and there, just for the sake of passing and move on to the next level. … not trying to be discontinued from the university."

The Workplace (Industry) demands- problem solving

- There was a common implication that engineering is a practice related to solving real problems (ill-defined) in the changing environment which require more than just formula or a software.
- In additional to analytical and problem-solving skills in engineering work, data strongly shows a necessity for critical thinking, creativity, research and lifelong learning skills.

"If engineers are here to solve problems, they must have the problem-solving skills."

The Workplace (Industry) environment –working with others

- Engineering workplace in Tanzania is a multidisciplinary and multi-level working environment requires them to effectively integrate with people from other disciplines such as sociology, for instance in order to come up with "solution[s] to solve society's problems."

- Multilevel –issues of communication and teamwork between high level and lower lever as they called others.

"Now, some other societies have got their cultures of which as an engineer you cannot establish the culture of the society unless you have a sociologist. Therefore, you have to come up with solutions that will solve the problem of the people that considers the cultural aspects. Now, if you don't integrate, then you cannot solve the problem."

"Those are people lower than us. They have diplomas, they have certificates, but when we make use of their experience and expertise, they really add a lot".

International firms - explicit professional competencies

- International firms who explicitly recognize professional competencies or the non-technical skills.
- As of September 2019, there were 184 (75%) local firms and 62 (25 %) foreign firms registered to work in Tanzania (www.erb.go.tz)

"[…] mean now there's lots of mobility and there are lots of international companies working in Tanzania, so today you may be working in the Tanzanian office, the next day you are working in the South African office and maybe even the Australian office."

Contextual potentials in developing relevance to practice

PBL and Practical Training in Engineering programs

- PBL model of delivery applied by very few institutions
- the practical training (secondments or placements)

Post-graduation – internship

- The main opportunity that graduate take to develop their practice is the SEAP program.

Lifelong learning attitude

- The graduates explained that since there was a lot of learning that is required after graduation and therefore building lifelong learning skills were important.

"[…] so I can say where maybe by Bachelor degree prepared me a bit, but not completely. I took the advantage of practical training. From there is where you go and see some physical stuff. Oh, so this is the centrifugal meter. But when you do in the class and you just say, Okay, to find the volumetric flow here, you just do some formulas, but when you go to the practical training, that is where you get the real test of what you do."

Summary – The need to understand our context

Time to build capacity in Engineering education research

- Opportunity for to invest in pedagogical research Teaching and Leaning projects as well as in Engineering Education
- Studying the Industry closely to understand the extent of the problem
- Institutions should engage more with industry in training their students through a scaffolded model of Work-Integrated Learning
- Study engineering education to understanding the structural constraints involved (e.g. accreditation, higher education system)
- Identify the potential areas of achievement that are relevant to African (SSA) context.
- Innovate engineering curricula to match industry demands- not to add content but to improve relevance
- We need to collaborate- there are many separate initiatives