A STRATEGY FOR IEEE ASSISTANCE IN BUILDING ENGINEERING CAPACITY IN UNDER-SERVED AFRICAN COUNTRIES

INTRODUCTION:

THE IMPORTANCE OF BUILDING ENGINEERING CAPACITY IN AFRICA

Technological innovation is the principal driver for improvements in quality of life and economic prosperity, and the engineering profession is central to technological innovation. Though true everywhere, these concepts are particularly important in developing countries, where technologies commonplace elsewhere have not yet reached large fractions of the population. In Sub-Saharan Africa, many people still do not have access to electricity, modern communications technology, clean water and sanitation, or modern medical technology.

Engineering capacity is thus a central element in development. Developing countries need a well-qualified engineering workforce, large enough to meet their needs and supported by the infrastructure and resources necessary to meet the needs of the population.

> *"Sub-Saharan Africa suffers a chronic lack of indigenous capacity in engineering."*
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> *"Engineering courses in SSA are often too theoretical, are based on outdated curricula, and are not relevant to local needs."*
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> *"Engineers for Africa"*
>
> *Royal Academy of Engineering (UK) 2012*

The need for greater engineering capacity is widely recognized across the African continent. Many African countries have produced development plans that identify goals and strategies, typically with 15-20 year timelines. These documents commonly speak to the important roles of scientists and engineers in meeting national goals and, in particular, to expanding their engineering workforce as a part of their development strategy.

The examples quoted below are from the governmental planning documents of five countries that the Committee has identified as initial targets for expanded IEEE engagement.

Ghana's *Economic and Social Development Policies, 2010-2016* acknowledges that "Currently, the status accorded science and technology in Ghana is low due to the inadequate allocation of budgetary resources to science, technology and innovation." It identifies the need to address the "lack of a national policy to promote the development of STI to support agriculture and small to medium scale enterprises; the lack of a national policy on commercialization of scientific research; and weak institutional arrangement to support science and technology development.

Kenya's *Vision 2030* states that "More resources will be devoted to scientific research, technical capabilities of the workforce, and in raising the quality of teaching mathematics, science and technology in schools, polytechnics and universities." The Kenyan Board of Engineers estimates that there are presently between 7000 and 8000 engineers in the country and about 700 receive undergraduate engineering degrees annually. They believe that, to meet their goals, they will need an engineering workforce of about 20,000 within a decade.

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Rwanda's *Vision 2020* says "Rwanda lags behind in professional training, with the most acute deficiency being apparent in the fields of applied and natural sciences and ICT. Although the country will continue to rely on imported technology from advanced countries, well-trained, specialized nationals will be essential to run as well as maintain technological systems ranging from medicine and agriculture to industry and telecommunications."

Uganda's *Vision 2040* uses the words engineer or engineering 25 times, including in calls for "leapfrogging, especially in the areas of science, technology, innovation, and engineering" and to "Develop and implement a national science technology and engineering system that will help in initiating, importing, modifying and diffusing new technologies."

Zambia's *Vision 2030* plan expresses the goal of becoming "A nation in which science, technology and innovations are the driving forces in national development and (which) competes globally by 2030." It includes a specific goal to "Acquire and upgrade infrastructure required for training in science and technology and R&D academic institutions by 2030."

Extensive outreach in the region and the personal knowledge of IEEE local volunteers reinforce the case that IEEE can best serve the development of African countries by helping them expand their engineering capacity.

OUTLINE OF THE STRATEGY

IEEE's approach in Africa needs to be well coordinated, make use of accumulated experience, and aim to cumulatively build on the results of several efforts.

IEEE must approach its support for the African engineering community by (1) engaging with and seeking guidance from African governments and engineering organizations; (2) drawing upon the resources of all relevant IEEE entities in an internally coordinated approach; and (3) partnering with other organizations that are addressing similar needs.

IEEE can best help African countries build engineering capacity by focusing on three broad goals, as follows:

Goal 1: Support Engineering Education and Workforce Development
Developing a strong engineering workforce requires a strong educational system that begins with primary school and continues through the course of engineers' careers. The greatest opportunities for IEEE to have an early impact lie in *continuing education*, especially in providing resources and opportunities for university faculty development and the transition of recent university graduates into the workforce.

Goal 2: Build a sustainable community of IEEE members and volunteers
As with other professions, engineers are most productive and innovative when they are a part of a community that can provide them with information and opportunities for mutual support. IEEE has communities in place in many African countries and strengthening them will greatly support capacity development. The effort will also include support for an initiative to establish a sustainable pan-African Council or similar entity that will enhance collaboration between local volunteers and better serve stakeholders outside of Sections.

Goal 3: Support Government policy development and increase opportunities for IEEE to serve as a resource for engineering capacity development
IEEE recognizes the essential roles played by national and regional governmental bodies in capacity building and proposes to proactively engage with such bodies, offering support and developing partnerships as may be desired and practical. IEEE is expanding its engagement in public policy globally, and this engagement shall extend to African countries and institutions, such as national ministries and the African Union.

TECHNNICAL AND GEOGRAPHIC SCOPE

The need, initially, to focus: While it is hoped eventually to expand across the under-served parts of Africa, it is necessary and appropriate to initially limit the technical and geographic scope of this effort. The financial and human resources required to quickly create a technologically broad, Pan-African IEEE strategy are not available. Additionally, building programs deliberately over time provides valuable opportunities to evaluate and improve new programs before expanding them to more of the continent. Co-location of programs under development can also be synergistic and efficient.

Technical Scope: The AHCAA will focus initially on Energy and ICT (Information and Communication Technologies). These two technologies have the greatest capacity to enable other technologies. They are commonly identified as priorities in the planning documents of African governments. They are areas wherein IEEE has extensive resources, and for which IEEE has, in recent years, publicly called for universal access.

Geographic Scope: The AHCAA will focus initially on programs in Ghana, Kenya, Rwanda, Uganda, and Zambia. As noted above, these five countries all have clear development plans calling for greater emphasis on science and engineering. IEEE has a well-established Section or Sub-Section in all but Rwanda. However, the Rwandan government has been especially proactive in addressing its energy and ICT needs and in strengthening its university system. The presence of a branch campus of Carnegie Mellon University in Rwanda will provide local resources and opportunities for collaboration.

Ghana

Uganda
Kenya
Rwanda
Zambia

AHCAA Focus Countries
in Sub-Saharan Africa
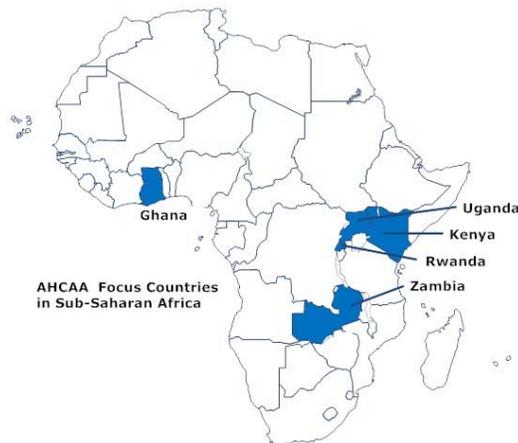
Notably, four other African countries, namely: Egypt, Nigeria, South Africa and Tunisia, have developed particularly strong IEEE Sections that significantly outperform the rest of the continent. These countries will serve as model Sections for the development of programs in the African context.

Coordination and Partnerships

The programs identified below will draw upon other organizations, within and outside of IEEE, as follows:

IEEE Technical Activities: Much of the technical information needed by African engineers has been developed by the IEEE Societies. The IEEE Communications Society is providing content for the African Virtual Conference series and is working to adapt some of its short courses to the African environment. The IEEE Computer Society will also provide some of its "Rock Star" content for the series. AHCAA expects to build upon these developing relationships, as it pursues the programs described below. In addition to intellectual content and volunteer engagement, AHCAA will be looking to Societies to strengthen and/or create robust Technical Chapters in the target countries.

IEEE Member and Geographic Activities: Robust IEEE Sections will be an important component in achieving AHCAA's goal of community building. Ghana, Kenya, and Zambia currently have established Sections. Uganda has recently formed a Sub-Section. Rwanda has a Student Branch, jointly hosted by the University of Rwanda and Carnegie Mellon-Rwanda. These entities all need to be strengthened. AHCAA will continue to assist and work with MGA in the development of local IEEE entities.

IEEE Educational Activities: IEEE-EA has been a central participant in AHCAA's outreach and planning activities over the past several years and, because of the centrality of education in capacity building, that relationship is expected to continue and grow. In some of the educational programs (Goal 1) described below, EA will assume the central role; in other educational programs, and in engagement with government organizations it will play a strong supporting role.

IEEE Standards Associations: Outreach by AHCAA has indicated an awareness of the importance of standards in product specifications, but perhaps less understanding of the potential for standards to drive innovation and technology penetration. Following a visit to the Kenya Bureau of Standards by AHCAA members in 2013, SA has opened a dialog with them, and is opening discussions with the standards bodies in Rwanda and Uganda. AHCAA will continue to support SA in these efforts.

Other NGOs: The Committee believes that, when it can identify programs of other NGOs that meet, or are relevant to, the needs it is trying to address, it should seek first to develop partnerships rather than begin to build completely new programs within IEEE. This concept has guided AHCAA's work on entrepreneurship training over the past few years, as it partnered with a consortium of professional societies to present workshops in Ghana and Kenya. (The consortium was led by the London-based Institute of Physics and included the Optical Society of America and the American Physical Society.) In two other examples, the Committee is developing a partnership with Seeding Labs, a U.S. based NGO that is currently working to provide African universities with advanced biomedical equipment, through which they would expand their work to engineering equipment, and it is working with the South African Institute of Electrical Engineers to provide greater publishing opportunities for African engineers.

PLANNED PROGRAMS

Goal 1: Support Engineering Education and Workforce Development

- Expanded Access to IEEE Xplore
- IEEE Virtual Events Program in Africa
- IEEE/UNESCO African Conference Scholarship Program
- Equipment and Laboratory Expansion Program
- IEEE/UNESCO African Distinguished Visitor Program
- Short Courses for New Engineering Graduates
- Developing Entrepreneurship Opportunities in Africa
- Expanding Access to TryEngineering.org, TryComputing.org, and TryNano.org
- Promoting Inter-university partnerships

Goal 2: Building a Sustainable Community of IEEE Members and Volunteers

- Strengthening Local IEEE Entities and Building Collaborations
- Engagement with National and Regional Professional Societies
- Volunteer Leadership Development Program
- African Student and Young Professionals Congress
- Supporting African Innovation, Small and Medium-sized Enterprises and Entrepreneurship
- Support for Standards Development in Africa

Goal 3: Government Policy Support and Increasing the Visibility of IEEE as a Resource for Engineering Capacity Development

- Negotiation of a Partnership with AU/NEPAD
- Revitalization of IEEE Partnership with UNESCO on Education in Africa
- Outreach to the Smart Africa Alliance