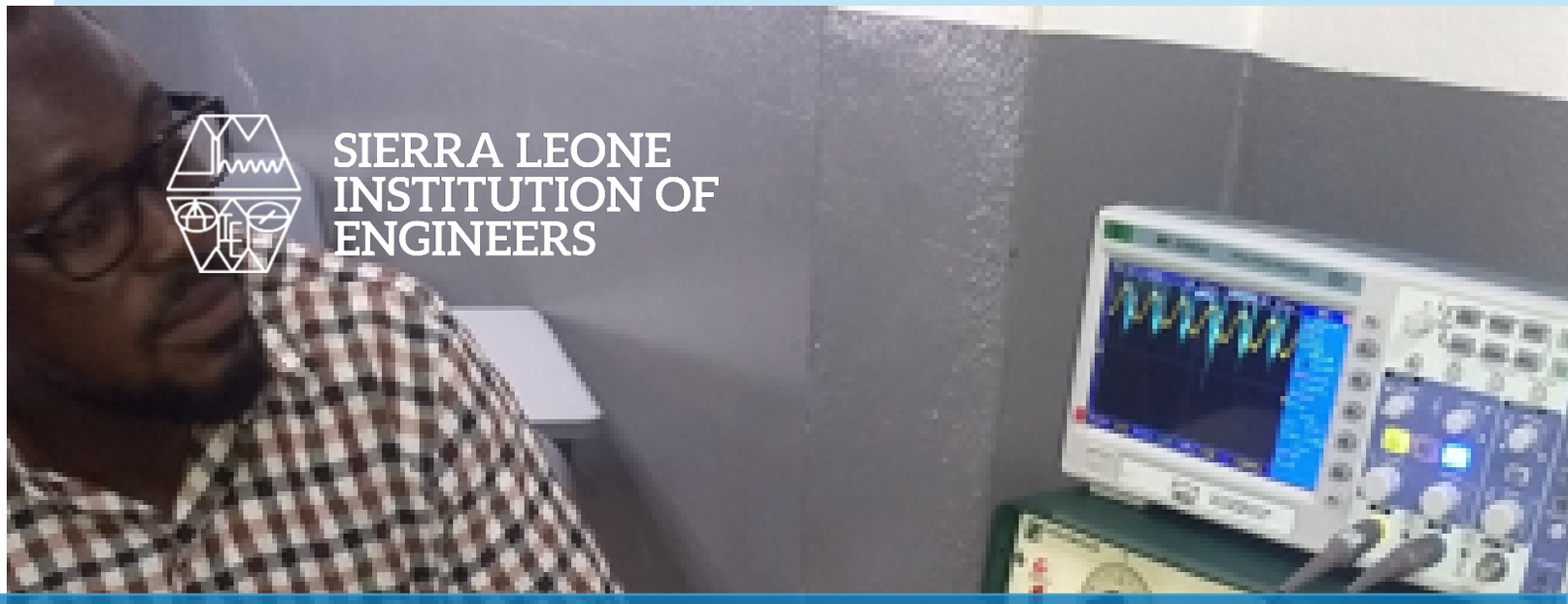
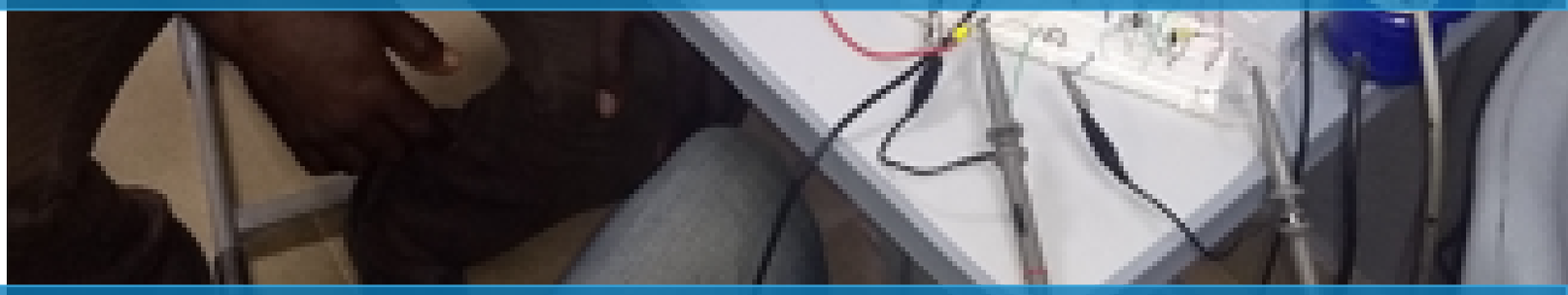


SIERRA LEONE INSTITUTION OF ENGINEERS

THE SIERRA LEONE INSTITUTION OF ENGINEERS

September 2022



UPGRADING ENGINEERING EDUCATION, TRAINING AND PRACTICE IN SIERRA LEONE

UNITY SERVICE LEARNING

ENGINEERS FOR CHANGE SIERRA LEONE

Imperial College London


OBASAI OJEH ELAY

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consistent in providing all that has been required to satisfactorily complete this programme.

To all our partners, SLIE is highly appreciative and grateful for both the individual and organisational sacrifices that have made this project a success! We owe you a debt of gratitude and look forward to finding future collaborations!

SLIE, EFCSL and our partners recognise the role played by and the effort exerted by the RAE to support the project particularly during the COVID pandemic. Special appreciation to Alice Marks, Catriona MacArther and Meredith Ettridge whose continuous support allowed us to overcome and continue, despite the numerous challenges faced.

Promotion of the Institution has improved significantly with our young engineers - students and recent graduates - and with industry in general. The funds provided by the RAE has addressed two of the GCRF's objectives: "Strengthen professional engineering bodies in Sub-Saharan Africa'' and "Effectively promote the engineering profession". The increased visibility of the Institution has been demonstrated by the number of engineering related organisations approaching SLIE to become special interest groups - the path used to ensure the Institution is able to embrace a diverse range of engineering specific focus groups. Membership is steadily rising, albeit slowly, but we are delighted to have started the process of reversing the recent decline.

Sharing best practice and increasing local engineering capacity has been a driver of this project and through the work of EFCSL and our local SLIE Education Committee, we have been able to do that through training courses and the creation of our Continuous Professional Development (CPD) framework. Special recognition must be given to Professor Jonas Redwood-Sawyer, Ing Louise Chaytor, Ing Lawrence Pratt, Ing Modupe Williams, Ing Henry Smith and Ing Rowland Gordon, without whose hard work and tenacity this would not have happened!

Like many other projects, we were adversely affected by the global pandemic. Due to the pandemic and travel restrictions, as well as enormous challenges in accessing basic resources in Sierra Leone, the scope of the project was reviewed. This resulted in delays and cancellations but we are thankful we did not lose anyone on our project and our thoughts and prayers are with all those families who lost loved ones during the pandemic. Working on projects in Sierra Leone is not always easy. We suffered from a range of challenges - theft of property, change of staff, misaligned expectations, budget expectations mishaps amongst many others. I would like to thank all those who powered through, especially the Steering Committee, the SLIE Council, our Executive Secretary and the staff of the SLIE Secretariat!

As an Institution our current strategic objectives are to:

- Demonstrate the value of maintaining registration with SLIE as a

professional institution
- Demonstrate the role and value of competent and regulated engineering profession to society
- Support the continuing professional development of all engineers
- Promote diversity and inclusion at all technical levels in engineering
- Continue and expand international collaboration with International Partners
- Develop the SLIE Secretariat to provide the requisite service for a modern secretariat

This project has supported all the above objectives and as the Institution moves forward, we commit to continuing to address the concerns of and improve the welfare of engineers, and work with all partners to deliver the education and training to meet future needs and demand for engineering skills.

Through this project we have been able to train circa 90 engineering graduates into employment, added to the improvement of the engineering faculty at USL, provided an opportunity for three senior lecturers to progress to PhD stage at USL, introduced CPD as a means of delivering competency in engineering in Sierra Leone, and created and established an Innovation Hub at USL.

Our message remains: the engineering sector is of vital importance to Sierra Leone and we as an Institution will ensure that engineering develops to enhance national development in Sierra Leone.

Ing. Trudy Morgan

President, Sierra Leone Institution of Engineers

CONTENTS

Abbreviations and Acronyms

ACP	Africa Catalyst Programme
CEC	Commonwealth Engineers Council
CPD	Continuing Professional Development
EfCSL	Engineers for Change Sierra Leone
FBC	Fourah Bay College
GOSL	Government of Sierra Leone
IA	Innovation Action
LCP	Local Content Policy
PERC	Professional Engineers Registration Council
RAE	Royal Academy of Engineering
SLIE	Sierra Leone Institution of Engineers
SPHEIR	Strategic Partnerships for Higher Education
TMP	Talent Mobility Partnership
USL	University of Sierra Leone
YEC	Young Engineers Corp

Chapter 1

Introduction

1.1 Sierra Leone Institution of Engineers

The Sierra Leone Institution of Engineers (SLIE) unites professional, graduate and student engineers [and is] dedicated to advancing the practice of engineering in all its branches, with particular application in Sierra Leone, for the betterment of humankind.

SLIE and the Professional Engineers Registration Council (PERC) were formed from the Sierra Leone Association of Technologists (SLAT). This was founded in the early sixties and represented professionals such as engineers, architects, surveyors, town planners, radiographers and laboratory technicians. Its aims and objectives were to enhance the performance and promote the technical and professional development of members.

As the membership of SLAT grew, the needs of engineers became more specific especially regarding the practice of the profession. This coupled with the fact that most of the members were engineers, led to the formation of SLIE in 1970 by a Memorandum of Association.

The objectives of SLIE include:

- Promoting and maintaining the unity, public usefulness, honour and interests of its members and making known the objectives of the Institution.
- Fostering linkages between SLIE and industry
- Promoting sound engineering practice
- Promoting engineering education in schools
- Promoting gender participation in engineering.
- Holding periodic meetings for members of the Institution
- Assisting and initiating action connected with the widespread dissemination of engineering knowledge in Sierra Leone.
- Arranging and making recommendations for public lectures, talks and seminars on subjects related to the objects of the Institution.

From 104 members of various disciplines, SLIE has now grown to over 1200 members and 150 student members. Current paid up membership is 415 engineers.

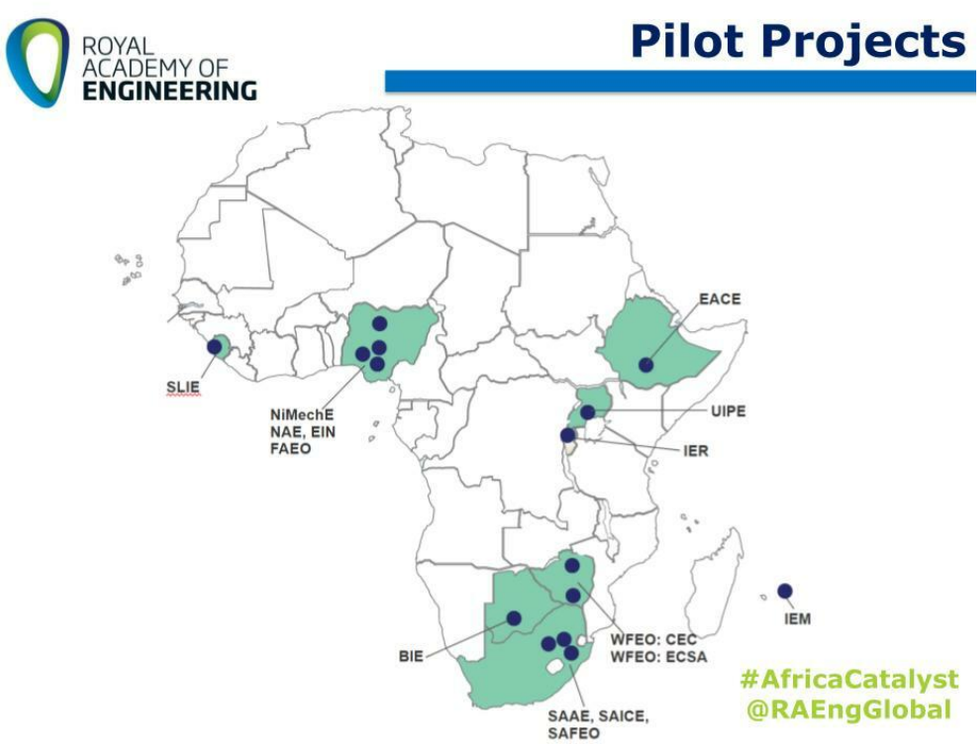
1.2 The Royal Academy of Engineering's Africa Catalyst Programme

In 2016, the Royal Academy of Engineering (RAE) UK, sponsored by the Global Challenges Research Fund, UK launched the Africa Catalyst Programme (ACP) – a capacity building initiative aimed at strengthening professional engineering bodies in sub-Saharan Africa to promote the profession, share best practice and increase local engineering capacity, to help drive development more effectively.

The programme initially required professional engineering Institutions in sub-Saharan Africa to work with engineering research, policy and business communities in the UK and sub-Saharan Africa to develop short engineering capacity building pilot projects to run between mid-December 2016 to mid-June 2017. SLIE was successful in this initial pilot project - one of 15 pilot projects - and completed the pilot project in June 2017.

Since 2016 the RAE through the Africa Catalyst Programme has awarded three grants to SLIE:

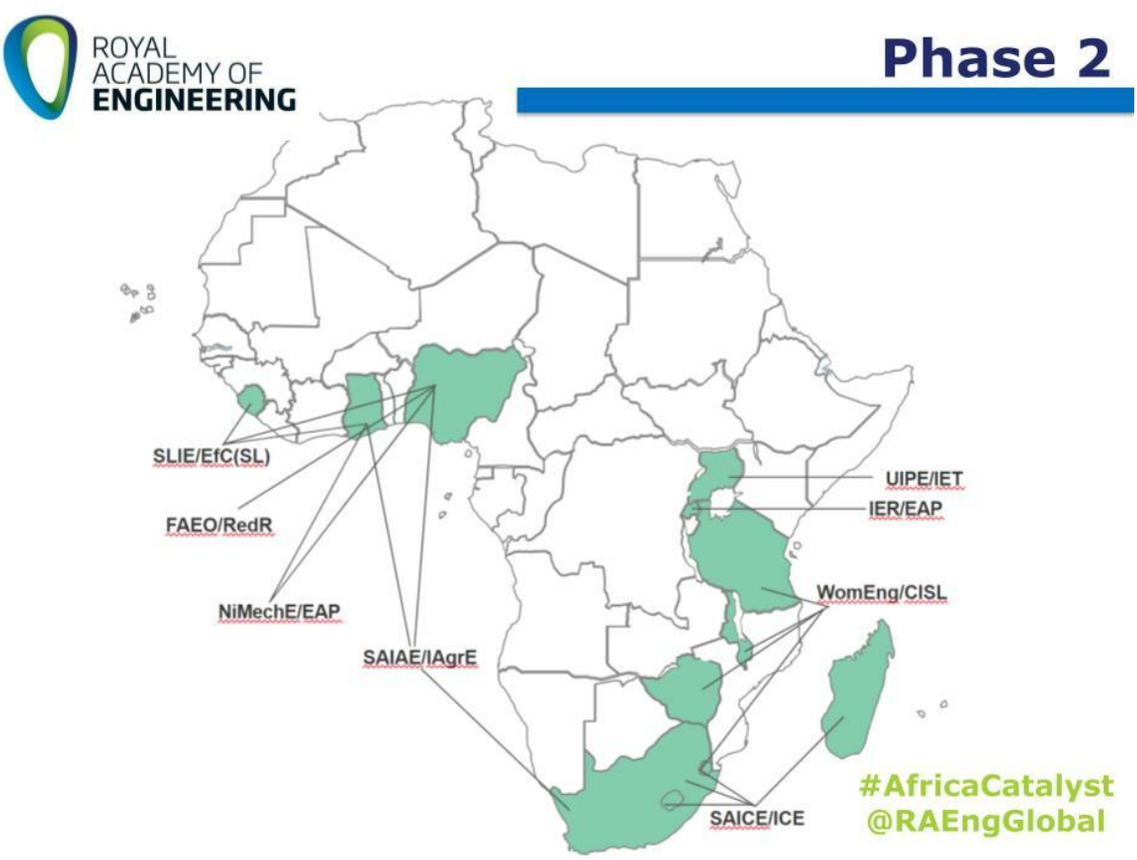
- ACP1 – a £40,000 grant aimed at increasing the employment prospects of engineering graduates and a preliminary evaluation of the undergraduate degree courses at the University of Sierra Leone (USL).
- ACP2 – a £294,000 grant designed to build on the lessons learned in ACP1 and expand the scope to other areas and institutions relevant to upgrading the training and practice of engineering in Sierra Leone.
- ACP3 - a grant of £69,950 to develop a framework for harmonising the education and training of engineers in West African universities and Professional Engineering Institutions across the West African region. SLIE led a collaboration of partners which included the West African Federation of Engineering Organisations.



1.3 SLIE's Africa Catalyst Project (ACP2)

In December 2017, SLIE successfully bid for a grant in the second phase of the Africa Catalyst Project (ACP2). The SLIE ACP2 programme consisted initially of five sub-projects which sought to address the following objectives:

- Improving job opportunities for recent graduate engineers from the University of Sierra Leone (USL).
- Improving the overall standard, relevance and quality of engineering courses and Continuing Professional Development (CPD) being offered by USL and SLIE.
- Empowering the engineering departments at USL to be creative in introducing innovation in research, teaching and development projects in partnership with industry, funders and external partners.
- Creating a community of engineers able to drive improvement in the standard of engineering practice.
- Drawing on the skills, connections and experience of the Sierra Leone diaspora engineers to support the objectives above.



1.4 Scope of the SLIE RAE ACP2 Report

This report describes the activities, achievements and outcomes of the SLIE RAE ACP2 project.

- Chapter 1 introduces the Institution in Sierra Leone and describes the key objectives of the SLIE project
- Chapter 2 describes the project and the key project parameters including

partners, governance, key risks and timelines.

- Chapter 3 outlines the background to the Young Engineers' Corp and highlights key achievements from that project.
- Chapter 4 describes the interventions undertaken to improve and raise standards at the University of Sierra Leone
- Chapter 5 describes the intervention to improve the training of engineers, post graduation including the establishment of a Continuing Professional Development framework.
- Chapter 6 highlights key actions in the establishment of an Innovation Hub at the University of Sierra Leone, including the participation of students and staff at the University of Sierra Leone.
- Chapter 7 is a synthesis of all the major learning of the project and identifies future pathways.

Chapter 2

Project Description and Methodology

2.1 Programme Scope and Key Deliverables

The programme was divided into five sub-projects:

- Part 1 – Young Engineers Corp (continued from the pilot project)
- Part 2 – Raising Standards of Academic Education
- Part 3 – Academic Accreditation Assessment
- Part 4 – Professional Training, CPD and Mentoring
- Part 5 – Applying Innovation to deliver Commercial Outcomes

2.1.1 Part 1: Young Engineers Corp 2

This was designed to improve the marketability and short-term job opportunities for newly qualified engineering graduates. The process included:

- the development of a framework for the selection of 100 graduates over the three year programme
- the identification, assessment and selection of potential candidates
- undertaking a skills gap assessment in conjunction with the engineering companies
- working with engineering companies to assess their needs and understand their perspective of the skills gap with engineering graduates
- the development of a cognitive and behavioural (soft skills) training programme for recently graduated engineers
- the development of a discipline based technical skills programme for recently graduated engineers
- sharing of the process and outcomes with government agencies and other stakeholders interested in the successful training of graduates

2.1.2 Part 2 & 3: Raising Standards at USL's Engineering Faculty

The initial two parts (Part 2 and Part 3) were combined as their ultimate goals were the same and would be undertaken by the same team. This project was designed to assist USL's Engineering Faculty raise pedagogical standards with the support of staff from Imperial College London (ICL). The goal was to improve the overall standard, relevance and quality of engineering courses at USL. This would be achieved by:

- providing on-going mentorship and support to the university academic staff to prepare them for academic accreditation assessment in Civils, Mechanical and Electrical, and Electronics course content syllabus review
- undertaking pre-assessment of the academic/ teaching staff at USL to identify training requirements and gaps for an accreditation assessment

- providing an assessment of UK Professional Institution Assessment for Accreditation
- developing programmes in collaboration with USL
- working with USL to obtain specialist requirements
- working with Engineers without Borders (Denmark) to co-ordinate their intention to establish a university exchange programme to support engineering training in Sierra Leone
- drawing up programme in agreement with USL to provide support from Danish Universities

2.1.3 Part 4: Professional training and developing CPD and supplementary training

Post graduate training locally is not a usual practice and this intervention was designed to encourage post-graduate training locally by national and international engineers. SLIE wanted to link membership renewal and elevation with continuous professional development and this provided the means to do so by:

- an assessment of the CPD provision in Sierra Leone
- establishing a programme of appropriate training courses that can be delivered by experts through webinars/internet and other media in collaboration with UK professional institutions.
- establishing a learner-centred approach to implementing CPD
- providing mentorship support to ICE candidates in Sierra Leone
- Identifying and providing mentorship to candidates qualified for IMechE and IET in Sierra Leone

2.1.4 Part 5: Applying Innovation to deliver Commercial Outcomes

This aimed to empower the engineering departments at USL to be creative in introducing innovation in research, teaching and development projects in partnership with industry funders and external partners. Working with a company, [Innovation Action] who specialises in introducing commercialisation innovation, this was achieved by:

- working with universities and companies in Sierra Leone to identify and provide training and support in developing suitable projects from research concepts to marketable products.
- providing staff training manuals and workshops in IP awareness, commercialisation and entrepreneurship
- exploring the possibility/feasibility of establishing a physical/virtual innovation incubator in collaboration with local/international partners at USL, including an international panel who would assess and rank opportunities.

2.2 Partner Organisations and their Roles

SLIE is the Professional Engineering Institution (PEI) that led the bid, in

collaboration and partnership with the Faculty of Engineering and Architecture at University of Sierra Leone.

Engineers for Change (Sierra Leone) (EfCSL) a diaspora not for profit organisation with in-depth knowledge of engineering training available in Sierra Leone was the main UK partner. EfCSL's primary aim is to raise awareness and provide practical assistance to bridge the gap in skill level and support local Sierra Leonean engineering institutions. This is achieved through developing collaborative working relationships with international organisations and the network of diaspora engineers from Sierra Leone. EfCSL coordinated the work deliverables of the UK partner organisations responsible for delivering various components of the project's scope and took responsibility on behalf of SLIE for managing the interface arrangements between the UK partners and SLIE and project management of work programmes of the UK partner organisations involved on the project.

The other partner organisations included:

- A team of UK University experts working out of Imperial College, London (Mike Templeton, Kristel Fobelets, Mike Lowe) provided support and mentoring to staff in the USL's Faculty of Engineering. They also undertook an assessment of the undergraduate degree courses of the three engineering disciplines (Civil, Mechanical and Electrical engineering). Their tasks included providing ongoing assistance to USL in raising teaching standards and addressing any weak areas in order to attain a successful accreditation assessment by the UK professional engineering institutions (ICE, IET, IMechE), by the end of the ACP2 programme in 2020.
- Innovation Action (IA) – Led by Dr Peter Fearon, this initiative brings people together to innovate on global challenges. IA partnered with SLIE to deliver a programme of innovation and entrepreneurship training workshops to students and engineers in Sierra Leone. IA also worked with the Sierra Leone diaspora community in the UK to identify commercial opportunities in technology and engineering with potential to contribute to the advancement and development of Sierra Leone and started the process of establishing a physical/virtual innovation incubator in collaboration with local and international partners at USL.

2.3 Project Governance

With the key partners working on two different continents, three different countries and many more cities, it was recognised that the project would establish a remote governance structure. A Programme Board was established with all stakeholders represented. Meetings would be held quarterly, aligned with the reporting to the RAE.

Additionally, in Sierra Leone, SLIE set up a local Steering Committee formed of senior representation from the SLIE Council and USL, chaired by the President of

Programme Board Representation
Sponsor Organisation
Royal Academy of Engineering
UK Partners Organisations
Engineers for Change (Sierra Leone)
Programme Lead: Modupe Williams Board Member: L. Pratt/ H. Smith
Team of Academic from Imperial College
Professor Mike Lowe
Innovation Action
Peter Fearon
Delivery Team
Sierra Leone Institution of Engineers
Programme Lead: Trudy Morgan
Board Member: J. R-Sawyerr
University of Sierra Leone - Faculty of Engineering)
Professor James Redwood - Sawyerr
Badamasi Savage
University of Sierra Leone Partner Organisation

SLIE. A Project Coordinator was responsible for managing the day-to-day interfaces with RAE and EFCSL. A member of the EFCSL board was always in attendance. Monthly reports were prepared and shared to all.

UK level meetings were also managed by EFCSL, with the Project Coordinator in attendance.

The COVID pandemic slowed down implementation but did not affect the governance team who met remotely.

2.4 Project Timelines

The project was initialised in January 2018 and a three year programme from January 2018 to January 2021 was submitted to the RAE.

A year into the project, the baseline was reset to reflect changes in project scope and realignment of the budget. This was specifically in relation to Part 3 which entailed undertaking an independent accreditation assessment of undergraduate degree courses at USL. The change was as a result of the initial assessment by the team from Imperial College London, which confirmed that this element of the project would extend beyond the timescales of the ACP2. It became apparent that the preparation for the recommended full accreditation would take more time than had been allocated. The funding allocated for this activity was therefore repurposed in consultation with the RAE and captured in the revised Baseline Report of December 2019.

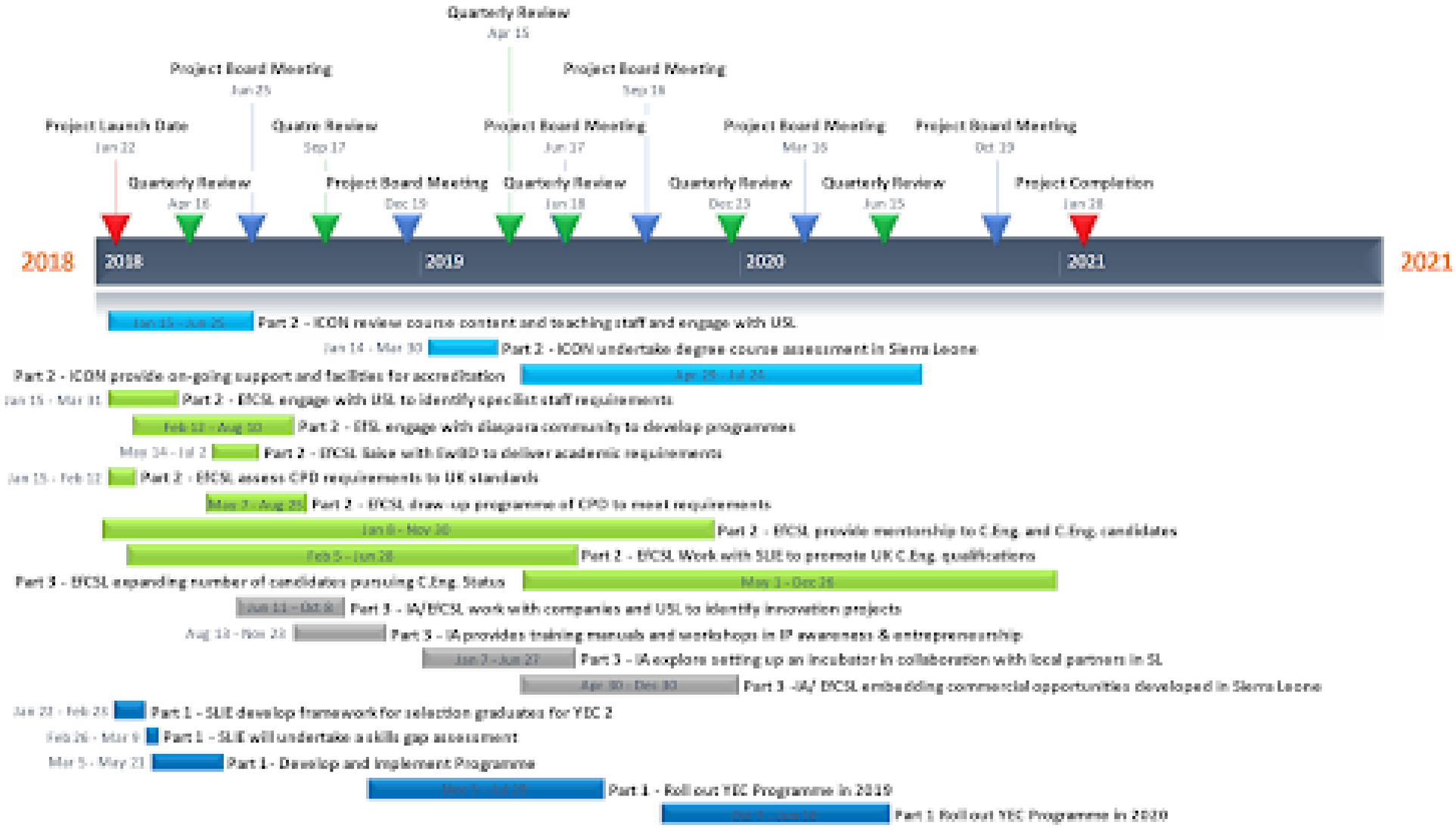
On 11th March 2020, the World Health Organisation (WHO) declared the novel CoronaVirus (COVID-19) outbreak a global pandemic. Sierra Leone's first case was confirmed on 31st March 2020 and the country went into the first of several lockdowns on 5th April 2020. Work on the project slowed due to compulsory COVID-19 safeguarding measures. The Project Team was able to keep working remotely and requested an extension of the project to June 2022. This request was granted by the RAE.

2.5 Project Cost Reimbursements and Payments

Payments from the RAE were made based on the agreed schedule. Funding was provided to SLIE and EFCSL on a phased basis. Payments were made against agreed deliverables and payment schedules, and endorsed by the Programme Board at Quarterly Review Meetings, then paid within two weeks on submission of the quarterly report to RAE.

Funds in Sierra Leone were further approved by the Steering Committee before disbursal and invoices and receipts collected and forwarded as requested by the RAE.

Travel expenses to Sierra Leone and hotel fares were incorporated in the baseline budget and reimbursed by the Programme Lead and responsible cost manager, in a timely fashion to facilitate efficient travel arrangements.


Quarterly Review
Apr 15
Project Board Meeting
Jun 25
Project Board Meeting
Sep 18
Project Launch Date
Jan 12
Quatre Review
Sep 17
Project Board Meeting
Jun 17
Project Board Meeting
Mar 19
Project Board Meeting
Oct 19
Quarterly Review
Apr 16
Project Board Meeting
Dec 19
Quarterly Review
Jan 18
Quarterly Review
Dec 23
Quarterly Review
Jun 25
Project Completion
Jan 28
2018
2018
2019
2020
2021
2021
Jan 15 - Jun 25 Part 2 - ICON review course content and teaching staff and engage with USL
Jan 14 - Mar 30 Part 2 - ICON undertake degree course assessment in Sierra Leone
Part 2 - ICON provide on-going support and facilities for accreditation
Apr 29 - Jul 27
Jan 15 - Mar 31 Part 2 - EICSL engage with USL to identify specilist staff requirements
Feb 12 - Aug 30 Part 2 - EISL engage with diaspora community to develop programmes
May 14 - Jul 2 Part 2 - EICSL liaise with EwBD to deliver academic requirements
Jan 15 - Feb 12 Part 2 - EICSL assess CPD requirements to UK standards
May 7 - Aug 25 Part 2 - EICSL draw up programme of CPD to meet requirements
Jan 8 - Nov 30 Part 2 - EICSL provide mentorship to C.Eng. and C.Eng. candidates
Feb 5 - Jun 28 Part 2 - EICSL Work with SLIE to promote UK C.Eng. qualifications
Part 3 - EICSL expanding number of candidates pursuing C.Eng. Status
May 1 - Dec 26
Jun 11 - Oct 8 Part 3 - IA/ EICSL work with companies and USL to identify innovation projects
Aug 13 - Nov 23 Part 3 - IA provides training manuals and workshops in IP awareness & entrepreneurship
Jun 3 - Jun 27 Part 3 - IA explore setting up an incubator in collaboration with local partners in SL
Apr 30 - Dec 30 Part 3 -IA/ EICSL embedding commercial opportunities developed in Sierra Leone
Jan 23 - Feb 25 Part 1 - SLIE develop framework for selection graduates for YEC 2
Feb 26 - Mar 9 Part 1 - SLIE will undertake a skills gap assessment
Mar 5 - May 21 Part 1 - Develop and Implement Programme
May 5 - Jul 29 Part 1 - Roll out YEC Programme in 2019
Oct 5 - Jun 26 Part 1 Roll out YEC Programme in 2020

Learning new skills with the Young Engineers' Corps

Chapter 3

Young Engineers' Corp (YEC)

3.1 Background to Young Engineers' Corp

SLIE works with all universities and tertiary institutions offering engineering courses across Sierra Leone. While technical colleges are focused on ensuring productive employment immediately after graduation, universities provide a much wider and often broad-based education aimed at providing graduates with a foundation that can be built upon both in industry and in research institutions.

Employers complain that graduate engineers do not have adequate practical experience and require further training when employed. SLIE and the universities in Sierra Leone are aware of this and USL has taken steps to address this issue. In consultation with industry, PERC and other stakeholders, USL recently carried out a comprehensive review of programmes, courses and curricula in all the engineering disciplines. The objective of this review was to ensure they include a fair measure of practical training as well as the acquisition of key 'soft' skills like communications, technical reporting and teamwork in the curriculum. Until the laboratories at Universities are fully functional, most graduates will have to rely on industry for practical experience.

Over the last decade, the number of students joining and participating in SLIE's activities has declined. Following several interventions, it was revealed that many young engineers were not aware of the role of SLIE in supporting engineers. Those who were aware did not believe that SLIE represented their interests, particularly around employment. This message was emphasised by young engineers at the SLIE 2014 Biennial Conference. SLIE has since been seeking opportunities to work with industries who can provide students with much needed hands-on experience that can only be obtained realistically in the work-place environment.

3.1.1 Government Intervention

In 2014, with the resurgence of Sierra Leone's mining sector, the country experienced increased economic activity, and was one of the fastest growing economies in the world (GDP growth 2011- 6%, 2012-15.2%, 2013-20.1%). To capitalise on this upturn and ensure that the average Sierra Leonean was able to

compete locally with more skilled foreign workers, the Government of Sierra Leone (GoSL) developed a Local Content Policy (LCP) to build up local capability through education, knowledge and skills transfer fromforeign workers to local staff.

Unfortunately the anticipated trickle-down effect did not materialise and GoSL, SLIE, PERC and other stakeholders became increasingly frustrated by the continuing recruitment of foreign workers in preference to local staff. Sierra Leonean engineers, technicians and graduates were being excluded from opportunities in Sierra Leone because of a perception that they were unprepared for the practical challenges of the industry.

GoSL realised the inadequate practical training of many graduates was compounding the youth unemployment challenge and required an urgent long-term solution. In response, it established the Skills Development Fund for engineering graduates. This was confirmed and ratified in the 2014 budget.

In 2015, the Minister of Finance and Economic Development's Budget Speech went further in specifying the following:

- *110. Already Le2.1 billion mobilized this year is ring-fenced for the Skills Development Fund. In addition, Le7.0 billion will be transferred from the proceeds from the Japanese Food Aid to the Skills Development Fund to support, among others, the establishment of a Young Engineers' Corps and access to advanced and specialized training for young medical graduates as well as roll-out a Young Professionals Internship Programme for university graduates.*
- *111. Sierra Leone has recently accepted an invitation to join other ECOWAS countries in a Talent Mobility Partnership (TMP) programme. The emerging initiative in the sub-region, encourages the practice of moving human resources across member countries with a view to effectively acquire, align, develop and engage high performing talents to foster national development.*

This allocation in the budget gave SLIE the impetus to set about developing a programme to address the urgent challenges identified by industry and young engineers. SLIE submitted a 24-month programme to MOFED for the YEC which was approved by the Ministry but never implemented.

3.1.2 YEC Pilot Programme

In November 2016, SLIE became aware of the Global Challenges Research Fund's Royal Academy of Engineering Africa Catalyst Programme, and a decision was made to submit a scaled-down version of the proposal submitted to MOFED.

Partnering with Engineers for Change Sierra Leone and the Commonwealth Engineers Council, SLIE submitted a two-part proposal for a framework for the training of young graduate engineers intended to enhance their employability and competitiveness in the international job market, in collaboration with USL and local employers.

- Part 1 – Focused on developing YEC for engineering graduates already in the job market and looking to improve their employability.
- Part 2 – Focused on enhancing the USL curriculum to include pedagogical approaches to encourage the skillsets employers required from graduates.

SLIE/PERC were notified in December 2016 that their bid had been successful and received a grant of £39,000.

3.2 Structure of the Young Engineers' Corp

3.2.1 Employers' Feedback

The structure of the YEC programme aims to address the key challenges reported by employers in Sierra Leone. Surveys and face-to-face interviews allowed various issues to be raised which were considered when designing the training.

Field-specific-knowledge and soft skills such as teamwork, commitment, and vision, feature strongly in the qualities that companies look for in their employees. There is therefore a need to fully align university curricula (using pedagogical tools such as team-based and problem-solving learning) and graduate employability through partnerships between universities and the job market. This is an ongoing process being addressed by Universities.

3.2.2 Agility - The Future of Work

Most engineers are described as "I-shaped" people. Their engineering study and practice forces them to become highly versed in a specific area of expertise. Further learning and practices tends to involve more of the same .

The world of work is changing and more employers are looking for agile workers - the "T-shaped" people. The T-shape is a metaphor for an individual's strengths, with the vertical line of the T representing expertise, discipline and knowledge of a particular field, and the horizontal line of the T representing cross-discipline competencies and the ability to collaborate with professionals in other industries or roles. Employers are interested in T-shaped individuals because they possess a wide variety of hard and soft skills.

SLIE's aim was to create T-shaped graduates who not only possess technical skills related to their field, such as mining, structures, electronics etc but who are now versed and cognisant of the soft skills that many employers value such as communication, ethics and time management.

3.2.3 Training Undertaken

The aim of YEC is to help make young graduates more employable, by providing structured training that addresses the cognitive and behavioural skills which employers say are missing. Topics include report writing and presentation skills, core computer skills, communication skills, commercial awareness, project management, critical thinking, problem solving, teamwork, stakeholder management. Technical skills are sharpened through a guided internship programme with a range of engineering companies. Internships follow a training regime aimed at increasing the productivity of successful interns by developing their soft skills as well as technical skills, with a view to permanent employment.

3.3 YEC Key Activities

3.3.1 Training Assessment Selection Day

For graduates to be selected for entry into the YEC training programme, they were required to meet the following minimum requirements:

- Completed a Bachelors' degree within the past year with a minimum of 2:2

in any Engineering discipline
- Be a student member of the SLIE and/or a member of the Engineering Society
- Show evidence of regular participation in the activities of the SLIE, Sierra Leone Women Engineers (SLWE) in the case of female graduates and the Engineering Society, especially attendance at public lectures, conferences and the SLWE Saturday Club.

The assessment process was designed to be transparent and assess a multitude of skills related to intelligence quota (IQ), execution quota (EQ), and leadership skills (LS). The following tests were set:

- Impromptu speech-giving (assessing LS, IQ, and EQ)
- Logical Reasoning (assessing IQ and EQ)
- Quantitative reasoning (assessing IQ)
- Comprehension test (assessing IQ and LS)

Grading was undertaken by a team of assessors consisting of SLIE members, as well as educators and training professionals. To ensure applicants were not overwhelmed by the assessment process, a thorough explanation of process and rationale was given. The transparency of the process ensured it was well received. Marking was done by participants and then checked. The top 20 students were selected based on their performance in the four tests.

3.3.2 Open Day and Candidate Commitment

Successful candidates were informed via email and phone messages and invited to an Open Day, where the SLIE team took them through the requirements of the course. Each graduate was required to sign a contract of commitment to confirm their availability throughout the training programme.

3.3.3 Procurement of Trainers

It was agreed that training and cognitive and behavioural skills training would need to be undertaken by training professionals. A tender process was undertaken to identify a suitable consultancy firm. Deliverables included:

1. The setting of minimum standards for each of the skills identified.
2. Develop SMART learning objectives/outcomes for each skill.
3. Develop a range of training materials directly related to learning objectives - presentations, handouts, design guides, codes of practice, design software programs etc. using a range of different tools such as Word, Excel programs to create training outlines and notes for the trainer,
4. Work with SLIE to provide guidelines for evaluating training effectiveness.

5. Provide SLIE with a final report containing the following information:
    - Where and how the training was organised
    - Number of participants
    - Signed attendance lists
    - Details of the training
    - Copies of training presentations
    - Whether the course and participants' objectives were met, including details on participants' assessment of the training programme

Afrecruit was chosen to undertake the training of the YEC2 and YEC3 cohorts and CTI Consulting were chosen to undertake YEC4.

3.3.4 Improving Basic Computer Skills

Most graduates are self taught when it comes to computer skills. The need for graduates to understand the use of spreadsheets was stressed by one potential employer of engineering graduates.

Computech - a Computer Training Center in Freetown - have regularly partnered with SLIE in delivering computer based training. For YEC, SLIE partnered with Computech for the provision of Basic Computer Skills for the graduate engineers. This training focused on upgrading the graduates on Microsoft Word (including touch typing), two days on Microsoft Excel, one day on Microsoft PowerPoint and a day on Microsoft Project.

It was interesting to note that the students' initial view was that the course was too basic following the first morning where they were taken through Microsoft Word. However, their views quickly changed later in the day when they were shown how to use Microsoft Excel. Of key importance to the soft skills training was training in PowerPoint – which would be extensively used. Computech kindly offered to provide the project with a half day free Microsoft Projects training. This was greatly welcomed by the students and they requested that more time be allocated for this training in the future.

3.3.5 Introduction to Project Management

As part of the first week, the graduates were given a short one day course on the Introduction to Project Management. The focus of this training was for them to understand the reasons why projects fail, introduce them to a formal project management process and the importance of the triple constraints of Project Management. The training allowed the graduates to take an integrated approach to managing projects and provides a strategic perspective of how to manage projects including:

- Understanding project management and the role of the project manager
- Being able to create project plans, schedules and budgets
- Being able to select and use the most appropriate project management tools

3.3.6 Soft Skills/Cognitive and Behaviour Skills

In order to fully understand the needs of industry when employing graduates, a questionnaire was sent to several companies to understand their perspective on the graduates. Questions included:

What qualities are you looking for in new employees, which one is most important?

Responses included: *loyalty, self discipline, integrity, open-mindedness, initiative, independent thought, commitment, willingness to work, sound basic knowledge, good communication skills, willingness and dedication to duty*

What do you usually find lacking in the fresh graduate engineers you employ?

Responses included: *real life experience; design or site experience; ability to make sound judgements on appropriateness of solutions; the ability to work in a structured environment and to be confident about what they already know; basic communication skills mainly the skills that are not core Engineering; ability to use basic software, lack of use of instruments, lack of practical experience*

Based on these responses, a curriculum was developed with the trainers and agreed as follows:

- Communication skills – verbal and written
- Confidence and assertiveness
- Time management
- Thinking skills – lateral and critical
- Emotional intelligence and empathy
- Team building
- Leadership skills
- Business ethics and etiquette
- Research skills
- Presentation skills
- Conflict resolution
- Customer service

Each module had a lead trainer and one facilitator per session to provide one-to-one support for trainees. This ensured each participant was fully conversant with the concepts and skills being introduced by the lead trainer.

Lecture notes, practical exercises, questions and answers, videos and role plays were used as delivery methods for the training. Training in career planning included two days of CV and cover letter writing and a panel interview.

A key challenge identified by the trainers and cohort was that insufficient time (three weeks) had been provided to cover the full scope of the training needed by the graduates. The trainers complained that the amount of time allocated for each module, due to the limited period available for training, was not sufficient to achieve full proficiency. Trainers therefore focused on providing a good introduction to the concepts and tools, whilst focusing techniques on those that will be most used by the trainees in their day to day life and work.

3.3.7 Internships/Job Placements

Critical to the success of the project was the placement of YEC trainees in companies with the potential to offer them long-term employment. At the end of the internships, graduates were usually offered follow-up placements and over 50% are currently employed. The general feedback from the employers was that there is a marked difference in the graduates who had been through the YEC programme. Additionally, the confidence levels of the graduates increased significantly allowing them to think outside the box.

All interns were asked to produce weekly reports on their progress. Some of these were very well executed under guidance from their companies, whilst others still required a lot of work.

3.3.8 Training Manuals

Most Sierra Leonean engineering companies do not have a formal training programme for their interns or staff. To support the training of YEC interns, SLIE worked with engineering lecturers from USL to develop training manuals that would be shared with placement companies. Heads of Departments from the USL led the production of the training manuals, with a section for weekly soft skills training included by the soft skills trainers.

To ensure an understanding of what was required from employers, SLIE asked each company to assign a champion and organised a training-of-trainers session

to reiterate the requirements of and expectations from employers.

3.3.9 CV Writing and Interview Skills

In the last week of the training, all students returned to the classroom for a final session on CV writing and interview skills. The students were taken through a series of exercises which allowed them to understand the difference between activities and achievements in a CV and were assisted to produce two different formats of CVs. Additionally, they were given one-on-one interview training which included a panel interview to which potential recruiters were invited.

3.3.10 Certification

At the end of the 10 weeks of training, graduates were provided with a certification of participation and completion. Employers, trainers, engineers and the family and friends of the interns were invited to the presentation. The President of SLIE presented the certificates, and the ceremony was televised for the national news station. Many graduates gave testimonials about what they had learnt and achieved during the 10-week process.

3.4 Soft Skills for Educators (USL Lecturers sessions)

Following the success of YEC2 and YEC3, the students made a request to SLIE for the soft skills training to be given to their lecturers so that they could transfer that training to a larger group of students.

The curriculum “Soft Skills for Educators” was developed by AfRecruit in collaboration with SLIE, to equip the lecturers at the Faculty of Engineering with the knowledge, skills, and professional qualities appropriate to the educational needs of its students. Assessment of competencies was structured to reflect the pathway of learning required throughout training. The curriculum also specifies the assessment formats selected to test the articulated objectives to ensure that all learning outcomes are seen as being valuable achievements.

The training focused on the following components:

- Communications
- Leadership
- Team building and teamwork
- Emotional intelligence
- Work ethics

The modules were delivered over the course of five days.

3.5 Highlights of YEC2, YEC3 and YEC4E

3.5.1 YEC 2

The YEC 2 Project started on 15th October 2018 and finished on the 8th January 2019. Twenty-two graduates were selected of which six (27%) were female. AfRecruit undertook the soft skills training and Computech undertook the Basic Computer skills.

The training scheduled was as follows

- Week 1- Basic Computer Skills and Project Management training
- Week 2 and 3 - Soft skills training with an emphasis on confidence and assertiveness; time management; thinking skills – lateral and critical; emotional intelligence and empathy; team building; leadership skills; business ethics and etiquette; research skills; presentation skills; conflict resolution; customer service
- Week 4 to 9 - 6 weeks internship with employers utilising manuals specifically developed Week 10 - CV writing, interview preparation and project closure

At the end of the internship, a number of the graduates were offered follow-up placements with some of the employers.

Currently, 6 graduates from different engineering companies have 3-6 months extended stay at the various companies they were assigned to.

3.5.2 YEC 3

The YEC 3 training started with the assessment day program on the 13th January 2020 with 53 students participating in the selection process. 25 cohorts were selected with 9 (36%) females and 16 males from the five engineering disciplines (civil, electrical, telecoms, mechanical, and mining). It was interesting to note that there was an increase in the number of cohort both at the selection stage and the training stage.

The 3 weeks computer and soft skills training started on the 20th January 2020 with 22 participants as three (3) participants dropped out for a range of different reasons.

An outcome of these lessons learnt from YEC2, was the introduction of PowerPoint training earlier, as the training involved daily presentation preparation as well Project Management, to get the students to start to think using a project based approach

- Week 1 - communication skills, confidence and assertiveness, leadership skills, team building, touch typing, Microsoft Word & PowerPoint and Project Management.

- Week 2 - written communication, research skills, presentation skills, conflict resolution, lateral thinking, emotional intelligence Microsoft excel and customer service.
- Week 3 – Business ethics & etiquette, Microsoft word & excel, time management and CV writing.

The 22 participants completed their soft skills training and were successfully placed in 11 engineering companies that started on Monday 24th February 2020 for a 6 week duration which was due to be completed on Friday 3rd April 2020.

There was a lag in the commencement of the internship as the number of companies willing to take graduates (especially for the mining graduates) was quite low. This was as a result of the current economic issue in the country. The internship started on the 24th February 2020 for six) weeks – ending on Friday 3rd April 2020. Unfortunately, four of the interns were terminated by one of the international construction companies as they reduced their staff numbers to not more than 50 in alignment with Government policy. They had however completed four weeks of training.

On the 31st March 2020, Sierra Leone got its first COVID-19 case and all face to face interactions became difficult as lockdowns were introduced and social distancing restrictions were introduced. As a result, the final week's CV writing and interview training was postponed. Most internship periods were extended with the exception of the mining cohorts whose internships were cut short because the company cut down on the number of staff.

Following several weeks of discussion at the Steering Committee level, with the trainers and Cohort 3, it was decided that the last week’s training could be held on the week of the 15th June 2020, but strict measures were introduced to ensure the safety of all. A large hall was hired at extra cost to ensure all participants could be accommodated and be socially distanced. A handwashing station was introduced at the entrance, masks were mandated and sanitizer was liberally applied to everything. We are glad to announce that no one contracted the virus during that time.

The last week of CV and interview was held on the week of 15th to 19th June 2020. To support the interview process, a team of engineers and HR specialists were invited to participate in the training. The interview sessions were undertaken by an all female panel. It was interesting to note the panel’s effect on the male and female students. The female students were confident and spoke confidently. Some male students were visibly shaken and it became evident that

the all female panel was disconcerting to them. This all-female ensemble resulted in one male cohort stating that it was not fair as there were no men and he felt uncomfortable. This was used as a learning opportunity to discuss the views and perspectives of women in engineering. It became a learning point for the male students – an opportunity for them to understand the challenges faced by some of the female students.

Members of the Steering Committee started the process of assessing the quality and validity of the internships provided.

The week was completed with a closing ceremony where certificates were presented to all attendees.

3.5.3 YEC 4

Following the successful completion of YEC3, SLIE was inundated with messages from graduates and students requesting a place on the next YEC programme. The start of YEC4 was delayed because of the COVID-19 pandemic. A flyer was produced and circulated widely on social media with an application deadline of the 28th of February 2021. The applications were filtered, and all qualified candidates were notified of the Assessment Day on Wednesday 10th March 2021.

Of the 86 people who expressed an interest, 56 candidates were invited for an assessment (and selection) day held at the newly established Innovation Hub (Part 5 of ACP2) at the Engineering faculty at Fourah Bay College, with participation from various company heads and university lecturers as assessors. Twenty-six graduates were selected - nine (33%) female and 17 male from the five engineering disciplines. Training started on Monday 15th March 2021.

Due to space restrictions imposed by the COVID-19 pandemic, Computech was no longer accessible for the training and the three-week training was moved to the Innovation Hub. Part of the training was also undertaken at the Electrical Department computer lab.

By the end of the first week of training, only three companies had agreed to take the interns for the six weeks internship/hard skills training. Due to the general lack of ongoing major projects and the closing/completion of other projects, companies were very reluctant to take graduates as interns, especially in the mining sector. Six companies took more than 80% of the cohort and they started their internship on the week of 15th April 2021 as planned. The remaining 20% started theirs on the 19th of April. All cohorts were successfully placed by the end of the third week of the training making a total of nine companies who

participated in the training. In the fourth week, several companies who had been approached came back to us requesting an additional three interns. These places were filled by interns who had been through the programme under YEC2.

Practising presentation skills

Chapter 4

Raising Standards at the University of Sierra Leone

4.1 Key Objectives and Inputs

This chapter is a review of sub-projects 2 and 3. These were combined as their ultimate goals were the same and would be undertaken by the same team.

Part 2 was a strategic collaboration between USL, a team of academic experts from Imperial College London (ICL), and Engineers for Change (EfCSL), with the objective of raising the standard of USL's Engineering Faculty.

This includes integrating the outcomes and resources being provided through two other current initiatives at USL, including:

- The Arab Bank for Economic Development in Africa (BADEA) project, which is designed to upgrade the university's teaching facilities, student residences and staff accommodation.
- The Strategic Partnership for Higher Education Innovation and Reform (SPHEIR) project, funded by the Foreign, Commonwealth and Development Office (FCDO), geared towards curriculum improvement and re-alignment, building a Quality-of-Service framework and robust stakeholder engagement.

Part 3 involved expanding the Civil, Mechanical, and Electrical and Electronic Engineering degree course contents to meet standards for international accreditation.

The main objective was to raise the standard of USL's Engineering Faculty, against the backdrop of the following significant structural deficits:

- Limited relevance of existing programmes (not adequately addressing national needs)
- Weak curriculum delivery (based on a traditional teacher-centred approach)
- High drop-outs rates and graduates without employable skill sets
- Weak and incomplete internal quality management systems and incomplete national and international accreditation system

The project aimed to tackle the above through the following objectives and inputs:

4.1.1 Key Objectives

- Improving the overall standard, relevance and quality of the engineering curricula being offered at USL.
- Empowering the engineering departments to be able to adopt and

implement teaching and learning processes that would produce more marketable graduates with hands-on skills.
- Working with a team of academic experts and the USL to expand the teaching and training material available to students, in partnership with UK universities and subject matter experts.
- In collaboration with EFCSL - drawing on the skills, connections and experience of the Sierra Leone diaspora community to support the objectives above.
- In collaboration with colleagues from Imperial College - planning and delivering Academic Accreditation from International Professional Engineering Institutions (PEI) for USL programmes and graduates.
- Increasing the number of candidates in Sierra Leone qualifying for membership of the UK and other international professional engineering institutions.
- Through the BADEA project - rehabilitate faculty infrastructure and upgrade teaching facilities
- Through the SPHEIR Project - review curriculum, setup quality management systems and strengthen stakeholder engagement

4.1.2 Key Inputs

The team of academic experts from Imperial College - Professor Mike Lowe, Dr Mike Templeton, Dr Kristel Fobelets - provided on-going mentorship and support to the university academic staff to deliver the requirements of the academic accreditation assessment. They also contributed to the assessment of the academic/ teaching staff at the university to identify training requirements and any gaps in teaching provision to meet the requirements of the accreditation. FBC/USL developed a document register and collated all data and information required for accreditation through the guidance of ICL experts

- FBC/USL implemented recommendations from imperial team assessment of degree course and teaching facilities
- EfCSL developed programmes in collaboration with the university in which subject matter experts from the Sierra Leone diaspora community can deliver training courses and lectures.
- EfCSL worked with Engineers without Borders (Denmark) to co-ordinate their stated intention to extend or establish an exchange programme to support engineering training in Sierra Leone.

4.2 Overview of the SPHEIR and BADEA Interventions

Under the SPHEIR Project course curriculum review, the following objectives were identified:

- Clear programme and course learning outcomes
- Course content at appropriate levels with required depth of knowledge.
- Inclusion of teaching, learning and assessment methodologies

- Teaching methodology emphasising critical thinking
- Standalone practical modules where students get hands-on skills.
- Elective modules.
- Total credits for bachelor's programmes reduced. E.g Three mathematics modules put together to Engineering Mathematics. Duplication in course contents removed.
- Course (Students) learning outcomes mapped to programme learning outcomes
- Staff office hours incorporated in the curriculum to provide for extra tutorship, supervision and counselling of students.
- A gender and Equity statement which prohibits harassment.
- A mandatory six months of Student Industrial Attachment

The curriculum improvement process involved collaboration with 19 institutions and 25 unique individuals from the public, private, and 3rd sectors, as well as STEM students. The stakeholder engagement helped improve the relevance of curricula and improve the employability of graduates while also informing unified regulatory guidelines.

SPHEIR also conducted staff training for academic staff on pedagogy skills, critical thinking and gender, inclusion and equity, and established an internal quality assurance unit IQA within the University to ensure quality implementation of the programmes with proper management systems.

The BADEA Project, rehabilitated existing faculty infrastructure and constructed new ones. It also provided teaching facilities including laboratory equipment.

4.3 Preparation for Accreditation

The activities under Parts 2 and 3, were split into different stages, each of which marks the completion of a significant section of the programme. Work scheduled at each stage required inputs from two or more project partners.

4.3.1 USL Curriculum Review

Part 2 – Stage 1

At the start of the programme, the Imperial College London (ICL) team shared project documentation, schedules and academic accreditation guides (IMechE, ICE and IET), with the USL team, in order to define the scope of course assessment. The USL team sent its existing Faculty Handbook to the ICL team. This allowed the Imperial team to start reviewing the course content and teaching resources, although a full assessment and report would only be done after ICL visited USL.

4.3.2 Exchange Visits

Part 2 – Stage 2

Three Heads of Departments (Mr. Oba Davies, Mr. Sahr Nynaloma, and

Professor Jonas Redwood Sawyerr) from the Faculty of Engineering USL paid a week-long visit to Imperial College London from 29th October to 2 November 2018. During this visit, they observed the ICL undergraduate teaching programme and met with corresponding HoDs. The visit concluded with a workshop in support of improving the education standards of engineering courses at USL. Following this, the USL HoDs submitted their reports on lessons learnt from the ICL visit to the USL Engineering Faculty Board and key best practices were factored in the curriculum review process and in the general faculty administrative structure.

Part 2 – Stage 3

The ICL team visited USL from February 19th to the 23rd 2019. The team included Professor Mike Lowe (Mechanical Engineering) Dr. Kristel Fobelets (Electrical and Electronics), Dr. Mike Templeton (Civil Engineering) and Dr. Esther Kamau (International Relations). During their visit, they were able to successfully:

- Meet with key USL staff to discuss how the project would be effectively delivered and how to possibly develop other partnerships
- Discuss accreditation requirements with faculty staff
- Audit engineering faculty facilities.
- Audit lecture delivery
- Audit staff and student research projects
- Interact with department staff and students

4.3.3 ICL Recommendations Part 2 – Stage 4

The ICL team provided a preliminary report on USL Engineering degree courses and teaching facilities including recommendations towards meeting academic accreditation requirements. The overall view of the ICL team is that USL has great strengths in its staff and students, and that there is good reason for optimism that educational standards can be raised, and accreditation can be achieved. However, this will need a programme of substantial change. Most significantly, the lack of practical provision in the educational programme was deemed a serious limitation. Some suggestions were made to help to accelerate this process. See attached appendix for ICL report. It was based on this report that Part 3 of the project was suspended, until such a time when the part eligibility status could be attained.

4.3.4 ICL Recommendation Part 2 – Stage 5

The key activities for Part 2 - Stage 5 included:

- EfCSL working with EWBD/ and the diaspora community to identify academic specialists required by USL
- The USL Team collaborating with academic specialists introduced by EfCSL.

Part 2 Stage 5 of the project was hindered by COVID 19 travel restrictions. EFCSL were not able to work with Engineers WIthout Borders Denmark during this

stage. Some online lectures were done, but the intended purpose of specialist module delivery was not achieved. This is now being considered with the easing of COVID 19.

4.3.5 USL Accreditation - Part 3

The key activities for Part 3 included:

FBC obtain a cost estimate for Accreditation from IMechE, IET and JMB

plan and deliver academic accreditation for Mechanical, Civil and Electrical Engineering

Accreditation was suspended following the gap analysis from the ICL assessment report. However work continues in improving the standards and collating the data required for accreditation.

4.4 RAE ACP2 Interventions at the University of Sierra Leone

Upon receipt of the assessment report, the Faculty of Engineering stakeholders held several review meetings and came up with the below improvement strategies.

Lab technician training

ICL donated computers

ICL team attending student's exhibition

HODs visit to ICL

No	Areas of improvement identified	USL current improvement strategies	RAE ACP 2 intervention
1	Lack of laboratories	Through the BADEA funded project a large consignment of laboratory equipment and materials was procured for the various faculty departments. Also, laboratories were renovated and refurbished	15 faulty engineering workshop machines and equipment repaired, including lathe machines, drilling lathe machines, shaping machine, folding machine, forging machine, two hacksaw machines, guillotine etc. see photos attached. Provided 25 Tool boxes to enhance technicians and students' practical work at the workshop. see attached sample photo. Sponsored procurement of certain laboratory consumables.Facilitated transfer of ex-service working laboratory equipment from ICL to FBC/USL. see photo attached.
2	Potential lack of teaching content at the right level in the higher years (4 and 5).	This issue was addressed in the revised curriculum review process of the SPHEIR Project	
3	Lack of discipline in the delivery of classes	Ensure adherence to set timetables, guidelines and policies and inflict punishment on defaulters.	This was examined with positive outcome through a student evaluation survey.
4	Lack of formal organisational information for students, such as timetables, notice boards, long-term planned activities.	Annually develop a faculty calendar that outlines and schedule all teaching and learning activities	Installed 3 notice boards at the various engineering departments to facilitate easy information dissemination.
5	Evidence of students suffering from stress caused by uncertainties about the teaching they will receive.	Transparency on course programmes, lecture notes, mode of delivery and assessment methods. Call on Career and Guidance Unit of the college ACCAS to provide continuous and effective counselling of students	Some counselling sessions for students were organised, with positive results as reported through the student evaluation survey.

6	Limited number of staff, most are ex-USL students, too few with a PhD degree.	Transparency on course programmes, lecture notes, mode of delivery and assessment methods. Call on Career and Guidance Unit of the college ACCAS to provide continuous and effective counselling of students	Some counselling sessions for students were organised, with positive results as reported through the student evaluation survey.
7	Stretched classroom facilities; some with not enough space/chairs, difficult to see and hear, etc.	New engineering buildings constructed under the SPHEIR project will help with the pressure of teaching space, student numbers, and quality of classroom teaching. Also, BADEA provided each department with classroom furniture.	Procured 4 projectors (This was also well received by students as indicated by the survey.)
8	Long lectures	Ensure no lecture exceeds two hours and explore the possibility of offering a few minutes break after each hour.	This was also examined with a positive outcome through the student evaluation survey administered.
9	Lack of research activities	Encourage and support staff to undertake research. Creation of specialised research centres. Introduction of more postgraduate research-based programmes. Training of students in project writing skills.	Innovation Hub established under Part 5 as a platform that enhances innovative research. Cohort Training in Part 1 also strengthens student Project Writing Skills
10	Lack of high-level computer infrastructure, fast broadband internet facilities.	BADEA funded project to procure computers. Improve internet connectivity, online presence, and automated processes	Facilitated the delivery of 78 desktop computers, donated by Imperial College London to the faculty of Engineering. Sponsored the procurement of computer parts to enhance student computer related labs at USL

11	Unreliable electricity power supply and water supply	Repair and maintain in good working condition the faculty and department generators. The faculty received 6 giant UPSs, through the BADEA project but not yet utilised due to absence of battery bank.	Sponsor the procurement of battery banks to work with BADEA secured UPSs.
12	Obtaining lab infrastructure but no technical support staff to keep the infrastructure running under use.	Employ 3 highly skilled and professional laboratory technicians.	Sponsor training of laboratory technicians
13	Part 3 of the project to undertake formal accreditation in September 2020 is not achievable.	In the coming years, work towards improving the standard of our engineering programmes to become eligible for accreditation.	ICL expert team provides mentorship.
14	Introduce systems of feedback from the students	Annually conduct Student Satisfaction Feedback Survey	Sponsor Student Satisfaction Feedback Survey.
15	Institute a personal tutoring system	Introduce a student personal tutoring system. Revised curriculum course information now has staff office hours that are used for counselling and tutorship.	Support organised remedial tutorship.
16	Provide a complete set of curriculum information for each department to ICL.	FBC have developed a document detailing the full range of data required for accreditation. This is being collated by 3 undergraduate course coordinators (CUGs). Electrical & Electronics Engineering department has collated over 98% of required data, while the other two departments Mechanical and Civil are slowly catching up. Through the SPHEIR project the Electrical & Electronics Engineering department has revised its curriculum (38 out of 50 modules were revised including other attributes that depict standard, quality and relevance curriculum.	The project appointed 3 CUGs on stipend from each department to collect data. The project provided 3 USB dongles to FBC staff to facilitate the upload of required data to EfCSL SharePoint for the attention of ICL expert team. The team from Imperial providing ongoing support to F.B.C in preparing for accreditation assessment

17	Develop learning objectives for each degree programme and each module. Align assessment methods with the learning objectives.	These issues were resolved under the SPHEIR revised curriculum.	This was also examined with positive outcome through the student evaluation survey.

4.5.2 USL ICL PHD Candidates

Through the project 4 staff are pursuing their PhD degrees with ICL supervision. These are:

USL PhD Candidate	**ICL Supervisor**	**Start date**	**Research subject**
Mr. Ishmael Kanu	Dr Wouter Buytaert	Oct 2019	Water resources
Mr. Obafemi Davies	Dr Jamie Standing	Oct 2019	Geotechnical engineering
Mr. Frederick Bruce	Professor Chris Cheeseman	Oct 2019	Sustainable materials

4.6 The Effect of COVID-19

Safeguarding measures introduced by the Government to limit the spread of COVID-19 meant that USL was closed for over six months. Due to COVID 19, Part 3 - achieving international accreditation could not be achieved during the lifetime of this project, although tremendous efforts were placed on collating the requisite data and facility improvement. Consequently, the project target was modified accordingly and work continues for accreditation later. This adversely affected the project. The project target was modified accordingly, while work progressed for accreditation later.

4.7 Conclusions

The project was able to meet most of its intended outputs under part 2. This resulted in the implementation of recommendations from the Imperial College London Team's assessment of degree course and teaching facilities, including

- Sustainable curriculum reform (CR) addressing labour market needs and employability.
- Innovation in teaching and learning methods.
- Sustainable and effective capacity and structures of quality assurance.
- Sustainable and effective structures for stakeholder engagement.
- Improvement in faculty infrastructure and teaching facilities
- Capacity building for teaching staff and technicians.

There have been many lessons learnt by the Faculty of Engineering, which are described below:

- Accreditation assessment looks at every activity within an institution.
- Research was lacking in FBC/USL even though research capacity has a powerful knock-on effect on teaching and accreditation requirements. Follow-up programmes should consider this.
- Establishing a good quality management system in an Institution should not be tied to project implementation.
- It was felt that the full endorsement of reform approaches by Institution leadership (HODs, Dean, DVC) was of decisive importance to get full buy-in and to secure lateral spread.
- Self-motivation and enthusiasm can overcome institutional inertia and resistance.
- Different projects within an institution always complement each other.
- For effective project delivery always plan for adequate staffing of project management
- Working environment and facilities can greatly impact on project delivery
- Engagement in such projects leads to personal academic growth which in turn leads to some of the project intended outcomes.
- Because the full scope of documentation required for assessment was not well defined, this created the risk of taking longer time than expected to

meet the target.

- Since the business world is constantly changing and shifting, curriculum review should be a continuous, cyclical process.
- The B.Eng. Hons programme is long (5 years) because of the low level of qualification of entering students, which, in turn, is a result of the low level of STEM education in secondary schools. Level of practice experience expected is high, making it difficult to accomplish in a short time.
- Resources and physical teaching tools are a bottleneck for practice-oriented teaching that can partly be offset by collaboration with Industry but not completely.
- The high qualification of lecturers does not automatically make them good teachers. Pedagogy trainings should be mandatory and a part of teaching qualification. Staff training should be a continuous process, thus the need for CPD
- Communication to students about the projects could have been better in the sense of more consistent updates and information directly addressed to students.
- College alumni networks could be leveraged for stakeholder engagement (internships, guest lecturers).
- Buy-in by Institution leadership (HODs, Dean, DVC) is key to the sustainability of the project.
- Sustainability can be attained by maintaining and motivating project staff to work to the logical conclusion of the project.
- The improvement of physical teaching tools such as computers (hardware/software), lab equipment, lab consumables, and physical teaching objects is key for appropriate and sustained delivery of revised curricula.
- Research should be strengthened as it bears direct connection to the relevance and effectiveness of teaching
- MoUs can help stabilize Industrial linkages

Engineering workshop repairs

ICL, SLIE, USL, EfCSL members

Chapter 5

Improving Continuing Professional Development

5.1 Continuing Professional Development

One of SLIE's strategic objectives is the furtherance of Continuing Professional Development (CPD) with all engineers, and encourages all engineers to engage in Continuing Professional Development (CPD) activities to ensure that their academic and practical qualifications do not become outdated or obsolete. This is because the ongoing process of frequently improving skills and competencies, enhances workplace performance and future career prospects of all engineers.

SLIE and EFCSL designed Part 4 to improve the CPD of all engineers - from graduates to senior and experienced engineers. It is intended to boost SLIE's existing work around developing and rolling out a CPD programme for engineers in Sierra Leone, with the overall aim of embedding a culture of training in the country, to create a community of engineers who can drive improvement in engineering standards; thereby ensuring that engineers have access to established knowledge and skills through various activities that constitute CPD.

Part 4 constitutes the following:

- A needs assessment of training from a range of perspectives
- Rollout of training for all engineers (free and paid) led by EFCSL to provide capacity building in areas where training is not normally provided or areas where engineers find too hard to normally pay for.
- Design and rollout of the SLIE CPD Framework and Handbook, with the aim of introducing a system of ongoing monitoring and management of CPD for engineers as a requirement for ongoing registration with SLIE.
- Exposure and support for a selected group of engineers to increase their overall standard of engineering practice by pursuing international (UK) Professional Engineering Institution qualification requirements.
- Creating a system in Sierra Leone that mirrors the UK PEI Specification (4) for Incorporated Engineer and Chartered Engineer qualifications, that will be administered locally by SLIE as a possible basis for recognising professional qualified engineers in Sierra Leone.

5.2 Training Needs Assessment

5.2.1 Training Needs Survey

A training needs survey was conducted, in conjunction with in depth interviews to determine

- The perspective of professional engineers in relation to their training needs

- What engineering employers felt their engineers needed in training to enhance their skills
- How the engineering training requirements match with the international standards for training and practice

The in-depth interviews were intended to determine what employers thought about the training needs of their workforce, and were also used to apprise employers of the new CPD Framework. Forty-nine companies, firms and government agencies were approached for this purpose although the intention was to reach 70.

The questionnaires were designed around the eight attributes of the Institute of Civil Engineers (ICE) CPD programme in the UK which was recently changed (Attributes for professionally qualified membership | Institution of Civil Engineers (ice.org.uk)). The intention was to align training requirements with the international standards of engineering training and practice and in line with the international accreditation standards. The attributes are listed below and were used in the training needs surveys.

- Knowledge and Understanding of Engineering
- Technical and Practical Application of Engineering
- Independent Judgement and Responsibility
- Commercial Ability
- Health, Safety and Welfare
- Sustainable Development
- Interpersonal Skills and Communication
- Professional Commitment

5.2.2 The Engineers Training Needs Survey

A questionnaire was developed and shared with the Education Committee for review. Using Google forms, the survey was made available to all professional engineers in June 2021. At the end of the survey period, we obtained 131 responses.

The individual engineers training needs survey can be found at this link https://forms.gle/hW88VpbqQkAguRDK6.

5.2.3 The Employers Training Needs Survey

In order to obtain information on the training requirements from an employer's perspective, a questionnaire was developed for the training needs of employers.. There was also a need to engage employers on the concept of CPD, the purpose and benefits and on their training needs through in-depth discussions. Over 50 firms, companies, Ministries Departments and Agencies and educational institutions were approached for the training needs survey. Two graduate engineers, Thomas Michael Salankole and Abdul Kaadiru Kallon were engaged for a period of four months and Daniel Metzger-Coker for a period of

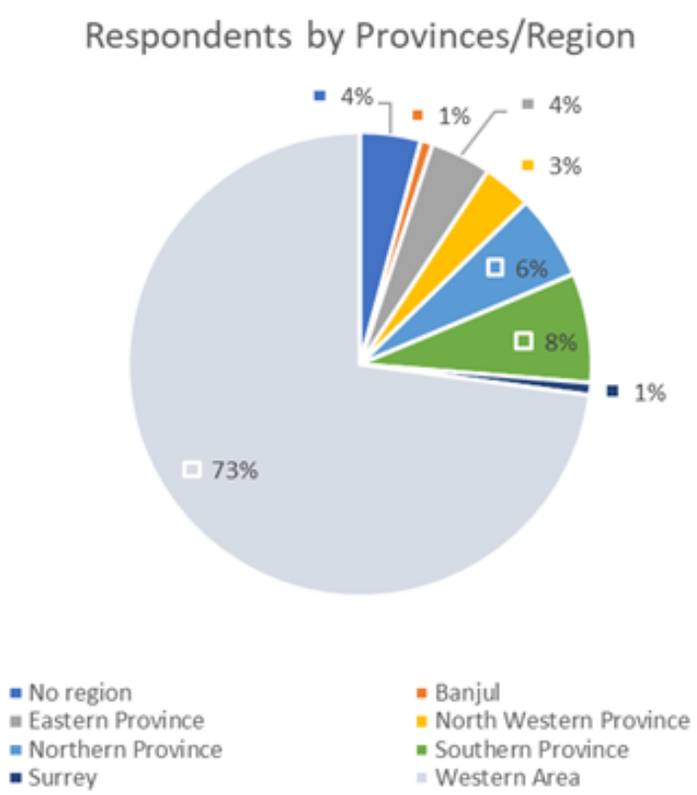
one month to assist in setting up appointments, organising meetings and participating in discussions with these institutions. These graduate volunteers and a member from the subcommittee assisted with engagements with the institutions and we were able to meet with 30 representatives of various institutions. We obtained a total of 20 responses from the employers. Difficulties with gaining access to key personnel who could provide answers to the survey was one of the challenges we encountered.

The employer's training needs survey can be found at: agrilincsamis.surveycto.com/collect/slie_questionaire_for_employers?caseid=.

5.2.4 The Analysis of the Training Survey

To ensure that the analysis of the surveys was effective, we engaged the assistance of a statistician, Mr. Chona Labor to assist with cleaning and analysing the data. As of September 2021, the total number of Engineers registered with SLIE/PERC was 1366. In total, there were 131 respondents for the individual engineer's survey and 20 respondents for the companies' survey respectively.

For the 131 engineers who completed the individual engineer's survey, this represented just under 10% of the total registered engineers in Sierra Leone, significant enough to make inference on the total population of engineers in the country. Out of the 20 respondents from the employers' survey, 18 were included at the time of the analysis. Similarly, these 18 employers who completed the survey represent over 10% of the total engineering companies in Sierra Leone, significant enough to represent the population. Once the data was cleansed, descriptive statistics was performed followed by inference statistics. In these statistics, we used box plots, rankings, and t-tests to see if there was any statistical difference between the responses of engineers versus the responses of companies.



The questions were based on the revised attributes for graduates and guidance on CPD from the Institute of Civil Engineers (ICE) in the UK. The range of courses selected was based on the categories under these attributes. There was a persistent request for inclusion of technicians and

technologists from the in-depth engagements with engineering employers. It is hoped that because of this in-depth survey our professional engineers will become familiar with the International Engineering Alliance (IEA) and the attributes for engineers captured in the Washington Accord as well as the Dublin and Sydney Accords for technologists and technicians.

5.2.5 Limitations

A significant comparison between the employer perspective and the employee perspective was difficult without further research because only three respondents who completed the individual engineer survey reported that they worked for the companies who completed the survey.

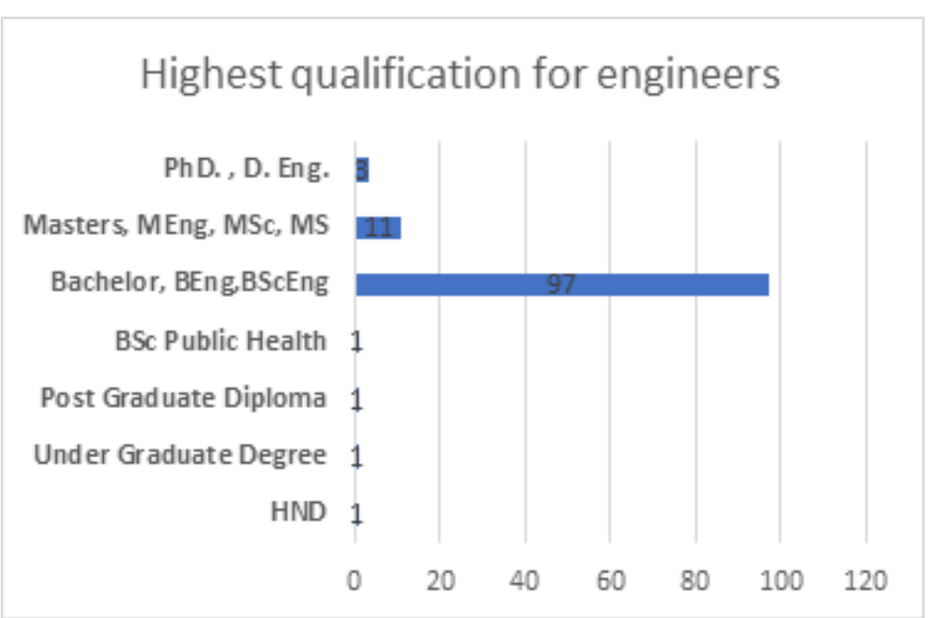
We do not have a full understanding of the total population of engineers in the country and their region. About three quarters of the engineers who completed this survey come from the Western Area. Therefore, we cannot say for certain if this is the true demographic representation of engineers across Sierra Leone.

Marginal errors and confidence intervals were not conducted in this analysis as it was deemed not to add much value to the analysis and conclusions.

5.2.6 Results of the Survey

The survey also showed that there were some significant differences for the ratings of attributes between the engineers and employers, with the greatest differences being how prepared they felt in their careers. There were common courses highlighted amongst both sets of respondents with communication skills, project management skills and ethical code of conduct coming out strongly.

Most engineers are qualified to a bachelor level (82%) and when added to the engineers with higher qualifications (Masters and PhD), this represents about 94% of engineers. Selecting only the western area (the largest area to complete the survey) didn't give a different representation of the highest qualification.



Despite a highly qualified population of engineers, 20% reported being unemployed and 37% reported not working for a company. Those working for a company, had a range of companies

they work for. Out of the 63% of engineers who work for themselves or a company, only three (2.5%) reported working for the 20 companies who completed the survey.

Out of the 20% unemployed, most have a bachelor's degree with one having a master's degree.

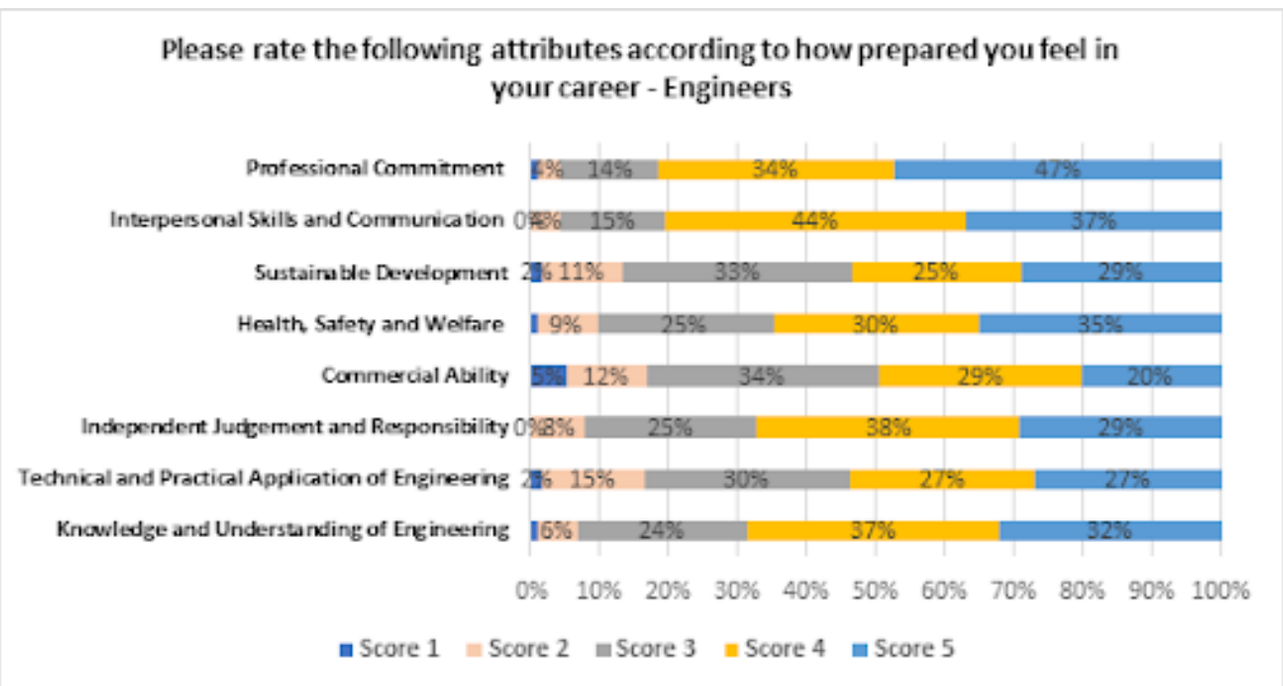
Just under 50% of engineers reported specialising in Civil Engineering, with the next major discipline being Mechanical Engineering. This pattern of discipline is similar in the western area where most respondents are located. However, when you drill down discipline further by the highest qualifications, PhD and Masters level, the distribution is slightly different with Civil still ranking the highest.

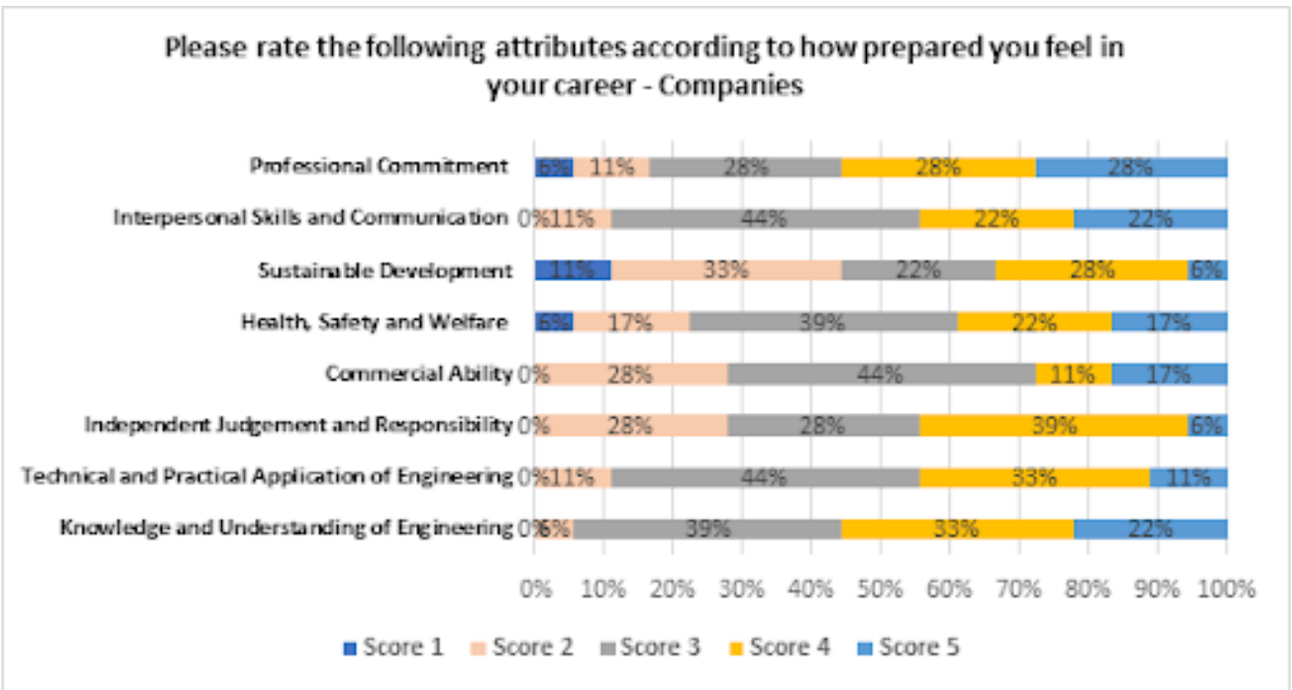
Civil Engineering was also represented at the top for the engineering companies. Other commonalities include Electrical Power System and Architectural.

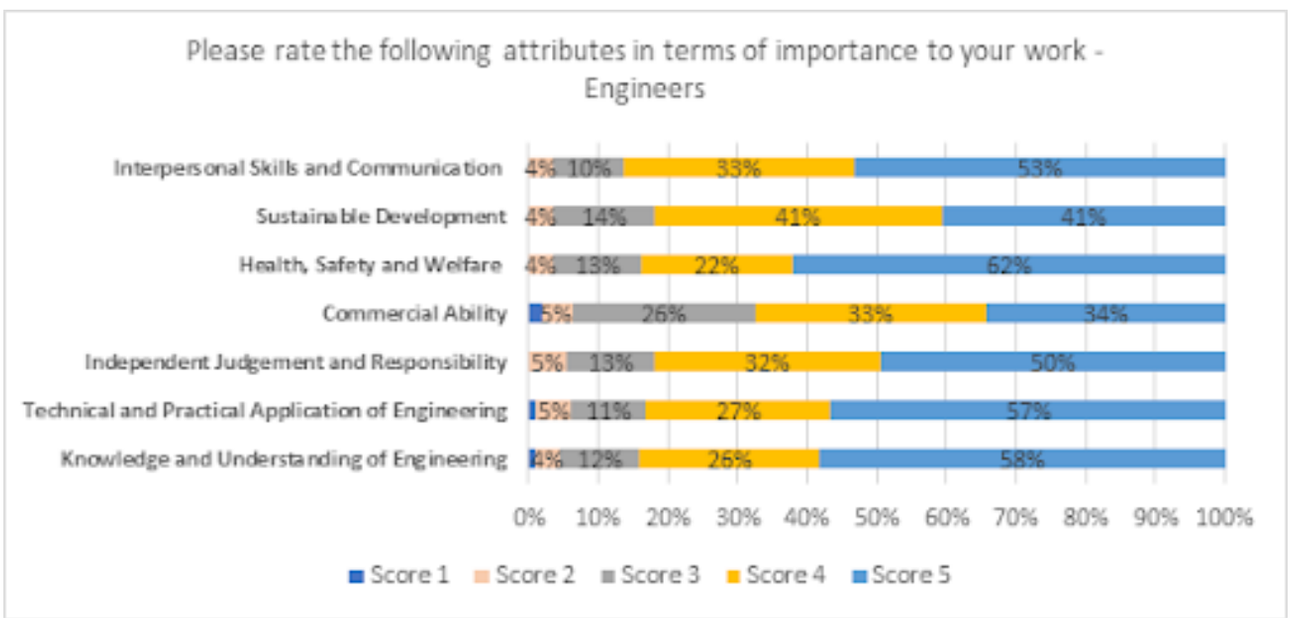
Likert scales, a unidimensional scale used by researchers to collect respondents' attitudes and opinions, were used to compare the opinions of individual engineers with those of the companies. Respondents were asked to rate their opinions on how prepared they were for their career. Companies were asked to rate how prepared they felt their employees were for their career.

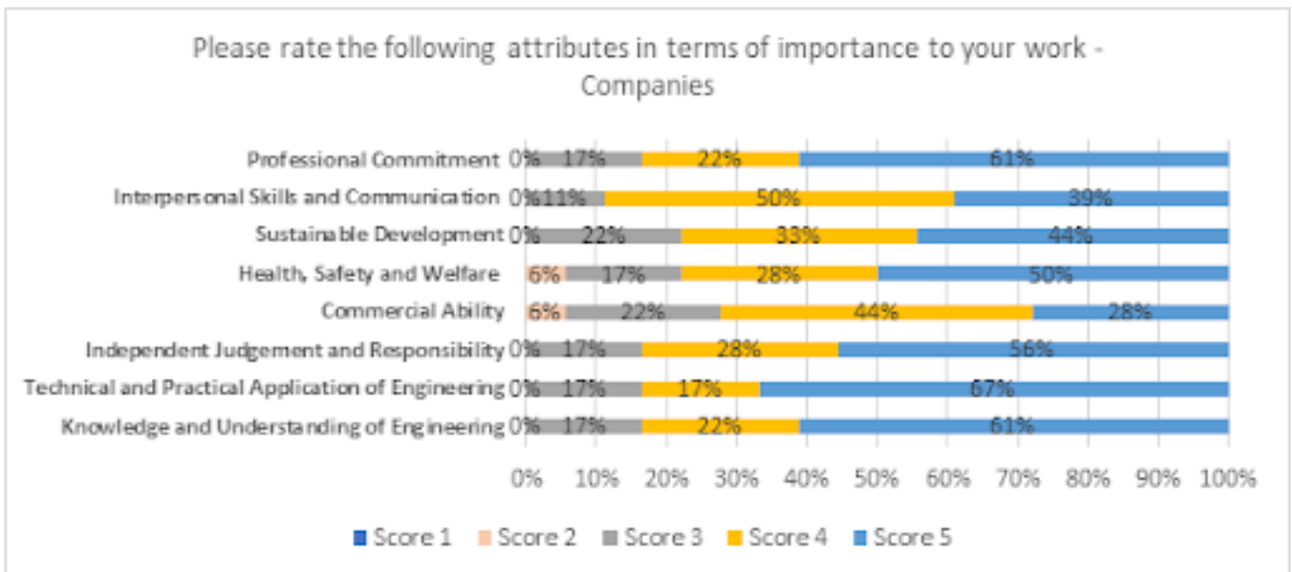
Interestingly, engineers felt they were more prepared for their careers than companies felt they were.

For example, 81% of individual engineers feel that they are well or highly prepared with regards to Professional Commitment, compared to 54% of employers. There were also differences in opinions between the companies and the individual engineers concerning the importance of the attributes to their work.




Please rate the following attributes according to how prepared you feel in your career - Companies
Professional Commitment 6% 11% 28% 28% 28%
Interpersonal Skills and Communication 0% 11% 44% 22% 22%
Sustainable Development 11% 33% 22% 28% 6%
Health, Safety and Welfare 6% 17% 39% 22% 17%
Commercial Ability 0% 28% 44% 11% 17%
Independent Judgement and Responsibility 0% 28% 28% 39% 6%
Technical and Practical Application of Engineering 0% 11% 44% 33% 11%
Knowledge and Understanding of Engineering 0% 6% 39% 33% 22%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Score 1 Score 2 Score 3 Score 4 Score 5

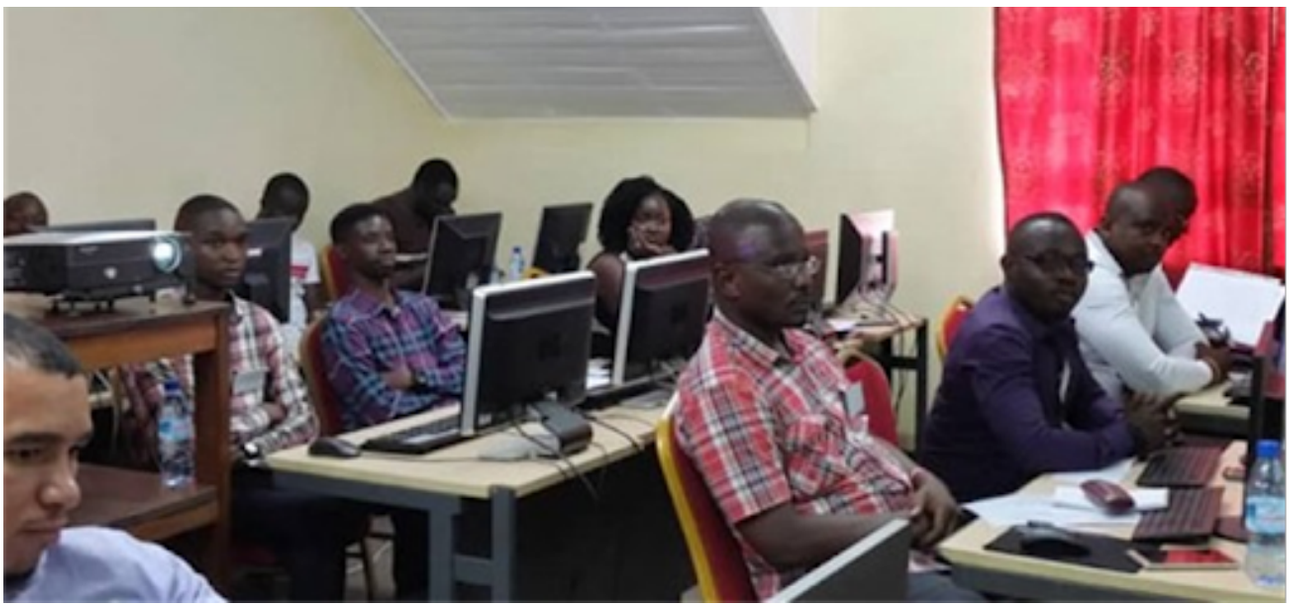

Please rate the following attributes in terms of importance to your work - Engineers
Interpersonal Skills and Communication 4% 10% 33% 53%
Sustainable Development 4% 14% 41% 41%
Health, Safety and Welfare 4% 13% 22% 62%
Commercial Ability 5% 26% 33% 34%
Independent Judgement and Responsibility 5% 13% 32% 50%
Technical and Practical Application of Engineering 5% 11% 27% 57%
Knowledge and Understanding of Engineering 4% 12% 26% 58%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Score 1 Score 2 Score 3 Score 4 Score 5


Please rate the following attributes in terms of importance to your work - Companies
Professional Commitment 0% 17% 22% 61%
Interpersonal Skills and Communication 0% 11% 50% 39%
Sustainable Development 0% 22% 33% 44%
Health, Safety and Welfare 6% 17% 28% 50%
Commercial Ability 6% 22% 44% 28%
Independent Judgement and Responsibility 0% 17% 28% 56%
Technical and Practical Application of Engineering 0% 17% 17% 67%
Knowledge and Understanding of Engineering 0% 17% 22% 61%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Score 1 Score 2 Score 3 Score 4 Score 5

5.3 EFCSL Led Selected Training Programmes

Engineering companies in Sierra Leone complain of a weak workforce with inadequate skills and experience to do various tasks and responsibilities. However, training in companies is limited due to lack of funds and limited projects. This leads to companies hiring engineers on a project by project basis, which does not include training of the hired staff. Engineers are expected to hit the ground running and there is little capacity for employing graduate and junior engineers. Part 4 was led by EFCSL who worked with the SLIE/PERC Education committee to develop and institute a training programme for all engineers.

AutoCAD 2017 2D and 3D Training



In October 2018 the programme began with offering AutoCAD 2017 (2D and 3D) to professional engineers, to enhance their skills and enable them to use electronic methods of design and drawing rather than the traditional T-Square and drawing board. The course was initially limited to 20 participants, but due to the response, this was increased to two sessions of the training at a reduced rate.

The team in Sierra Leone offered an Introduction to Project Management Course in November 2018 in Freetown which attracted young engineers aspiring to become project managers. Eleven engineers took part in the training course, and all said that the course was very informative and helpful to their career.

In 2019, an Introduction to Building Regulations and Fire Safety Engineering in Freetown by EFCSL engineers who came to Freetown specifically to deliver these courses. Fire Safety is not normally considered in Sierra Leone and its content caused many engineers to rethink their design and implementation process.

The Critical Path Method and PERT courses were undertaken in the capital city of the Southern Province Bo, toensure engineers working outside the capital were able to actively participate in the RAE ACP programme.

EFCSL offered the following courses to resident engineers over two years before

the COVID-19 pandemic:

- Introduction to Building Regulations and Fire Safety Engineering
- Introduction to Health and Safety in Construction
- Introduction to Quality Management
- Introduction to Bridge Design and Construction
- Introduction to Asphalt Technology
- Introduction to Asset Management

All the training programmes were well attended with participants ranging from 140 at the Introduction to Building Regulations and Fire Safety Engineering and about 100 participants at the Introduction to Quality Management in Construction, to 40 at the Introduction to Asphalt Technology. The Introduction

to Asset Management
COVID-19 pandemic in
2021 because in-perso

Positive feedback was
Introduction to Buildin
overwhelming particip
delivered by a Fire Saf
over 20 years of exper
informative, interactiv
Meaningful discussion
the Fire Safety Act bec
policies and incorpora
for building permits w
attendees was the imp
structures.

5.4 CPD Framework

Previously, the SLIE Edu
Committee and the PE
development of engine
engineering training ar
CPD framework as part

In 2017, Ing. Prof. Redw
South African model. T
CPD Framework. EFCSL
(UK) to include the attri
on the Ghana Institute

The CPD framework is a
obtaining CPD, describe
engineer could obtain c
how it would be evaluat
audited, the right to app

The final CPD Framewo
Committee for commen
Committee. The CPD Fra
before rollout.

To facilitate the process
SLIE created an online p

engineers at various companies, firms, government and educational institutions and unemployed engineers.

- Development of the curriculum
- Delivery of courses matched to the 8 attributes of the ICE CPD programme.
- Creation of the CPD Framework
- Creation of an online CPD Platform and redesign of the SLIE Website
- The SLIE/PERC CPD team engaged with various MDAs, like Ministry of Works and Public Assets (MWPA), NATCOM, National Minerals Agency (NMA), Petroleum Directorate, and other engineering institutions, firms and sole proprietors on the new SLIE/PERC CPD framework. The objectives of these engagements were to:
    - Introduce the new SLIE/PERC CPD framework and presentation of the CPD booklets
    - Conduct a training needs survey to determine the needs of both engineering employers and employees
    - Encourage employers to support the CPD programme of SLIE/PERC by incorporating this CPD programme as part of their institution's performance appraisal system
    - Promote membership and registration of both SLIE and PERC.
- Create and disseminate the individual engineer training needs questionnaire and online survey form on Google.
- Select graduate engineer volunteers for the CPD programme.
- Set up a list of institutions to target for engagement.
- Develop questionnaires for CPD training needs survey form for engineering employers and creation of the employer's survey form on SurveyCTO Collect.
- Letters were sent to various MDAs, like MWPA, SLRA, NATCOM, NMA and EWRC requesting a list of engineering companies. Two MDAs responded with their lists i.e., MWPA and NMA.
- Letters were also sent requesting engagement with SLIE/PERC on the new CPD program.
- Engagements with MDAs, and firms on the CPD programme while a training needs survey was conducted for both employers and individual engineers.
- Held consultative meetings with engineering institutions, firms, engineers in the Southern Province on the CPD programme in Bo town, Bo District, in Freetown and in Makeni, Bombali District, Northern Province.
- The SLIE/PERC CPD team held engagements on the new SLIE/PERC Continuous Professional Development program with 49 MDAs, companies and institutions.

5.4.2 Results of the Employer Engagements

Most companies and institutions expressed support for the CPD programme and welcomed the initiative. They are willing to incorporate it as part of their performance appraisal system. However, there were some significant suggestions and comments listed below.:

- Suggestions that the Ministry of Labour incorporate the requirement that engineers should be registered with SLIE and PERC before being considered to have the requisite qualification to practise. While most employers are willing to cooperate with SLIE/PERC, they could not insist that their engineering employees be registered with SLIE or PERC unless the Ministry of Labour required it. However, CPD units could be considered for performance appraisals.
- Engineers made recommendations for SLIE/PERC to establish a salary scheme for all professional engineers, incorporating a minimum threshold for every qualified and registered engineer, which should be presented to parliament for approval.
- Inclusion of technicians and technologists as part of SLIE membership and incorporating them under the CPD programme with a clear career path to becoming professional engineers because they also play a vital role in the engineering profession.
- Concerns about small engineering institutions not accredited by The National Council for Tertiary Vocational and other Academic Award (NCTVA), and/or Technical and Vocational Education and Training (TVET), offering engineering courses and diplomas without any engineering standard compliance.
- Recommendations for providing accreditation or certification for the various educational programmes provided by various small colleges, institutions and universities. Candidates for employment presenting certificates from unknown institutions.
- Strong desire for regulation of the engineering practice especially in the construction sector. Some firms operate with little or no engineering background and no registered professional engineer executing engineering projects.
- SLIE/PERC activities have been focused mostly in Freetown neglecting the provinces. Hence engineers within these areas feel left out. Several recommendations were made for SLIE/PERC to develop an online platform for the registration process.
- There is little awareness of SLIE among students in tertiary institutions. Students only get to know about the institution or membership procedures in their final year, after graduation, or when they start working.
- Suggestion that some sort of examination be given to distinguish a graduate engineer from a professional engineer and/or to progress to the

Consultations with Road Maintenance Fund Administration on CPD

Consultative Workshop on CPD in Makeni, Bombali District, Northern Sierra Leone

level of corporate engineer.

- Companies are willing to offer internships to students to promote new unexploited areas of engineering such as oil and gas, petroleum and process engineering, and chemical engineering.
- Request for training in technical competence, ethics, soft skills, health and safety, management, leadership skills, report writing, presentation skills, communication skills and project management.
- SLIE/PERC should work with tertiary and vocational institutions in reviewing the engineering curriculum relevant to the needs of employers.
- Some professionals are willing to work with SLIE/PERC in offering their expertise in their field of discipline through webinars, workshops, public lectures and in person training courses. Some institutions have offered to conduct the training or offered to give lectures, webinars or workshops in their field of engineering. For example,
    - EGTC would like to use their training facility to offer training to other engineers as well as theirs in partnership with SLIE/PERC. They also have engineers with over 20 years of experience.
    - The Petroleum Directorate would like to offer bimonthly seminars and workshops at FBC, delivered by the CEO to equip engineers in process and chemical engineering.
    - Concern for the threat posed by the lack of Health and Safety standards, especially in the construction sector. Most of the firms are owned by business people rather than engineers and are not always aware of H&S requirements.
    - If SLIE/PERC intends to provide H&S training, it must be more practical than theoretical, as most people can identify hazards on paper but cannot identify them on site.
    - In terms of the mining sector, NMA has been doing a fantastic job in their career development programmes for both student and graduate engineers. Suggest SLIE/PERC set up a replica of the NMA's career development program for other disciplines of engineering
- SLIE/PERC engage with NMA, to enforce training on mine engineers /supervisors once the framework is implemented especially for the Chinese owned companies.
- Suggestion of a database developed by SLIE/PERC, incorporating all registered engineers and their employment status, so engineering employers can access it whenever there is a need for recruitment.
- Graduate engineers, especially mining engineers are challenged to secure employment because employers say they lack the needed skill sets (Mining analytical tools/software).

Further discussions with firms, companies and institutions highlighted the following.

- In terms of the Petroleum sector, Sierra Leone as a nation is still untrained

for oil and gas activities. There are concerns of several foreign staff being imported once there is a boom in this sector and companies start coming to operate in Sierra Leone. Some professionals recommended establishing a Chemical Engineering, Petroleum Engineering, Reservoir Engineering and Production Chemist departments in our tertiary universities in Sierra Leone.

- The FLS Power Group Academy, is an accredited institution of NCTVA, offering diploma and certificate training for technicians in electrical and solar installation, literacy skills, and entrepreneurship. They are willing to work with SLIE/PERC and become one of the CPD training providers.
- The Mining Engineering Department, FBC, is working on designing short courses designed for the specific needs of the mining industries.
- SOCFIN company currently has an agreement with the Chemistry Department, University of Sierra Leone, for internships, field visits, and recommendations for recruitments when needed, and it was suggested that SLIE/PERC come to an agreement with SOCFIN, for opportunities for engineering students and graduate members.

5.6 Mentor Scheme for UK PEIs

The project gave 12 candidates working in Sierra Leone the opportunity to apply for academic assessment with the UK Profession Engineering Institutions (PEI).

Of the candidates that applied, a number with postgraduate degrees from international universities and an undergraduate from USL were assessed to be eligible for Chartered level status. Those candidates without a postgraduate degree were assessed at I. Eng level. The candidates were assigned Mentors with the requisite qualification to support them on the programme. They were also provided with financial assistance to cover PEI application costs and membership fees. Two of the candidates have now successfully completed their training and will be sitting for their final exams in 2022.

This work led to reinforced trust in the newly formed CPD, mentorship and professional training accreditation process, as well as ensuring that qualification standards continue to be comparable with international standards.

It also indicated that a supply of potential mentors both in the diaspora and in Sierra Leone could be achieved.

5.7 Intermediate Professional Development

Intermediate Professional Development covers from post-graduation until registration in a graduate engineer’s competency development.

The UK Professional Engineering Institutions (PEIs) all offer web-based support schemes, but membership costs are beyond the means of most Sierra Leonean graduate engineers.

Experience gained from mentoring graduate engineers in Sierra Leone,

suggested that a local scheme, based upon the UKSPEC4 Competencies and employing UK PEI accredited mentors and locally trained Nominated Professional Engineers (NPEs,) like the UK PEI's delegate mentors, would potentially provide a supported route to UK Registration. A pilot trial was required to prove the concept.

Building on successes of the past, participants were chosen from previous YEC graduates. The rationale of this was that having gone through the programme, they understood the objectives of the IPD programme.

The outputs and outcomes of the trial included:

- A survey of all participants and the Steering Committee Group on the suitability of these routes for training professional engineers Sierra Leone
- A mapped-out governance process for incrementally implementing the proposed new training route and how to incorporate existing members into the new levels of membership.
- Policy covering selection of mentors and candidates for membership.
- Policy on employer assessment and support for professional development scheme
- Impact on the curriculum of the relevant academic course and institutions
- Setting local attainment levels against the specified Attributes (Eng Tech, I. Eng. C. Eng) for each level
- Options for final assessment process of candidate's suitability for admission to full membership of SLIE/ PERC.

To execute the pilot there were several lower-level tasks:

- Establish a recruitment criteria and recruit participants.
- Generate a local induction scheme for mentors and NPEs.
- Provide guidance to developing graduates, mentors and NPEs as to how the Scheme should be managed. Initially for the Pilot this would be based on schemes that operate within the UK but amended to reflect local conditions.
- Identify a project manager and establish governance arrangements for the conduct of the trial under the control of SLIE.

5.7.1 Progress.

The pilot phase is likely to extend beyond the life of the ACP2 project depending on the ongoing support and active engagement of the participants.

The strategy was to launch the pilot project under ACP2 but future support and direction will be provided beyond the lifespan of ACP2 by SLIE as one of the legacies of the ACP2 project in Part 4.

Assessing progress of the outcomes and outputs will commence as the pilot matures. This activity will be managed by the SLIE Project Manager, however progress against the lower-level tasks is as follows:

- Recruitment criteria were established, and 18 Graduate Engineers were recruited. This number is assessed as the largest number that can be satisfactorily supported with the mentoring strength currently in place. The degree to which the recruitment process and criteria were successful will be judged by the performance of the 18 graduates on the trial.
- The documentation to support the mentor and NPE Induction Process has been generated and the individuals identified. Roll out commences on 8 November. The adequacy of the arrangements will be judged during the pilot.
- Guidance documentation has been generated and will be distributed as the trial commences.
- Governance Arrangements. The project manager is in place but the local governance arrangements, including the local review of documentation are insufficiently developed. These arrangements, together with employer engagement and linkage to SLIE's CPD programme and data bases currently represent a risk.
- If the mentoring arrangements can work satisfactorily, the development of the graduates will be supported by mentors with direct experience with UK PEI qualification, identified by Engineers for Change (Sierra Leone).

5.7.2 Issues and Challenges Identified

- Seventy organisations were targeted across various disciplines of engineering, to introduce the new SLIE/PERC CPD programme and conduct a training needs survey. However, only 49 of these institutions responded.
- Only a few of the firms that have already been engaged on the CPD programme, have shown commitment by completing the employers training needs survey form.
- We were unable to get any forms from Southern Province or the Northwest.
- The analysis showed that of the engineers' survey respondents, there were only 2.5% who were actually employed by any of the companies in the employer's surveys.

5.8 Effect of COVID-19

Like many other countries, Sierra Leone's economic growth has been affected by the COVID-19 pandemic. This has had an impact on sustainable engineering projects..

Effect of COVID-19 on Part 4- CPD includes:

- Challenge of accessing some target firms to engage on the CPD program of SLIE/PERC, due to stringent COVID-19 measures imposed by these firms.
- Limited face to face engagements, as most of the activities were through Zoom meetings and online webinars.

- CPD courses and training once accessed in-person, were now accessed through Zoom meetings and online webinars.

From the above suggestions, SLIE will need to use all available platforms both physical and digital including its website and social media to remain engaged with its membership and to equip them with the tools to develop their career through CPD.

5.9 Conclusions

- Some of the lessons learned in exploring how to align the training of Engineers in Sierra Leone with international standards includes how students are prepared for employment as part of the undergraduate training. We are therefore suggesting that the following changes be considered:
- Undergraduate engineers need to include employer work placements as a significant and core part of the curriculum.
- The Faculty of Engineering needs to build stronger links with industry to increase the awareness and understanding of industry challenges and opportunities amongst students and academic tutors.
- The curriculum should encompass a Problem Based Learning approach that fosters teamwork and encourages students to work in teams with different technical disciplines.
- The Guest Lecture series started under the HEP SSA project at USL should be a core part of the curriculum and resources should be provided to ensure that this series of lectures continues.
- Ongoing efforts by SLIE and PERC can only be fruitful and productive with the PERC Amendment Act being passed in parliament. Therefore SLIE & PERC are working assiduously to ensure this act gets passed as soon as possible. It gives them the legal mandate to regulate the engineering profession and promote CPD.
- The challenge posed of registration and membership for engineers and firms in the provinces can be overcome by offering online registrations. This has been done with a redesign of the SLIE Website.
- SLIE/PERC needs to further engage with organisations especially in the provinces on a regular basis, beyond the Part 4 project. This is now ongoing through regional consultations.
- SLIE/PERC should consider inclusion of technician members under its membership structure, and incorporate them into the CPD programme in order to successfully improve and maintain the engineering standards in the country.
- There should be a periodic curriculum review at the universities and SLIE/PERC should help the administration establish a new curriculum based on industry demand.
- There should be more awareness of the institution and promotion of

engineering to STEM students at both secondary and tertiary institutions. There should be a consultative engagement with heads of technical institutions on how to incorporate all engineering students as student members of the institution. This awareness can start from orientation day of freshmen year, though final year unto graduation for engineering students.

- SLIE/PERC must engage the Ministry of Labour on this new CPD framework. Efforts need to be made to take collaborative measures to enforce SLIE membership as a legal requirement for securing engineering jobs and participating in the CPD program.
- The Ministry of Technical and Higher Education, Technical and Vocational Education and Training (TVET) and NCTVA Council should be engaged in establishing the standards for engineering training, monitoring and evaluation of technical institutes providing services in engineering education and certification.
- Establishment of good partnership with engineering firms for training, internships and employment of members would be beneficial to SLIE/PERC through regular visits and engagement.
- Partnership with the universities must continue and SLIE/PERC contribute to periodic review of the engineering curriculum to meet the needs of employers and develop a well-structured career development plan for graduate engineers straight from the university, and also further engage with engineering firms to support this career development program.
- Each registered professional engineer must understand the PERC code of conduct and abide by it. It should be made available online to all members and registered firms.

Body text

Chapter 6

Developing Innovation to Deliver Commercial Outcomes

6.1. Rationale

Part 5 - “Developing Innovation to Deliver Commercial Outcomes” - involved working with the universities and companies in Sierra Leone to identify and provide training and support to develop suitable innovation projects from concept to market.

Innovation Action led this component with support from SLIE and Engineers for Change (Sierra Leone) in the UK.

The main aim of part 5 was to explore the feasibility of establishing an innovation incubator at USL, in collaboration with local and international partners.

The objectives included:

- Engaging with companies in Sierra Leone, USL and its Alumni, and the diaspora to identify innovation projects
- Drawing on UK and Sierra Leonean expertise in commercialisation and Intellectual Property (IP) protection to provide training for participants
- Establishing an international panel drawn from USL staff, USL alumni and the UK diaspora to assess and rank projects
- Providing mentoring and internship opportunities for participants as a direct result of the UK – Sierra Leone Innovation Networking event held in the UK in October 2018.
- Introducing an inventor reward scheme for successful exploitation of IP, that suits the requirements of Sierra Leone (also a consequence of the October 2018 UK- Sierra Leone Innovation Networking event).

6.2. Outline of Part 5

- Selection of participants from FBC Students and other innovators
- Selection of technical review committee to review innovation projects
- Conduct workshops for participants in IP awareness, commercialisation, entrepreneurship, and customer service
- Provide international internship opportunities for participants
- The creation of an inventor reward scheme for successful exploitation of IP (pilot innovation incubator)
- Setting up a physical innovation incubator at FBC – University of Sierra Leone

6.3. Activities undertaken

Activities undertaken included:

1. A Sierra Leone innovation Event held at the Royal Academy of Engineering hosted by: Engineers for Change (Sierra Leone) and Imperial College London
2. Opened an Innovation Hub at USL (formally opened 19th February 2021)
3. Engaged with both Sierra Leone based and international companies and USL to identify innovation projects
4. Negotiated with USL to provide a physical space on campus for the Innovation Hub
5. Drafted a Business Operating Model for the Innovation Hub which shows its relationship with the innovation ecosystem
6. Established an Advisory Board to support the development of the Hub, drawing on local and international expertise
7. Delivered workshops in Sierra Leone in collaboration with Innovation Action (led by Dr Peter Fearon) and the Freetown Business School to help graduates develop the skills to progress ideas from concept to commercial product.
8. Provided training in Intellectual Property awareness and entrepreneurship in Sierra Leone with local partners May 2019
9. Engineers for Change undertook a crowdfunding exercise to help raise funds for the furniture and equipment for the Innovation Hub
10. Raised awareness of the potential work of the Hub and received donations of desktops from Imperial College and from Christopher O'Neil, a former student of Fourah Bay College who works as an IT Consultant in Germany, also received Wi-Fi equipment from the Rotary Club of New Malden, UK
11. Recruitment of a manager and administrator to take over the day-to-day management of the Hub
12. Received donation of 20 computers (laptops and desktops) from two FBC alumni
13. Produced a short video showcasing the transformation of the Hub
14. Completed interior decoration of the Hub and equipped it with computers and internet routers
15. Conducted a week-long research and consultancy training course for university staff, lecturers, and researchers in June 2021 with an international outlook
16. The management team supported by the advisory board is currently working with other researchers to set up the Hub's operating structures
17. The Hub management team is project managing support to technical specialists to deliver WASH training facilities and training curricula at the Government Technical Institute in Freetown. A 1-day workshop was organised for the project consultants.

18. Opened access to the Hub to the following groups:
    - Industry and Businesses. One of the main objectives of the Innovation Hub is to provide solutions to the problems faced by industry. Engineering companies therefore have access to the Innovation Hub through SLIE.
    - USL Students. University students have a direct link to the Hub, whether they are researchers working on their own dissertation projects or with other students or lecturers on larger projects. The Hub also serves as an innovation incubator to small start-up companies owned by the students. The Innovation Hub in return benefits from administrative funds from research projects and equity for a certain number of years.
    - USL Lecturers. University lecturers have access to the Hub as researchers, consultants or associates. The Hub provides web-based resources and human resources in the form of associate researchers and administration. It serves as an incubator or accelerator to start-ups or small companies owned by lecturers. Lecturers are engaged with the Innovation Hub under the terms and conditions of the Advisory Services for Technology, Research and Development (ASTRAD) System. Proceeds from such research or consultancy works are shared based on the formal agreement between the Hub and the individual consultants as set out in the terms and conditions of the ASTRAD policy document.
    - SLIE / Other Professional Institutions. SLIE and other Professional Institutions can partner with the Innovation Hub in bidding for projects. Individuals with ideas are encouraged to have discussions with the operational team at the Hub to see what help can be provided and how their ideas and concepts can be supported. An innovation event scheduled for 9th December 2022, will see local innovators showcasing their concepts and ideas and battling each other in a 'Dragons Den' type competition tfor funding/ support to progress their ideas.

6.4. Effect of COVID-19

Due to the COVID-19 virus the week-long entrepreneurship, research and consultancy training course planned for 2020 was delayed. The pandemic also affected the formal launching of the Hub because of the restrictions on gatherings and other safeguarding measures. The launch was carried out in February 2021, as a hybrid virtual and physical event. This enabled the required social distancing and allowed international participation at the event, which was widely appreciated.

6.5 Lessons for USL

The following lessons and recommendations, are offered as USL prepares to take complete responsibility for the Hub:

- While successful events may be held by the Hub, those events alone would not be evidence of a successful Hub. The ability of the Hub to consistently provide an environment conducive to the incubation of ideas, and the eventuation of the incubated ideas into viable business propositions, is the unerring marker for success.
- A dedicated core of full-time staff is recommended as the primary way to make the Hub successful, supplemented by several volunteers and part time staff. Part-time staff may be primarily students, but may also include lecturers, non-academic members of the university community, and persons from outside the University.
- To ensure that the intended purpose of the Innovation Hub is served, it will be more beneficial to devote the earlier years of the Hub to building its institutional infrastructure . The minimum infrastructure recommended should include a robust organisational structure, competent and motivated workers, a set of operational policies, processes and systems, and an independent structure for the management of its own funds and activities.
- For commitment and impact, the Hub needs to be autonomous in developing and managing its own goals, objectives, activities, relationships, and funds.
- The University must remember that motivation among expected stakeholders and prospective beneficiaries of the Hub (e.g., academic departments, students) will usually be low. Thus, rather than expecting the Hub to run off only the good will of cooperating departments of the university, a significant amount of effort needs to be placed on building the Hub's organisational structures, and to supporting the team that avails itself to achieve the Hub's goals.

6.6 Future plans for the Innovation Hub

USL intends to develop and implement projects that promise immediate benefits for its teaching and research, and also contribute to sustainable development as a side effect.

USL sees great potential in the Innovation Hub, both for industry and students. The Hub will help foster business, start-up, government, and industry partnerships, create new jobs, and ensure the next generation of engineers continue moving Sierra Leone forward. Industry is expressing interest in cooperating with USL through the Hub to access novel technology and a broad array of research expertise, and talent particularly geared towards sustainability challenges. Academics will also gain from this by accessing state-of-the-art equipment and educational experiences, which will increase the reputation and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recognition of the university.

The Hub has attracted its first consultancy from the Netherlands Universities Foundation for International Cooperation (NUFFIC) through USL to implement a project on “strengthening partnerships between WASH stakeholders in Sierra Leone”. The main activity of this consultancy is to provide mentoring support to the Government Technical Institute (GTI) to deliver a new WASH course in Sierra Leone. The project components include the provision of guidance and technical support to ensure GTI is well placed to deliver professional WASH education and training, and to work with GTI and Maastricht School of Management, Netherlands in the design and layout of a practical WASH training facility. Other partners involved in the project implementation include the GUMA Valley Water Company, Sierra Leone Water Company, Ministry of Water Resources and Ministry of Health and Sanitation.

Young Sierra Leonean innovators, including USL students have expressed a great deal of interest in participating in the activities of the Hub. As a result, the Hub is currently in the process of inviting diverse innovators with technology-based solutions to showcase their innovative products. This will not only establish exciting collaborations with imaginative people but provide an opportunity to further develop ideas for the market. The Hub is also exploring specific research issues and pilot projects with companies, start-ups, and individuals.

Chapter 7

Conclusions

7.1 Young Engineers Corp

Sierra Leone, as a developing nation, requires a diverse range of professional and experienced engineers to help clean the environment, build the clean and efficient transportation systems, find new sources of energy, develop solutions to the water crisis, aid the alleviation of the country's food security problems, and increase the standard of living in Sierra Leone.

Sierra Leone's many young graduate engineers are entering a market where there are limited jobs. Due to the economic challenges and project cycles, many Sierra Leonean companies are unable to hire engineers and provide them with careers. Many still employ recently graduated engineers on a project by project basis which is not conducive to strategic career progression for young engineers.

It is critical that Sierra Leonean engineering companies understand the impacts of a changing industry on their talent pipeline and renew their commitments to their less experienced engineers. Mentoring has become more important as many younger engineers continue to worry about their prospects and development. SLIE recognises that the industry cannot afford to stop developing graduate and less experienced engineers through training; which will in turn allow SLIE to upskill the workforce, but to improve our resilience as a sector.

Today's engineering market is fast-paced and changing before our eyes and for young engineers to capitalize on this trend, they should have a broad range of knowledge.

Part 1 was a 'quick win' to redress the disproportionate rate of unemployment by engineering undergraduates from the University in Sierra Leone. It was targeted at the recent graduates that had not been finding difficulty in seeking employment. The log frame identified the following key indicators of success:

- Objective: Better effectiveness of graduates in the working environment
- Output: A minimum of 25 graduates in long term employment were taken through a programme over 3-monthly training sessions which included work placement. 4 cohorts of graduates received this training over the duration of the project.

The Young Engineers' Corp programme guided its cohorts to focus on both their personal qualities as well as their professional ones. The aim was to embed in the psyche of all cohorts to be willing to work hard; complete tasks on time; accept there will be challenges to face; have excellent oral and written communication skills; have the capability to learn new things; and be prepared

to learn them by themselves. This was demonstrated in the responses by the employers who agreed that the quality of the graduates going through the YEC programme was evident in the following ways:

- YEC graduates were able to communicate better and were more confident in expressing their lack of understanding and this enabled the companies to address areas of weaknesses thereby more able to assist them and use less time explaining tasks
- YEC graduates understood their strengths and demonstrated greater confidence in their abilities
- YEC graduates had a positive attitude and were more willing to work in a team

Following the specific request by YEC Cohort 3 on the need to align university curricula (for example using pedagogical tools such as Team-based and Problem based learning) and graduate employability through partnerships between universities and the job market - a selection of lecturers from the USL Faculty were trained to teach and disseminate information on soft skills in a manner similar to how the YEC trainers provided Soft Skills training for the ACP2 programme. This one week training was not fully attended and the exercises were not fully followed. It is understood that this will be addressed through the SPHIER project currently being undertaken at the University of Sierra Leone.

In conclusion, the Young Engineers Corp programme through its iterations has been able to demonstrate that through specific training, the gap between graduate engineers and the employers who so desperately need a young and agile workforce but are missing out on a wide selection of national engineers can be bridged. All stakeholders need to recognise the need, validity and of this training and funding needs to be put towards providing this bridging training for all graduates. It is the belief of SLIE that Cognitive and Behavioural Skills should be an integral part of the training at all Universities offering engineering in Sierra Leone. Additionally, despite the initial cost to companies, more effort should be made to engage and train more graduates and recently qualified engineers. The SLIE IPD programme is developing a training programme that will provide a training framework and material for all engineering companies who are interested.

7.2 Raising Standards at University of Sierra Leone's Engineering Faculty

The aim of the Engineering Faculty of USL is to improve it’s programme in order to be able to be accredited by the Washington Accord, the Sydney Accord or the Engineering Council UK. The Washington Accord (and all other accreditation organisations) promote the effective mutual recognition of accredited Engineering Degree courses in each of the signatory countries and recognises that professional engineering education programmes accredited by the signatories deliver outcomes that are substantially equivalent to the Washington Accord Graduate Attributes (learning outcomes).

A key outcome from Part 2 was the final close-out report of January 2022 by the team from Imperial College London on the Faculty's preparation for accreditation following their initial assessment on the department's readiness for UK PEI academic accreditation in February 2019 of the 3 core undergraduate courses in Civil, Mechanical and Electrical Engineering. Their findings indicated that significant progress had been made in addressing their recommendations of the initial review. Their report acknowledged the effort undertaken by all 3 departments in taking positive steps towards addressing the requirements for accreditation in spite of the ongoing financial constraints which limited the faculty's ability to provide adequate laboratory facilities. The report further recommended that the faculty should seek to identify creative opportunities to upgrade its laboratories and to provide additional computer equipment for student projects. Nevertheless, the report concluded that all 3 departments that were part of the review process should make contact with the UK PEI for an initial review to chart the route toward accreditation.

SLIE recognises that as the Project Lead there were lessons that would have helped the project's execution. Some of these are highlighted below:

- The budget needed to raise the standard of engineering programmes is quite huge. Therefore, some planned activities were factored under the SPHEIR and BADEA project, making this project deliverables dependent on the outputs of other projects.
- Always consider the political context within the institution of a project and build external communication tools accordingly to the corresponding strategic considerations. Resource this upfront and generously.
- Designed proper internal communication channels amongst project members can help facilitate project implementation.
- Choosing the right project membership is central to the success of the project.
- The increasing establishment of the "train-the-trainer" approach would led to a localisation of the trainings that makes it significantly easier to sustain them.
- Build strong and well-staffed project management units.
- Issuing formal certificates for the trainings would be very helpful as it provides a documented recognition that could be made visible at the universities (as formal "currency").
- The quality of mentoring at internship should be standardized (in the form of guidelines) and monitored accordingly.

In conclusion it is important that the Faculty of Engineering continues with the progress of continuous improvement of its curriculum, facilities and teaching practices aligned with the recommendations from the two ICL reports. This will enable the Faculty to present for full academic accreditation when the funding is available to deliver the review and assessment process by the UK PEIs.

7.3 Improving Continuing Professional Development

SLIE has consistently advocated for ongoing Continuing Professional Development and this ACP2 programme has provided an opportunity for SLIE/EFCSL to develop a needs assessment of training as well as rolling out training for all engineers (free and paid).

Of great significance to the Sierra Leone Engineering sector has been the design and rollout of the SLIE CPD Framework and Handbook which has introduced a system of ongoing monitoring and management of engineering professionals. The CPD process is now linked to SLIE renewal of membership, and SLIE successfully enrolled more members through this process. The implementation of an online CPD platform was also essential.

Part 4 was aimed at ensuring engineers in Sierra Leone received and paid relevant attention to their continuing professional development. This was considered necessary in order to raise the standards of training of engineers in the country to increase employment prospects and reduce reliance on engineers. The expected outcome from Part 4 was an increase in the number of graduates from Sierra Leone actively pursuing C.Eng./ B.Eng. training

Key outputs from Part 4 were:

- Improvement in teaching and academic courses at the university
- Improvement in quality and relevance of CPD courses provided by SLIE
- Successful candidates at C.Eng./ I. Eng assessment

Report and feedback from the 12 engineers who are pursuing their international (UK) Professional Engineering Institution qualifications is pending.

Creating a system in Sierra Leone that mirrors the UK PEI Specification (4) for Incorporated Engineer and Chartered Engineer qualifications, that will be administered locally by SLIE as a possible basis for recognising professional qualified engineers in Sierra Leone.

All ongoing efforts by SLIE under this project, in improving the engineering standard, training, and practice will only become sustainable with the PERC being the independent regulators of all engineering activities in the country.

In conclusion, the introduction of the training needs assessment, delivery of training courses, development of the CPD framework, brochure and online platform has allowed SLIE to meet one of its strategic objectives of supporting engineers in their career. CPD itself will be sustainable once implemented, because it will be an ongoing process for all engineering professionals, who intend to maintain competence, professionalism and certification. A structured curriculum delivered in partnership with EfCSL and other partners will definitely enable professional engineers to adopt the practice of maintaining their skills and knowledge through courses offered to them and consistent recording and reflection on their learning and application in the workplace. Therefore, with the

partnership of companies, firms, sole proprietors and government institutions the CPD programme is expected to be sustainable and pay for itself through training fees levied for certain courses.

7.4 Developing Innovation to Deliver Commercial Outcomes

Part 5 was targeted at promoting innovation in research to deliver commercial outcomes and USL's Engineering Faculty was chosen as a partner. This component involved working with the Universities and companies to identify and provide training and support in developing suitable projects from research concepts to marketable products.

The outcome expected from Part 5 was a number of businesses started or initiated as a result of the intervention. The expected outcome was the delivery of Innovative concepts ideas and products that had been identified and given required support to progress to market.

The Hub has been a challenge worth taking. It has uncovered the potential within Sierra Leone to move the country to a new level of industrialisation. The impact of the Innovation Hub is far reaching for all involved in the development and implementation stage.

As part of lessons learnt it is critical for budget allocations to such projects to be carefully apportioned to ensure the right support structure is available and that staff are sufficiently motivated.

It is recommended that the following actions be undertaken to strategically position and strengthen operations of the Innovation Hub within its business and innovation ecosystem:

1. Establish a clear profile and visibility by defining the Hub's primary aim and focus.

The Hub's primary aim is to strengthen innovation, sustainability and inclusiveness in SMEs and start-ups by enhancing:

- Innovation in research and promoting the translation of research into new ideas, products, and services that can benefit Sierra Leone and the sub-region.
- Innovation in education by stimulating creativity in thinking and action in support of development opportunities as well as addressing local challenges while searching for new solutions.

2. Define the instruments the Hub is going to apply.

The Innovation Hub will apply the following instruments to achieve its objectives:

- Incubator services to technological start-ups - networking space, labs/test sites, seed money for innovative initiatives.
- Advisory services in key business areas - technology/ICT applications, energy/cost saving as well as quality enhancing technology/management

practices/sales.
- Technical training and coaching - in key business and technological areas.

3. Define knowledge management, networking and learning strategies for key areas.

To become a learning centre, the Innovation Hub will document, share and exchange knowledge and experience with colleagues at pertinent university departments. It may do so by providing a home to a range of networking activities pertinent to its core business area of inclusive and sustainable management and use of natural resources:

- Friends of the Innovation Hub network - facilitating links with key governmental, non-governmental and private sector organisations and potential investors to generate support for the Innovation Hub business initiatives.
- Business value creation - developing innovative, cost/energy-efficient value propositions
- Public Private Partnership building - scaling up and out through public private partnerships and investment.
- Reading the Business Environment - identifying and mobilising key actors and investors to support specific business initiatives in key sectors of the Sierra Leone economy.

In each of these areas, the Innovation Hub will also offer training courses to staff, students and small and medium entrepreneurs from the sectors the Innovation Hub engages with.

4. Strategically position the Hub by linking up with current policy objectives.

To link up with the Government of Sierra Leone's policy objectives, the Hub will mobilize the human, technical and scientific resources of the University of Sierra Leone to contribute to achieving sustainable and inclusive economic growth and employment, by promoting and strengthening entrepreneurship in targeted economic sectors such as civil works, environmental services, telecom/electronics, information and communication technology, mechanical and electrical installation and maintenance.

5. Align its mission with the UN Sustainable Development Goals, with a particular focus on:

- SDG 6: Ensuring availability and sustainable management of water and sanitation for all;
- SDG 7: Access to affordable, reliable, sustainable, and modern energy for all,
- SDG 8: Promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all, and,
- SDG 9: Building resilient infrastructure, promoting inclusive and

sustainable industrialization, and fostering innovation.

7.5 ACP2 - “The Catalyst Effect”

The RAE ACP2 project has been a catalyst for change at SLIE and provided leverage for its interactions with engineers in Sierra Leone.

Building Credibility: SLIE has effectively started building and developing trust specifically with young engineers, specifically as a result of the YEC programme where communications have opened between student, graduate and young engineers and SLIE. This communication has increased the credibility of the Institution as it looks for creative ways to convey its ideas, concepts and content.

Creating Cohesion: SLIE has improved its relationship with a wider range of stakeholders as a result of ACP2. It has improved its relationship with USL, local companies and engineering sector leading Ministries, Departments and Agency. As a result of its YEC and CPD interactions, it has expanded into the telecoms, petroleum and renewable energy sectors.

Generating Momentum: Through the intervention of EFCSL and ICL at USL, staff at USL have exhibited that elevates and accelerates performance, specifically in relation to the improvement of the curriculum and pedagogy. The introduction of the CUGs and the approvals from Senate on a number of the recommendations can only accelerate progress toward the Faculty’s objectives.

Amplifying Impact: The work around the establishment of the Hub has promoted excellence and encouraged innovation at USL. Imaginative Solutions and value-adding ideas for solving problems and achieving objectives are now being suggested in relation to the success of the Hub.

Appendices and Annexes

Appendix 1	Impact of the Project on SLIE and Key Partners
Appendix 2	Africa Catalyst project – final report Report from the UK academic specialist team Report date 2022-01-17
Appendix 3	Africa Catalyst Phase 2 Project, Parts 2 and 3 Report of visit by the Imperial College London team to Fourah Bay College, University of Sierra Leone, 19-23 February 2019. Report date 2019-03-22

Appendix I

Impact of the project on SLIE and key partners

Part 1 YEC 2	**Activities**	**Meeting Project Objective**
SLIE to develop the framework for selection of 150 graduates for the Young Engineers Corp 2 over the three-year programme	Work with the University to identify students for the Young Engineers Corp project and undertake assessments to shortlist suitable candidates	Improving the short-term job opportunities for graduate engineers from the University of Sierra Leone and the marketability or job readiness of graduates
SLIE to undertake a skills gap assessment in conjunction with the engineering companies	SLIE will work with a wide range of engineering companies to assess their graduate needs and use that information to inform and develop the student selection process and training requirements	
Development and implementation of the soft skills programme for recently graduated engineers with an appropriate training company	Work with the University and the selected soft skills trainer to develop and implement soft skills training to meet the needs of employers	
Development and implementation of the hard technical skills programme for recently graduated engineers with an appropriate training company to fill gaps in conjunction with local companies	Alongside engineering companies, set up a training centre for generic technical skills for graduates to meet the needs of employers	

Part 1 was a ‘quick win’ to redress the disproportionate rate of unemployment by engineering undergraduates from USL. It was targeted at recent graduates who had found difficulty in seeking employment. The log frame identified the following key indicators of success:

Objective: Better effectiveness of graduates in the working environment

Output: A minimum of 25 graduates in long term employment were taken through a programme over 3-monthly training sessions which included work placement. Four cohorts of graduates received this training over the duration of the project.

Whilst these initial steps by the University and GoSL can help in addressing the issue of the quality and relevance of graduates in a socio-economic context and its impact on reducing youth unemployment, a more broad based approach is required to create the synergies not only to address the issue better but also to sustain it for the foreseeable future.

We know that the Young Engineers Corp programme through its three successful iterations will be able to meet the gap between graduate engineers and the employers who so desperately need a young and agile workforce but are missing out on a wide selection of national engineers

A combination of field-specific-knowledge and soft skills such as teamwork, commitment and vision, feature strongly in the qualities that companies look for in their employees. Sadly, universities and other further education institutions do not assign much time to developing these skills as they try to provide an education which will meet the demands of the profession for those wishing to move into engineering practice after graduation, as well as cater for students who wish to embark upon postgraduate programmes leading to higher educational certification. There is therefore a need to align university curricula (for example using pedagogical tools such as Team-based and Problem based learning) and graduate employability through partnerships between universities and the job market.

Internships invariably require that the participants are registered students in an undergraduate or postgraduate engineering programme, and as such are time-bound and quite often lead to the definition of final year industry-based projects for the dissertations of students under that programme. The conditions for graduate internship on the other hand, are typically dictated by the employer, and usually follow a training regime aimed at increasing the productive employment of successful interns by way of developing their soft skills as well as industrial practices, after a stipulated period of attachment with the company.

The Soft Skills training provided to the YEC since March 2017 by AfRecruit, proved to be a resounding success. It helped

participants to comprehend, learn and retain the training coursework. The methods utilised by AfRecruit to impart the training were such that the YEC asked if their Faculty leaders could be trained to teach and disseminate information in a manner similar to how AfRecruit provided Soft Skills training for the Corp. This would in turn contribute significantly to the improvement of capacity building within the industry. The Soft Skills for Educator training is specifically geared to supporting FENG to address challenges faced in educating their students towards global citizenship.

The methods by which lectures are delivered in general in educational institutes in Sierra Leone are archaic and non-participatory and not cognizant of the many ways in which individuals learn and retain knowledge (aural, visual, tactile). Lectures tend to be ones where the students are talked ‘at’ discussions, group or individual, are not actively encouraged and student /teacher relationship is more authoritarian than participatory. Furthermore, hard skills are emphasized with little to no attention paid to soft skills (for either student or teacher). It is acknowledged worldwide that for an individual to be successful, 20% hard skills and 80% soft skills is the formula to be applied. The quality of the student’s education depends on Educators' skills, motivation, performance, teamwork and dedication.

Part 2 & 3 - Raising standards at USL's Engineering Faculty	**Activities**	**Meeting Project Objectives**
The UK partner through the team academic specialists from Imperial College was provide on-going mentorship and support to the university's academic staff to prepare them for academic accreditation assessment in Civils, Mechanical and Electrical & Electronics	Course content syllabus review	Improving the overall standard, relevance and quality of engineering courses and CPD being offered at the University of Sierra Leone and the professional institution
The team of academic specialists from Imperial College were to undertake a pre-assessment of the academic/ teaching staff at the university to identify training requirements and any gaps in the teaching provision in preparation for an accreditation assessment	Provide an assessment of UK Professional Institution Assessment for Accreditation	
Develop programmes of training courses and lectures in collaboration with the university that subject matter experts from the Sierra Leone diaspora community can deliver.	Work with University to obtain specialist requirements for teaching and training	

Parts 2 and 3 as set in Chapter 2 sort to provide a framework for baselining the academic training of engineers at the University of Sierra Leone in-line with UK Professional Engineering Institutions. The scope of parts 2 and 3 is as outlined in Table 1.

The Part 2 LogFrame outlined the following indicators:

- Impact of Part 1: More productive academic staff re-research, publications and innovative pedagogical skills
- Impact of Part 2: Attain Academic Accreditation by Dec 2020 or define a clear route to attaining academic accreditation of undergraduate degree courses
- Outcome from Part 1: More satisfied academic staff with increased pedagogical skills Relevance of the contents of

the curriculum and teaching approaches – reflects the needs of the job market. Well established labs and workshops. More graduates with hands-on skills

Part 4 –professional training and developing CPD and supplementary training	**Activities**	**Meeting Project Objectives**
Assess CPD provision in Sierra Leone and draw-up a programme of appropriate courses and training that can be delivered by experts through webinars/ Internet and other media in collaboration with UK professional institutions.	Assessment of CPD Provision in Sierra Leone	Improving the overall standard, relevance and quality of engineering courses and CPD being offered at the University of Sierra Leone and the professional institution
	Learner-centred approach to implementing CPD	
Provide mentorship support to ICE candidates in Sierra Leone that are currently registered to qualify for I. Eng. and C.Eng.	Meet with candidates 2/ year for more in-depth assessment and to provide support of training requirements.	
Identify and provide mentorship to qualified candidates for IMechE and IET in Sierra Leone, provide support in achieving I.Eng. / C. Eng. Status	Review training requirements and provide assessment and feedback to candidates	

Part 4 was aimed at ensuring engineers in Sierra Leone received and paid relevant attention to their continuing professional development. This was considered necessary in order to raise the standards of training of engineers in the country to increase employment prospects and reduce reliance on engineers. The log frame defined the following indicators for Part 4:

The outcome from Part 4:

- An increase in the number of graduates from Sierra Leone actively pursuing C.Eng./ B.Eng. training
- Outputs from Part 4:
- Improvement in teaching and academic courses at the university
- Improvement in quality and relevance of CPD courses provided by SLIE
- Successful candidates at C.Eng./ I. Eng assessment

Part 5 – Promoting innovation in research to deliver commercial outcomes	**Activities**	**Meeting Project Objectives**
Working with the Universities and companies in Sierra Leone in identifying and providing training and support in developing suitable projects from research concepts to marketable products.	Deliver workshops and training in Sierra Leone on Entrepreneurship and Commercialisation of products and concepts. Work with Sierra Leone Diaspora Community to explore opportunities for innovation and direct investment to support the country's development. Explore options for setting up an innovation incubator in Sierra Leone	Empowering the engineering departments at USL to be creative in introducing innovation in research, teaching and development projects in partnership with industry funders and external partners
Innovation Action was to provide staff training manuals and workshops in IP awareness, commercialisation and entrepreneurship		
Explore the possibility/feasibility of establishing a physical/virtual innovation incubator in collaboration with local and international partners at the University of Sierra Leone.		
The incubator was to draw on UK expertise in commercialization and IP protection		
An international panel drawn from Sierra Leone staff and alumni and the UK diaspora would assess and rank opportunities.		

Part 5 is targeted at promoting innovation in research to deliver commercial outcomes

This component involves working with the Universities and companies to identify and provide training and support in developing suitable projects from research concepts to marketable products. The log frame defined the following indicators for Part 5:

The outcome from Part 5:

No. business start-up or initiated as a result of the intervention

Africa Catalyst project – final report

Report from the UK academic specialist team

Report date 2022-01-17

Report by academic specialists from Imperial College London:
Prof Mike Lowe (Department of Mechanical Engineering)
Prof Mike Templeton (Department of Civil and Environmental Engineering)
Dr Kristel Fobelets (Department of Electrical and Electronic Engineering)

Summary

The team of academic specialists from Imperial College London (ICL) has guided and revised the UK Engineering Institutions' accreditation potential of different Engineering Departments (Mechanical, Civil and Electrical) at Fourah Bay College, University of Sierra Leone. The activities undertaken in the Africa Catalyst project aimed to raise standards of education, administration and quality control concerning the required international deliverables in higher education of engineering students. Ultimately, Fourah Bay College's accreditation readiness for UK Engineering Institutions was evaluated and this report contains guidance towards future progress.

While multiple visits by each team were planned during the project, only one visit took place with further visits impeded by subsequent Covid-19 restrictions. The one visit that took place was very successful in establishing an excellent baseline for further collaboration. The information gathering potential of future visits were replaced by video recordings of lectures and laboratory sessions. Although very valuable, this does not replace the in-person experience one can obtain by meeting staff, students and administrators face to face.

This report summarises the key findings from the visit and further online communications, video recordings and data uploads. It evaluates the response by Fourah Bay College to our suggestions towards accreditation requirements and readiness.

The overall view of the academic specialist team is that USL has great strengths in its staff and students, and there is good reason for optimism that the educational standard can be, and in some cases is raised, such that accreditation can be achieved.

One of the issues raised in previous reports was the lack of practical provision in the educational programme, supported by appropriate hardware as well as dedicated staff support. In addition, student feedback and College level oversight of quality control in pedagogical provision is of ultimate importance for UK Engineering Institutions' accreditation. This latter requirement is most commonly reflected in the Intended Learning Outcomes (ILOs) of the different modules and the degree programme overall.

1. Background

The Africa Catalyst project is funded by the UK government's Global Challenge Research Fund, administered by the Royal Academy of Engineering. The project was awarded to the Sierra Leone Institution of Engineers (SLIE) in collaboration with the UK charity Engineers for Change Sierra Leone (EfCSL); it started in January 2018 and runs for three years.

The academic specialists from Imperial College London (ICL) were involved in two of the five parts of the project: Part 2, "Raising standards at USL's Engineering Faculty", and Part 3, "Attaining international academic accreditation". The team provided specialist knowledge in education according to their three respective departments:

- Prof Mike Lowe, of the Department of Mechanical Engineering
- Prof Mike Templeton, of the Department of Civil and Environmental Engineering
- Dr Kristel Fobelets, of the Department of Electrical and Electronic Engineering

The counterpart departments and their representatives at Fourah Bay College, University of Sierra Leone were:

- Mr Sahr Tamba Nyalloma, of the Department of Mechanical and Maintenance Engineering including Mining Engineering
- Mr Beresford Obafemi Arnold Davies, of the Department of Civil Engineering
- Samba Sesay Prof, of the Department of Electrical and Electronic Engineering

The USL representatives visited ICL in 2018 (29 October to 2 November), except for Prof. Sesay who was represented by Prof Jonas Redwood-Sawyerr. The academic specialist team visited USL in 2019 (19-23 February). The purpose of the visits was to establish a baseline against which future progress could be compared. Further visits had to be cancelled due to Covid-19. However, different online meetings were organized during the rest of the project to reflect and advise on progress. These meetings were well attended by the different representatives and were effective in maintaining forward momentum on the actions required for improving the teaching and learning quality and standards to support accreditation.

This report reflects on the progress made since the visits and evaluates the accreditation readiness of the three engineering programmes. Accreditation requires many processes to be established and data to be collected that can evidence the implementation and impact of these processes. Therefore, since the visits, the USL colleagues implemented different processes as recommended in the previous report (report date 2019-03-22) and gathered and submitted available information about the taught programmes.

The report is organized as follows: first a summary of the 2019-03-22 SWOT analysis is given, followed by the suggested changes resulting from this analysis. Section 4 evaluates the current position of the different departments with respect of the progress made towards accreditation for the different accreditation bodies.

2. Summary of SWOT analysis 2019-03-22

The observations of the visiting team from their visit are summarised as follows:

(a) Strengths

1. Overall good, reliable, dedicated and approachable staff.
2. Good, motivated students.
3. Appropriate engineering module structure for current needs of the country.
4. Good proportion of staff with industrial or out-of-education experience.
5. The opportunity within the syllabus for industrial placements.
7. A good quantity of teaching materials.
9. Good opportunities for space for teaching with new buildings.

(b) Weaknesses

1. Lack of laboratory, ICT and classroom facilities.
2. Potential lack of teaching content at the right level in the higher years (4 and 5).
3. Lack of consistency in the delivery of classes as timetabled.
4. Lack of well-defined programme syllabus.
5. Lack of formal organisationally information for students.
8. Lack of staff number and diversity.
9. Limited partnership between staff and students.
11. Some classes are very long in time.
12. Lack of research activities.

(c) Opportunities

1. Strongly motivated staff and students who understand the systems.
3. Staff with good external connections.
4. Country with great human and material resources.
5. New building.
6. Organisational changes can be easily implemented.
7. Good international intent for development in Africa.
8. Accreditation could bring strong opportunities.

(d) Threats

1. Due to lack of laboratories, the students might not have the necessary skills.
2. Accreditation will require very significant changes, requiring a lot of staff time.
3. Lack of adequate infrastructure might jeopardise accreditation efforts.
4. Private universities that are better funded might take the best students.
5. Political instability and/or health threat-imposed closures, interrupt education.
6. Lack of technical support staff to keep the infrastructure running under use.
7. Uncertainty, delays, and possible reduction of government funding.

3. Suggested changes 2019-03-22

To progress towards accreditation, the academic specialist team made different recommendations achievable within the timeframe of the project. These recommendations are summarised below. In section 4, progress will be evaluated against these recommendations. The USL team was asked to upload all accreditation relevant documentations on the project's SharePoint. The academic specialist team uploaded accreditation requirements of the different UK accreditation bodies: IET (Electrical Engineering) ; IMechE (Mechanical Engineering) and Joint Board of Moderators (JBM) (Civil Engineering). In addition examples of programme and module specification forms were made available together with the link to the Intended Learning Outcomes required by UK-SPEC.

(a) Organisational changes

1. Appoint a member of staff to manage the entire teaching programme for their department.
2. Form department-specific student societies and support them by staff involvement.
3. Introduce systems of student feedback and ensure action is taken where necessary.
4. Institute a tutoring system for academic and personal development.
5. Establish an accessible and useful timetable – cohort, times, location, module, lecturer and enforce its implementation.

(b) Curriculum

1. Make a complete and accessible curriculum information booklet/website available. This booklet should include the aims and objectives of the different streams, their intended learning outcomes, and the available modules.
2. Complete the programme and module specifications forms for each department. These should include aims, syllabus, intended learning outcomes, description of teaching and test. Align assessment methods with the learning objectives.

(c) Staff development

1. Encourage and enable academic staff to obtain a PhD.
2. Work towards opportunities for academic staff to do some research.
3. Look for opportunities for academic staff to apply for grants to support research and teaching development.

4. Evaluation of progress towards accreditation 2022-01-17

The following evaluates the actions taken by the different USL departments in response to the "*3. Suggested changes 2019-03-22*" that were proposed by the academic specialist team to support the move towards UK accreditation. Each department is evaluated separately, and the evaluation is done in view of the suggested changes proposed in section 3. The UK accreditation bodies for the different engineering departments, although having one overarching aim of high-quality education and student support, is different in their specific accreditation requirements.

4.1 Electrical Engineering

(a) Organisational changes

1. *Appoint* a member of staff to manage the entire teaching programme for their department.
   Dr. Melvin Haffner (MH) was appointed to oversee the response to the requirements for UK IET accreditation. MH took great initiative in setting up different projects towards fulfilling the UK IET requirements for accreditation. Prof. Samba Sesay supported the workload added to MH in this role. The equivalent of MH's role in the UK would be the DUGS (Director of Undergraduate Studies) of the department.
2. *Form department-specific student societies and support them by staff involvement.*
   Currently, there is no evidence that this has been implemented. The recommendation is to focus on supporting the setting up of student societies. Based on my (KF) experience during our 02/2019 visit to USL, your students are highly motivated and have excellent ideas that can support the USL EEE society. Thus, initiating an Electrical Engineering Student Society will be relatively easy. Allocate a suitable member of staff to support the students in setting up a society by reaching out to students in the department and helping with setting up support by the University.
3. *Introduce systems of student feedback and ensure action is taken where necessary.*
   MH has set up a student feedback questionnaire. His questionnaire is excellent but might benefit from a reduction in number of questions. For many modules there was good student feedback. This feedback was mostly positive due to excellent staff and student engagement. What is required now is definition of how action is taken in response to students' feedback (who is responsible and who supports this responsibility). Action does not necessarily mean you agree with the complaints but means you talk to students to explain the situation.
4. Institute a tutoring system for academic and personal development.
   There is no evidence that a tutorial system has been set up.
5. Establish an accessible and useful timetable – cohort, times, location, module, lecturer and enforce its implementation.
   A basic timetable has been set up for the different year. Unfortunately, due to Covid-19 restrictions is has been impossible to establish the impact of this formal timetable on the student experience. There is a need to evaluate whether the published timetable, on sharepoint, delivers the required student information and staff action.

(b) Curriculum

1. Make a complete and accessible curriculum information booklet/website available. This booklet should include the aims and objectives of the different streams, their intended learning outcomes, and the available modules.
   A curriculum booklet that informs on the requirements of the accreditation body (IET) is available on sharepoint[i]. The question is whether this information is also suitable for current and future students? We invite USL students and staff to evaluate the available information and its usefulness towards choosing this particular degree/stream.

2. Complete the programme and module specifications forms for each department. These should include aims, syllabus, intended learning outcomes, description of teaching and test. Align assessment methods with the learning objectives.
   Although extensive notes are available, there is still a need to submit all modules specifications and link them to the programme specification to get an overview of the programme. The map of learning outcomes across the degree is essential and will need to be established for IET accreditation.

(c) Staff development

1. Encourage and enable academic staff to obtain a PhD.
2. Work towards opportunities for academic staff to do some research.
3. Look for opportunities for academic staff to apply for grants to support research and teaching development.

Action has been implemented towards staff career development, but it is too early to see any impact.

(d) Accreditation readiness

There has been satisfactory progress towards establishing processes in teaching, learning, infrastructure, and management as well as data availability & collection needed to fulfil the requirements for IET accreditation. The recommendation is to progress with the implementation of recommended processes as well as the increase of information disclosure and mining while ascertaining the implementation of the intended learning outcomes of an electrical engineering course as specified by the UK-SPEC and accredited by the IET. One item that needs more work is the implementation of external examiners, these cannot be academics that are or were previously affiliated with the department. Completion of programme specifications as well as all module specifications with clear definition of intended learning outcomes in line with UK-SPEC will be essential for UK accreditation with the IET.

Based on the changes implemented, if maintained, implemented and extended as suggested above, I recommend that you invite an initial review by the IET as a new member. This will allow you to copy the documentation available on SharePoint to ADAMS and evaluate the areas where more effort and information is required (concerning the course intended learning outcomes). The steps required for this initial evaluation step can be found on the IET website.

4.2 Mechanical Engineering

The following areas are deemed to be either partially completed or still require progress, based on the evidence provided by the USL Mechanical Engineering and Mining Engineering team.

(a) Organisational changes

1. Appoint a member of staff to manage the entire teaching programme for their department.
2. Form department-specific student societies and support them by staff involvement.
3. Introduce systems of student feedback and ensure action is taken where necessary.
4. Institute a tutoring system for academic and personal development.
5. Establish an accessible and useful timetable – cohort, times, location, module, lecturer and enforce its implementation.

(b) Curriculum

1. Make a complete and accessible curriculum information booklet/website available. This booklet should include the aims and objectives of the different streams, their intended learning outcomes, and the available modules.
2. Complete the programme and module specifications forms for each department. These should include aims, syllabus, intended learning outcomes, description of teaching and test. Align assessment methods with the learning objectives.

(c) Staff development

1. Encourage and enable academic staff to obtain a PhD.
2. Work towards opportunities for academic staff to do some research.
3. Look for opportunities for academic staff to apply for grants to support research and teaching development.

(d) Accreditation readiness

Significant progress has been made in developing changes to achieve the recommendations; these have been discussed during the project period and have been supported in detail by uploads of new information onto the project Sharepoint. The uploads have addressed in particular the curriculum and assessment. These include lecture notes, lecture presentations, example examination papers, and procedural documentation for the evaluation of the ILOs. Timetables are provided too, showing a coherent planning of the lectures throughout the 5 years course programmes. The USL management team has also made some organisational changes, including the agreement for the appointment of a Coordinator of Undergraduate Studies, a key appointment to oversee and ensure the management of the teaching activities. On the practical side, the refurbishment of many workshop machines has provided a practical training environment for manufacturing that was lacking but is now quite well covered. This project has also provided a large number of computers for the joint use of all of the engineering departments, which addresses another important element of practical engineering training. Other elements are in progress but not yet delivered.

The overall recommendation is to progress with the implementation of recommended processes as well as the increase of information disclosure, and to assess these against the expectations of the IMechE towards the goal of accreditation. The IMechE has a well-developed web page to access the accreditation process and materials, which is: https://www.imeche.org/membership-registration/support-for-universities. This sets out the procedure. It also has multiple links, including forms and guidance documents for download. A one-page document that sets out a commentary on this with a bit more detail has been shared on the project Sharepoint.

Completion of programme specifications as well as all module specifications with clear definition of intended learning outcomes in line with the IMechE requirements will be essential for UK accreditation. In general the academic taught components are well aligned and should not need very much more development. But the practical side, including workshop training, individual and group project work, and education in professional skills, will need more attention. The documentation to manage and demonstrate the processes will also need to be developed further.

Based on the changes implemented, if maintained, implemented and extended as suggested above, I recommend that you then contact the IMechE to request an initial review.

4.3 Civil Engineering

The following areas are deemed to be either partially completed or still require progress, based on the evidence provided by the USL civil engineering team.

(a) Organisational changes

1. Appoint a member of staff to manage the entire teaching programme for their department, with clearly defined responsibilities and deliverables.
2. Form department-specific student societies and support them by staff involvement.
3. Introduce robust systems of student feedback and ensure action is taken where necessary. Record the minutes of meetings with student representatives and share them with the student body when appropriate.
4. Institute a tutoring system for academic and personal development.
5. Establish an accessible and useful timetable – cohort, times, location, module, lecturer and enforce its implementation.

(b) Curriculum

1. Make a complete and accessible curriculum information booklet/website available. This booklet should include the aims and objectives of the different streams, their intended learning outcomes, and the available modules.
2. Complete the programme and module specifications forms for each department. These should include aims, syllabus, intended learning outcomes, description of teaching and test. Align assessment methods with the learning objectives.

(c) Staff development

1. Encourage and enable academic staff to obtain a PhD.
2. Work towards opportunities for academic staff to do some research.
3. Look for opportunities for academic staff to apply for grants to support research and teaching development.

(d) Accreditation readiness

The overall recommendation is to progress with the implementation of recommended processes as well as the increase of information disclosure and mining while ascertaining the implementation of the intended learning outcomes of a civil engineering programme as accredited by the Joint Board of Moderators (JBM), found here: https://www.jbm.org.uk/media/hiwfac4x/guidelines-for-developing-degree-programmes_ahep3.pdf.

Completion of programme specifications as well as all module specifications with clear definition of intended learning outcomes in line with JBM requirements will be essential for UK accreditation, to ensure that all the core civil engineering subjects are covered. This should also include incorporation of the JBM Learning Threads (e.g. design, sustainability, health and safety,

professionalism and engineering ethics, climate change mitigation/adaptation) which should be covered through the entire degree programme, with logical learning progression planned from year-to-year of the programme.

While the financial constraints of the department are acknowledged, the department should continue to look for creative opportunities to upgrade their laboratory and computing facilities for use in teaching, to grow the practical teaching aspects of the curriculum. This project has already led to improved computing facilities, which is a step in the right direction, provided these are used in teaching and there are plans for their upkeep and upgrading in future as necessary.

Based on the changes implemented, if maintained, implemented and extended as suggested above, I recommend that you invite an initial review by the JBM as a new member.

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[i] Revised Curriculum Review Summary.docx (sharepoint.com)

Africa Catalyst Phase 2 Project, Parts 2 and 3

Report of visit by the Imperial College London team to Fourah Bay College, University of Sierra Leone, 19-23 February 2019.

Report date 2019-03-22

Report by ICL team:
Dr Kristel Fobelets (Department of Electrical and Electronic Engineering)
Dr Mike Templeton (Department of Civil and Environmental Engineering)
Prof Mike Lowe (Department of Mechanical Engineering)

Summary

The team of academic specialists from Imperial College London (ICL) visited their counterpart engineering departments at Fourah Bay College, University of Sierra Leone, on 19-23 February 2019. The visit was planned as one of the activities of the Africa Catalyst Phase 2 project, with the overall aims of raising standards of education (project Part 2) and preparing for accreditation by UK engineering institutions (project Part 3). The purpose of the visit was to observe teaching, talk to staff and students and gather information. The three academic specialists were accompanied by Dr Esther Kamau from the International Relations office of ICL; Dr Kamau is helping to develop engagement and opportunities between ICL and universities in Africa.

The visit was very successful. The visitors had good opportunities to observe and to hold many discussions, and were impressed by the attitude and determination of both staff and students. This report summarises the key findings from the visit and makes some suggestions for actions, changes and additional support. The findings are preliminary at this stage, addressing the visit and ideas arising from it; a formal report covering the educational detail will follow later after the USL staff have completed the provision of the detailed course information as planned in the project.

The overall view of the ICL team is that USL has great strengths in its staff and students, and there is good reason for optimism that the educational standard can be raised and accreditation can be achieved. However this will need a programme of substantial change over a period of time. Most significantly, the lack of practical provision in the educational programme is a serious limitation that would block accreditation. This will need to be addressed before an application for accreditation could be recommended, and even if changes can be started soon, it is expected to take several years. Nevertheless, some suggestions are made to help to accelerate this process.

1. Background

The Africa Catalyst Phase 2 project is funded by the UK government's Global Challenge Research Fund, administered by the Royal Academy of Engineering. The project was awarded to the Sierra Leone Institution of Engineers (SLIE) in collaboration with the UK charity Engineers for Change Sierra Leone (EfCSL); it started in January 2018 and runs for three years.

The academic specialists from Imperial College London (ICL) are involved in two of the five parts of the project: Part 2, "Raising standards at USL's Engineering Faculty", and Part 3, "Attaining international academic accreditation". The ICL team provide specialist knowledge in education according to their three respective departments:

- Dr Kristel Fobelets, of the Department of Electrical and Electronic Engineering
- Dr Mike Templeton, of the Department of Civil and Environmental Engineering
- Prof Mike Lowe, of the Department of Mechanical Engineering

The counterpart departments and their representatives at Fourah Bay College, University of Sierra Leone are:

- Prof Samba Sesay, of the Department of Electrical and Electronic Engineering
- Mr Beresford Obafemi Arnold Davies, of the Department of Civil Engineering
- Mr Sahr Tamba Nyalloma, of the Department of Mechanical and Maintenance Engineering
    - Mining Engineering (currently part of Mechanical Engineering)

The USL representatives also visited ICL in 2018 (29 October to 2 November), except for Prof. Sesay who was represented by Prof Jonas Redwood-Sawyerr).

The purpose of the ICL team visit to USL was to observe teaching, talk to staff and students and gather information. The three academic specialists were accompanied by Dr Esther Kamau from the International Relations office of ICL Dr Kamau is helping to develop engagement and opportunities between ICL and universities in Africa.

This report sets out observations from the visit and makes some suggestions for actions, changes and additional support. The findings are preliminary at this stage, addressing only the visit and ideas arising from it. A second report is planned later, to include coverage of the specific elements of the taught course programmes in the engineering departments at USL. This will require the USL colleagues to provide detailed information about the taught programmes; this provision is in process.

2. SWOT analysis

The observations of the visiting team from their visit are summarised as follows:

(a) Strengths

1. Overall good, reliable, dedicated staff who do some good, solid teaching, and are very approachable towards questions from the students.
2. Good, motivated students, who pay attention in class, who are passionate about their studies and have a vision for the future.
3. Appropriate engineering module structure that is focussing on the current needs of the country. Flexibility in adapting to changes in requirements because of ability and willingness of staff to adapt to change.
4. Good proportion of staff with industrial or out-of-education experience.
5. The opportunity within the syllabus for industrial placements between 4th and 5th year.
6. Teaching in English.
7. A good quantity of teaching materials (hand-outs, problem questions etc) seems to be available in general, and seems to be accessible to students by internet or smart phone.
8. Very creative ideas to get around limitations in resources, including use of smart phones, class organisation by student representatives, and students finding materials and facilities externally to achieve their project goals.
9. Good opportunities for space for teaching when the new building comes into use.

(b) Weaknesses

1. Lack of laboratories is impacting strongly on the capabilities and competitiveness of the student cohort for industrial placement and for the workplace afterwards. Students are acutely aware that they are not being prepared in a way that makes them ready for industrial jobs.
2. Potential lack of teaching content at the right level in the higher years (4 and 5). The right content is taught but potentially at the wrong level (to be evaluated in more detail when the detailed information is available).
3. Lack of discipline in the delivery of classes. It seems that it is common for lectures to be delayed or missed, including pushing back the start of modules from their planned sates until the latter parts of semesters; this creates a strong impediment to steady learning, disengages the students from those modules, and prevents the integration of linked modules.
4. Lectures not following a defined programme strictly from start through to finish of the module.
5. Lack of formal organisational information for students, such as timetables, notice boards, long-term planned activities.

6. Loss of control of the timetable because of catching up previous years that got behind. This is compounded by uncertainty about whether a steady state timetable can ever be achieved without future years getting behind again.
7. Evidence of students suffering from stress caused by uncertainties about the teaching they will receive.
8. Limited number of staff, most are ex-USL students, too few with a PhD degree.
9. Limited partnership between staff and students. Both staff and students are well intentioned, and mutually respectful, but they are not engaged with each other to understand and develop teaching.
10. Stretched classroom facilities; some with not enough space/chairs, difficult to see and hear, etc.
11. Some classes are very long in time.
12. Lack of research activities.
13. Lack of high-level computer infrastructure, fast broadband internet facilities.
14. Unreliable electricity power supply and water supply.

(c) Opportunities

1. Strongly motivated staff who understand the weaknesses of the current systems.
2. Very engaged student cohort who might be willing to contribute to innovation in teaching and who have a vision of supporting the development of the country.
3. Staff with external connections in higher education as well as in industry.
4. Country with great resources and university (staff and students) with awareness that in order to exploit these resources for the benefit of Sierra Leone, higher education needs to ensure that graduates can have an impact in this area.
5. New building that will help a lot with the pressure of teaching space, student numbers, and quality of classroom teaching (seeing, hearing).
6. Some changes to improve the educational standards could be made with zero or minimal costs, eg discipline in timetabling, student-staff engagement, etc (some example recommendations to follow later in this report).
7. There is currently a good international intent for development in Africa, especially in the UK.
8. The achievement of accreditation could bring strong opportunities for USL, its graduating students, and the country.

(d) Threats

1. Due to lack of laboratories, the students do not have the necessary skills to find internships in industry. Industry is not confident that when they take students for internships, they will be useful to the company.

2. Accreditation will require very significant changes, and there is a risk that the people involved will not be able to maintain the momentum to do this. Not everyone will be happy about having to make big changes, and it will require staff to give more time.
3. Accreditation will be threatened by not resolving the problems of: variety and level of staff (PhD); lack of computer infrastructure; lack of laboratory infrastructure.
4. Private universities that are better funded and directly compete on student intake might take the best students and staff away from USL.
5. Political instability and/or health threats (e.g. Ebola), closing the university for long periods of time.
6. Obtaining lab infrastructure but no technical support staff to keep the infrastructure running under use.
7. Uncertainty, delays, and possible reduction of government funding.

3. Planning for accreditation by UK Institutions

The view of the ICL visitors is that the proposed plan of Part 3 of the project to undertake formal accreditation in September 2020 is not achievable. Accreditation should be achievable, but this is going to take substantially longer.

The key omissions are the laboratory and practical aspects of the courses, which are essential for accreditation. The development of these at USL will require time and financial investment. They will also increase demand on staff time, so it is inevitable that the university will have to increase the number of teaching staff, although much of the focus can be on technician level personnel.

The organisational difficulties relating to class scheduling, integration and discipline of delivery, and student-staff engagement, are also essential, but these are more easily achievable and less expensive.

Accrediting institutions will want to look at the teaching programme running in the steady state. Therefore the changes that are put in place need to run for a few years before the accreditation is requested.

The recommendation by the ICL academic specialists is to:

(a) Make the changes that are possible soon, such as low cost organisational improvements.

(b) Pursue opportunities to implement more major changes, such as laboratories and projects teaching, as soon as is feasible.

(c) Engage in discussion with the accrediting bodies and identify their expectations.

(d) Aim for a submission for accreditation after one cycle (4-5 years) of teaching an improved course with organisational rigour and adequate practical elements.

4. Suggestions for changes that could start soon

(a) Organisational changes

1. Each Department should appoint a member of staff to manage the entire teaching programme for their department. This is the role called DUGS (Director of Under-Graduate Studies) at ICL. Dr Fobelets and Dr Templeton are the DUGS for their respective departments. The DUGS must have the confidence and backup of the Head of Department (HoD) to be able to conduct their role. The DUGS role should be expected to require on average 1 day per week by the appointed staff member.
2. Form department-specific student societies and support them by staff involvement.
3. Introduce systems of feedback from the students, to let the staff know how the teaching is working out. Include a lecture evaluation survey at the end of each module, and a student-staff committee that meets once or twice per semester to make constructive plans for improvements.
4. Institute a personal tutoring system, whereby each student is assigned to a member of staff who they meet regularly, and with whom they can discuss their progress, problems, ambitions, concerns, etc.
5. Fix the timetable. Specify times and locations for each teaching session, then publish those and keep strictly to them. Change the culture amongst staff such that everyone expects strict keeping to the timetable to be the norm. Enforce this culture by recording what actually happens, to DUGS and HoD, and for teaching performance to be linked to staff promotion criteria.
6. Identify the dependencies between linked modules (eg topics in one module that require the students to have studied an underpinning capability in another), and schedule teaching to enable these. A common challenge is for mathematics topics to be covered at the right time for their needs in other modules. This will require coordination between staff, overseen by the DUGS.
7. Initiate contact with UK accrediting institutions and keep them in the loop with developments over the next few months/years. ICL will help with initial contact with the institutions.
8. Raise height of whiteboards and identify, in discussion with students, any other simple improvements to teaching spaces.

(b) Curriculum

1. Provide a complete set of curriculum information for each department to ICL. This might best be based on extension of the information in the handbook. Needs are set out on the project SharePoint.
2. Fill in information on programme and module specifications forms for each department and send to ICL. These forms are provided separately with this report. Example programme specifications at ICL are provided on the project SharePoint. This

information will help ICL to perform the review of the curriculum, and will also provide a framework for USL to work towards the needs of accreditation.

3. Develop learning objectives for each degree programme and each module, and ideally for each lecture the lecturer should highlight the key points at the start and end. Align assessment methods with the learning objectives.

(c) Staff development

1. Encourage and enable academic staff who do not have a PhD degree, but wish to, to undertake one. ICL staff could help with some remote supervision. This may require the USL departments to establish a new PhD programme or revive an existing one.
2. Work towards opportunities for academic staff to do some research, even if low level at first.
3. Look for opportunities for academic staff to apply for grants (eg the UK's Global Challenges Research Fund, GCRF) with external partners, eg ICL partners; where possible use this work to grow laboratory equipment and facilities. This step may need to wait until after a few USL staff have completed their PhDs, by which point they will have more of a publication track record and there will be evidence of a good working relationship for research collaboration between USL and ICL.

5. Suggestions for additional support from the Imperial College team

The ICL team would like to provide additional help, and are open to discussion of possibilities. Since returning to the UK after the visit, they make the following two suggestions:

(a) Computers

The ICL team will be able to provide some used desktop PC computers for USL during this year. These are ex-service computers from research and teaching in ICL. They would typically be 4-5 years old. It is anticipated that there could be 30 more of them. Related to this:

1. Would USL like to have these, and if so, how many?
2. Could USL make provision to secure these, make them available to students, and maintain them? Do they have suitably skilled and available staff who could manage the software installations, repairs, and regular timely support to keep them running so that they remain available for students at all scheduled times.
3. Could USL obtain access to software operating systems and software to run on them. They would be provided without anything installed (ICL will be obliged to remove the existing software on the computers). One possibility is to install Linux (free), which could be done before shipping. Alternatively, perhaps there is a means in Sierra Leone to purchase Windows?

4. If this is of interest, then discussion should be progressed soon, ideally before the middle of this year.

(b) Laboratory classes

The ICL team might be able to help with the creation of laboratory classes. Some of the rigs for basic laboratory classes for students in early years might be cheap to replicate, and ICL could investigate how to do so in a manner that takes advantage of what is easily available in Sierra Leone. This could be done as a student project at ICL, then shipped to USL, then their manufacture replicated by students at USL in order to make multiple sets for teaching. Related to this:

1. Would USL be interested in pursuing this? If so, this would best be discussed separately for each department.
2. Could USL provide the resources to run laboratory classes, including maintenance of the rigs, preparation of instructions and related teaching materials for the laboratory classes, and marking of student work, eg laboratory reports? This will require additional time of academic staff and of technical/technician support.
3. A possible timetable for this could be for ICL student projects to run during the academic year from October 2019, to deliver a prototype rig in June/July 2020.
4. If this is of interest, then discussion should be progressed during the coming 6 months. Student projects at ICL will be decided in September.
5. It might be possible to provide some ex-service laboratory equipment from ICL. ICL's Department of Electrical Engineering has identified some old, but working, analogue oscilloscopes and power supplies that could be donated. It might be possible to find other electrical equipment and/or equipment in other departments too. Interests should be discussed individually with the departments. Again, any plan to provide these should include the provision of maintenance and instructions for use, so that the equipment can be used successfully for teaching.

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