Successes in University – Industry Partnerships – Perspectives from Durban University of Technology

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***Abstract*—The Higher Education Partnerships project in Sub Saharan Africa funded by the British Royal Academy of Engineering, which ran from April 2017 to March 2019. It is a network of engineering faculties and schools from the Hub University (Lead University) - University of Namibia (UNAM), UK Partner University - University of Cambridge; and three Spoke Universities (Satellite universities): Durban University of Technology, University of Nairobi Kenya and the University of Addis Ababa, with the aim of enhancing quality engineering education and training. This paper presents the outcomes of the project, namely: graduate engineers and technicians who meet the expectations of modern industry and engineering professional bodies; and are relevant and therefore employable nationally and regionally; academic and technical staff with enhanced practical experience and better teaching skills, and enriched and relevant engineering curriculum at universities.**

Keywords—University-Industry Partnerships, RAEng, UoN, UNAM, DUT, AAU, Cambridge University, HEPSSA.

I. INTRODUCTION

Over the years, it's been observed that there is a growing lack of engineering capacity in Sub-Saharan African region. This is coupled with a skills gap, skills shortage and poor graduate employability [1], [2], [3]. University of Namibia (UNAM) applied for funding from the Royal Academy of Engineering (RAEng) to enhance the quality of engineering education in selected Sub-Saharan universities through the university-industry partnerships, serving as Hub University. The RAEng approved funding totalling GBP 140,000 over a two-year period, from 1st April 2017 to 31st March 2019. The Project Manager at UNAM was Professor Frank Kavishe, UNAM selected the University of Cambridge as UK Partner with Professor Catherine Rae, as the UK contact person.

The Higher Education Partnerships in Sub Saharan Africa (HEPSSA) project is an academia-industry initiative and partnerships between University of Namibia (UNAM) Faculty of Engineering & Information Technology (Hub University) with the University of Cambridge (UK Partner), as well as three Spokes universities, namely Addis Ababa University (AAU), Ethiopia, University of Nairobi (UoN), Kenya and Durban University of Technology (DUT), South Africa [4], [5], together with selected local industries, namely: Namibia Ports Authority (NamPort), NORED and Ohorongo Cement Company, Namibia; Weatherly Mining Namibia, Navachab Gold Mine, Namibia, SONNY Sugar Company, Kenya; East African Portland Cement Company, Kenya; Kenya Power and Lighting Co., eThekwini Electricity, Durban, South Africa; Global Armatures Pty Ltd (South Africa), Solary System (Pty) Ltd and Eskom, South Africa.

The objective of the project was to enhance the quality of engineering education and training through collaborative and research, secondment to university academic/technical staff to industry for short-term internships, embark on industry-initiated research and secondment of industrial experts to universities. The goal is to enable participating universities produce versatile, industry-relevant, well-informed, versatile and marketable graduate engineers and technicians who meet the expectations of modern industry and professional bodies and are employable both nationally and regionally.

II. SUCCESSES IN UNIVERSITIES-INDUSTRY PARTNERSHIPS

The Hub University and Spoke Universities second their staff members to selected local industry during vacation time to engage in practical industry projects and learnerships. The industry experts were invited to the universities to share their engineering project experiences through Guest Lectures, postgrad student co-supervision, course moderation and to contribute to the development of new or existing engineering curricula.

At Durban University of Technology, staff undertook their internships at Global Armatures Pty Ltd (South Africa) and Solaray System (Pty) Ltd, while Eskom (South Africa's Electric Utility) provided financial support to the project, and eThekwini Electricity participated in the project through industry Guest lectures. UNAM, (Hub University) organized several Professional Development and Knowledge Sharing Workshops in Windhoek, Namibia and Nairobi, Kenya to ensure that participating universities and industries have a platform to present their experiences and share information relating to research and practical project experience.

The selection of suitable Industrial Partners is necessary to ensure that industry-initiated research is undertaken with financial support from the industry, which Eskom served optimally. The activities undertaken at Durban University of Technology include the following [5]:

- Deployment of Staff to Industry.
- Industry Participation.
- DUT Collaborative Research
- Invited Industry Guest Lectures
- MOU between UNAM and DUT

A. Industry Guest Lectures

Dr Sanjeeth Sewchurran, Chief Engineer, eThekwini Electricity presented two RAE sponsored industry guest lectures at Durban University of Technology. Figure 1 – 3 show participants at the lecture.

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Fig. 1: Industry Guest Lecture – The Changing South African Power System
Fig. 2: Dr Sanjeeth Sewchurran delivering a Guest Lecture at DUT

Fig. 3: Industry Guest Lecture at DUT

B. Deployment of Academic and Technical Staff to Industry

A total of five staff members participated in this program at Durban University of Technology, namely:

- Ntombi Mazibuko (MEng Candidate)
- Sipho Lafleni (MEng Candidate)
- Nomhle Loji (MEng Candidate)
- Elutunji Buraimoh (DEng Candidate)
- Sindi Malanda (MEng Candidate)

The following industries served as partners and hosted DUT academic and technical staff during their secondment and industry placement:

- Global Armatures Pty Ltd (South Africa) – traction motors – electrical machines
- Solaray System (Pty) Ltd – Solar-PV and renewable energy.

Fig. 4: Ms Ntombi Mazibuko served at Global Armatures – Traction motor repairs.

Fig. 5: Mr. Sipho Lafleni served at Global Armatures working on DC Traction motor drives.

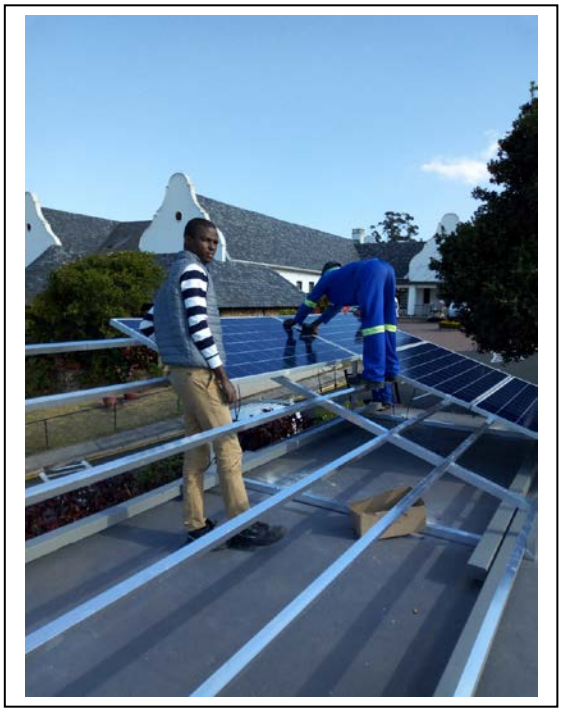

Fig. 6: Mr. Tunji Buraimoh served at Solary Systems providing turnkey Solar PV and Solar Thermal Installations for commercial and industrial client.

Beside the acquisition of valuable engineering skills and technical experience, some staff members also used this

training and exposure to satisfy relevant work experience towards professional registration with Engineering Council of South Africa (ECSA).

C. Collaborative Research Projects

The following are the on-going research projects:

- "Evaluation of grid-scale battery energy storage system as an enabler for large-scale renewable energy integration". This activity is being undertaken by Mrs Nomhle Loji in collaboration with Eskom Smart Grids towards an MEng degree.
- "Modelling and performance analysis of a universal motor fed from a renewable energy Nano-Grid". This activity being undertaken by Ms. Ntombi Mazibuko shares infrastructure in load modelling, solar-PV, energy storage and towards an MEng degree.
- "Performance analysis of singe-phase induction motor fed from a photovoltaic renewable energy System." Is undertaken by Mr. Sipho Lafleni. This activity also shares infrastructure with grid-tied inverter for reactive power support. It is also undertaken towards an MEng degree.
- "Development of a multi-level converter-based D-STATCOM / Battery energy storage system (BESS) for power quality enhancement in high RES penetrated microgrid" is conducted by Mr. Tunji Buraimoh, and undertaken towards a DEng degree.

D. Industry Funding for Research Projects

The following research grants were received for on-going research projects at DUT. Eskom - through its Tertiary Education Support Program (TESP) supported financially projects in smart micro-grids and energy storage systems.

#	Recipient	Project Title	Amount (R)	Funder
1	Ms N Mazibuko	Renewable Energy	R50000.00	Eskom
2	Mrs Nomhle Loji	Grid-scale Energy Storage	R30000.00	Eskom
3	Prof IE Davidson	Smart Micro-Grids Research	R70000.00	Eskom
4	Prof IE Davidson	HVDC Studies	R70000.00	Eskom
5	Prof IE Davidson	Research Outputs and Productivity	R171000.00	DUT/DHET

III. Collaboration Between UNAM and DUT

To facilitate inter-varsity collaboration and staff/student exchange, a memorandum of understanding (MOU) has been established between the University of Namibia and Durban University of Technology. This MOU also encompasses all partner universities under this HEPPSSA project.

Through this project/MOU, UNAM supported DUT staff to attend a Knowledge Sharing Workshop in Namibia in March 2019. Further joint research projects have been identified in the Energy Systems for Smart and Intelligent Cities renewable energy research area for viable engagement between UNAM and DUT.

The Department of Electrical Power Engineering at Durban University of Technology is engaged in research in technology relating to HVDC, power systems (including lines) and power electronics relating to AC systems in a smart grid utility environment. The focus going forward is on:

- Building Capacity in Electric Power and HVDC Engineering
- Smart Grids and Renewable Energy Technologies
- Research, Independent Testing and Verification Services
- Power System Solutions and Smart Utility services

The critical collaborative research project is: Energy Systems for Smart and Intelligent Cities. The research focus is undertaken with partner universities under the following sub-themes and areas [5]:

A. Smart Grids - modernization of electrical power systems

- Smart grid design, smart micro-grid modelling and simulation. Smart grids are also 'self-healing' and can repair faults and reduce outages, since they can detect fluctuations and disturbances to the grid and isolate parts of it.
- Electrical grids merging bi-directional power flow with information flow to monitor changes in usage and supply electricity.
- Utilizing digital communications technology to detect and react to the usage of the electrical supply and integration into the power grid.
- Technical and non-technical loss minimization in delivery systems.

B. Smart Cities Infrastructure and Innovation

Research studies in this area will focus on, but not limited to the following:

- Smart materials and nanotechnology to boost energy supplies, including grid-scale energy storage. Advanced solar PV materials, solar PV energy systems, fuel cells.
- Innovative new infrastructure: charging stations for electric cars; electric vehicles, battery electric vehicle, plug-in electric vehicle, hybrid electric vehicle.
- Design of integrated and autonomous energy systems for buildings; hybrid and integrated energy systems; micro-turbines, co-generation.
- DC renewable energy to consumer homes and businesses. Generating RE in DC: renewable IPP generators; LV-DC grids. Technical loss minimization to achieve substantial savings in decreasing voltage transformations achieved by direct DC generation.
- Smart transportation systems, vehicle-to-grid (V2G) infrastructure, energy-saving green IoT applications; home and industry automation.
- Energy storage and utilization in cities, includes: underground hydro-pumped storage schemes (UGHPS), district energy systems; electrical and thermal energy, energy sustainability/conservation and

recapture, mitigating green-house gas emissions (GHG) emissions and carbon neutrality.

IV. Conclusions and Achievements

It has been observed that most graduates from Durban University of Technology were employed nationally since they were all South Africans. However, they met the criteria for regional employability since they follow a curriculum aligned to the Washington Accord. Over the period of this research project, the following have been achieved at DUT as a Spokes University in the Higher Education Partnerships in Sub Saharan Africa project funded by the British Royal Academy of Engineering.

The lead Researcher at DUT has successfully graduated three Doctoral and four Masters students in Electrical Engineering, with several dissertations under examination at both DUT and the University of KwaZulu-Natal (UKZN), Durban where students are under supervision. To date researchers at DUT have published 8 accredited journal papers [6], [7], [8], [9], [10], [11], [12], [13] and 16 peer-reviewed conference proceedings [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29].

More academic staff at DUT have now been registered with the Engineering Council of South Africa.

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