COVID19 crisis and engineering in Sub-Saharan Africa: what response and what next?

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Abstract

The COVID-19 outbreak is primarily depicted as a health and economic crisis, but it is fundamentally also a crisis of an engineering nature. While research has been carried out on the impact of the pandemic on engineering globally or in the Western world, little to no research has been conducted about its impact on the engineering sector in Africa. Ecorys was commissioned by the Royal Academy of Engineering, UK to collect evidence on the contribution of engineering to tackling the COVID-19 crisis in Sub-Saharan Africa; provide a forward-looking view on how the crisis is likely to impact engineering in Sub-Saharan Africa in the years to come, and develop recommendations for the engineering sector on how to make best use of the opportunities offered by the crisis. The research involved document review and interviews with engineering stakeholders across Africa with a focus on 10 African countries namely Botswana, Cameroon, Ghana, Kenya, Lesotho, Nigeria, South Africa, Uganda, Zambia and Zimbabwe. Ultimately, this research seeks to inspire and facilitate learning among engineering actors across the continent, to support their impact and crisis recovery efforts, and enhance their profile among governments and their constituents.

Keywords: COVID19 crisis, Engineering, Sub-Saharan Africa, Post-crisis outlook, Professional Engineering Institutions, Innovation.

1 Introduction

The aim of this research was twofold:
• to collect evidence on the contribution of engineering to tackling the COVID-19 crisis in Africa by mapping the different interventions that have taken place and their outcomes;
• to provide a forward-looking view on how the crisis is likely to impact engineering in Africa in the years to come and to develop recommendations for the engineering sector on how to make best use of the opportunities offered by the crisis.
Ultimately, this research seeks to inspire and facilitate learning among engineering actors across the continent, to support their impact and crisis recovery efforts, and enhance their profile among governments and their constituents.

2 Methodology

We selected 10 countries to be covered in detail by our research, based on early evidence of effective engineering interventions, namely: Botswana, Cameroon, Ghana, Kenya, Lesotho, Nigeria, South Africa, Uganda, Zambia and Zimbabwe. In half of these countries, we were privileged to be able to draw on the networks we have built over time, as part of our work with the Academy on the GCRF Africa Catalyst programme. In the other countries, the team is indebted to the people who voluntarily (and enthusiastically) agreed to contribute to the research. We also closely collaborated with the Federation of African Engineering Organisations (FAEO) through a Memorandum of Understanding.

Our methodological tools included:

• In-depth desk review and 20 interviews with engineering stakeholders in each of the 10 countries covered by this research. The number of interviews and breadth of the desk review carried out per country were adapted to the level of sophistication of the engineering response to the crisis.

• Wider desk review and six interviews with high-level stakeholders able to provide a cross-country perspective, namely the Royal Academy of Engineering; FAEO; WomEng; the Science, Technology and Innovation Policy Research Organization; the African Center for Economic Transformation; and the African Centre for Technology Studies.

3 Results

3.1 Impact on engineering sector in Africa

- Exposed existing vulnerabilities in connectivity and health infrastructures
- Impacted FDI, and thereby investment in essential infrastructures
- Exposed reliance on foreign manufacturing and prompted local manufacturing
- Disrupted engineering education and research
- Disrupted the way engineering works

A multi-faceted impact

- Traditional engineering fields have been negatively impacted: civil, mechanical, chemical, electrical and transport specialisms
- Newer fields have thrived: information, communication and computing engineering; robotics, AI, geospatial, medical and biomedical specialism

3.2 The Engineering response (Times New Roman 10)

Engineering actors involved include:

- Donors and development partners
- Academia, in particular engineering universities incubators
- Private sector: companies, start-ups, social enterprises and individual entrepreneurs
- PEIs both FAEO and national PEIs: helping raise awareness about the virus and the measures that can prevent its spread; distributing PPE, sanitizer and in some cases food; facilitating discussions around the implications of the COVID-19 outbreak, and how engineers can best cope and minimize the spread of the virus; developing health and safety guidance for engineering activities; contributing to policy making by contributing ideas and expertise; initiating fundraising efforts to support the response to the crisis. Subsequent paragraphs, however, are indented (here insert the second paragraph). Please see below how to insert Table 1 and Fig. 1 in the text.

The six main categories of engineering response were:
- local design and manufacture of medical, personal protective and sanitary equipment
- rapid building of treatment, isolation or testing facilities
- private sector: companies, start-ups, social enterprises and individual entrepreneurs
- Funding, fundraising and direct support to vulnerable members
- Robotics innovations
- Moving Education and training online

Cross-country collaboration:
- Experience sharing but little to no coordinated action
- Strengthening Engineering Ecosystems in Sub-Saharan Africa SEESA
- CARE project

The crisis brought engineering actors together around the same goal resulting in new or improved collaboration. In South Africa, 32 PEIs are collaborating for the first time, In Ghana and Zimbabwe, infrastructures construction was the result of tight collaboration, Funding and fundraising has been collaborative in many countries. However deeper issues remain unaddressed.

3.3 Impact on priorities for engineering

- Greater focus on new technologies and digitalization, ICT, IA, robotics, 4D printing
- Technology and systems design evolution towards automation, distance control and touch-less features
- Greater focus on emergency response preparedness
- Greater focus on local manufacturing
- Greater focus on green and blue economy

3.4 Lessons Learned

- Engineering needs to be more adaptable and deliver infrastructures quickly
- Tighter links are needed with policy makers to better anticipate such crisis and articulate better engineering responses
- Engineers need to better understand human behaviour to be able to better serve society
- Engineers need to share best practices across countries and remain forward-looking
- Greater investment is needed in Research and development

3.5 Opportunities

- Greater self-reliance and local capacity-building
- Promote engineering
- Developing more socially responsive technological innovations; building frameworks for resilience through human-centered designs
- Ease of doing business

Role of PEIs

- Educate the general public on the new normal
- Help the transition towards the new normal by initiating resolutions and helping build new infrastructures
- Become more agile: less bureaucratic and get more forward-looking. Greater engagement with private sector

4 Discussion (Times New Roman 12)

Role of the engineering community as a whole

Our research has identified a number of opportunities that the African engineering sector could build on in the years to come.

- **Accompanying the journey towards self-reliance**

Just as in the rest of the world, the COVID-19 outbreak has been a wake-up call for many countries in Africa about the need to reduce reliance on global supply chains, and in particular reliance on European or Chinese manufacturing. The crisis has led to the development of aspirations to build self-reliance and develop national supply chains. Engineers have a critical role to play in accompanying this transformation. There is therefore an opportunity for African engineering to become more focused, practically-oriented, and to make the most of existing capacities rather than attempting to mimic what exists elsewhere.

- **Building local engineering capacity**

Directly in line with this, there is a major opportunity to build the local capacity of engineers. Because of COVID-19-related international travel restrictions over the past year, there has been no choice but to involve local engineers in delivering complex projects that were previously dominated by foreign engineers. In addition to absorbing skills and knowledge through this process, local engineers have been working collaboratively with Western or Asian peers on an equal footing, thereby positively re-equilibrating the power balance with their counterparts in other parts of the world.

There is an ongoing need for the engineering sector to keep its talent at home rather than losing young engineers to emigration. The pandemic has shown that local engineers can work to provide innovation and solutions and there is now an opportunity to build on this, by focusing on matching local talent to post-COVID engineering needs.

- **Increasing the visibility and standing of the engineering profession**

While the COVID19 crisis is primarily labelled as a health and economic crisis, it is fundamentally also a crisis of an engineering nature. As documented in our research, the African engineering community has played a critical role in recovery efforts. Yet, these efforts went unnoticed by the general public for the most parts. Engineers should not shy away from branding themselves and showcasing the efforts they have undertaken. This is an occasion to raise awareness about the essential nature of engineering and improve general public trust in the field.

By improving the standing of the profession, engineers will be in a stronger position to voice their agenda and influence policymaking towards building resilience against future global crises with world-class technologies and innovative ideas to solve practical problems. This increase in recognition could also enhance allocation of finances for infrastructures and engineering research.

- **Matching skills to changing future priorities**

Given the changing future priorities for the engineering sector, linked to issues such as digitalisation, the green economy, climate change, and water management, it is key that skills acquisition and development are adapted to these priorities. This will require collaboration between PEIs and skills providers, including universities. The recent increase in the visibility of the engineering sector may help to increase student intake in key engineering disciplines.

- **Expanding cross-sectoral collaboration**

During the COVID-19 outbreak, it became clear that a wide range of successful projects were being carried out based on cross-sectoral partnership. Collaboration between engineering practitioners, researchers and the government is likely to improve, as the need to relocate production will enhance the need for cooperation throughout the value chain. However, stakeholders fear this renewed impetus in collaboration could fade in the medium term. Deeper issues also remain unaddressed, such as the gap between universities and industry, the lack of communication between PEIs and the government and low resources and capacity of PEIs.

It is therefore crucial that engineers continue to collaborate with key organisations within their countries, such as governments, universities and industry, forging partnerships across countries, disciplines, sectors and areas of the economy (i.e. public and private sectors). This is indispensable to help tackle the longer-term impacts of the pandemic, cope with future crises and to respond effectively to society's future priorities.

The post-COVID world is also an opportunity for governments to collaborate more with the engineering community. In South Africa, the government is now focusing on delivering infrastructure and there is appetite to develop partnerships between the public and private sectors in terms of capacity building. In Zambia, for example, EIZ expressed a view that mechanical, civil, biochemical, electrical, management and geotechnical engineering will need to change and adapt, following the crisis, notably through more regular and meaningful collaboration and cooperation with the health and emergency services, water and sanitation, oil and gas, renewable energy, digital and technology, defence and marine sectors, and the education system as a whole. It is vital to plan ahead so that links can be built up and communication channels and processes can be put into place.

- **Building more socially responsive and resilient infrastructures**

The crisis has been an opportunity to decompartmentalise engineering and align innovations and infrastructures more directly with the needs of African society. Human behaviour is not rational, especially in times of crisis, and this needs to be reflected in infrastructures. By coming together across multiple disciplines and gaining greater exposure to social sciences, African engineers might be able to 'think out of the box' and develop more holistic solutions that better address societal needs. Finally, this is a real opportunity for engineers to lead emergency preparedness efforts and build resilience as part of their design processes. Engineers need to adopt human-centred designs with the next generation in mind to ensure sustainability. An example of this is the need to accommodate the greater demand for cross-border mobility and technological solutions from the new generation.

- **Sharing best practices**

Engineering communities will need to increase the sharing best practices among themselves and keep a forward-looking outlook. Different engineering actors tend to work in siloes even within countries: for example, entrepreneurs tend to be disconnected from PEIs. Cross-country fertilisation of ideas and learning could go a long way to improving engineering capacity in Sub-Saharan Africa and keeping the profession innovative and forward-looking. There is also scope to establish channels to facilitate such exchange and learning, and to make the most of FAEO.

- **Utilising the greater ease of doing business**

One of the positive aspects of the crisis is of course the increased possibilities of working, collaborating, and networking online. There is an opportunity for engineers to make the most of these new avenues to expand the reach of their businesses, find new business partners and increase their visibility. Technology also offers engineers an opportunity to work more closely and seamlessly in teams across different countries. Building on this, engineers may soon be able to utilise online tools to brainstorm ideas and strategies and develop prototypes in real time in a virtual room. Focus group/qualitative research and survey technologies could also allow real time data capture and facilitate remote collaborative engineering work. Finally, the opportunities offered by moving work online can also lead to new business models.

Role of Professional Engineering Institutions in the 'new normal'

Stakeholders interviewed for this research felt that PEIs have primarily contributed to collaborative efforts, rather than led their own initiatives. It was also felt PEIs have not always been in the front line, and that they could sometimes have played a more prominent role in the effort to mitigate the effects of the crisis. Nevertheless, this research has identified many ways in which PEIs have stepped up and worked with the government and other partners to help out, in particular through fundraising, distributing PPE or coordinating efforts to build essential facilities. COVID-19 could therefore help advance PEIs' longer-term vision to promote the character and status of the profession and increase public awareness and confidence in this. PEI efforts have also widely diverged from a country to another, although our research identified a number of common ways in which PEIs can develop.

- **Reflecting, learning, and helping the transition towards the 'new normal'**

African PEIs have a responsibility to help their countries to transition into the 'new normal', whatever that might look like. They can do so by bringing the sector together and facilitating reflection on what is needed for the future of their countries in the years to come, and initiate an open and sustained dialogue with policymakers. They can also steer efforts to build new infrastructures. Of course, this is not a simple journey for PEIs, as many of them are under-resourced and have limited capacity.

Nevertheless, there are examples of PEIs embracing that role already. In Nigeria, for example, the National Society of Engineers is encouraging its members to use funds made available by the Nigerian government to boost entrepreneurship development. The NSE is also encouraging its members to develop innovations that can help the nation to grow and stimulate job creation.

- **Becoming more agile**

Our research found that African PEIs are often seen as bureaucratic, highly political and difficult to navigate for outsiders. For this reason, some engineering actors feel like they are playing catch-up rather than leading the way forward. There is now a real opportunity, as a result of the crisis, for PEIs to embrace the need to become more agile, play a more central role in recovery efforts, and exert more thought leadership. A priority in the eyes of many, is for PEIs to migrate online as soon as possible. Another immediate priority would be to organise dedicated conferences with members and the sector more widely to agree on resolutions to address future challenges.

5 Conclusions

Whilst the COVID-19 outbreak is primarily depicted as a health and sanitary crisis, it is fundamentally also a crisis of an engineering nature. It is therefore not surprising that the African engineering community has actively mobilised and deployed an array of interventions and solutions. From our research, it is clear that the COVID-19 crisis is likely to have a lasting impact on engineering priorities in sub-Saharan Africa. Our research has identified a number of opportunities that the African engineering sector could build on in the years to come.

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