Expanding Engineering Capacity for Sustainable Development

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Introduction

The Asian Civil Engineering Coordinating Council (ACECC) is an organization of 17 national civil engineering societies established in 1999 to "...to promote collaborative work towards sustainable development of infrastructure within the Asian regions."[1] The ACECC does its work mainly through its technical committees. A committee on sustainable infrastructure (TC14) was established in 2011 led by the American Society of Civil Engineers (ASCE). The three-year (2019-2022) objective of TC 14"...is to develop a sustainable infrastructure roadmap tailored to the Asian region and supportive of the UN SDGs." The TC 14 roadmap is adapting the ASCE Five-Year Roadmap to Sustainable Development priorities - (1) Do the Right Project; (2) Do the Project Right; (3) Expand Technical Capacity; and (4) Advocate for sustainable infrastructure.[2]

Background

The members of ACECC represent some of the least developed and some of the most developed economies. Infrastructure priorities vary from ensuring basic services to expanding high speed rail. The physical obstacles to infrastructure development in the ACECC countries are some of the most challenging in the world from the mountains in Nepal to the delta region of Bangladesh. UNOPS has demonstrated that infrastructure underpins all 17 Sustainable Development Goals (SDGs) and one of the first requirements for any infrastructure system is to support basic services.[3] The UN defines the infrastructure basic services necessary to eliminate extreme poverty (SDG1) as: water & sanitation (SDG6), electricity (SDG 7); mobility (SDG 9&11), waste collection(SDG 11), and ICT (SDG 5&9).[4]

Formal engineering education is well established in all of the ACECC countries and most of the countries are full members of the Washington Accord (WA) for engineering accreditation. In 2021, the International Engineering Alliances (IEA) working with UNESCO and the World Federation of Engineering Organizations (WFEO) updated the Graduate Attributes and Professional Competencies (GAPC) to specifically address the SDGs.[5] Engineering accreditation agencies that are signatories to the WA are updating their accreditation standards to ensure that their graduates meet the updated attributes.

The graduate attributes are keyed to three levels of engineering work: technician, technologist, and engineer. Corresponding to the WA are the Sydney Accord for technologists, and the Dublin Accord for technicians. Of the ACECC counties only Australia, Chinese Taipei, Korea, and the United States are members of the (SA), and only Australia, Korea, and the U.S. are members of the DA.

Dr Marlene Kanga Past President of WFEO made a presentation on the updated GAPC at the Asia Pacific Economic Cooperation (APEC) Technical and Vocational Education and Training (TVET) workshop in May 2021.[6] According to the workshop website, the workshop was part of a project to promote industry-academia collaboration through industry-driven vocational education and training programs that encourage female participation in non-traditional sectors such as engineering and meet industry needs. Dr. Kanga's presentation focused on the GAPC attributes for engineers and is available on the WFEO website.[7] The differences among the attributes - engineer, technologist, technician - are mainly the level of work that is done. For example, for "Depth of Analysis required", an engineer is expected to be able to address problems that "Have no obvious solution and require abstract thinking, creativity and originality in analysis to formulate suitable models." A technician is expected to be prepared to analyze problems that "Can be solved in standardized ways."

The WFEO UNESCO report Engineering for Sustainable Development addresses the role and need for technologists and technicians only to a very limited extent.[8] Certification as opposed to licensure is the main credential for technicians and technologists in most countries and certification is discussed in some detail in chapter 4.2 but only in the context of continuing engineering education (CEE) and not as a work credential.

For ACECC member countries, limited membership in the DA and SA suggests that more needs to be done especially in the least developed ACECC member countries. Technicians and technologists play an important role in designing, constructing, operating, and maintaining basic infrastructure services in all countries particularly in rural areas. In contrast to licensure for engineers, certification is the common credential for technicians and technologies. Certifications are awarded by government agencies and

private-sector organizations. For certifications by private sector organizations, third-party accreditation should be mandatory.

Some idea of the role and importance of certified technicians and technologists even in advanced economies can be seen in U.S. federal and state programs for certifications and capacity building in infrastructure. For the water and wastewater sector, the United States Environmental Protection Agency (USEPA) has guidelines for certification of water treatment and wastewater treatment plant operators.[9] The actual programs are operated by state agencies and actual requirements vary from state to state. For example, Maryland law requires that operators and superintendents of water-treatment plants be certified.[10] The U.S. Department of Energy has developed four certifications for home energy professionals to support the DOE Weatherization Assistance Program and the home energy upgrade industry.[11]

The State of Maryland maintains the Mid-Atlantic Region Technician Certification Program (MARTCP) for technicians performing quality control/quality assurance testing in various materials disciplines supporting road construction.[12] Many of these certifications can be earned with a secondary level education and appropriate work experience.

Education is a basic human right and Article 26 calls for technical and professional education to be generally available.[13] In a 2012 report, the Special Rapporteur on Human Rights, reported on technical and vocational education and training from a rights perspective. This report also addressed the importance of TVET in the post-2015 "Education for All" and development agendas and concluded with a set of recommendations.[14]

The UN system has done extensive work on vocational education applicable to SDG 4 specifically targets 4.3, 4.4, 4.5, and 4b. UNESCO hosts the Inter Agency Group on TVET.[15] There is a UNESCO's designated center for TVET, the International Center for Technical Education and Training (UNEVOC). UNESCO-UNEVOC is working to increase the participation rate of youth and adults in formal and non-formal education and training but notes that achieving SDG 4.4 requires more international cooperation and coordination.[16] The UN through UNESCO is in a unique position to facilitate this cooperation and coordination across the entire spectrum of engineering work - technician to engineer.

To summarize, technologists and technicians along with engineers play a key role in providing basic infrastructure services in all countries. The importance of vocational and professional education is clearly identified in SDG 4 but it has not received the attention it deserves in educating and training engineering and applied science technicians and technologists. The UN system has done extensive work on TVET that is applicable to the engineering and applied science fields but it is not finding its way into practice. A focused collaboration with the professional societies, academic institutions, and other interested stakeholders has many potential benefits. Increasing the number of engineering technicians and technologists in the least developed countries would provide much needed human resources for supporting basic infrastructure services. Jobs that go with these services are rewarding and long term and often offer the opportunity for advancement. For example, a field technician moves to a water plant supervisor. There are also opportunities for further education where an individual trained as a technician after some work experience goes on for a bachelor's degree.

Recommendations

The 2022 STI Forum should explore the role that technologist and technician education in engineering and the applied sciences (SDG 4) can play in achieving the SDGs.

UNDESA should call on the Science and Technological Community Major Group (STCMG) to identify pathways, opportunities, and existing resources to highlight the important role that technicians and technologists in engineering and the applied sciences can play in achieving the SDGs starting with providing basic services in the least developed countries.

UNDESA should collaborate with the STC MG to prepare a briefing paper on the role of engineering and applied science technicians and technologists in achieving the SDGs and leaving no one behind.

The UN should request the WFEO to recommend ways that engineering technician and technologist education can be further strengthened to support achieving the SDGs.

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