UNCST

The Republic of Uganda

Tracer Study of Engineering Graduates in Uganda

An Expedition from University to Work

UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY
Ministry of Science, Technology and Innovation

Tracer Study of Engineering Graduates in Uganda

An Expedition from University to Work

UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY
Ministry of Science, Technology and Innovation

December 2016

Published by

Uganda National Council for Science and Technology (UNCST)
Plot 6 Kimera Road Ntinda
P.O. Box 6884 Kampala - Uganda

Tel: +256-414- 705 500
Fax: +256-414- 234 579
E-mail: info@uncst.go.ug
Web: www.uncst.go.ug

Authors:

Steven Sebbale
Ismail Barugahara

ISBN:978-9970-26-007-2

Executive Summary

Engineering is a key driver of innovation, technology achievement and national transformation. Uganda's National Development Plan II highlights the country's strategy for enhancing the contribution of engineering in the transformative growth sectors such as mining, energy and agro-processing. In that regard, the Uganda National Council for Science and Technology (UNCST) routinely conducts surveys on human capacity personnel in science and technology (HRST) with the view of informing Science, Technology and Innovation (STI) human capacity development policy and plans in the emerging fields of Science, Technology and Engineering (STE). The specific aim of this survey was to highlight the transitionary aspects of engineering graduates into the formal and informal workplace. This was undertaken by tracing and establishing the career trajectory of a cohort of engineers who graduated between 2008 and 2012.

A total of 1210 engineering graduates who graduated in Uganda during the time period were reached. Survey results showed that civil (25.7%), mechanical (17.2%), telecommunication (17.6%), electrical (14.1%) and agricultural (5.4%) engineering remain the dominant fields. Other emerging fields like Fire, Oil and Gas, Textile and Pharmaceutical engineering each represented only 0.1% of total engineering graduates.

Most engineering graduates (74.6%) found their first job less than a year after graduation. This could be because 61.9% searched for engineering related jobs three years prior to graduating. In this survey, 78.8% of engineering graduates were employed while 3% and 0.6% were either unemployed or inactive, respectively. Most of the engineers (64.6%) were working in the Business sector. Proportionately, there were more civil engineers working in the Government sector than all the other fields of engineering combined. Over half (57.6%) of engineers were working in firms that were undertaking 'core engineering'.

Most (63%) of the engineering graduates in non-core engineering firms were either sales agents, brokers, accountants, bank tellers or other related clerks. Whereas 72% of engineering graduates described their current occupation as being 'closely related' to their undergraduate training, a third (34%) of female engineers were in professions that are not related to engineering. In addition, whereas the number of male engineers in 'unrelated' professions reduced by 11%, the number of female engineers in such professions increased four-fold (400%) between 2008 and 2012. The number of engineers in 'closely-related' professions increased by 46% and 123% for female and male engineers, respectively.

Engineers employed by government and local governments were generally earning high incomes. Engineers working as civil engineering technicians, electrical engineering technicians and telecommunication engineers were earning more than 2.8 million shillings per month. On the other hand, engineers who were in 'unclassified' occupations were earning less than UGX 800,000

per month. Similarly, 68.4% of the engineers who were earning more than UGX2.8 Million were working in the business sector. The private non-profit sector accounted for the least earnings.

Most (91.7%) of the engineers were not formally registered, particularly those in the non-traditional fields like software, bio-systems and management engineering. This was mainly due to lack of minimum requirements for registration. Proportionately, far fewer women engineers were registered.

Over half of the engineers interviewed had worked in another part of Uganda outside urban Kampala. They got employed mainly in some of Uganda's major urban districts like Jinja, Mbarara, Gulu, Mbale, Hoima, Arua, Wakiso, among others. Civil engineers were found to be the 'most mobile' while software engineers were the 'least mobile'. Only 14.8% of female engineers were nationally mobile. Internationally, engineering graduates were found to be mainly mobile within the EAC region (38%) with Kenya, China, Rwanda, South Africa, Tanzania representing the top five destinations of engineers between 2008 and 2012. The Survey shows that 39.3% of engineers (especially in the fields of Software engineering) do not know whether they will be operating professionally in Uganda in the next five years.

Whilst 61% of engineers were involved in research and innovation activities, such innovations occurred in the more traditional fields of engineering (civil, electrical and mechanical). Despite the increasing number of engineering graduates, Uganda still has one of the smallest per capita ratios of engineers per population (one engineer per 53,000 people vs a desired global average of 1:770).There were less engineers involved in traditional mechanical/manufacturing, with more engineers being involved in the more knowledge-intensive segments of ICT/software /computers (6.5%), electronics/electrical (4.1%) and construction-related sectors like roads and highways (4.4%), construction and civil works (3.7%).

The findings provide a basis for targeted interventions in the area of STI human capital development policy. In order to achieve the middle income status, Uganda will have to significantly step up the pace of industrial production and processing. In addition, achievement of the Sustainable Development Goals (Agenda 2030) and the National Vision 2040 will require engineering graduates that can be deployed to provide solutions to the economic, social, health, safety, legal, and cultural challenges facing communities in Uganda. By enhancing the contribution of women engineers, stemming the brain-drain of young engineering graduates; providing continuous professional learning through streamlined engineer registration; updating and reviewing engineering curricula and supporting engineering research and innovation; Uganda has the potential to leapfrog to middle income status by 2040.

Table of Contents

Executive Summary . . . iii
Table of Contents . . . v
List of Abbreviations . . . viii
At a Glance . . . ix
List of Tables . . . xi
List of Figures . . . xii
List of Boxes . . . xiv
Foreword . . . xv
Acknowledgement . . . xvi

Chapter One: Introduction . . . 1
1.1 Engineers and Development . . . 1
1.2 The Role of Engineers . . . 1
1.3 Engineering in Uganda . . . 2
1.4 Rationale for the Study . . . 4
1.5 Objectives . . . 5

Chapter Two: Methodology . . . 7
2.1 Introduction . . . 7
2.2 The Target Population . . . 7
2.3 Data Collection Methods and Tools . . . 8
2.5 Challenges to the Methodology . . . 9

Chapter Three: General Findings . . . 11
3.1 Total Number of Graduates (2008–2012) . . . 11
3.2 Age, Class and Gender . . . 11
3.3 Engineers by Field of Engineering . . . 12
3.4 Field of Engineering by Gender . . . 13
3.5 Training of Engineers in Ugandan Universities . . . 14

Chapter Four: Employment . . . 23
4.1 Introduction . . . 23
4.2 Employment Status of Engineering Graduates (2008–2012) . . . 23
4.3 Employment Status by Gender . . . 24
4.4 Employment Status by Age Group . . . 24

4.5 Early Career in Engineering 24
4.6 Self-employed Engineers 26
4.7 Employment by Sector 27
4.8 Trend in Employment of Graduate Engineers by Sector: 2008 – 2012 28
4.9 Field of Engineering and Sector of Employment 28
4.10 Engineering graduates by Employment Type 29
4.11 Core and Non-Core Engineering 30
4.12 Areas of Specialisation 31
4.13 Nature of Work 32
4.14 Engineers by ISCO Classification 33
4.15 Earnings 35
4.16 Unemployed and Underemployed Engineers 39

Chapter Five: Engineer Registration 41
5.1 Engineer Registration in Uganda 41
5.4 Registration by Field of Engineering 43
5.5 Registration by Gender 44
5.6 Registration by Occupation 45
5.7 Reasons for Non-Registration 45

Chapter 6: Scientific Innovations 47
6.1 Introduction 47
6.2 Research and Innovation Activities 47
6.3 State of Innovation 48
6.4 Innovation by Occupation 50
6.5 Innovation by University Type 50
6.6 Innovation by Year of Graduation 51

Chapter Seven: Mobility 53
7.1 Engineers and Mobility 53
7.2 Future Mobility of Engineers 53
7.3 Engineers' Mobility Intentions 54
7.4 Destinations of Engineers: Geographical mobility 56
7.5 Ugandan Engineers in the EAC 57
7.6 Time spent outside Uganda 58
7.7 Mobility across Uganda 58
7.8 National Mobility by Field of Engineering 59
7.9 Occupational Mobility 60
7.10 Occupation by Gender 62

Chapter Eight: Emerging Issues . . . 65
8.1 Sectoral Issues . . . 65
8.2 Gender . . . 66
8.3 Further studies . . . 66
8.4 Where are the jobs? . . . 66
8.5 What is in demand? . . . 66
8.6 The future outlook . . . 67
8.7 University Industry Linkage . . . 67

Chapter Nine: Conclusions . . . 69
9.1 Engineering Education . . . 69
9.2 Employment . . . 70
9.3 Engineering fields with highest demand . . . 70
9.4 Women and Engineering . . . 70
9.5 Policy . . . 71
9.6 Structure of Engineering . . . 71

Chapter Ten: Recommendations . . . 73
10.1 Policy . . . 73
10.2 Higher Education . . . 73
10.3 Lower education . . . 73
10.4 The Engineering Pipeline . . . 74
10.5 Gender . . . 74
10.6 Availability of Engineers . . . 74
10.7 University-Industry Linkages . . . 75
10.8 The Role of Manufacturing . . . 75
10.9 Research and Development . . . 75
10.10 Registration . . . 76

APPENDIX I: Firms, Enterprises, Ministries, Departments and Agencies . . . 77
APPENDIX II: Survey Questionnaire . . . 85

List of Abbreviations

ADB	African Development Bank
EAC	East African Community
ERB	Engineers Registration Board
GDP	Gross Domestic Product
GOU	Government of Uganda
MNC	Multi National Corporation
MOSTI	Ministry of Science, Technology and Innovation
MSEs	Medium and Small Enterprises
NEMA	National Environment Management Authority
NTSEG	National Tracer Survey of Engineering Graduates
NSTP	National Science and Technology Plan
NWSC	National Water and Sewerage Corporation
ICT	Information and Communication Technology
ISU	Institute of Surveyors, Uganda
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
S&T	Science and Technology
SRB	Surveyors Registration Board
STE	Science, Technology and Engineering
STI	Science, Technology and Innovation
UETCL	Uganda Electricity Transmission Company Limited
UIPE	Uganda Institute of Professional Engineers
UNCTAD	United Nations Conference on Trade and Development
UNCST	Uganda National Council for Science and Technology

At a Glance

Average age of engineers:	32 yrs
Main field of engineering:	Civil Engineering
Main Sector of employment:	Business Sector
Top Three Employers:	1. UMEME 2. National Water & Sewerage Corporation 3. MTN
Proportion of unemployed engineers	3.1%
Main university for engineering training:	Makerere University (54.8%)
Average number of years for Bachelor's degree training:	3.88 years
Percentage of graduates with First Class and 2nd Upper degrees:	77%
Main postgraduate training undertaken by engineers:	Project Planning and Management
Average time to enter employment after graduation:	One Year
Proportion of registered engineers/surveyors/ architects:	7.85%
Three main areas of specialisation:	ICT, Power Systems, Water
Relationship between engineering training and current employment:	Closely related (72.3%) Unrelated (5.2%)
Proportion involved in research and innovation activities:	37%
Innovation types:	Successful Innovations: 32% Ongoing Innovations: 61% Abandoned Innovations: 7%
Proportion of engineers in core-engineering firms:	73.3%
Proportion of engineers who have moved out of the country for career-related reasons:	40.4%
Country where Ugandan engineers have spent the longest career-related period:	Kenya
Proportion of engineers who intend to leave Uganda in the next five years:	33.9%
Percentage of engineers intending to continue working in their field of engineering:	91.6%
Percentage of female engineers (to total engineers):	18.3%

Proportion of female engineers in core-engineering firms:	76%
Percentage of female engineers to total engineers in core engineering firms:	17.5%
Percentage of female engineers employed as engineers:	68.4% (Total: 71.7%; Male: 72.4%)
Female unemployed engineers as a proportion of total female engineers:	3.1% (Total:3.1%; Male: 3.1%)
Female engineers involved in research and innovation activities:	27.2% (Total:37%; Male: 39.2%)
Female registered engineers as a proportion of registered engineers:	6.1%
Proportion of female engineers who are self-employed:	13% ((Total:17%; Male: 17.9%)
Occupation (ISCO-88) with most female engineers:	Telecommunications Engineering
Proportion of female engineers who have worked outside Kampala District:	50% (Total:62%; Male:65%)
Female engineers in employment UNRELATED to engineering:	9.6% (Total: 5.2%; Male: 4.2%)

List of Tables

Table 1:	Engineering Workers According to ISCO-08	7
Table 2:	Top ten fields of Engineering with Graduates with Post-graduate Training	21
Table 3:	Employment Status by Age Group	24
Table 4:	Graduate Employment by Sector (2008-2012)	28
Table 5:	Change in Employment by Sector (2008-2012)	28
Table 6:	Field of Engineering by Sector of Employment (2008-2012)	29
Table 7:	Engineering Graduates by Employment Type	29
Table 8:	Core Engineers by Sector of Employment (2008-2012)	30
Table 9:	Non-Core Engineers by Sector of Employment (2008-2012)	31
Table 10:	Gross Monthly Earnings of Engineering Graduates (2008-2012)	35
Table 11:	Gross Monthly Earnings by Occupation	37
Table 12:	Gross Monthly Earnings of Engineering Graduates by Sector of Employment	39
Table 13:	Time Spent Searching for Employment	40
Table 14:	Innovation by Field of Engineering	49
Table 15:	Longest Time spent outside Uganda	58
Table 16:	National Mobility by Field of Engineering	60
Table 17:	Occupational Mobility: Number of Previous Employers	61
Table 18:	Occupational Mobility: Number of Years with Current Employer	61
Table 19:	Changes in Occupations of Engineering Graduates, 2008-2012	64

List of Figures

Figure 1:	Transforming Science and Technology to Meet Society Demands	2
Figure 2:	Engineer Categories covered under this Survey	4
Figure 3:	Components of the Survey Questionnaire	8
Figure 4:	Total Engineering Graduates and Survey Respondents: 2008-2012	11
Figure 5:	Engineers by Age, Class and Gender (2008-2012)	12
Figure 6:	Distribution of Graduates by Field of Engineering	13
Figure 7:	Gender Distribution by Field of Engineering	14
Figure 8:	Training of Engineers by Institution	15
Figure 9:	Trend of Engineering Graduates by Gender and Institution	15
Figure 10:	Proportion of Total Graduates with First and Upper Second Class Degrees	16
Figure 11(a):	Proportion of Male Graduates with First and Upper Second Class Degrees	17
Figure 11(b):	Proportion of Female Graduates with First and Upper Second Class Degree	17
Figure 12:	Graduates with Previous Engineering Training	18
Figure 13:	Proportion of Graduates who have undertaken Postgraduate Training	19
Figure 14:	Further Studies Undertaken by Gender and Field of Engineering	19
Figure 15:	Further Studies by Institution	20
Figure 16:	Main Fields of Postgraduate Studies	21
Figure 17:	State of Employment of Engineering Graduates (2008-2012)	23
Figure 18:	Time Taken to Secure Employment (by Field of Engineering)	25
Figure 19:	Time Taken to by Female Graduates to Secure Employment (by Field of Engineering)	25
Figure 20:	Trend of Engineer Early Career Employment (2008-2012)	26
Figure 21:	Graduates who Formed Companies (2008-2012)	27
Figure 22:	Engineering Graduates by Areas of Specialisation	32
Figure 23:	Relationship of Training to Current Employment	33
Figure 24:	Engineering Graduates (2008-2012) by ISCO Classification	34
Figure 25:	Earnings by Field of Engineering	36
Figure 26:	Engineers earning Less than 800,000UGX by Year of Graduation	38
Figure 27:	Registered Engineers in the EAC	42
Figure 28:	State of Registration of Engineers (2008-2012)	42
Figure 29:	State of Engineers' Registration by Field of Engineering	43

Figure 30	State of Registration by Gender and Field of Engineering	44
Figure 31:	State of Registration by Occupation	45
Figure 32:	Reasons for Non-registration	46
Figure 33:	Percentage of Engineers Conducting Research and Innovation Activities	48
Figure 34:	Research and Innovation by Occupation	50
Figure 35:	Innovation by University Type	50
Figure 36:	Engineer Intentions of Leaving Uganda	54
Figure 37:	Engineers' Mobility Intentions	37
Figure 38:	Female Engineers intentions by Field of Engineering	55
Figure 39:	Male Engineers intentions by Field of Engineering	55
Figure 40:	Main reasons for Movement of Engineers	56
Figure 41:	Destination of International Geographical Mobility	57
Figure 42:	International Mobility: Top Ten Destinations of Engineers (2008-2012)	57
Figure 43:	Engineer Mobility Across the East African Community (2008-2012)	58
Figure 44:	National Mobility of Engineers Across Major Districts in Uganda (excluding Kampala)	59
Figure 45:	ISCO Occupations by Gender	62
Figure 46:	ISCO Occupations by Fields of Engineering	63

List of Boxes

Box 1:	Engineering Graduates and Engineering Jobs in the UK	33
Box 2:	Engineer Registration Trends in South Africa	43
Box 3:	Engineers and Innovation: Australian experience	49

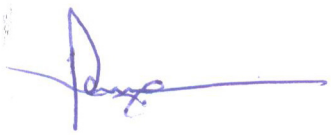
Foreword

Uganda needs a strong engineering sector to achieve the development milestones underlined in the National Vision 2040. Therefore, increasing the supply of engineers in the areas of energy, construction, manufacturing and industry will support Uganda's development aspirations of transforming into a middle-income country over the next twenty years.

The Uganda National Council for Science and Technology is committed to undertake surveys across Science, Technology, Engineering and Mathematics (STEM) disciplines as a way of providing policy makers with a definitive evidence base. The aim of this Study is to raise awareness of the vital contribution that engineers make to our economy and to understand the training and deployment patterns of this highly trained human resource. The Study provides valuable information on the employment landscape of Ugandan engineers that can inform future human resource planning in this vital area. The report shows that the opportunities of employment for engineers are generally available although there is still excess capacity for a growing economy like Uganda.

This Study Report makes an important contribution to the national human capacity discourse and should provide the engineering fraternity in Uganda with vital insights into the existing opportunities that can enhance engineers' engagement in the national and regional development agenda.

I am optimistic that the recommendations from this report will provide the much required evidence base for structured interventions in this vital sector.



Dr. Peter Ndemere
Executive Secretary
Uganda National Council for Science and Technology

Acknowledgement

The Uganda National Council for Science and Technology (UNCST) is grateful to the Government of Uganda that fully financed this study. Specifically, the UNCST is grateful to the Lead authors, Mr. Sebbale Steven, Ms. Noeline Basiime and Mr. Komakech Jacob in the Human Capital Development Unit for undertaking the study. The technical input and useful insights of staff from the Science, Technology Policy Development and Coordination Division of UNCST comprising of Ismail Barugahara, Richard Lutalo, Mafabi Patrick, Bashir Kagere and Immaculate Muyingo are hereby acknowledged with thanks. Also acknowledged are the comments from different stakeholders from academia, industry and professional organisations that were helpful in providing contextual insights that informed the survey narrative. The research team is also thankful to the devoted team of enumerators and all the engineering graduates who responded to the survey. Your input is highly valued.

Chapter One: Introduction

1.1 Engineers and Development

Over the last decade, the number of graduates across Uganda's higher education system has been increasing owing to a highly liberalised sector. This has been coupled with several pro-science policies across Uganda's education system that have been spurred by a general recognition of the contribution of science to economic development. The growth in higher education and the continuous demand for people with Science, Technology and Innovation (STI) skills is an indication of how Uganda is gradually transforming into a knowledge-based and skills-driven economy. Higher Education Institutions (HEIs) are now charged with the task of producing graduates who are capable of applying technology and knowledge-based information to the nature and demands of their work environment. This is consistent with an ongoing global narrative. Across the globe, various countries are taking stock of their skills' inventories and matching them to their growth ambitions. Science, Technology and Engineering (STE) graduates have the critical skills that provide the basis for knowledge production, innovation and economic transformation.

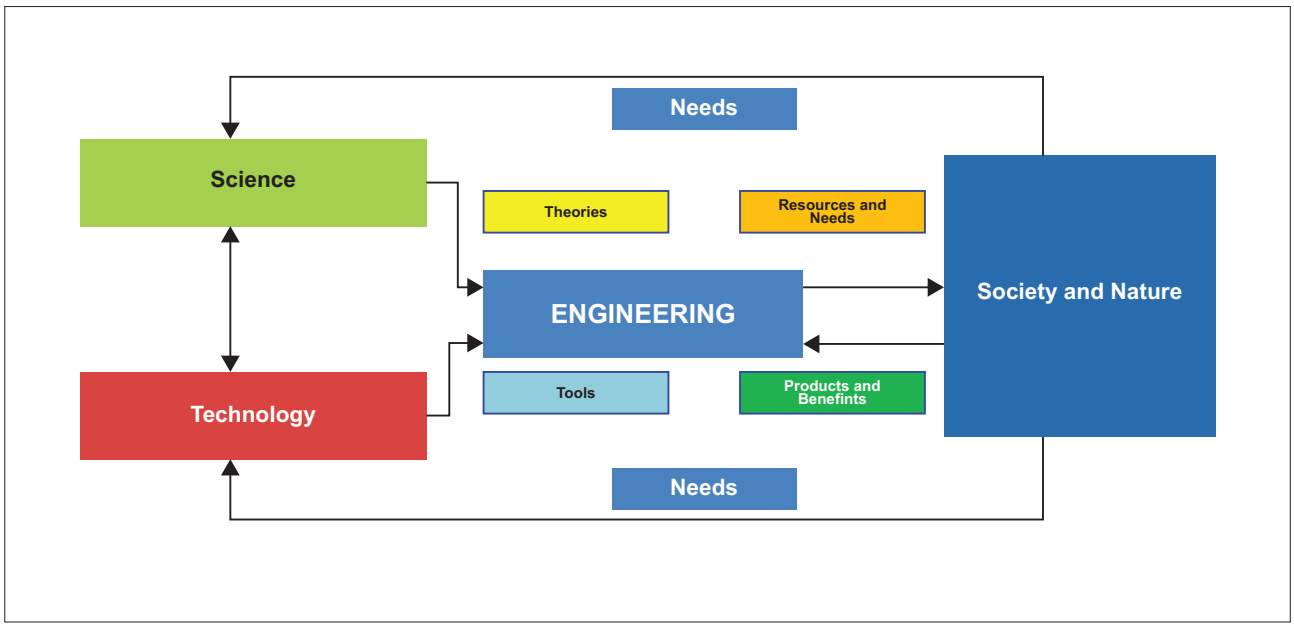
1.2 The Role of Engineers

Engineers provide the bridge between science and society. This is because in order for a country to achieve sustainable economic development, there is need to develop technological capacity and application of technological know-how to meet the peculiar challenges facing that country. As such, science, technology and engineering are the primary drivers for any country's effort towards gainfully participating in the competitive global knowledge economy. Engineers play a pivotal role in mechanisation of production processes and in the development of infrastructure. It is anticipated that engineers will play a vital role in enabling Uganda achieve its National Vision 2040 owing to their strategic role as creators, designers, fashioners and builders of most of the infrastructure that allows for other economic activities to take place. Their role in power and energy, water supply, transportation, environment, housing, railways, roads, highways and bridges, irrigation, telecommunications, airports and harbours, information technology and scores of other specializations is critical for national infrastructural transformation.

Moreover, engineers play a vital role in the adoption, adaptation, diffusion and application of the newest and emerging technologies. Engineers are necessary for turning ideas into global commercial successes. With a wide range of potential areas for application, engineers provide the "engine" that can sustainably support most of the other sectors of the economy. The complex relationship between science, technology and engineering can be conceptually portrayed in the Figure 1. As shown, engineering provides the central hub for converting science and technology into products and processes that respond to the needs of society. Engineers use challenges on the one hand and scientific knowledge and mathematics on the other to create technologies,

infrastructure and solutions needed to address human, social and economic issues. Ultimately, through innovation, engineers act as interlocutors between social needs and commercial applications.

Figure 1: Transforming Science and Technology to Meet Society demands



Source: UNESCO (2010)

1.3 Engineering in Uganda

The role and contribution of engineers in Uganda has not been well catalogued and calibrated. Training is still under-subsidised and the fields of engineering training are still narrow. Uganda's apparent 'undeveloped engineering' sector has inevitably 'attracted' off-shore engineering expertise who are now undertaking some of the headline engineering projects in Uganda from hydro electricity generation, petroleum exploration, to mining, manufacturing, etc. with local engineers being generally deployed in light industry and manufacturing. Whereas the Government of Uganda (GOU) has supported several pro-science policies that have emphasised and prioritised the training in Science, Technology, Engineering and Mathematics (STEM), there still exists an apparent mismatch between the demand and supply of STEM graduates on Uganda's job market. This has resulted into high unemployment, underemployment and labour migration. Several reforms within the education sector have been geared towards increasing the gross enrolments in science disciplines at tertiary level. However, the absence of a coherent framework to track the national human capacity needs requirements has made it difficult to identify priority areas for employer-led training and a delineation of industrial and manufacturing human capacity requirements that can offer Uganda the necessary regional and global competitive edge.

Uganda has made great structural strides in higher education infrastructure development (with a rapid increase in the number of universities from two universities to forty-five universities

between 1989 and 2015 respectively). A plethora of reforms within the sector has witnessed the liberalised provision of higher education which has resulted into an increase of university graduates from 53,556 in 2006 to 94,927 by 2012[1]. This has been complemented by increased enrolments in S&T fields, introduction of new S&T courses across both private and public universities and an emerging pro-science agenda. Despite these enhanced quantitative outcomes, poor qualitative outcomes relating to graduate unemployment and underemployment still characterise much of Uganda's labour market.

1.3.1 Engineer Training in Uganda

Education and training of engineering graduates in Uganda started in 1970 with the opening of the Faculty of Technology at Makerere University and an intake of twenty-seven students.[2] In 2002, Kyambogo University also started offering graduate programs in engineering. These two universities provide the nucleus of engineering training in Uganda. Engineer training in Uganda takes on average four years. Whereas the total number of graduates in different fields of engineering has generally increased, the number of graduates in engineering, as percentage of total graduates, reduced from 3.3% to 2.9% between 1990 and 2013. Increase in the total number of engineering graduates has been more than offset by increase in other disciplines like the social sciences, humanities and natural sciences. In Uganda, the main traditional engineering disciplines are Mechanical, Civil and Electrical. Of recent, new engineering fields have emerged. These include Telecommunications, Agricultural, Computer, Software, Petroleum and Bio-systems engineering.

A bachelor's degree in engineering is typically referred to as the Bachelor of Science in a specialty branch. Bachelor of Engineering (BEng) is more focused on theoretical and abstract thinking and creative analysis in solving problems and prepares graduates for the continuation of education for advanced degrees in engineering. In reference to the Bologna process[3], first cycle graduates are expected to be both employable and qualified to enter a second cycle programme. After graduation, graduates are required to undergo Continuous Professional Development (CPD) and to register with their professional body, the Uganda Institute of Professional Engineers (UIPE). It is estimated that about 3,000 engineers had been trained in Uganda by 2010[4] Graduates with a first cycle degree in one of the fields of engineering enter a wide variety of positions with many different types of organizations. There are many graduates of engineering programmes who use their engineering education to access other non-engineering professions such as Law, Medicine, financial services, sales, or non-engineering management. However, like many countries in Sub-Saharan Africa, the human capacity in Uganda for engineering is still low. This has resulted into a dependence on foreign expertise in certain specialist fields of engineering.

---

1 UNCST Database.

2 UNESCO (2010), Engineering: Issues, Challenges and Opportunities for Development, A Report produced by the United Nations Educational Scientific and Cultural Organisation.

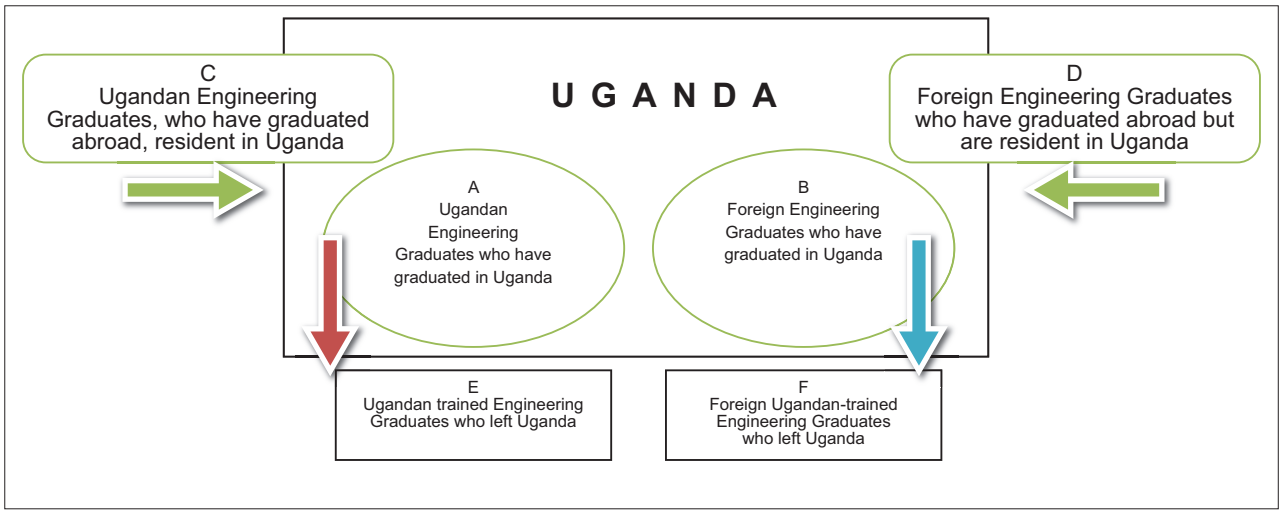
3 Bologne Pro - A series of meetings and agreements between European countries to ensure comparability in the standards and quality of higher educaton qualifications.

4 Lugujjo. E (2010), Challenges and Prospects of Engineering Education and Training in Uganda, in Engineering: Issues, Challenges and Opportunities for Development, A Report produced by the United Nations Educational Scientific and Cultural Organisation.

1.3.2 Categories of Engineering Graduates

There are different categories of engineering graduates. As shown in Figure 2, engineers in Uganda (by training) will fall in any of the categories from 'A – D'. Engineering graduates 'E – F' are enumerated in the countries where they practice or train.

Figure 2: Engineer Categories in Uganda



1.4 Rationale for the Study

Graduate (and employer) studies constitute one form of empirical basis which can provide valuable information for evaluating the results of the education and training by a specific institution(s) of higher education. Many of the higher education institutions in Uganda have not conducted graduate engineering tracer studies to establish where their graduates are. In addition, information on the professional success of the graduates and the relevance of knowledge and skills on the labour market is scanty. According to the National Science, Technology and Innovation Policy (NSTIP) 2009, Uganda needs to build an educational and training system that produces human resources with capacity to generate and effectively apply STI based on the contemporary and future needs of society. The NSTIP articulates the need to strengthen science and technology education; build future S&T capabilities through focused programs in basic and higher education; align vocational, technical and skills development programs to the requirements of global competitiveness of Uganda industries; harness the potential of locally available S&T expertise in the different sector; and maximise the contribution of Uganda S&T professionals abroad to the national S&T development efforts.

Uganda seeks to engage in the global knowledge economy which calls for training in particular fields of science and technology (S&T). Therefore, it is imperative that the human resources produced within the national higher education system provide such solutions to society's needs. It is anticipated that engineers will play a pivotal role in helping Uganda realise its National Vision 2040. The results of this study therefore compliment the collective narrative on engineering

training received within the universities. It is hoped that lessons learned from the study can inform reviews in curriculum and training patterns across the different fields of engineering. The competence of the Engineering training programs will be gauged by the occupational opportunities presented to the graduates, their present positions, their occupational, geographical, upward mobility and the nature of the jobs they obtain immediately after graduation.

This tracer study seeks to address a number of knowledge gaps regarding engineering training, career, mobility and contribution to innovation and economic transformation from the perspective of the graduates who have been in the workplace long enough (7 years) and those who have recently joined (3 years). Moreover, these graduates could provide insights to key policy questions such as:

- Where are engineering graduates finding employment?
- What is the regional dispersion of engineering graduates?
- What is the nature of their employment?
- How long does it take engineering graduates to find employment?
- Which fields of engineering provide faster employment and why?
- How do graduates find employment?
- What are the gender lessons for engineering training and employment?

1.5 Objectives

The Tracer Study examines the career trajectory of engineering graduates from university education and the world of work. The specific objectives are to:

- Establish the employability and employment status of engineering graduates on the labour market
- Analyse the sectors of employment and mobility of engineering graduates.
- Assess the earning potential of engineering graduates engaged public and private engineering practice.
- Establish the career and professional growth prospects for graduate engineers.

Chapter Two: Methodology

2.1 Introduction

Tracer studies involve retrospective analyses of sampled elements of the population to evaluate long term impacts of intervention programmes. This chapter presents the methodology employed in undertaking this tracer study. The study design was influenced by the research objectives and a review of administrative data as well as interactions with key informants in the education sector.

2.2 The Target Population

This study targeted graduates who attained Bachelor's degrees in engineering academic programmes from public and accredited private universities[5] in Uganda for the period 2008 and 2012 inclusive. In this report an 'engineer' is defined as any engineering graduate working in or out of the engineering profession in accordance with the International Standard Classification of Occupations (ISCO-08). The classification for engineering workers provides the breakdown below. (See Table 1)

Table 1: Engineering Workers According to ISCO-08

Architects, town and traffic planners
Civil engineers
Electrical engineers
Electronic and telecommunication engineers
Mechanical engineers
Chemical engineers
Mining engineers, metallurgists and related professions
Cartographers and Surveyors
Architects, engineers and related professions not elsewhere classified

Source: International Labour Organisation Classification of Occupations for 2008, ISCO-08).

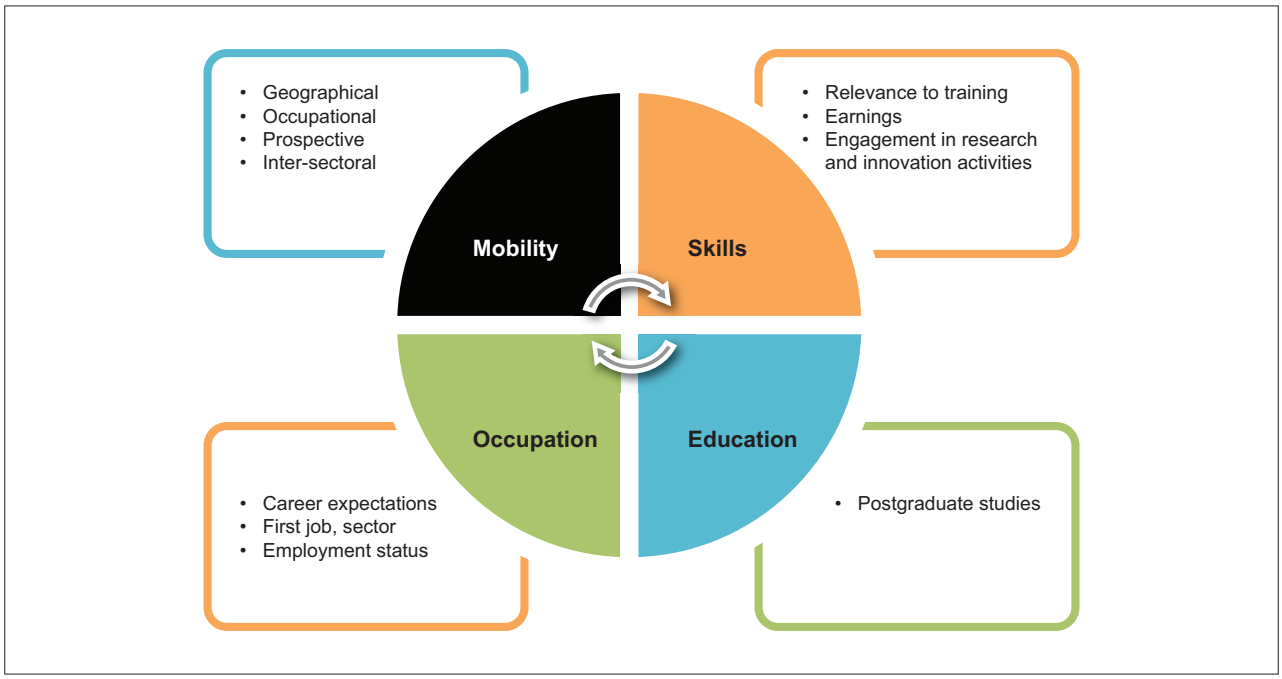
5 Makerere, Kyambogo, Busitema, Ndejje, Kampala International, Gulu and Nkozi Universities

2.3 Data Collection Methods and Tools

The study followed internationally agreed tracer survey guidelines of the Organization for Economic Co-operation and Development (OECD) for tracking the occupational and geographical mobility of key personnel. The primary data collection methods included review of related literature, key informant interviews and face-to-face interview with the identified graduates. The questionnaire used to collect data from graduates was adapted from the Career of Doctorate (CDH) Survey undertaken by OECD. Following internal reviews and adaptation by UNCST technical staff in line with the survey objectives, this questionnaire focused on 7 areas of assessment:

a) General Information
b) Education Background
c) Further studies
d) Early Career
e) Current Employment
f) Unemployed persons
g) International Mobility

Figure 3: Components of the Survey Questionnaire



2.3.1 Data collection approach

The study was conducted between April and June 2015. The questionnaire was administered by a team of five trained enumerators. An e-version of the questionnaire was also developed and administered via e-mail. The primary contact information of the graduates was derived from their respective universities. In addition, registers provided by the Uganda Institute of Professional Engineers, Engineering Registration Board, Architects Association of Uganda,

Uganda Surveyors Association, previously conducted surveys on engineers, alumni organizations, social media platforms (LinkedIn, Facebook, etc.) were also utilised. UBOS National Housing Census Preliminary Results, Company Register at Uganda Registration Services Bureau were, among other sources of contact information. Snow balling was used to identify and locate those graduates with incomplete contact information. Interviewers were given a maximum of three follow ups and outside that a non-responsive case would be considered.

2.3.2 Data Management and Analysis

Two statisticians coded and entered the data in customized data entry packages with check programs designed in CSPRO. Data Analysis was done using Statistical Package for Social Scientists (SPSS). A tabulation plan, with levels of disaggregation was developed to guide the analysis and presentation framework. Microsoft Excel was used for graphical representations. Bivariate analysis, employing Chi-square and F-tests was used to test for relationships between two variables.

2.5 Challenges to the Methodology

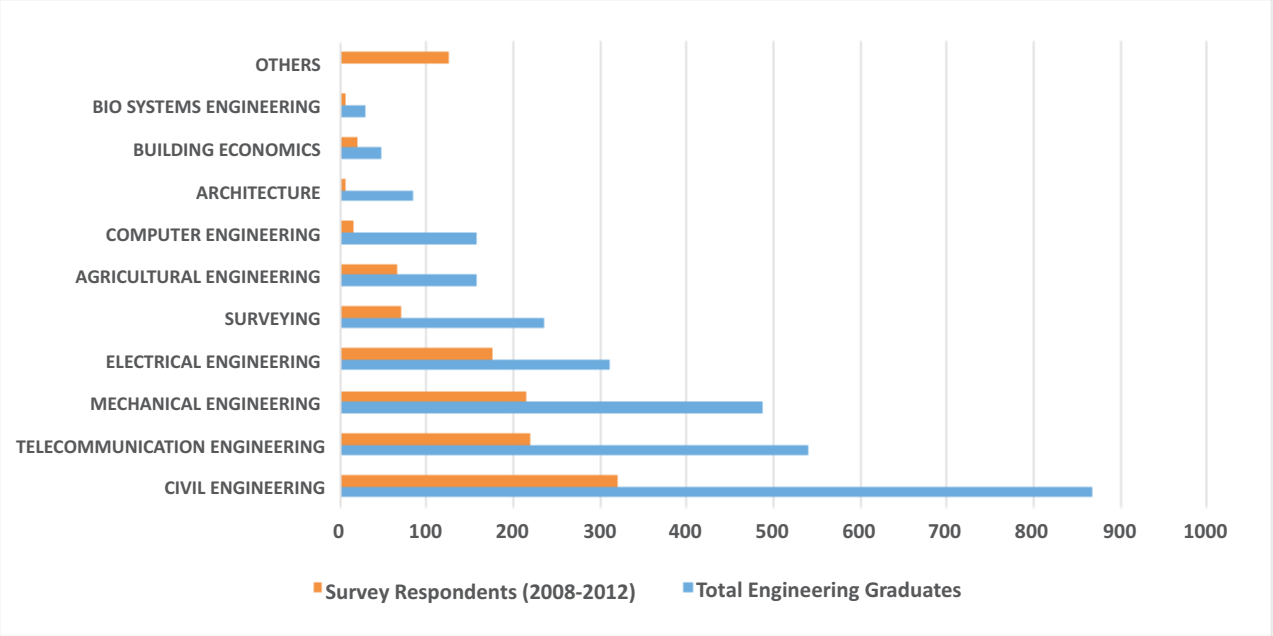
a) Some of the institutions did not have the current contact information for the graduates. This made the tracing process complex. However, multiple sources of information were used for respondent triangulation and identification.
b) Some of the respondents were unwilling to provide the required data. This was overcome by either making multiple visits to such respondents or making clarifications about the objectives of the Survey.
c) Some of the targeted graduates were out of the country while others could not be located.

Chapter Three: General Findings

3.1 Total Number of Graduates (2008-2012)

Between 2008 and 2012, 2,919 engineers graduated in the various fields of engineering disciplines in Uganda. The number of engineering graduates increased by 55.7% over this period. This survey reached 1,210 engineers of the total number of engineers who graduated for that period corresponding to a 41% response rate. In addition, the survey contacted a third (34%) of the total graduating engineers for any given year per field of engineering. Figure 4 below shows the proportionate distribution of the respondents across the different fields of engineering.

Figure 4: Total Engineering Graduates and Survey Respondents: 2008-2012



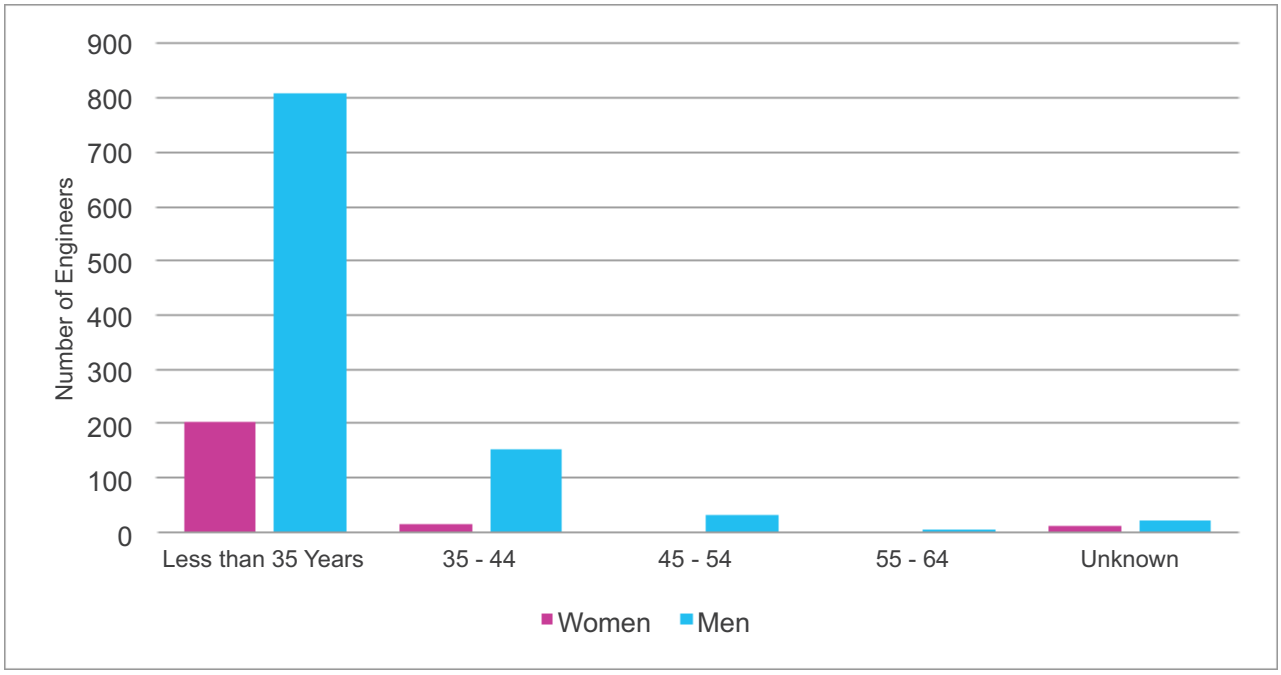
As shown above, civil engineering is the dominant field of engineering although 'other' fields of engineering like Oil & Gas, Petroleum, Bio-systems, Textile and Computer engineering have emerged recently.

3.2 Age, Class and Gender

Most (83%) of the engineers who participated in this survey were less than 35 years old. Proportionately, female engineers were relatively much fewer and their numbers 'disappeared' in other age groups (See Figure 5). It is quite possible that many female engineers drop out of the profession or simply exit into other careers as they grow older. The presence of women, although

increasing, is still small relative to the population as a whole in nearly all engineering fields. Due to targeted gender-affirmative policies, the overall number of female students enrolling for university education has increased. However, proportionately fewer women enrol (and graduate) in the different fields of engineering. Female engineers contribute about one-fifth (20%) of graduates in the traditional fields of civil, electrical and mechanical engineering. Across the different fields, women were more pronounced in fields like architecture and bio-systems engineering while female participation in emerging fields like Industrial and Management Engineering and Software Engineering was minimal. This gender divide is fuelled by perceptions within the profession, the absence of mentors and the inadequate support for a gendered approach to engineering training.

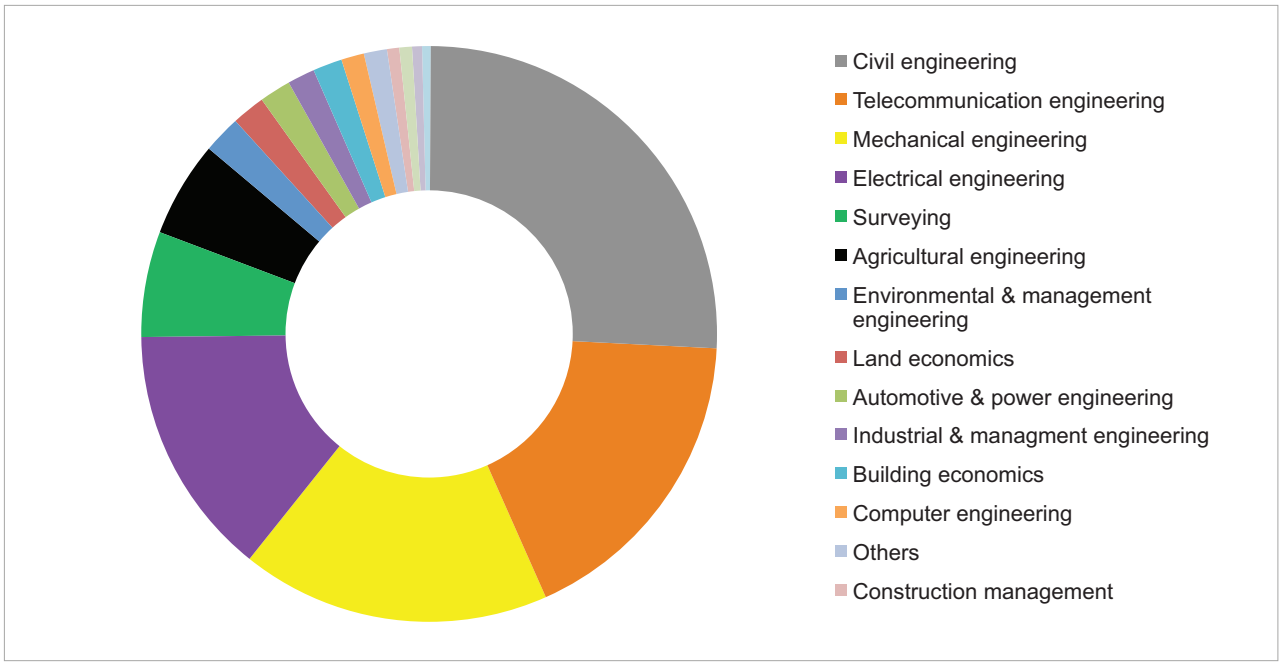
Figure 5: Engineers by Age, Class and Gender (2008-2012)



3.3 Engineers by Field of Engineering

In recent years, the scope of engineering disciplines has broadened. According to the Organisation of Economic Cooperation and Development (OECD), there are now over thirty named degree programmes with new programmes being added regularly. According to this study, Civil and Telecommunication engineering were the most popular fields of engineering in Uganda. These two fields accounted for 48% of engineering graduates during the period 2008-2012. Telecommunication engineering is one of the new non-traditional fields of engineering that has emerged owing in part to Uganda's vibrant telecommunication sector. It is also a possible reflection of gradual alignment of engineering training to the availability of job-market opportunities.

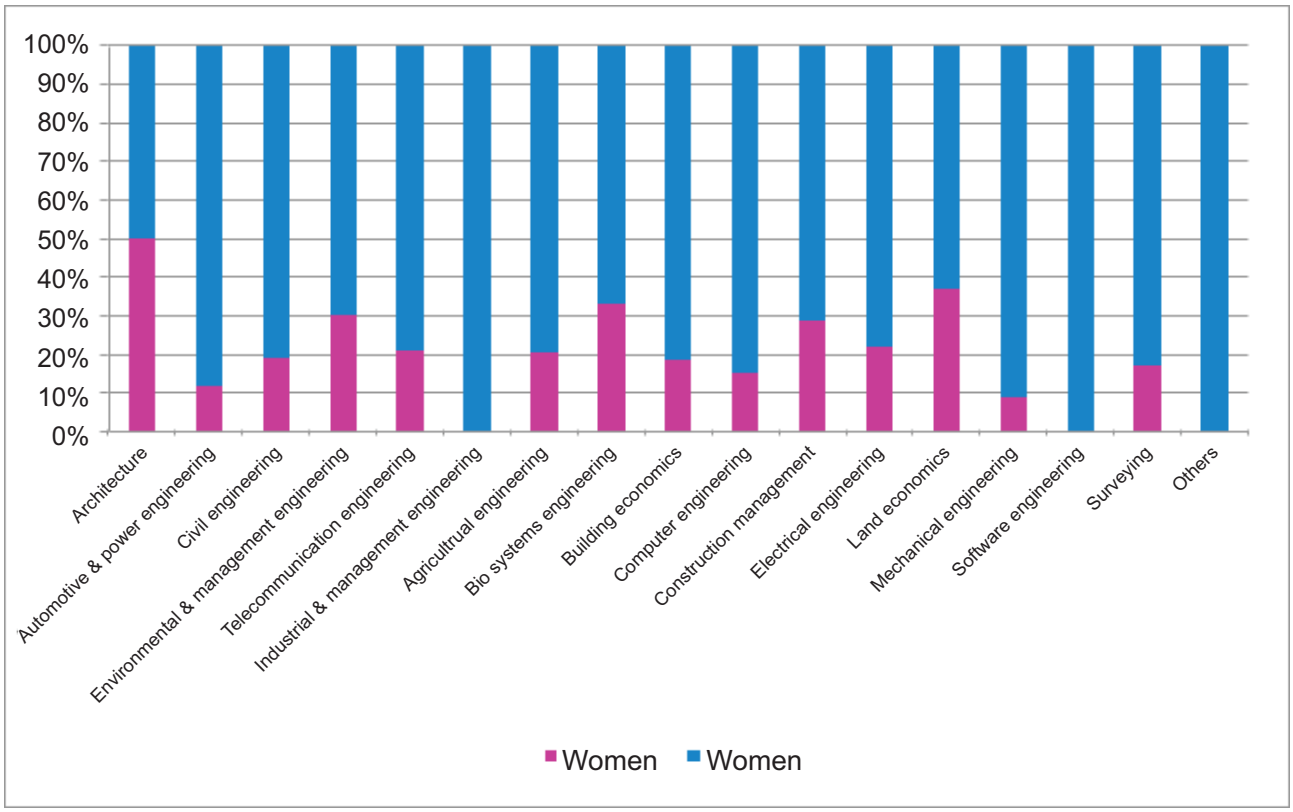
Figure 6: Distribution of Graduates by Field of Engineering



3.4 Field of Engineering by Gender

According to the survey, women have achieved parity in the field of Architecture although they still represent less than 30% in the traditional fields of civil, electrical and mechanical engineering graduates as shown in Figure 7.

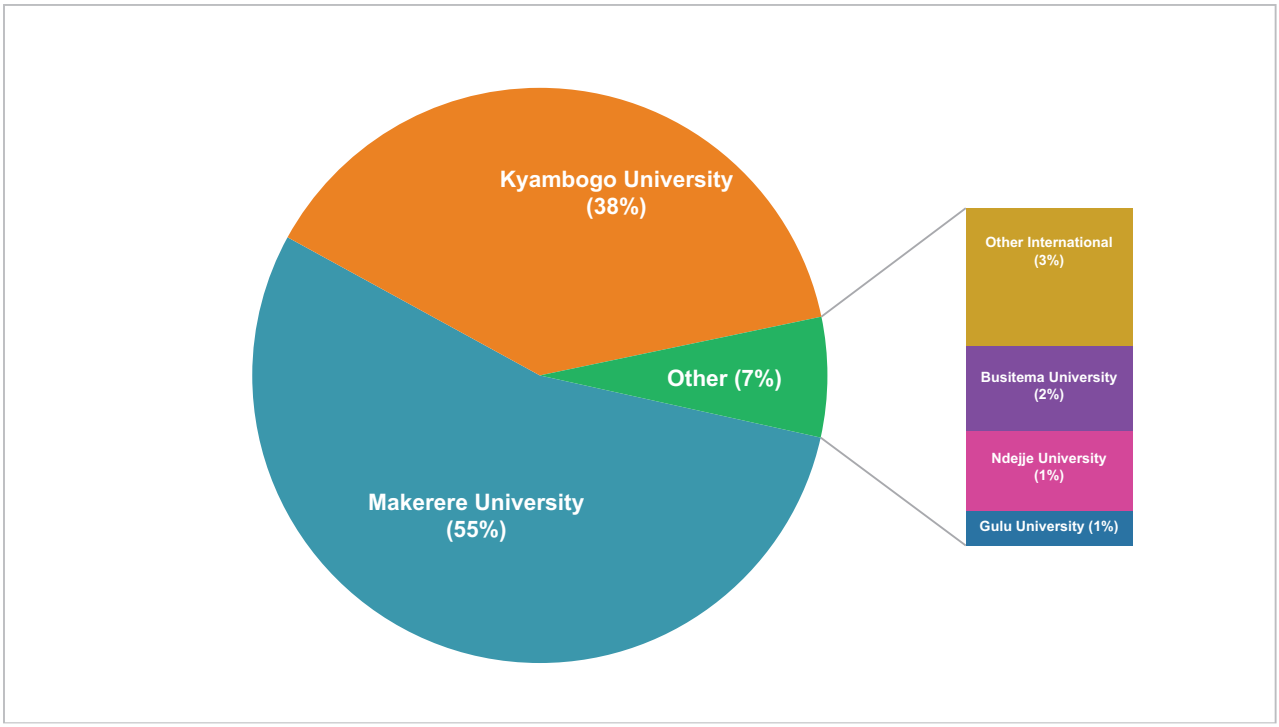
Figure 7: Gender Distribution by Field of Engineering



3.5 Training of Engineers in Ugandan Universities

More than half (55%) of the engineers in this study cohort had trained at Makerere University for their first degree. Kyambogo University is the other major university providing undergraduate training in engineering. Other universities like Ndejje, and Busitema have also commenced engineering training. Only 3% of engineers in the selected cohorts attained their undergraduate qualification from universities outside Uganda.

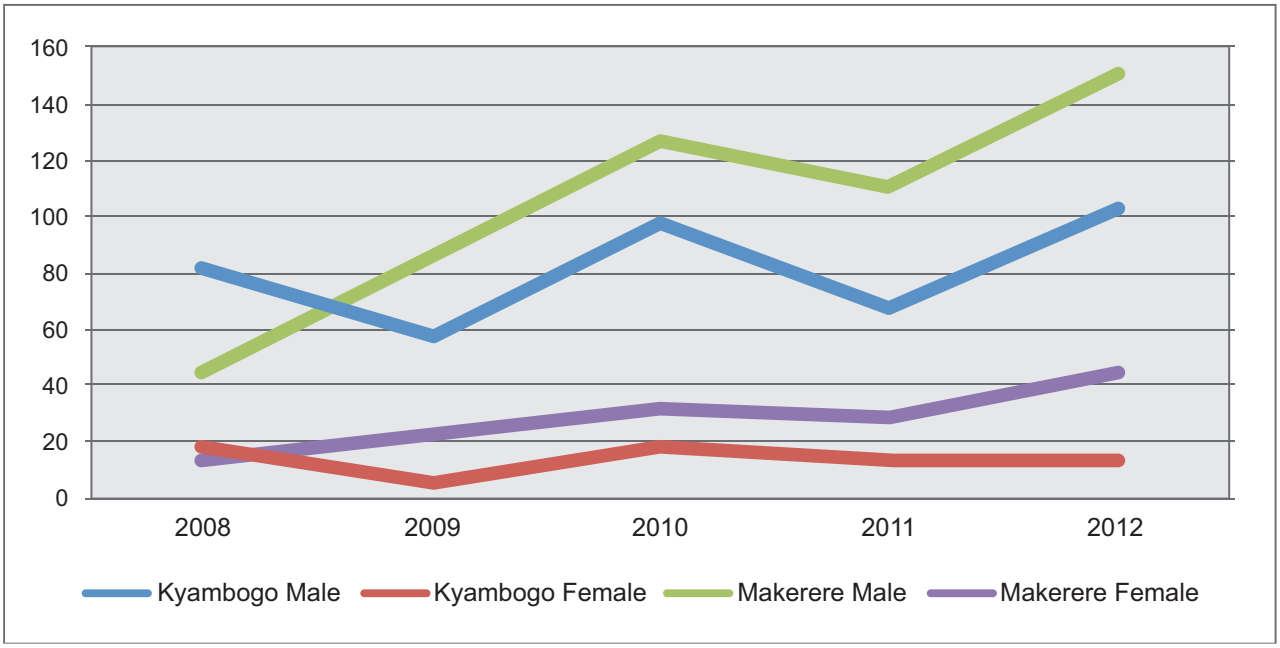
Figure 8: Training of Engineers by Institution



3.5.1 Gender Participation in Engineering Training (2008-2012)

Between 2008 and 2012, the total number of engineering graduates increased by 115%. Male engineers increased by 118% while female engineering graduates increased by 110% over the same period. The proportionate increase in engineering graduates was mainly driven by male graduates from Makerere University.

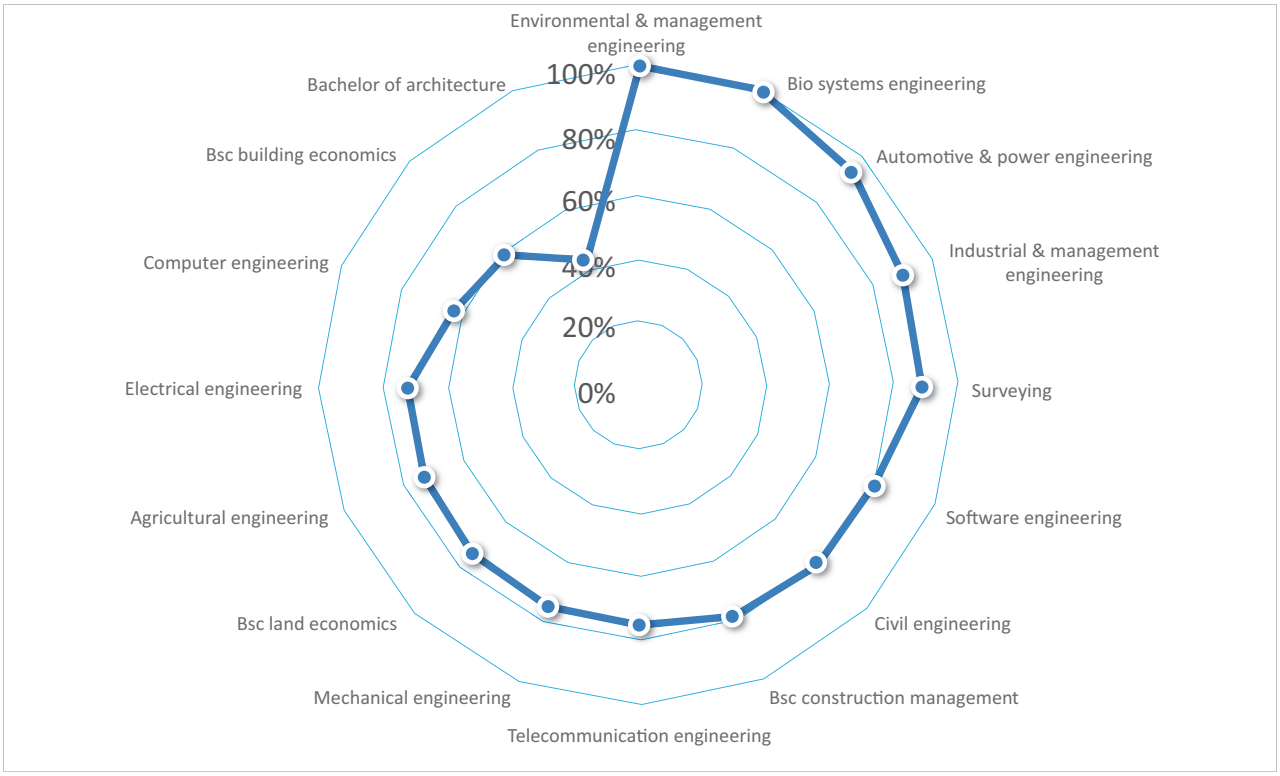
Figure 9: Trend of Engineering Graduates by Gender and Institution



3.5.2 Performance at Undergraduate training

Performance in undergraduate training indirectly determines the on-ward capacity for specialisation, occupational mobility and technical learning. Findings from the survey show that graduates in engineering generally perform well. Over three quarters (75%) of engineering graduates across the different fields of engineering had scored either a First Class degree or a Second Upper degree. Auxiliary fields like Architecture had the least number of graduates with similar performance.

Figure 10: Proportion of Total Graduates with First and Upper Second Class degrees



3.5.3 Performance by Gender

The Survey shows that there is no significant variance in academic performance between male and female graduates. Female graduates are equally as competent as their male counterparts with regard to 'quality of qualification'. Moreover, as shown Figure 11(a), women have a more balanced performance across the different fields of engineering. Survey results show that between 2008 and 2012, the number of women graduates who achieved 'first-class' and 'upper-second' degrees increased from 73.3% to 82.5% compared to their male counterparts who marginally increased from 76.7% to 79.1%, respectively.

Figure 11(a): Proportion of Male Graduates with First and Upper Second Class Degrees

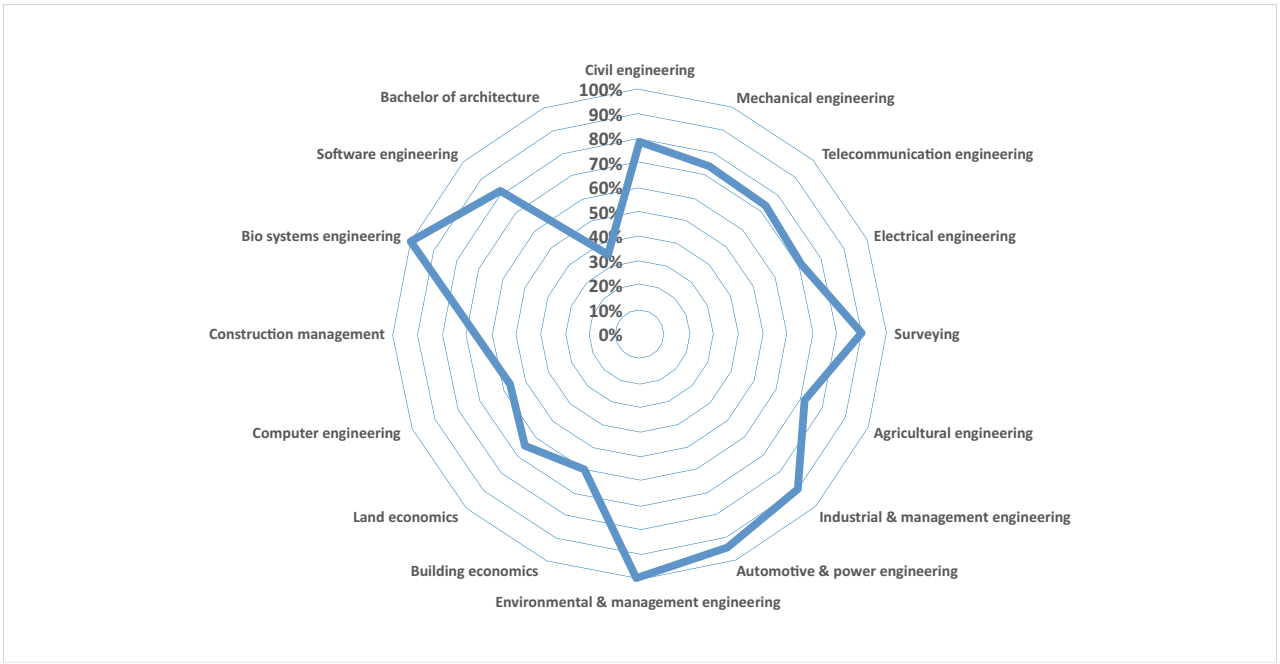


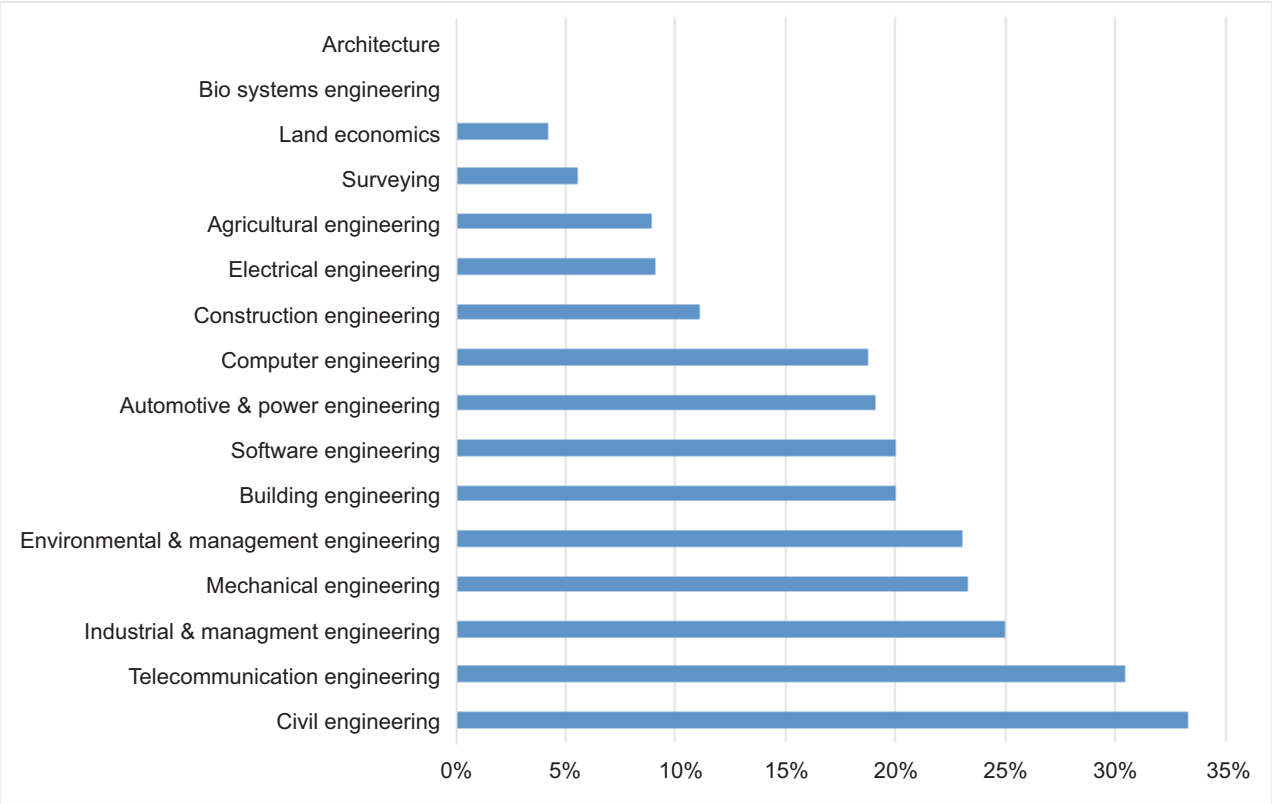
Figure 11(b): Proportion of Female Graduates with First and Upper Second Class Degrees

3.5.4 Previous Engineering Training

The field of Civil engineering had the most graduates who had received prior training in engineering before enrolling for the undergraduate degree. The International

Standard for Classification of Education (ISCED) developed by UNESCO was used to calibrate the level of training. Accordingly, 52% of graduates with prior training in engineering had been in Technical colleges (ISCED Level 5) while 42% (ISCED Level 6) had previously received university-level training. Further analysis shows that 71.9% of those who had some prior training before pursuing undergraduate courses in engineering had undertaken post-secondary non-tertiary education, which offered them direct access to tertiary education.

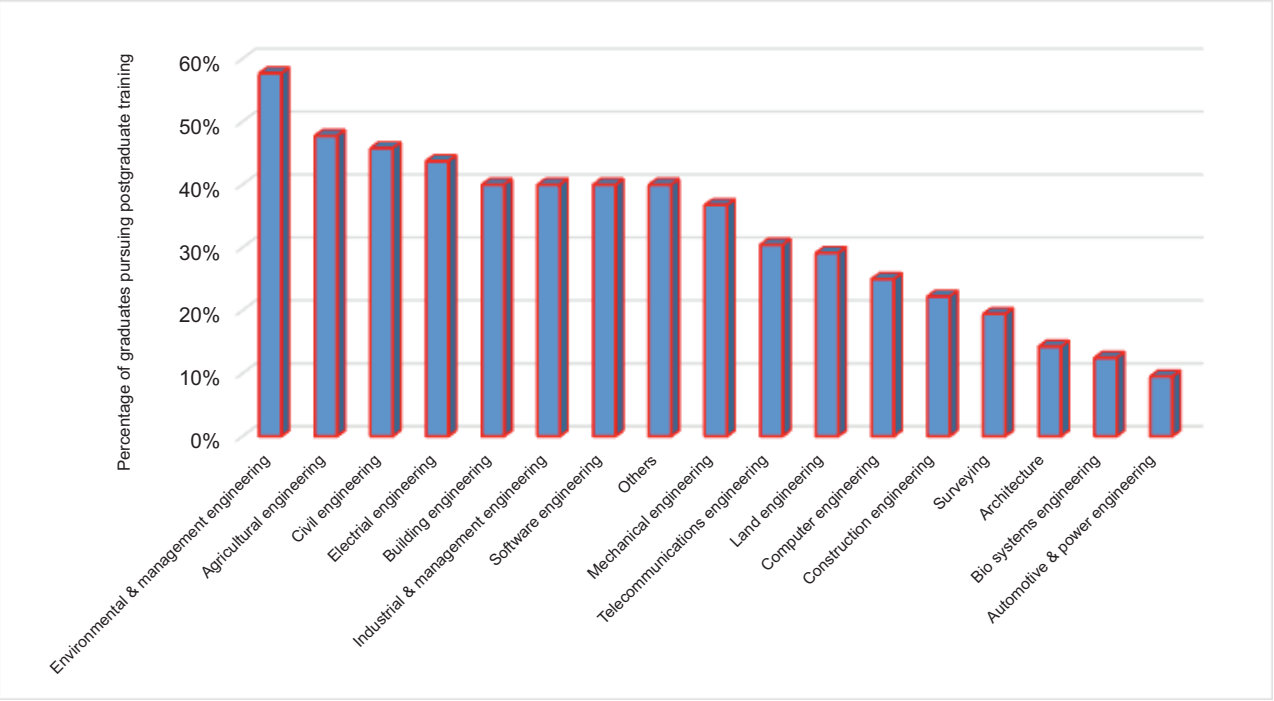
Figure 12: Graduates with previous engineering training



3.5.5 Further Studies undertaken by Field of Engineering

Over half (50%) of the graduates of Environmental and Management engineering had gone for further studies or postgraduate training. This could point towards a dearth of opportunities for graduates with degrees in the 'non-traditional' fields that would require them to have some additional qualification to be competitive. There were also comparatively higher number of graduates from the traditional fields of Civil and Electrical engineering pursuing further studies.

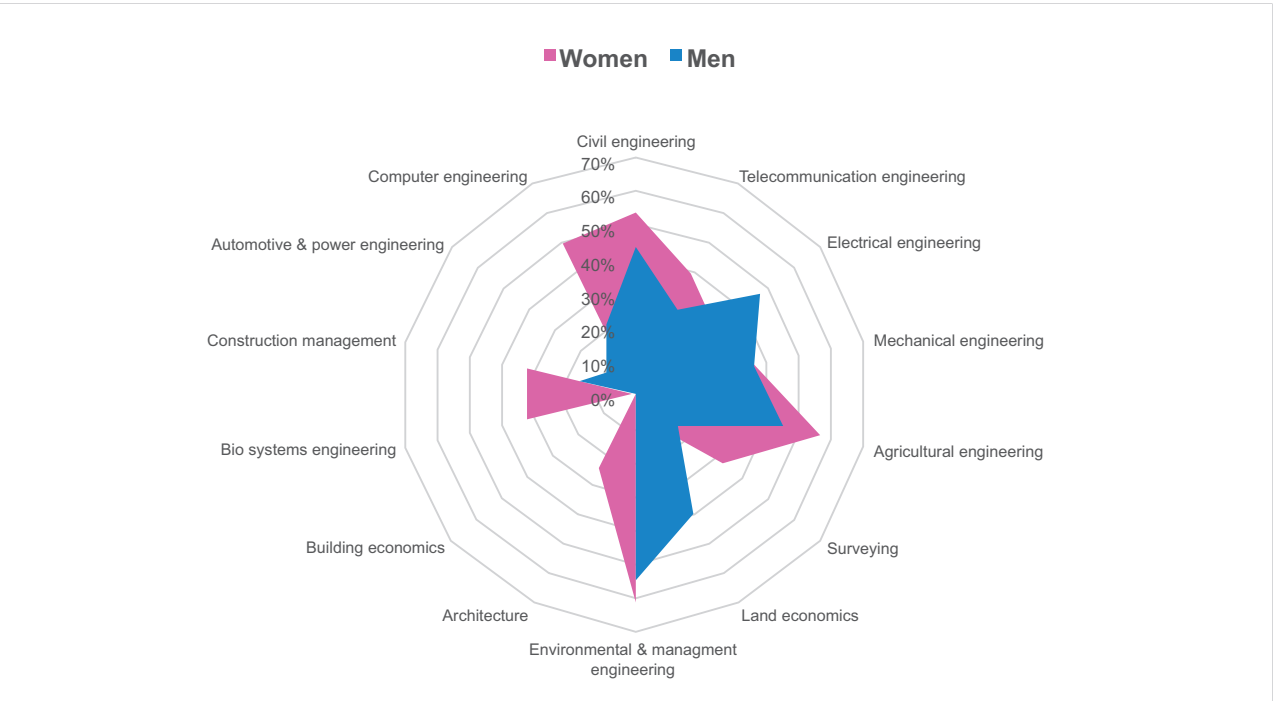
Figure 13: Proportion of Graduates who have undertaken postgraduate training



3.5.6 Further Studies and Gender

Generally, there are more male engineers pursuing further studies. However, proportionately more female graduates of agricultural, civil, telecommunication engineering were going back for further studies compared to their male counterparts.

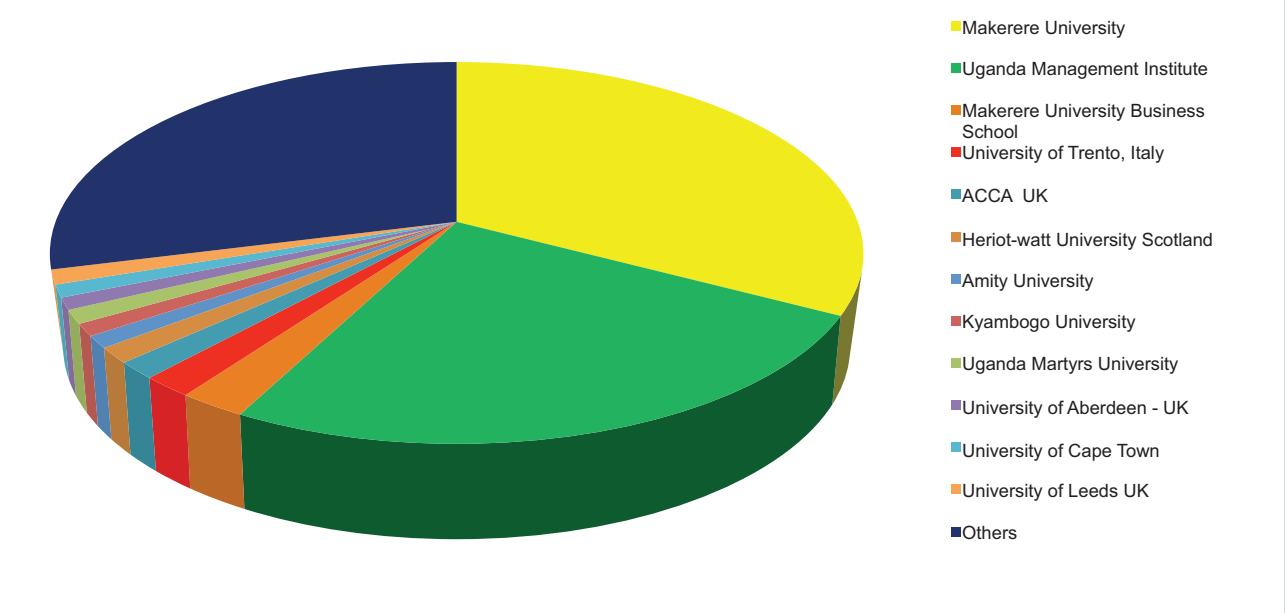
Figure 14: Further studies undertaken by Gender and Field of Engineering



3.5.7 Further Studies by Institution of Learning

According to the survey, Makerere University provides a third (33%) of postgraduate learning for engineers. This is followed by the Uganda Management Institute (25%). This besides, postgraduate education is scattered across several universities most of which are outside Uganda (6% of such Universities and Institutes were in the UK)

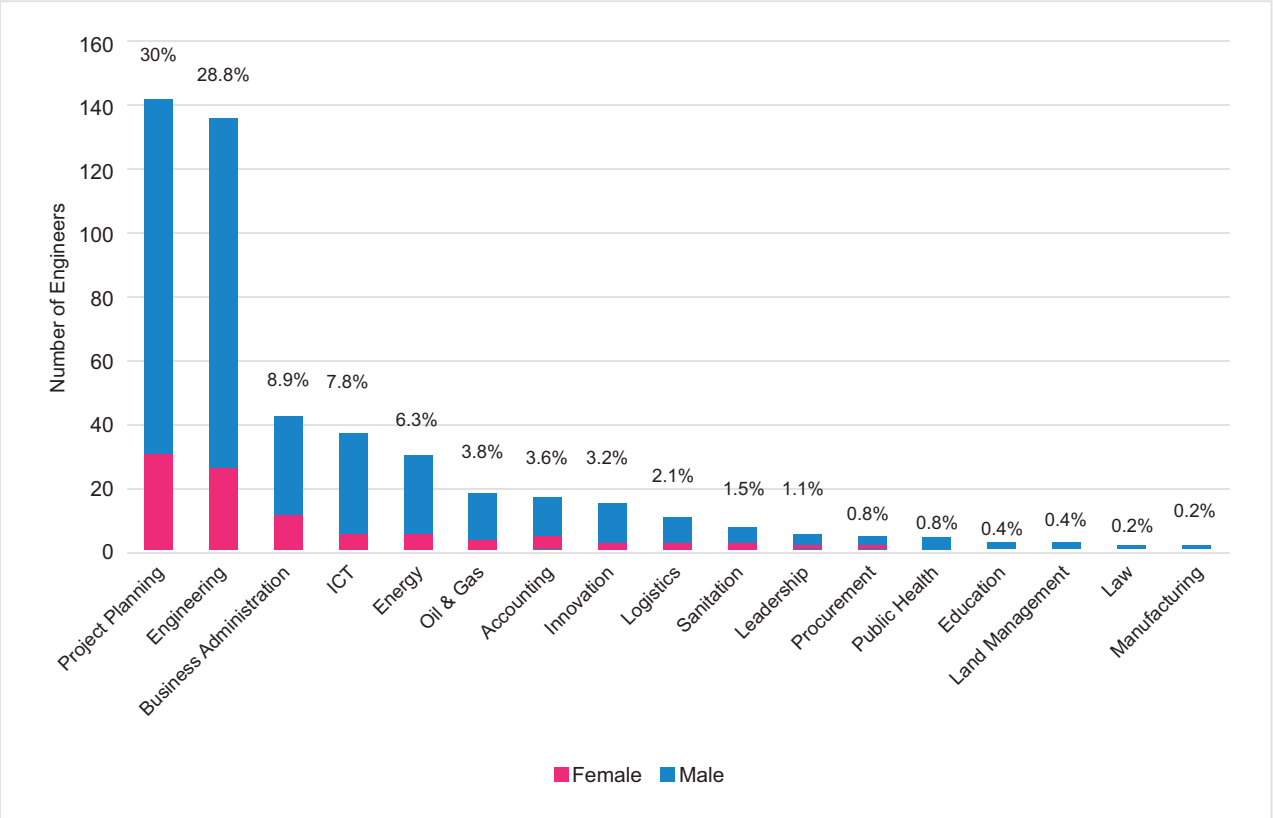
Figure 15: Further Studies by Institution



Most (61.2%) engineers identified 'career development' as the principal reason and 'competitiveness in the labour market' as a secondary reason for pursuing further studies. The main impediments to the pursuit of further studies were largely financial limitations (53.9%) and time constraints (34.85%). As shown in Figure 16, 30% and 28.8% undertook postgraduate studies in project planning and engineering respectively. Current engineering training may not be preparing students to operate in a multi-skilled labour market place which requires certain additional skillsets in business, finance and project management.

> *"Universities should incorporate practical skills like business principles in the curriculum because these are required in the field"*
> **Graduate Mechanical Engineering, 2005-2009**

Figure 16: Main Fields of Postgraduate studies (by Gender)



3.5.8 Postgraduate Training by Field of Engineering

Survey results show that most postgraduate training is being conducted in Civil, Mechanical and Electrical engineering. Just over half (51%) and 32% undertook training at Masters and Diploma levels respectively.

Table 2: Top Ten Fields of Engineering with Graduates with Post-graduate Training

Field of Engineering	Bachelors	Certificate	Diploma	Masters	Total
Civil engineering	0	11	55	81	147
Mechanical engineering	0	14	21	44	79
Electrical engineering	0	10	24	43	77
Telecommunication engineering	1	23	20	23	67
Agricultural engineering	0	5	4	23	32
Environmental & management engineering	0	3	4	8	15
Surveying	0	4	7	3	14
Building economics	0	0	6	2	8
Industrial & management engineering	0	0	5	3	8
Land economics	0	3	0	4	7

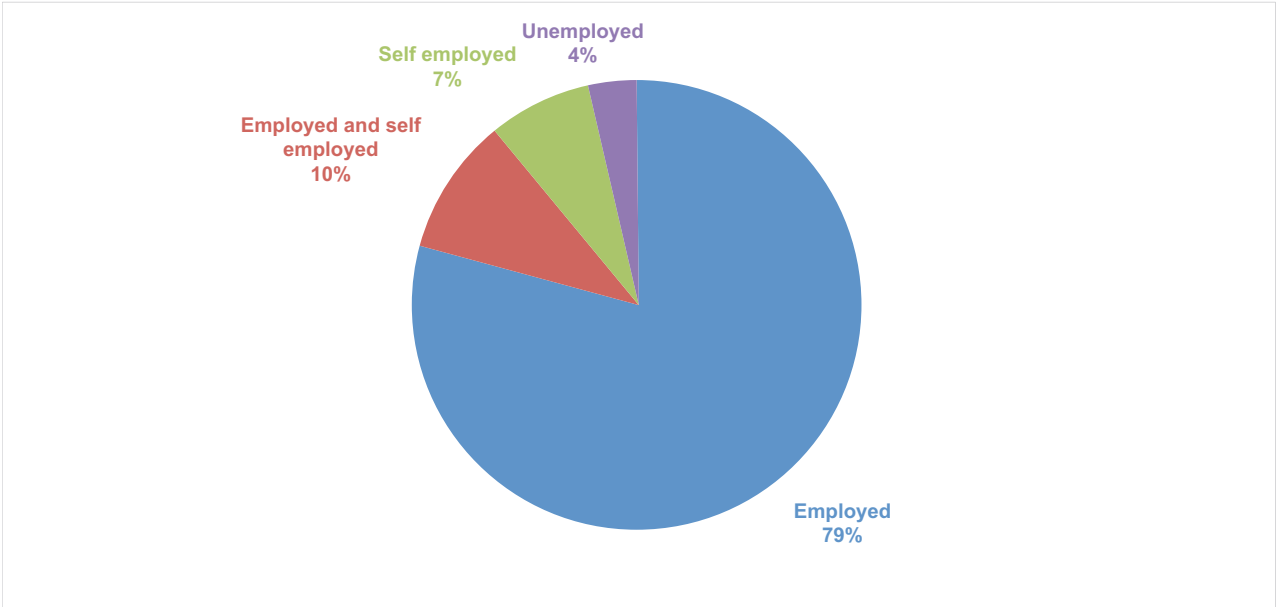
Chapter Four: Employment

4.1 Introduction

Since engineering training started in Uganda, there has been a steady trend away from seeking employment in traditional research and teaching positions toward applied research and development and non-academic employment. Engineering graduates have been prepared for employment positions in government and the higher education sectors. However, recent graduates are able to choose from an expanding number of non-traditional careers in other fields like agro-engineering, renewable energy, food processing and finance. Whereas the number of engineering graduates has gradually increased over the last fifteen years, the absorptive capacity of the labour market is still low. Engineering graduates have to compete for a limited number of opportunities in a narrow public and private sector. Historically, engineering graduates got into positions of employment quicker than most of the other professions and were often head-hunted by companies and government institutions. This was mainly due to the limited number of highly trained engineering personnel. Currently, transition from training to professional employment takes longer with creeping inactivity among engineering graduates.

4.2 Employment Status of Engineering Graduates (2008-2012)

Figure 17: State of Employment of Engineering Graduates (2008-2012)



4.3 Employment Status by Gender

As shown in Figure 17, the majority (79%) of the engineers were employed while 4% were unemployed. Survey data shows that women engineers are less likely to be unemployed. Whereas women contribute about 18.8% of total engineers employed, they also contribute about a fifth (21%) of the unemployed. This is because the number of male engineers greatly overshadows that of female engineers in Uganda. There are limited number of female engineers in the fields of software engineering, industrial & management engineering, computer engineering and mechanical engineering. Between 2008 and 2012, the number of employed female engineers increased by 126%. This is higher than the rate for male engineers and all engineers at 115% and 118%, respectively, over the same period. However, fewer women who graduate with engineering qualifications go into engineering professions.

4.4 Employment Status by Age Group

Three quarters (75%) of the engineers who were reported to be in self-employment were less than 35 years. However, the same category was responsible for 91% of those who were unemployed.

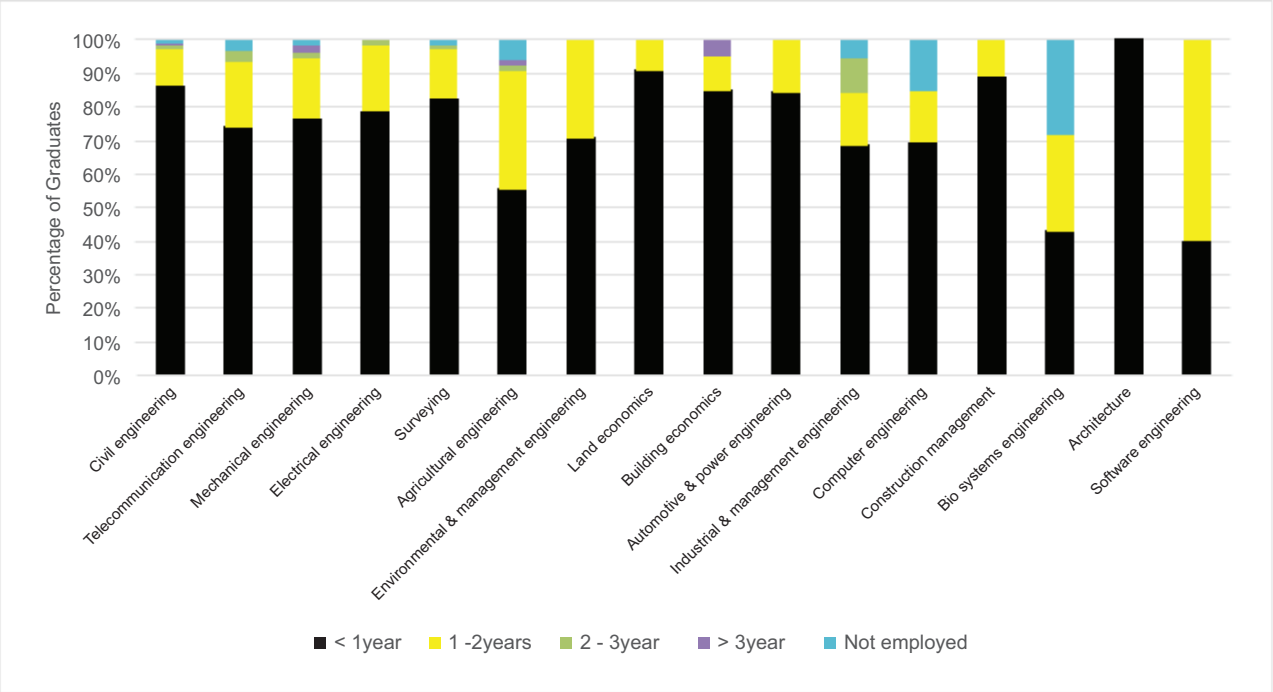
Table 3: Employment Status by Age group

Age	Labor status				Total
	Employed	Unemployed	Self employed	Employed and self employed	
Less than 35years	803	41	66	96	**1006**
35 - 44	128	3	18	18	**167**
45 - 54	22	1	4	6	**33**
55 - 64	2	0	0	0	**2**
65+	0	0	0	0	**0**
Unknown	28				**28**
TOTAL	**983**	**45**	**88**	**120**	**1236**

4.5 Early Career in Engineering

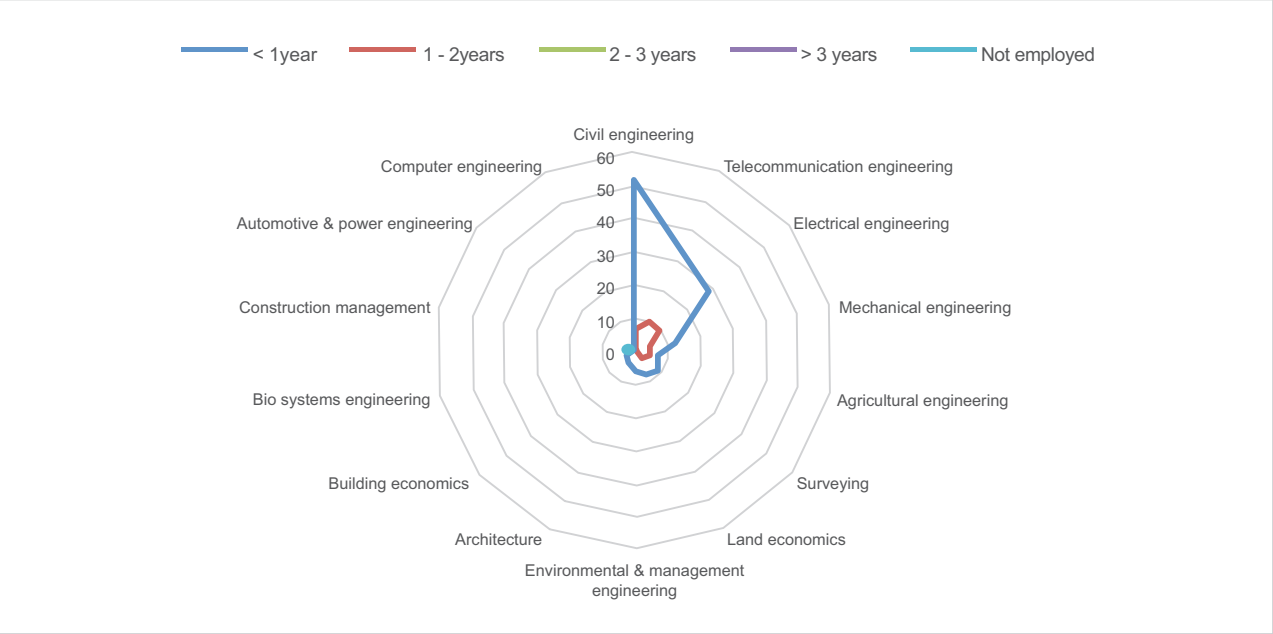
There is general consensus that Engineering graduates are employable. As such, engineering graduates often find jobs or employment soon after graduation. In this survey, at least 40% of graduates got their first jobs less than one year after graduation (all Architecture graduates had received employment less than one year upon graduation). Graduates in software engineering, agricultural engineering, bio-systems engineering and several other fields took up to two years before securing employment.

Figure 18: Time Taken to Secure Employment (by Field of Engineering)



As shown in Figure 19, there was no obvious difference in securing employment for either male or female engineering graduates.

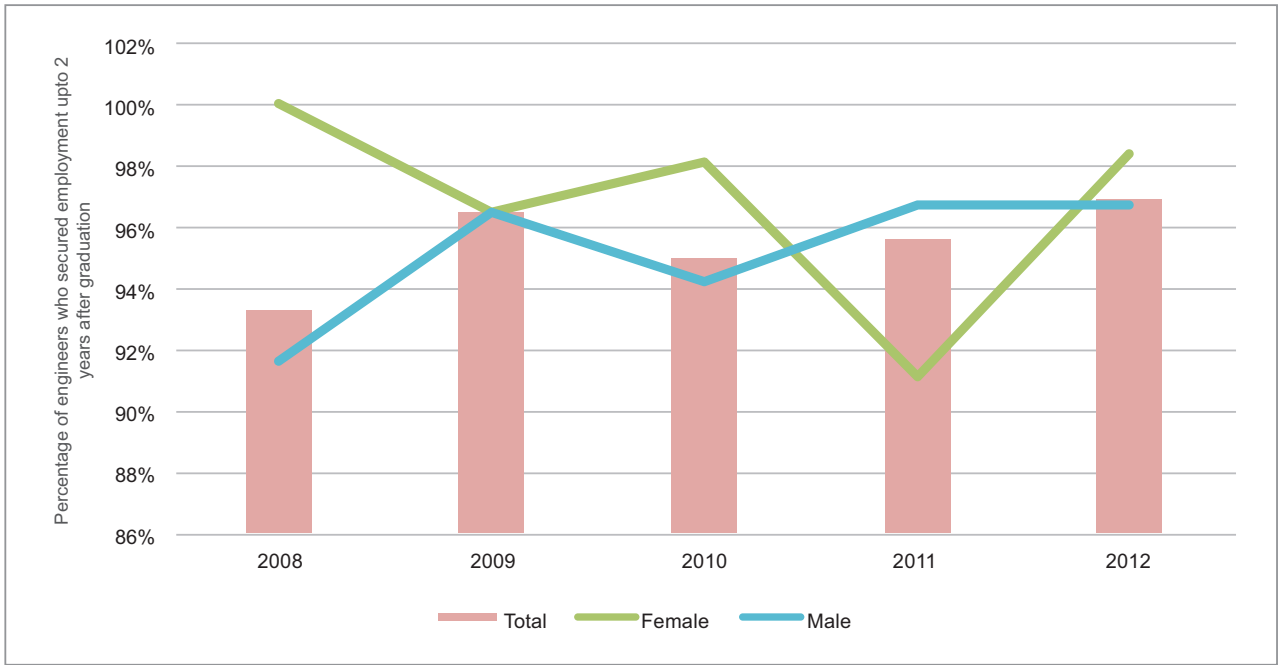
Figure 19: Time Taken to by Female Graduates to Secure Employment (by Field of Engineering)



The propensity to get employed at the earliest opportunity after graduation may be a proxy indication of the demand of graduates from specific fields. In this study, there were consistently more engineers getting into employment between 2008 and 2012. By 2012, those who had been

in employment for more than two years after graduation had increased to 97%. Apart from 2011, the proportion of female engineers entering paid employment was higher than their male counterparts.

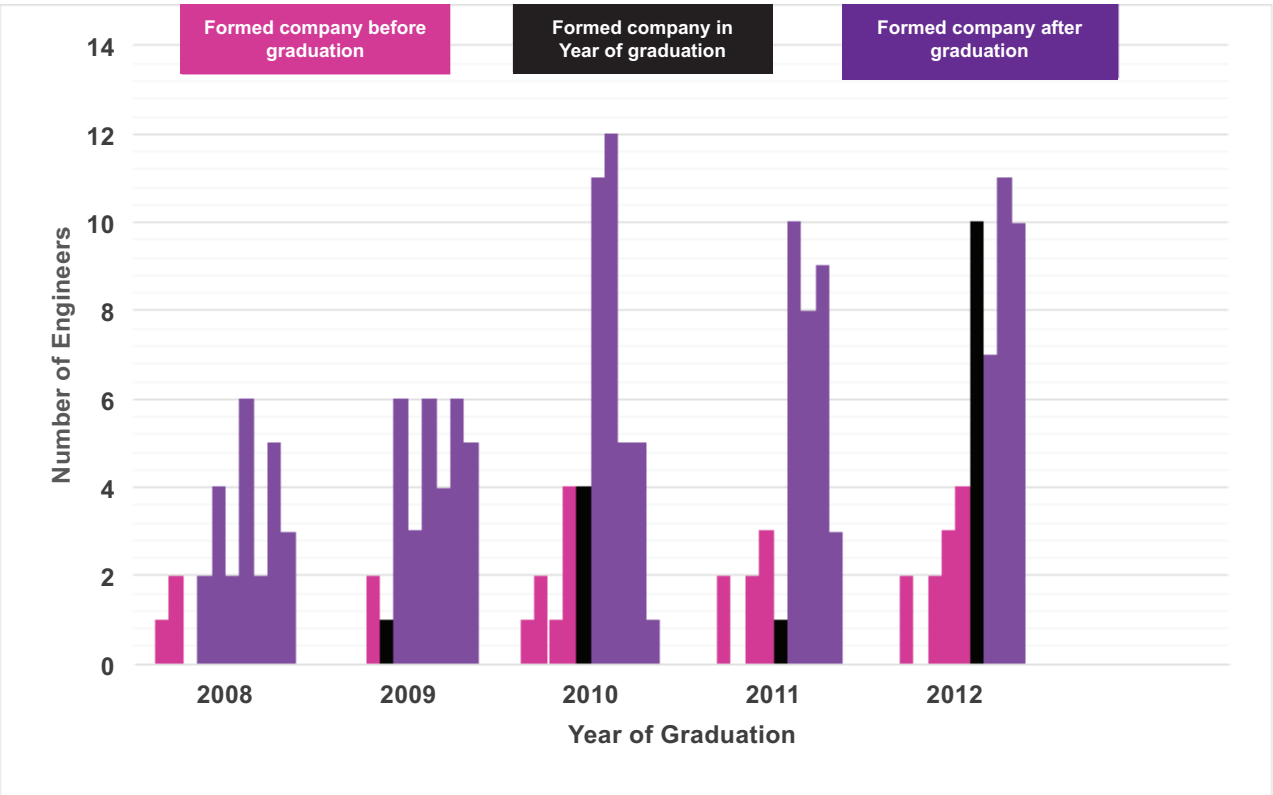
Figure 20: Trend of Engineer Early Career Employment (2008-2012)



4.6 Self-employed Engineers

The number of engineers who open up companies or go into self-employment has been on the increase since 2008. Across all the data for the reference period, more self-employed engineers opened up their business after graduation. Since 2009, more engineers were able to open up businesses in the year of their graduation as shown in Figure 21.

Figure 21: Graduates who formed companies (2008-2012)



However, female engineering graduates were only 14.4% of the total number of self-employed engineers. Female graduates generally struggle to become entrepreneurs owing to several social and financial factors that make them self-exclude from opening up business entities.

4.7 Employment by Sector

Employment of engineering graduates is dominated by the business sector. These include large Multi-National Companies (MNCs), large local Companies and other Medium-Sized Enterprises (MSEs). The Consultancy market for engineering services is also large with engineering consulting firms offering services to central and local government, sub-contracting firms, investors and other industrial firms. Over the long term, the demand for engineering graduates in business and industry is increasing as more employment options become available. They are involved in diverse areas such as manufacturing, information science, software engineering, data processing, visualization and electronic networking. The Private Non-Profit (PNP) sector employs the least number of engineers while less than 5% enter academia or higher education. About 4.1 percent of engineers could not be categorised by sector of employment owing to their nomadic nature of engagement.

Table 4: Employment of Graduate Engineers by Sector (2008-2012)

SECTOR	Frequency	Percentage
	51	4.1
Business Enterprise	806	64.6
Government	305	24.4
Higher Education	44	3.5
Private Non Profit	41	3.3
Total	**1247**	**100**

4.8 Trend in Employment of Graduate Engineers by Sector: 2008 – 2012

Between 2008 and 2012, the number of engineers working in business enterprise sector increased by 123%. There were more women engineers joining the private non-profit and government sectors. Positions for engineering graduates in government have generally been increasing and this trend is likely to continue. However, there is likely to be more demand for engineers to work in particular fields, such as those related to environmental protection, water, civil works and petroleum. The government has for long been the major source of employment for engineers. However, this trend is decreasing for most fields of engineering. This can be attributed to public sector program cuts and hiring freezes that have reduced the number of new engineers being hired. There are fresh niches of opportunity in specific fields, such as energy and environment, but the overall numbers are steady or declining in particular sectors.

Table 5: Change in Employment by Sector (2008-2012)

SECTOR	Percentage change in employment 2008-2012		TOTAL
	Male	Female	
Business Enterprise	126%	112%	123%
Government	46%	87.5%	53%
Higher Education	40%	0%	125%
Private non profit	50%	400%	233%

4.9 Field of Engineering and Sector of Employment

Proportionately, there were more civil engineers working in the government sector than all the other fields of engineering combined. Government, Higher education and the Private non-profit sectors were not employing any graduates in Bio-systems engineering, architecture and software engineering.

Table 6: Field of Engineering by Sector of Employment (2008-2012)

Field of Engineering	Sector of Employment					Total
	Unknown / Unemployed	Business Enterprise	Government	Higher Education	Private non profit	
Civil	13	167	124	7	10	321
Telecommunication	4	170	26	13	7	220
Mechanical	9	147	50	5	4	215
Electrical	6	114	48	6	2	176
Surveying	1	55	13	1	2	72
Agricultural	11	28	11	13	4	67
Environmental & Management	0	12	9	0	5	26
Land Economics	0	17	4	0	3	24
Automotive & Power	1	14	6	0	0	21
Building Economics	1	14	4	0	1	20
Industrial & Management	1	16	3	0	0	20
Computer	1	12	1	0	2	16
Construction Management	0	6	3	0	0	9
Bio Systems	3	5	0	0	0	8
Architecture	0	7	0	0	0	7
Software	0	5	0	0	0	5
Other	0	14	3	0	1	18

4.10 Engineering graduates by Employment Type

Part-time work within a profession is a sign of the flexibility of the workplace. In this survey, 'temporary work' was defined as "all employment with less than 35 usual working hours per week". As shown in Table 7, only 3.7% of engineering graduates were undertaking such work. Most engineering graduates were either employed on permanent or contractual basis.

Table 7: Engineering graduates by Employment Type

Employment Type	Frequency	Percent (%)
Undeclared	32	2.6
Permanent	563	45.1
Temporary	46	3.7
Contract	506	40.6
Other	11	0.9
Total	**1247**	**92.9**

4.11 Core and Non-Core Engineering

4.11.1 Core engineers by Sector of employment

Over half (57.6%) of engineers in the survey were working in occupations that were described as 'core engineering'.[6] Most of the graduates in core-engineering occupations are graduates of the traditional engineering fields of civil, electrical, mechanical and telecommunication engineering. Between 2008 and 2012, the number of engineers pursuing careers in core engineering increased by 140%. This growth has mainly been driven by an increase in the engineers providing engineering consultancy services in the business sector.

"Practical training is still below the required level for Ugandan engineers to be competitive in their regions because the universities are ill equipped & the lecturers are not in touch with the technological & practical advancements"

Graduate, Mechanical Engineering (2008-2010)

Table 8: Core Engineers by Sector of Employment (2008-2012)

Field of Engineering and Technology	Sector of employment (Employed as engineer)				
	Business Enterprise	Government	Higher Education	Private non profit	TOTAL
Agricultural engineering	26	15	0	1	42
Automotive & power engineering	21	8	1	0	33
Civil engineering	98	77	1	7	183
Electrical engineering	62	27	3	2	94
Mechanical engineering	89	32	1	3	125
Surveying	8	1	0	0	9
Telecommunication engineering	90	16	6	1	113
Others	82	28	2	7	119
Total	**476**	**204**	**14**	**21**	**718**

4.11.2 Non-Core Engineers by Sector of Employment

Most (67%) of the engineering graduates in non-core engineering professions were in the business sector. Those engineering graduates who did not go into mainstream engineering occupations tended to become sales agents, brokers, accountants, bank tellers and related clerks. Similarly, 21% were in the government sector. Such engineers had either branched off into running private business (moved on from mainstream

"I loved Telecom engineering, but to my disappointment I have not worked within the field. Jobs are about technical know-who and not your capability, grades or love for engineering! Besides I am still looking for an engineering job"

Graduate, Telecommunication, First Class degree holder, working as Bank Teller

6 Working in the company/organization/Institute that is totally related to their engineering stream/branch.

engineering) or were employed in government Ministries, Departments and Agencies (MDAs) in varying administrative roles.

Table 9: Non-Core Engineers by Sector of Employment (2008-2012)

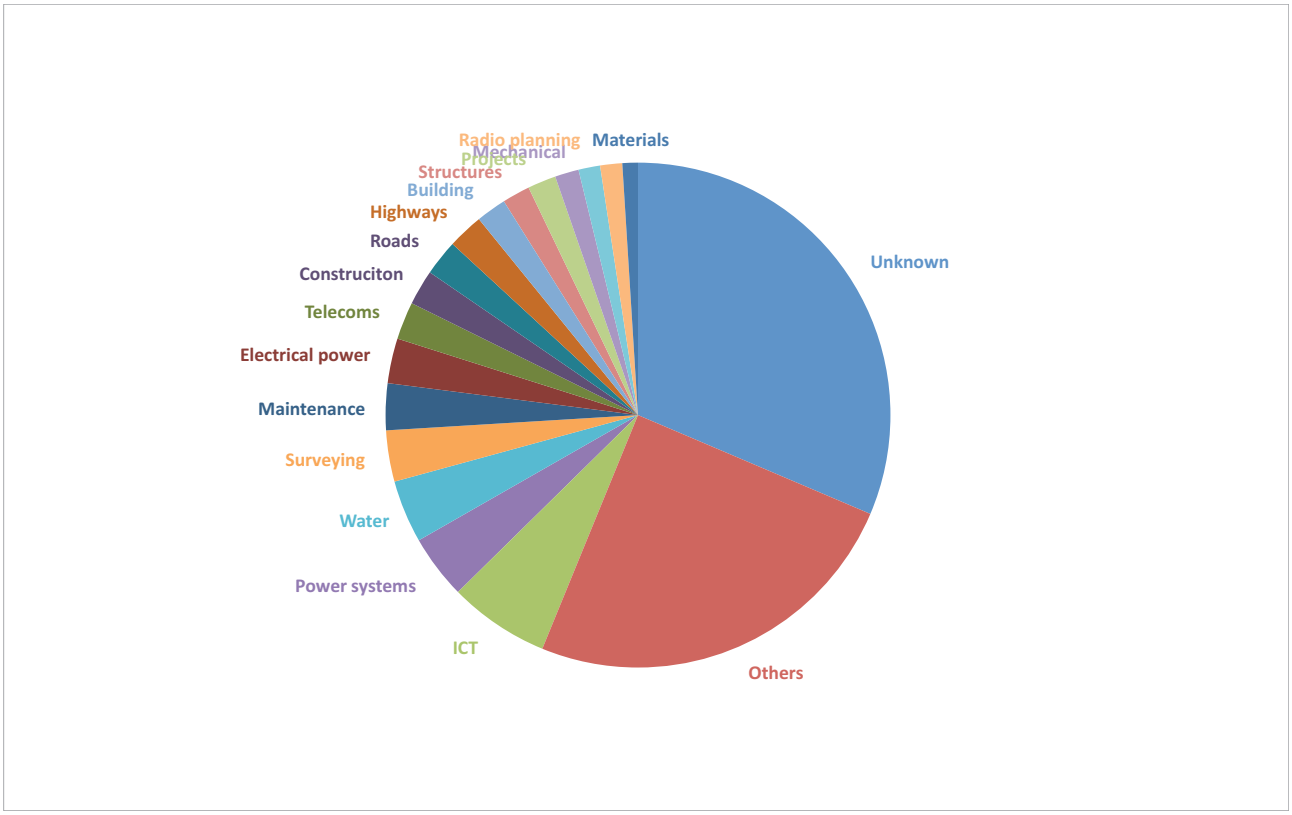
Field of Engineering and Technology	Sector of Employment (Not Employed as an Engineer)				
	Business Enterprise	Government	Higher Education	Private non profit	Total
Agricultural engineering	15	2	5	3	25
Land economics	9	2	0	0	11
Civil engineering	19	16	4	0	39
Electrical engineering	14	6	2	0	22
Mechanical engineering	26	8	3	0	37
Surveying	32	8	0	2	42
Telecommunication engineering	27	3	6	3	39
Others	33	10	2	1	46
Total	**175**	**55**	**22**	**9**	**261**

4.12 Areas of Specialisation

Uganda still lacks engineers with sufficient skills and experience owing to several factors ranging from limited internship, a dearth of on-the-job training opportunities (apprenticeships); institutional policies and approaches to engineering; unsubscribed professional registration; brain drain; and inappropriate education curriculum. Collectively, these factors make it difficult to specialise or enter specialised engineering markets. In this survey, when asked about the area of specialisation, many engineers didn't know or have any particular area of expertise. However, the highest number of specialists was in the areas of ICT, Power systems, Water etc. as shown in Figure 22.

> *"More hands-on courses have to be introduced in these universities and more emphasis on employing lecturers with some years of practical experience; that is, not retaining 1st class degree holders without experience in the work place"*
>
> **Graduate, Mechanical engineering (2006-2011)**

Figure 22: Engineering Graduates by areas of Specialisation



4.13 Nature of Work

Most (72%) of engineering graduates described their current occupation as being 'closely related' to their undergraduate training. This is consistent with previous studies that have shown that 76% of engineering graduates in Uganda are in careers 'related' to their training. A third (34%) of female engineers were involved in careers or professions that are not related to engineering. Telecommunication, civil, mechanical and electrical engineering graduates are in careers that are closely related to their undergraduate training. Between 2008 and 2012, the number of engineers in closely-related professions increased by 46% and 123% for female and male engineers, respectively. In addition, whereas the number of male engineers in unrelated professions has reduced by 11%, the number of female engineers in such professions increased four-fold (400%) between 2008 and 2012.

Figure 23: Relationship of training to current employment

Box 1: Engineering Graduates and Engineering Jobs in the UK

We know that only around 70 per cent of those who study engineering go on to work for a company whose primary activity is engineering. That could mean that many graduates go into higher earning sectors but also that others work for engineering firms in non-engineering roles such as business, management or even sales. The annual What Do Graduates Do? Report from the Higher Education Careers Service Unit (HESCU) found that average salaries for engineering graduates tend to be above those for other subjects because of the larger proportion of graduates working in full-time engineering roles. Among mechanical engineering graduates, for example, 64.2 per cent surveyed were working as engineering professionals (not just in engineering companies) and only 22.9 per cent were in other professional roles, with just 8.4 per cent in business, finance or management compared with 13.2 per cent for all graduates.

What do graduates do? A Report for the Higher Education Careers Service Unit HESCU, UK 2015.

4.14 Engineers by ISCO Classification

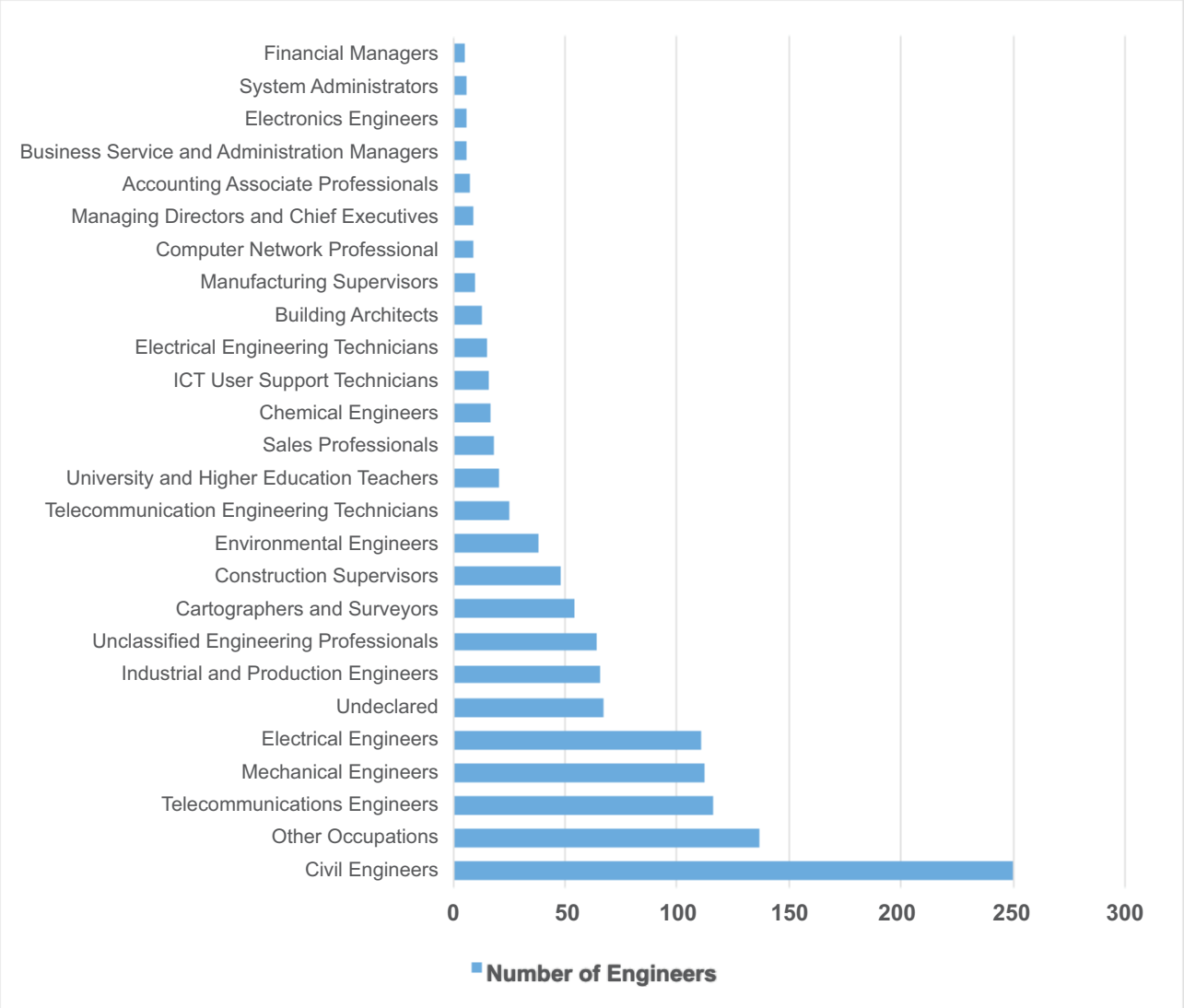
The International Standard Classification of Occupations 2008 (ISCO-2008) provides a framework for classifying and aggregating occupational information. According to the classification,

engineering professionals design, plan and organize the testing, construction, installation and maintenance of structures, machines and their components, and production systems and plants, and plan production schedules and work procedures to ensure engineering projects are undertaken safely, efficiently and in a cost effective manner[7]. Responses from the survey were coded using standard ISCO methodology to ensure comparability of Uganda's engineering capacity with other countries. Following this standard classification, Figure 24 shows the spread of engineering graduates across different occupations.

Institutions of higher learning ought to educate employers on the main areas that agricultural engineers can work in. Relatedly, essential course units which are relevant to the job market should be incorporated to the degree/ diploma program accordingly.

Graduate Agricultural Engineering, 2003-2008

Figure 24: Engineering Graduates (2008-2012) by ISCO Classification



7 International Labour Organisation, Draft ISCO-08 Group Definitions: Occupations in Science and Engineering at http://www.ilo.org/public/english/bureau/stat/isco/docs/d12b.pdf

4.15 Earnings

4.15.1 Monthly Income of Engineering Graduates

In choosing a career, expected monetary returns are always of interest and importance. Earnings in engineering, as in other professions, vary considerably and are affected by many factors. Generally, the average annual salaries for engineering graduates are higher than average annual salaries for other S&T graduates. In addition, the length of experience is one of the most significant factors affecting earnings. For most engineers, earning capacity increases with added years of experience and professional reputation. In this survey, income bands were based on standard GoU salary schedules for new graduates.

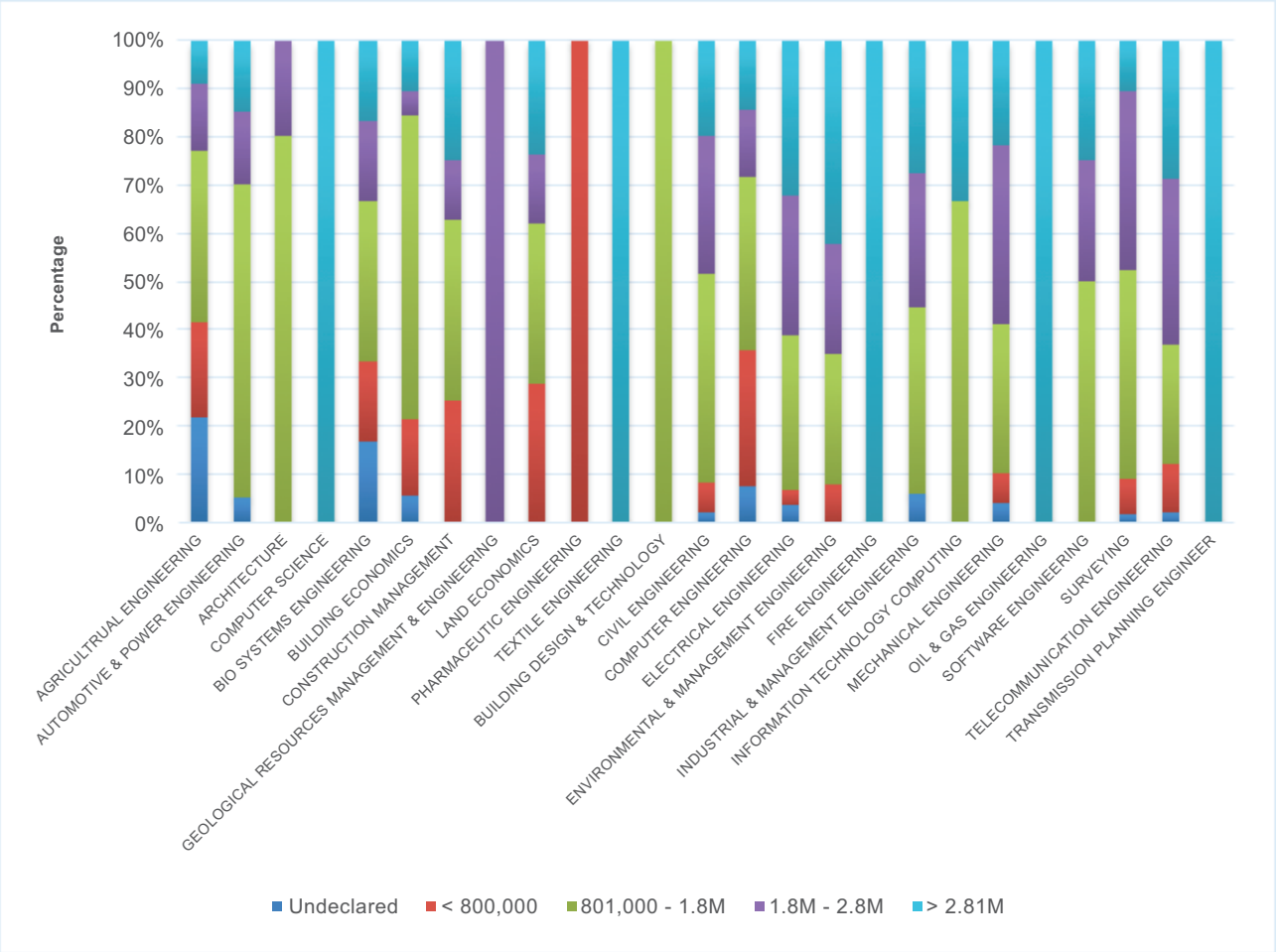
Table 10: Gross Monthly Earnings of Engineering Graduates (2008-2012)

Gross Monthly Earnings (UGX)	Frequency	Percent
Undeclared	44	3.5
< 800,000 (< $242)	95	7.6
801,000 - 1.8 Million ($242 - $545)	426	34.2
1.8M - 2.8 Million ($545 - $848)	354	28.4
> 2.81 Million (> $848)	276	22.1
TOTAL	**1195**	**95.8**

4.15.2 Earnings by Field of Engineering

Engineers in transmission, oil and gas, fire, textile and computer engineering were earning more than UGX 2.8 million. Conversely, engineers in pharmaceutical engineering were earning less than UGX800,000, the lowest income stratum. The survey found a significant relationship between the field of engineering and the level of earnings.

Figure 25: Earnings by Field of Engineering



4.15.3 Earnings by Occupation

According to the survey, engineers working as civil engineering technicians, electrical engineering technicians and telecommunication engineers were earning more than UGX 2.8 million shillings. On the other hand, engineers who were unclassified were earning less than UGX 800,000 as shown below.

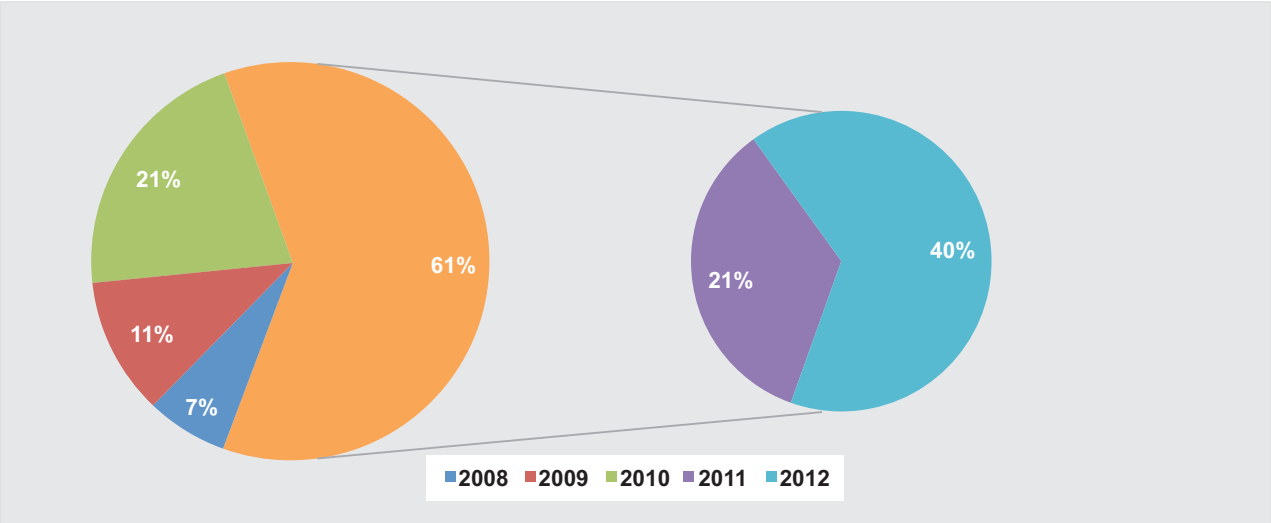
Table 11: Gross Monthly Earnings by Occupation

Occupations by ISCO Classification	< 800,000 (< $242)	801,000 - 1.8M ($242 - $545)	1.8M - 2.8M ($545 - $848)	> 2.81M (> $848)	TOTAL
Accounting Associate Professionals	1	4	1	2	**8**
Building Architects	1	5	3	3	**12**
Business Service and Administration Managers	1	1	2	2	**6**
Cartographers and Surveyors	6	22	12	7	**47**
Chemical Engineers	1	5	6	4	**16**
Civil Engineer	18	109	72	44	**243**
Computer Network Professional	0	5	1	2	**8**
Construction Supervisors	3	17	15	11	**46**
Electrical Engineer	2	31	32	41	**106**
Electrical Engineering Technicians	3	7	3	2	**15**
Electronics Engineers	1	1	1	3	**6**
Environmental Engineers	3	11	11	13	**38**
Financial Managers	1	0	2	2	**5**
ICT User Support Technicians	2	3	3	6	**14**
Industrial and Production Engineers	3	21	18	17	**59**
Managing Directors and Chief Executives	3	3	1	2	**9**
Manufacturing Supervisors	1	4	3	2	**10**
Mechanical Engineer	4	40	38	25	**107**
Other Occupations	16	49	39	26	**130**
Sales Professionals	4	6	3	3	**16**
System Administrators	0	2	2	2	**6**
Telecommunication Engineering Technicians	3	6	7	7	**23**
Telecommunications Engineers	6	31	45	30	**112**
Unclassified Engineering Professionals	4	23	17	14	**58**
University and Higher Education Teachers	2	8	6	2	**18**
TOTAL	**95**	**426**	**354**	**276**	**1151**

4.15.4 Earnings by Year of Graduation

Employment outcomes and earnings may vary according to the available number of opportunities for employment. From the survey, most (61%) of the graduates earning less than 800,000UGX graduated in the most recent years considered under this survey (2011 and 2012). Graduates from 2008 represented 7% of graduates within this earning group.

Figure 26: Engineers Earning Less than 800,000UGX by Year of Graduation



4.15.5 Earnings by Sector

There was a strong relationship between the sector of employment and income. Accordingly, 68.4% of the engineers who were earning more than UGX2.8 Million were in the business sector. The Private Non-profit provided the least earnings. Average earnings were highest for Civil, Electrical, Mechanical and Telecommunication engineers. Engineers employed by government and local governments were generally earning higher incomes.

Table 12: Gross Monthly Earnings of Engineering Graduates by Sector of Employment

Sector of Employment	Undeclared	< 800,000 (< $242)	801,000 - 1.8M ($242 - $545)	1.8M - 2.8M ($545 - $848)	> 2.81M (> $848)
	39	3	3	2	1
Business Enterprise	0	55	257	264	189
Government	1	21	141	67	70
Higher Education	3	8	15	10	6
Private non profit	1	8	10	11	10
TOTAL	**44**	**95**	**426**	**354**	**276**

4.16 Unemployed and Underemployed Engineers

Unemployed engineers represented 4% of the total number of engineering graduates. This is slightly above the national average rate of 3.63%[8] that was registered between 2003 and 2013. Unemployed engineering graduates were mainly in the fields of agricultural, civil, and mechanical engineering. Half (52%) of the unemployed engineering graduates had been searching for employment for a period spanning up to a year. Those engineers who were not searching for employment were mainly undertaking further studies; constrained by limited job opportunities, poor salaries and domestic responsibilities, among others. Most (63%) of the unemployed were from Makerere University and were mostly male (81.6%). Over half (68.4%) of the unemployed had not undertaken any postgraduate training. Those who had undertaken postgraduate training had done so in an engineering field.

Almost all (94.7%) of unemployed engineers were not intending to continue working in their field of engineering, with only 14.3% intending to stay in the country over the next five years. Recent graduate engineers are experiencing increasing delays in securing permanent employment. That is, it is taking longer for recent graduates to get into the workplace as indicated in Table 13.

8 www.tradingeconomics.com/uganda/unemployment-rate

Table 13: Time Spent Searching for Employment

Period spent searching for employment	Frequency	Percent
< 6 – 12 months	35	52
12 – 24 months	14	22
24 – 36 months	11	18
> 36 months	2	8
Total	62	100

When recent graduates do find employment, they are increasingly underemployed or underutilized. Many engineering graduates are able to obtain only part-time jobs that do not explicitly require an engineering degree. This survey defined the underemployed as "those working part-time but seeking full-time work or those working in a non-engineering jobs but desiring an engineering job". The underutilized are the unemployed (those who do not have positions but are seeking positions) plus the underemployed.

Chapter Five:
Engineer Registration

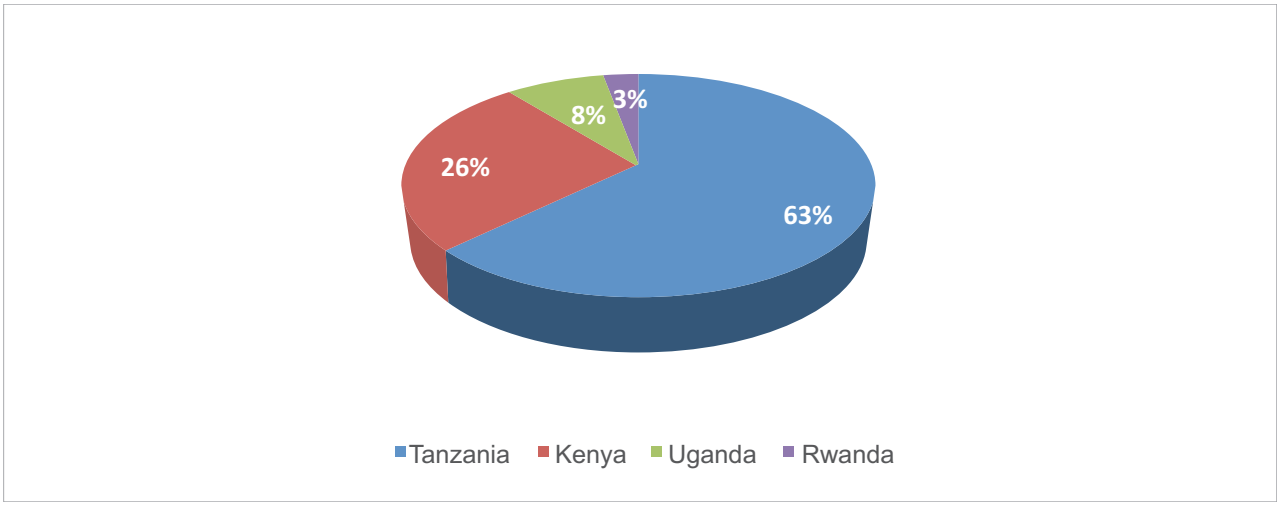
5.1 Engineer Registration in Uganda

Registration of engineers remains an internationally recognised approach for regulating professional practice in a jurisdiction for good conduct of practice. It isolates and enforces discipline, streamlines responsibilities, clarifies legal roles and confers professional prestige and esteem[9]. In some countries, graduates with only a first degree may be limited in the type of work they may enter. In Uganda, the Engineers Registration Act (1969), Cap 271 makes it a mandatory requirement for anyone intending to practice engineering in Uganda to first register with the Engineers' Registration Board (ERB). The ERB seeks to register and licence engineers to practice in Uganda. The Board, appointed by the Minister for Works and Transport, discharges this mandate in close collaboration with Uganda Institution of Professional Engineers (UIPE), an independent association of engineers. Registration of an engineer in Uganda should occur four years after graduation from a recognised engineering school and attainment of corporate membership of UIPE. Registration must also require one to undergo two years of pupilage training and an additional of working under direction of a registered engineer.

The number of registered engineers in Uganda is still low compared to the other countries in the East African Community (EAC). Kenya has a register of 1,400 engineers which is twice that of Uganda. (By 2015, Uganda had a register of 772 engineers of which 494 were in practice.) Under Article 104 of the EAC treaty, partner states agree to a protocol to facilitate the free movement of persons, free movement of labour, free movement of services and the right of establishment and residence. Specifically, the Mutual Recognition Agreement (MRA) for engineering professionals in the EAC enables a professional in one state in the region to be recognised as a professional in all the member states. The MRA for EAC engineers was signed on 7th December 2012 between Uganda, Kenya and Tanzania. Proportionately, 63% of the registered engineers in the EAC are from Tanzania as shown in Figure 27.

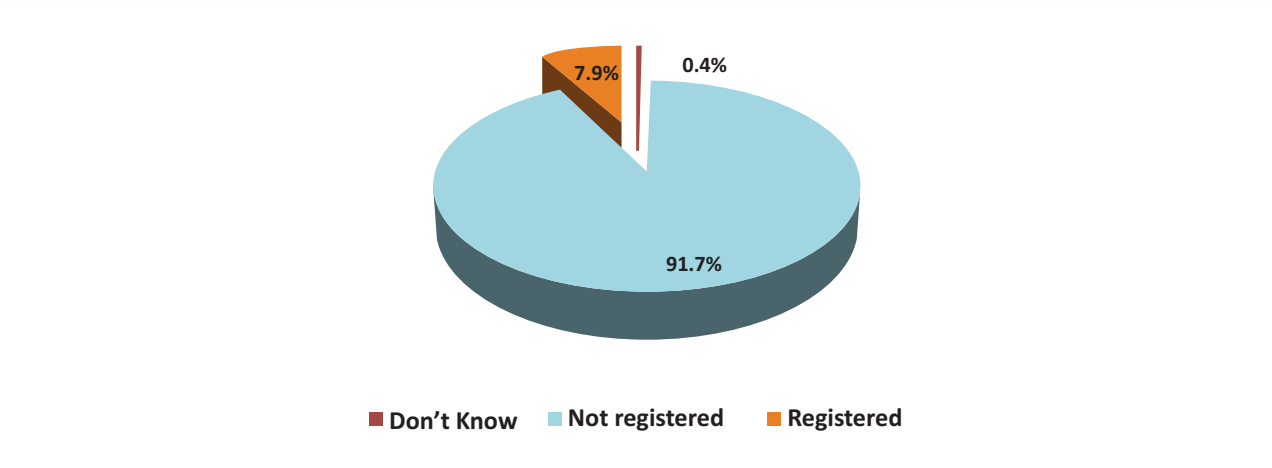
9 Why Are Engineers in Short Supply in Uganda – Article in the New Vision – 14th April 2015.

Figure 27: Registered Engineers in the EAC



In this survey, most (91.7%) of the engineers who graduated between 2008 – 2012 are not registered and therefore risk not benefiting from EAC integration and the established MRAs.

Figure 28: State of Registration of Engineers (2008-2012)



Box 2: Engineer Registration Trends in South Africa

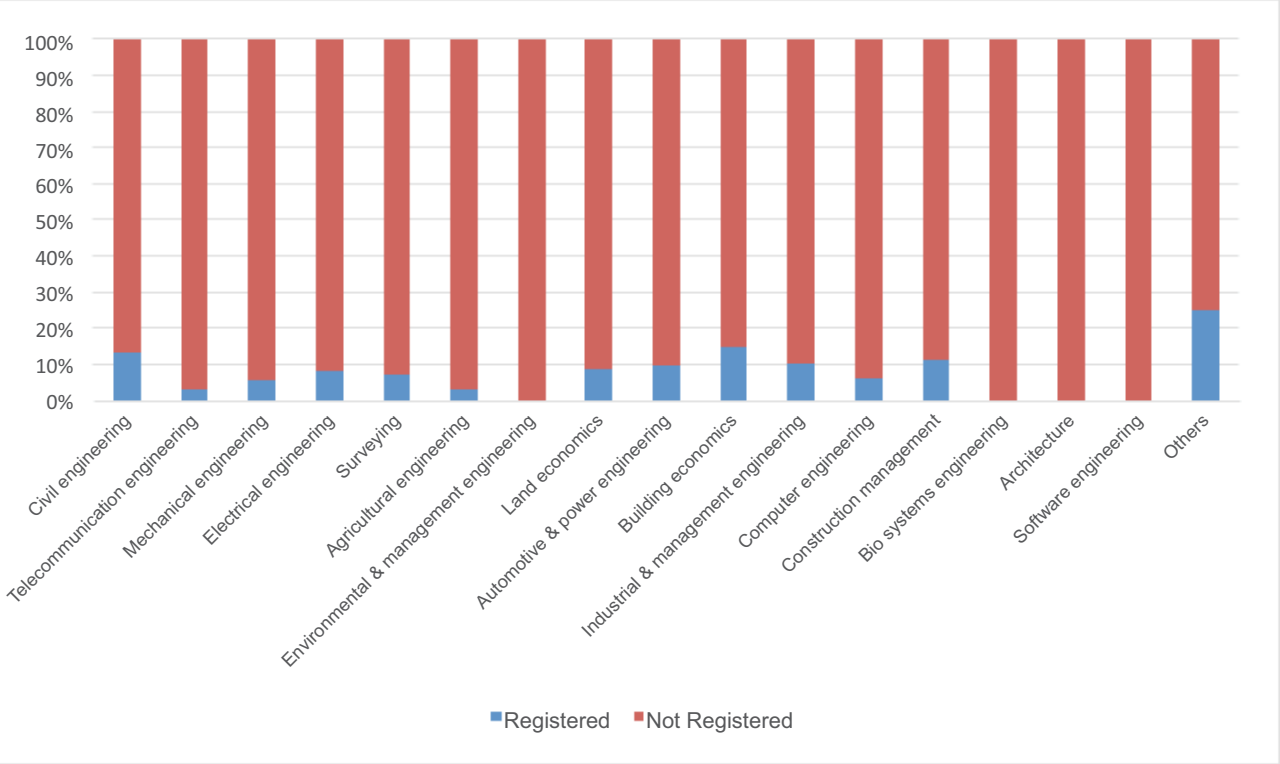
One of ECSA's key strategic thrusts is the growth of registered engineering professionals. In this regard, ECSA managed to maintain growth in registration numbers during the 2014/2015 financial year. The continued growth trajectory in registration numbers can be a result of many factors which include, among others, awareness campaigns on the benefits of registration presented to industry and higher education institutions by ECSA. The database of registered persons increased from 43 967 on 31 March 2014 to 45 806 on 31 March 2015, which represents an increase of 4.1% over the reporting period. Like in the previous years, a large number of cancellations due to non-payment of annual fees were noted. Remarkably, the year-on-year increase in new registration in various categories from 2010 to 2014 is indicative of government and industry becoming more and more committed to good quality service provision in the country. This is elaborated by these important stakeholders' commitment towards the creation of enabling training environments which also facilitate the development and progression of candidates towards achieving the desired competencies for professional registration.

Engineering Council of South Africa, Annual Report 2014/15

5.4 Registration by Field of Engineering

Whereas registration across all the core fields of engineering was less than 30%, engineers in the fields of software, bio-systems, and management were among those who were not registered at all. New fields like telecommunication, agricultural engineering had less than 5% registration.

Figure 29: State of Engineers' Registration

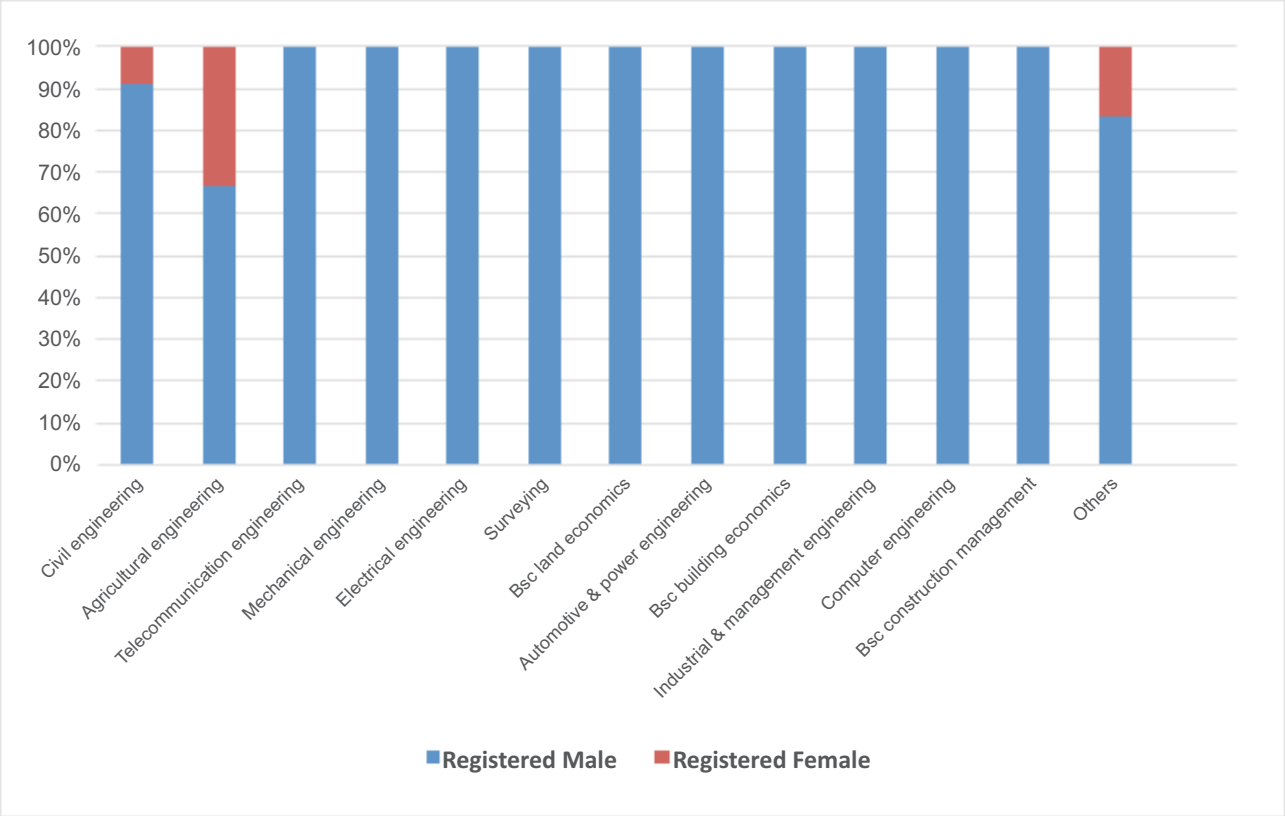


5.5 Registration by Gender

Registration levels across gender are generally the same. There are more male registered engineers across all traditional and non-traditional fields of engineering. Female engineers simply 'disappear' by registration status.

> *"Please streamline the procedures that Engineers have to go through to be registered".*
>
> **Graduate, Automotive & Power Engineering**

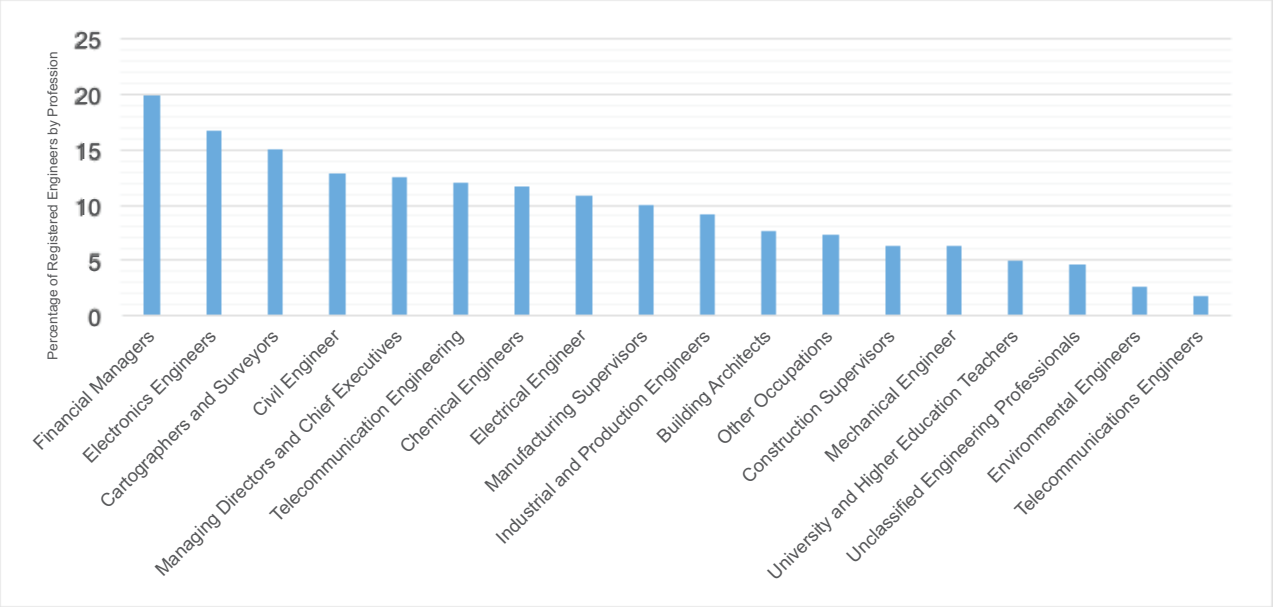
Figure 30: State of Registration by Gender and Field of Engineering



5.6 Registration by Occupation

Registration levels by occupation show that a fifth (20%) of engineers working as finance managers were registered. For the auxiliary fields of engineering, 15% and 7% of surveyors and architects were found to be registered, respectively. In addition, 12% of engineering graduates from Kyambogo University were registered compared to 6.7% from Makerere University. Most (96%) of registered engineers had received their undergraduate engineering degree in Uganda.

Figure 31: State of Registration by Occupation



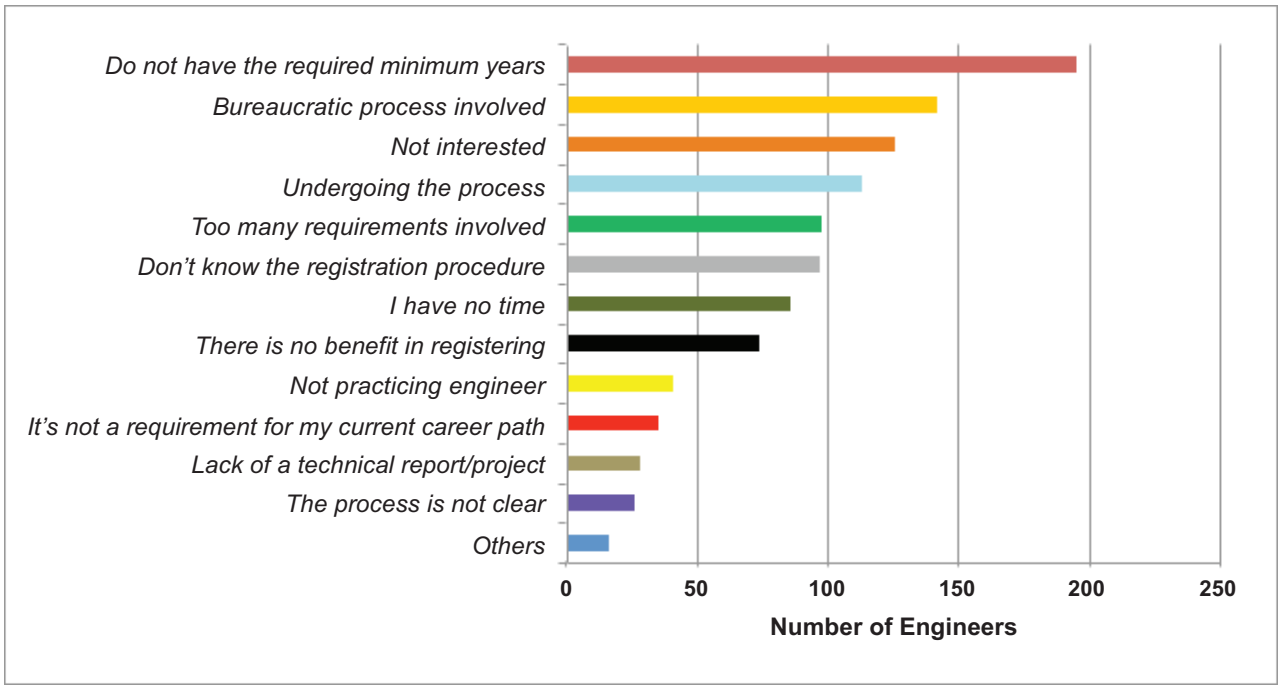
5.7 Reasons for Non-Registration

Several reasons were put forward for non-registration. Most of the factors were mainly to do with the process of registration and the associated difficulty of meeting the requirements for registration.

"The conditions for registration do not favour engineers in academia or those working in up-country field stations."

Graduate, civil engineering (2006-2010)

Figure 32: Reasons for Non-registration



Chapter 6:
Scientific Innovations

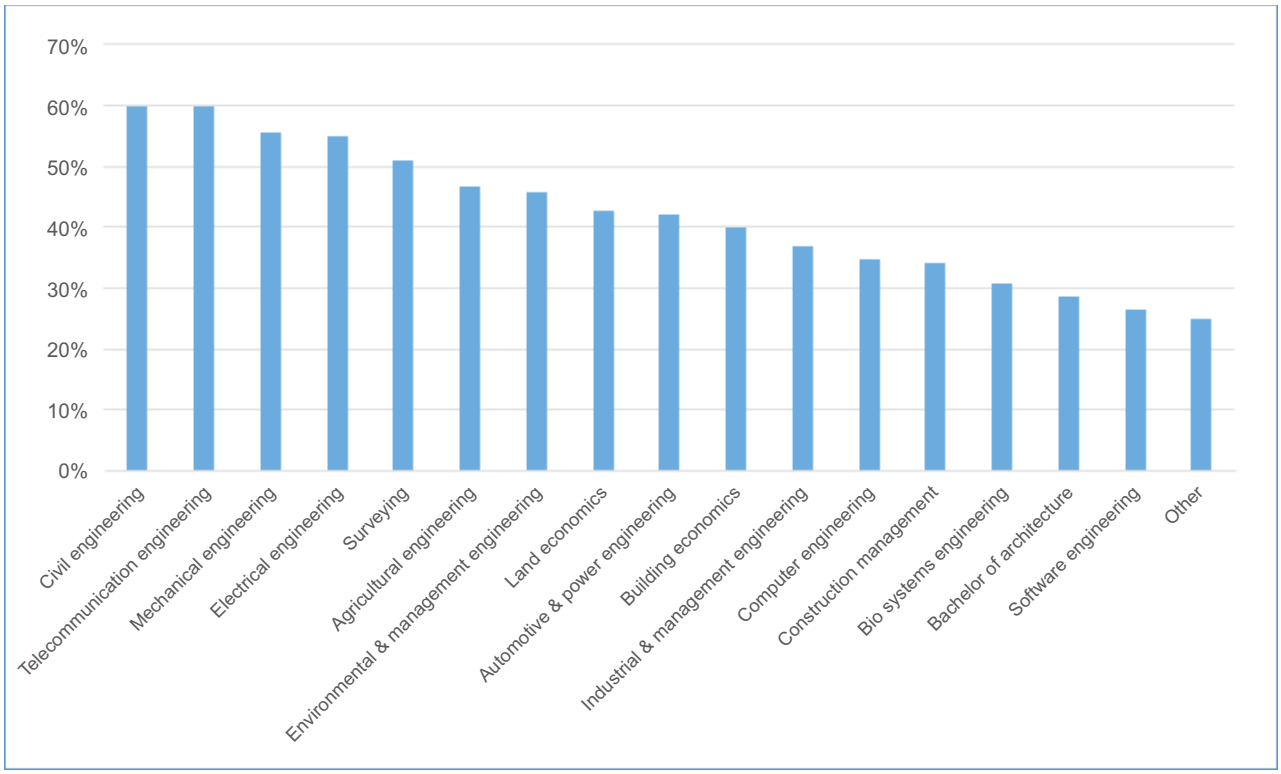
6.1 Introduction

Innovation is a key driver for increasing living standards and quality of life. In particular, engineers play a critical role in innovation and in improving society. Many industries essential to Uganda's economic growth such as construction, mining, telecommunications and manufacturing require significant engineering and associated innovation. By focusing on innovation in industries relevant to engineering, it is possible to increase productivity and contribute to the economic prosperity of the nation. Most recently, Ugandan engineering has been at the forefront of several turn-key innovations that have shown the potential to create solutions to contemporary challenges. Innovations like the Kiira EV Vehicle have showcased the potential contribution innovation in engineering can make towards national development.

6.2 Research and Innovation Activities

Sixty-one percent of engineers were involved in research and innovation activities. The highest research and innovation activities were conducted in the traditional fields of engineering (civil, electrical and mechanical). Telecommunication engineers also conducted research and innovation. The least innovation was undertaken by software engineers. Between 2008 and 2012, the number of female engineers involved in research and innovation activities modestly increased by 50% while male engineers increased by 130%.

Figure 33: Percentage of Engineers Conducting Research and Innovation Activities



6.3 State of Innovation

Proportionately, 32% carried out 'successful' innovations, 61% had 'on-going' innovations while 7% had 'abandoned' innovations. The most 'successful innovations' were undertaken in the fields of mechanical engineering while civil engineering accounted for 'abandoned innovations'. Female engineers were involved in only 10% of successful innovations and in 19% of abandoned innovations. The barriers to innovation include lack of resources, absence of innovative culture in organisations, unavailability of technology resources, inadequate strategic alliances and weak industry/university collaborations.

"I would like to work in my line of engineering given an opportunity. I have developed a facial recognition log-in device that can be used by insurance companies to track client details. It can also be used by different organisations to track their employees."

Graduate Telecommunications Engineering, 2008-2012

Table 14: Innovation by Field of Engineering

Field of Engineering and Technology	Successful Innovations1	Ongoing Innovations2	Abandoned Innovations3	Total
Civil engineering	26	73	7	106
Telecommunication engineering	28	45	5	78
Mechanical engineering	32	52	6	90
Electrical engineering	25	51	4	80
Surveying	9	8	2	19
Agricultural engineering	10	13	1	24
Environmental & management engineering	4	3	1	8
Land economics	2	7	2	11
Automotive & power engineering	2	6	0	8
Building economics	3	4	1	8
Industrial & management engineering	5	3	0	8
Computer engineering	1	7	1	9
Construction management	2	2	1	5
Bio systems engineering	1	2	0	3
Architecture	0	2	0	2
Software engineering	0	2	0	2
Others	2	9	1	12

Box 3: Engineers and Innovation: Australian experience

One of the main ways that the Government supports business R&D is through the R&D Tax Credit. In 2010 the Government undertook to change this incentive program. The new R&D tax incentive provides a tax offset for expenditure on eligible R&D activities and for the decline in value of depreciating assets used for eligible R&D activities.

The two core components of the new R&D incentive are:

- A 45 per cent refundable R&D tax offset for eligible entities with a turnover of less than $20 million
- A non-refundable 40 per cent R&D tax offset for all other eligible entities

According to members of Engineers Australia, other forms of financial support are desirable including tax incentives for those financing innovative ventures.

This could include, for example:

- A taxation holiday on profits generated from new innovations for a specified number of years higher rates of depreciation on equipment required to exploit a novel idea
- Incentives paid to researchers and organisations relating to their commercialisation success using a percentage of Australia's Future Fund to finance commercialisation of innovations that are likely to produce high returns for Australia.

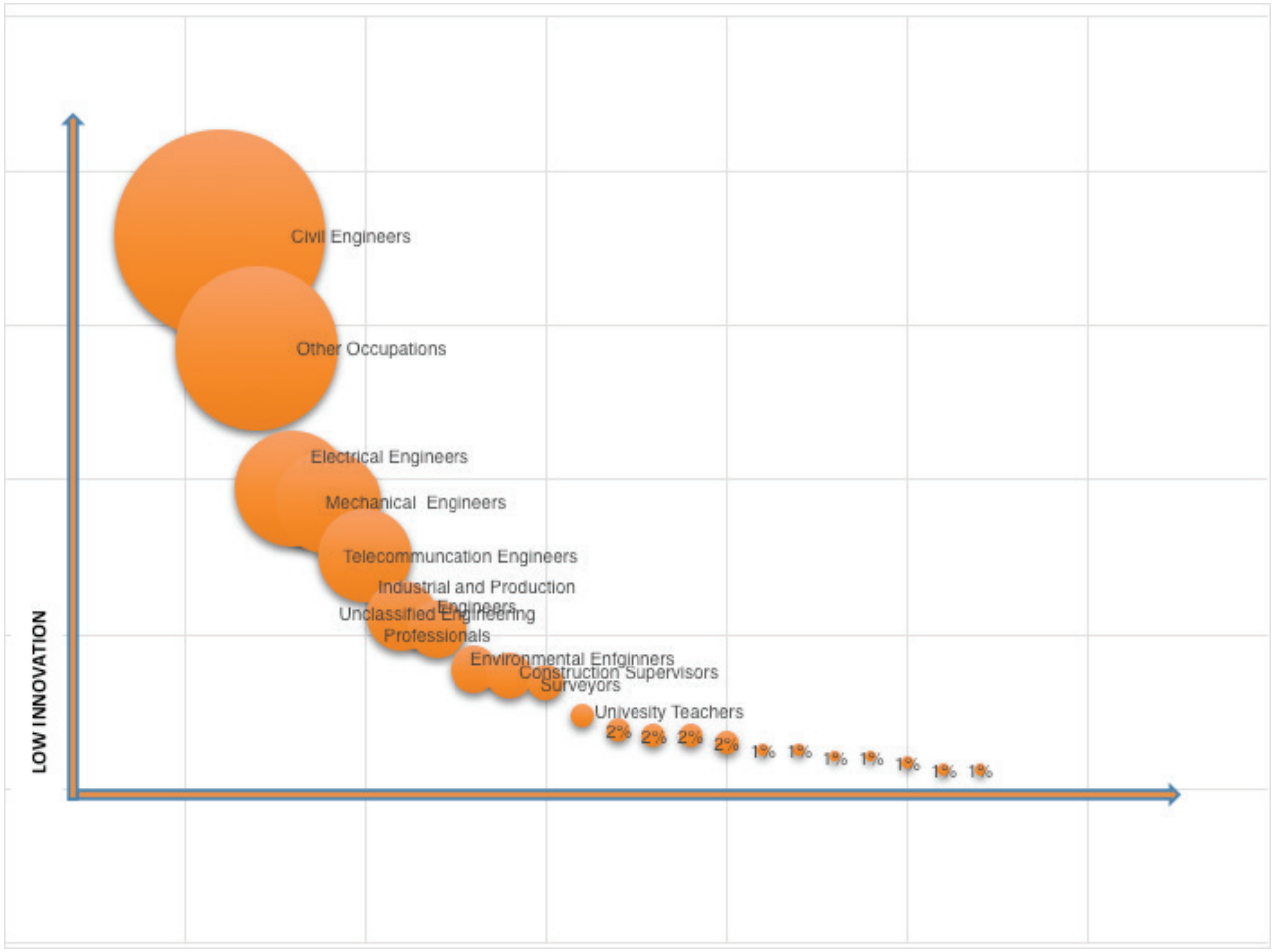
The currently limited pool of domestic venture capital could be expanded by making investments in Australian ventures more attractive to overseas investors.

Innovation in Engineering Report, Engineers Australia Innovation Taskforce, June 2012

6.4 Innovation by Occupation

Considering a continuum (from high to low innovation activity), those graduates whose occupation was 'Civil engineer' reported the highest engagement in innovation activities while those in academia / university teaching were among the least involved in innovation.

Figure 34: Research and Innovation by Occupation

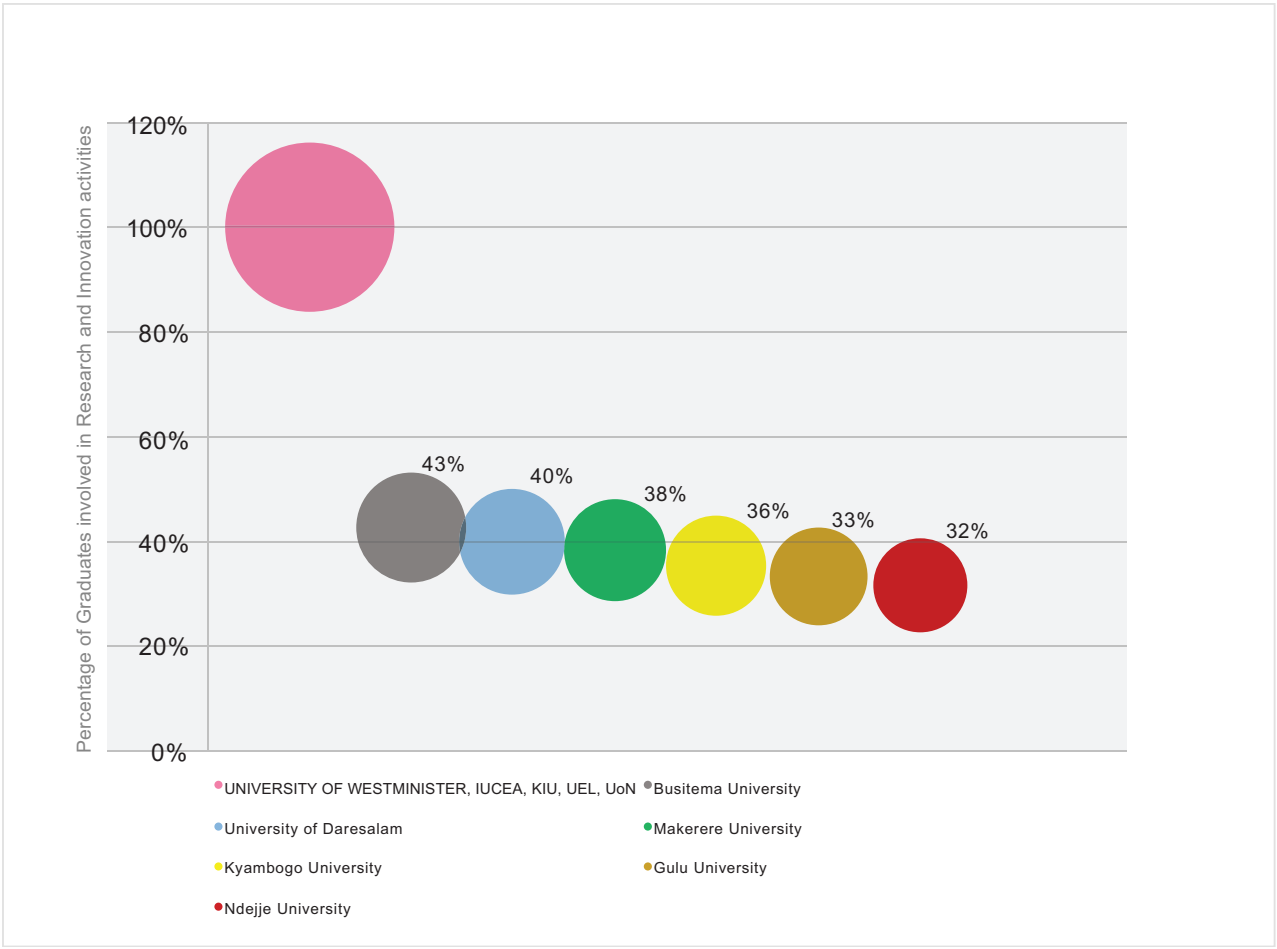


6.5 Innovation by University Type

Research and Innovation among Ugandan universities is still low. Ugandan universities are generally not R&D intensive and largely focus on the core traditional goals of teaching and community service. In 2012, Higher Education Institutions (HEIs) in Uganda contributed 0.13% to the national Gross Expenditure on Research and Development (GERD)[10]. Foreign universities have embraced innovation as a strategy for smart growth. In this survey, all graduates from foreign universities were involved in innovation activities. Less than half of graduates from local universities were involved in research and innovation activities.

10 UNCST (2012), National Survey of Research and Development, 2012, Uganda National Council for Science and Technology

Figure 35: Innovation by University Type



6.6 Innovation by Year of Graduation

Survey results show that there was no significant difference in innovation activity for the different graduates in the period of reference. About 37% of graduates from 2008 were involved in research and innovation activities compared to 39% in 2012. The number of graduates involved in research and innovation activities has therefore increased marginally between 2008 and 2012.

Chapter Seven: Mobility

7.1 Engineers and Mobility

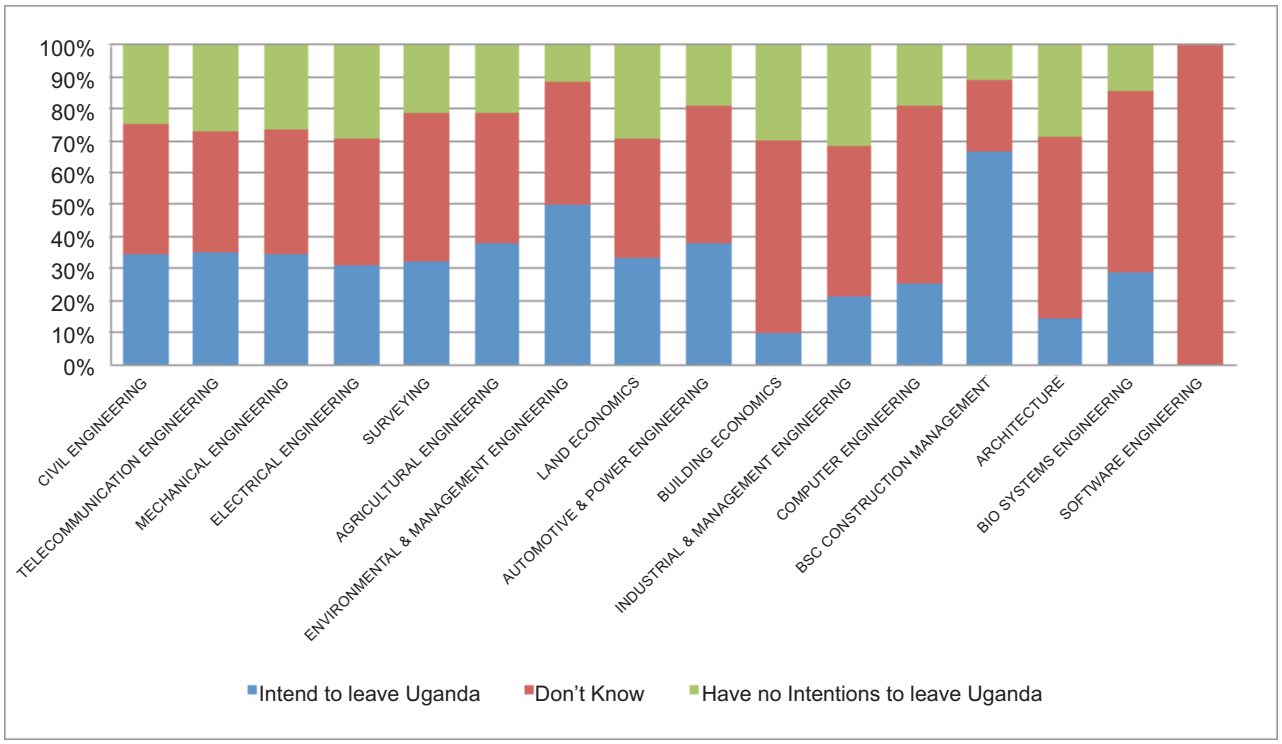
The international mobility of highly skilled workers, in particular Human Resources in Science and Technology (HRST) such as scientists, engineers and IT experts is critical to manpower planning. The mobility of engineers can occur within national or international universities, Public Research Institutes (PRIs) and enterprises in the same industry or the same sector of the economy. Mobility of engineers is driven by a variety of job related, academic, personal and family reasons. Mobility of engineers is closely related to other issues, such as career opportunities, pay, working conditions, R&D in firms and open science[11]. The survey sought to analyse the mobility of engineers between sectors, the flows of engineers between Uganda and other countries as a means of calibrating the future professional dispersion of engineers.

7.2 Future Mobility of Engineers

The study shows that 39.3% of engineers were uncertain about whether they will be professionally operating in Uganda over the next five years. For instance, all Software engineering graduates were uncertain as to whether they would be in Uganda in the next five years. Software developers and engineers are the creative minds behind the computer digital revolution. Some of these engineers develop the applications that allow people to do specific tasks on a computer or another device. Others develop the underlying systems that run the devices or that control networks. The global shortage of software engineers and the fast growth of demand for software applications in advanced economies is expected to attract such software talent.

11 https://www.innovationpolicyplatform.org/content/mobility-researchers-and-engineers

Figure 36: Engineer Intentions of Leaving Uganda

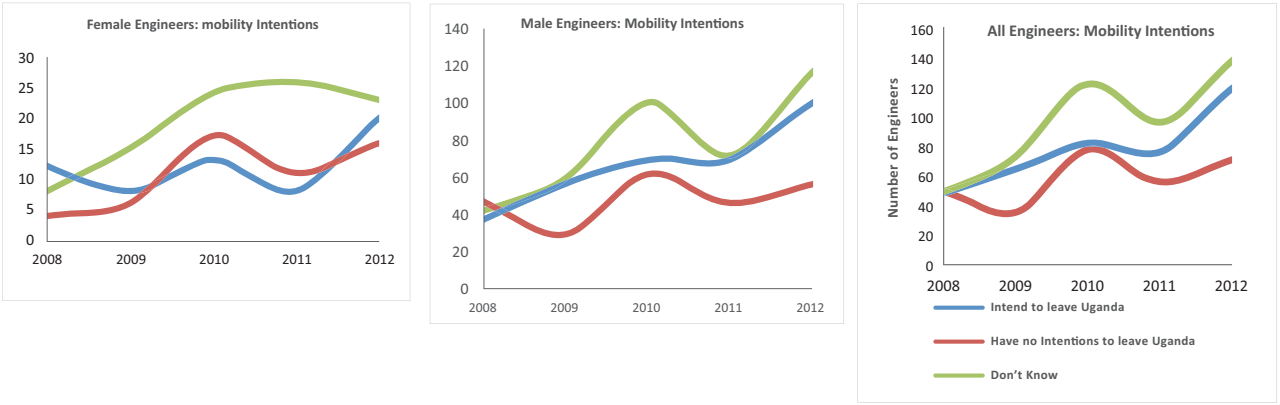


7.3 Engineers' Mobility Intentions

7.3.1 Mobility Intentions by Gender and Field of Engineering

As shown in Figures 37 below, between 2008 and 2012, there is uncertainty as to the occupational and geographical mobility of engineers. Moreover, the number of engineers (regardless of gender) intending to leave the country is consistently higher than those intending to stay.

Figure 37: Engineers' Mobility Intentions



Proportionately, more women engineering graduates have no intention of leaving the country over the next five years. However, for male engineers, the proportion of those intending to leave or who are uncertain about whether they will be available in the next five years is almost the same. In general, female engineers were more explicit about their future in the country.

Figure 38: Female Engineers intentions by Field of Engineering

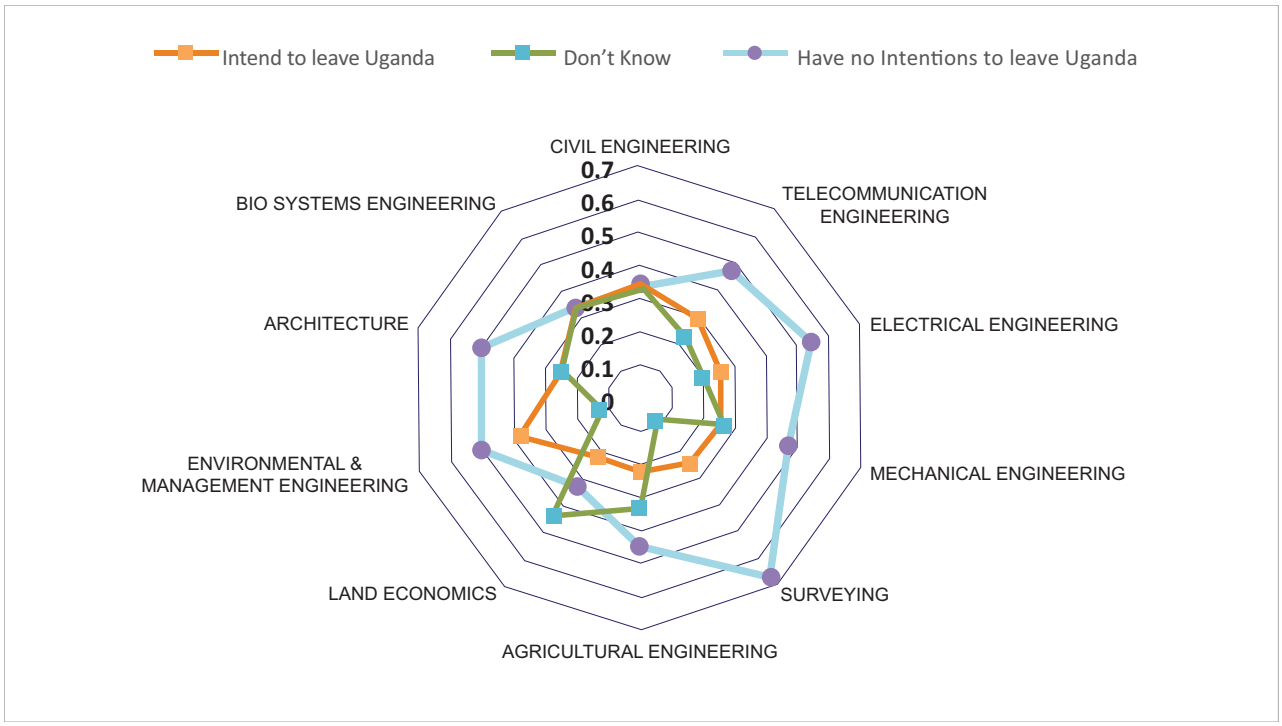
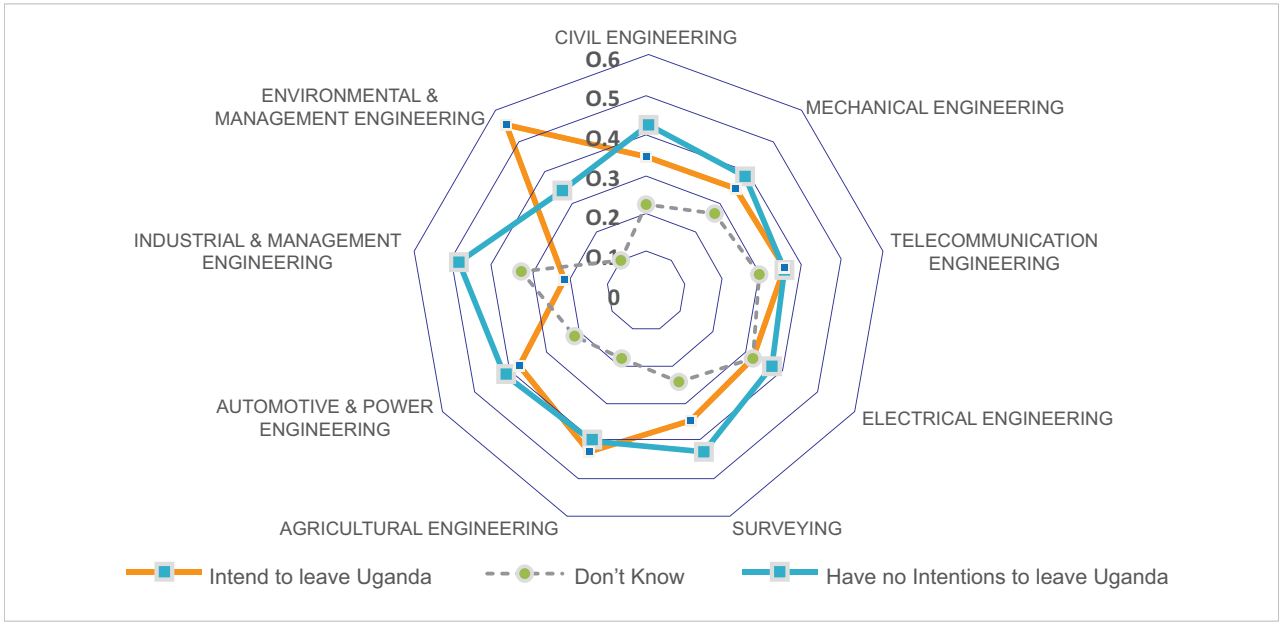


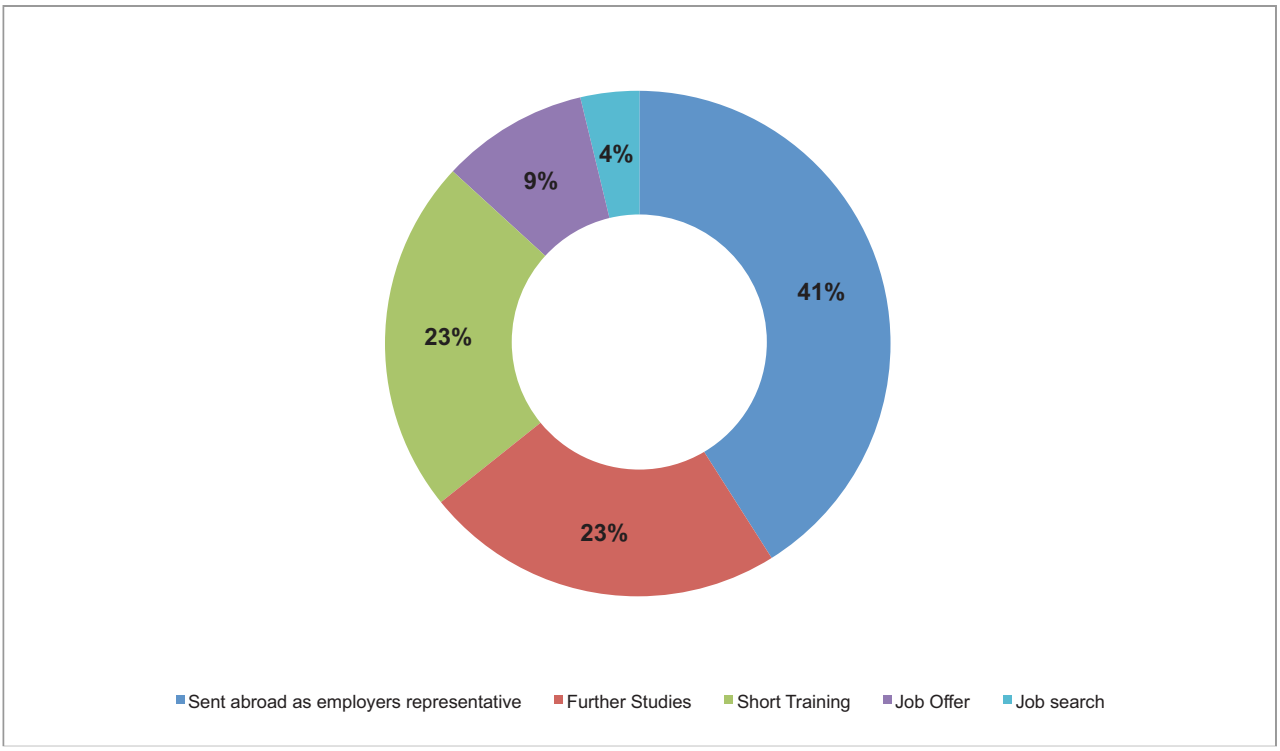
Figure 39: Male Engineers intentions by Field of Engineering



7.3.2 Reason for Engineer Mobility

The survey found that engineering graduates move for a variety of reasons. For this cohort of engineers, movement was mainly due to on-job assignments.

Figure 40: Main Reasons for Movement of Engineers



7.4 Destinations of Engineers: Geographical mobility

Geographical mobility of engineering professionals is the movement of professional engineers around the world. International benchmarking helps engineers change employment, change country of residence and access restricted work in new jurisdictions. The engineers are usually working in a different jurisdiction to the one in which they qualified and acquired professional standing. As highly skilled personnel, the tracking of movement of engineers across national borders is critical to national human resource planning. Whereas it is difficult to make any far-reaching judgments from a country-level survey, it is evident that on a regional basis there is more geographic mobility within EAC as shown in Figure 41 than within some other regions.

Figure 41: Destination of International Geographical Mobility

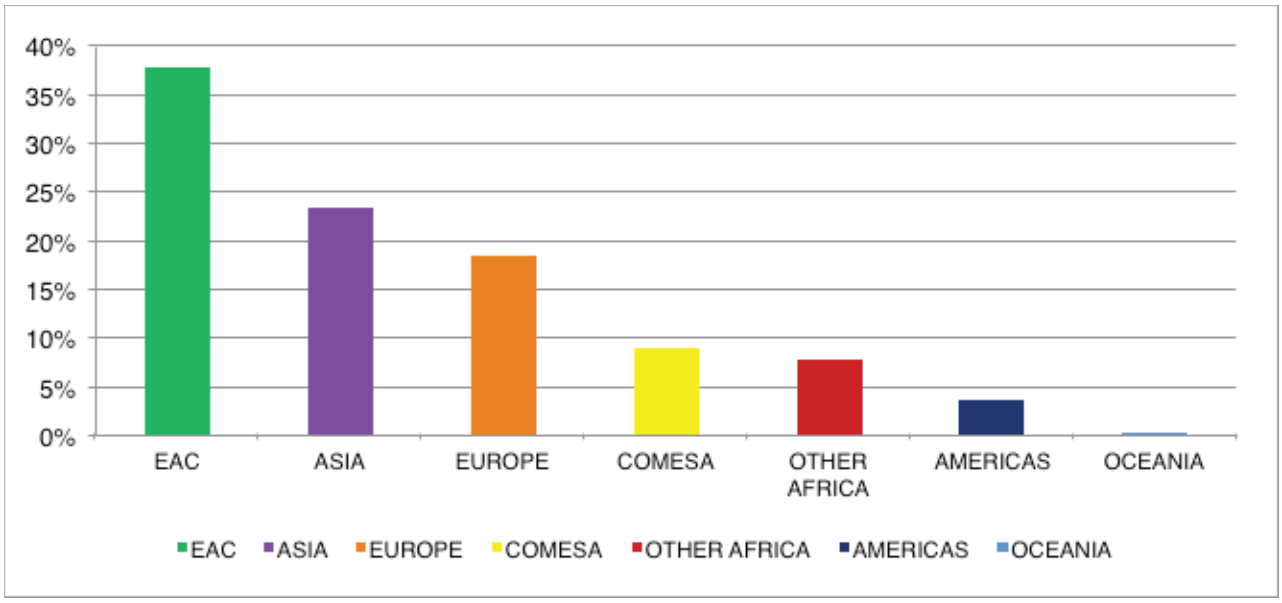
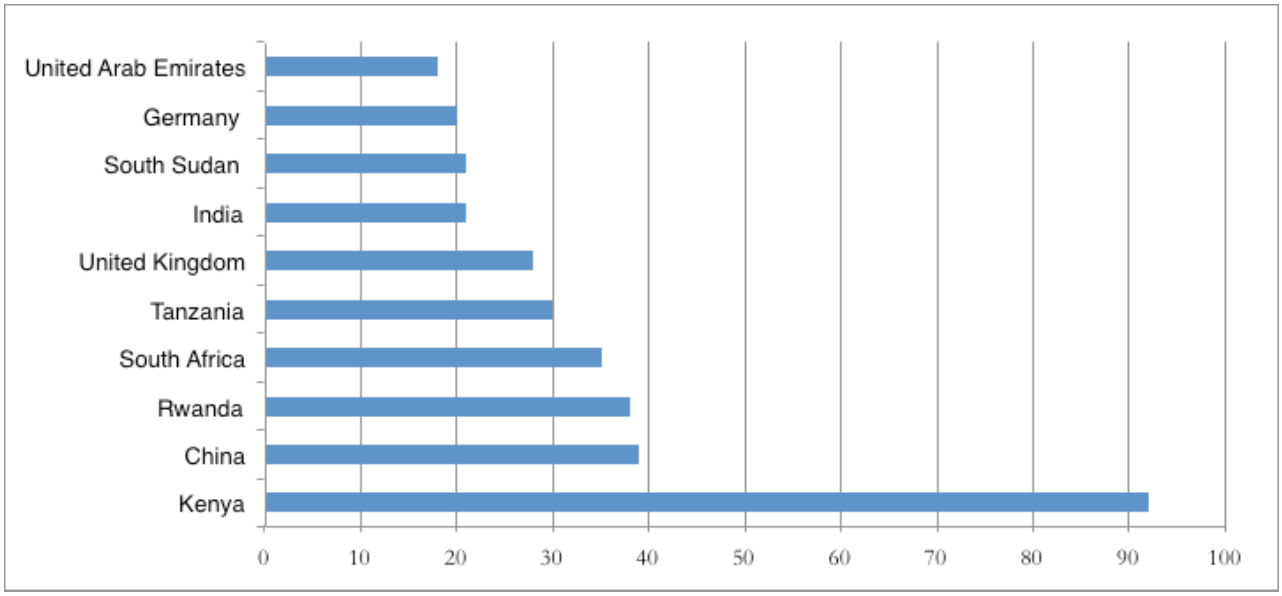


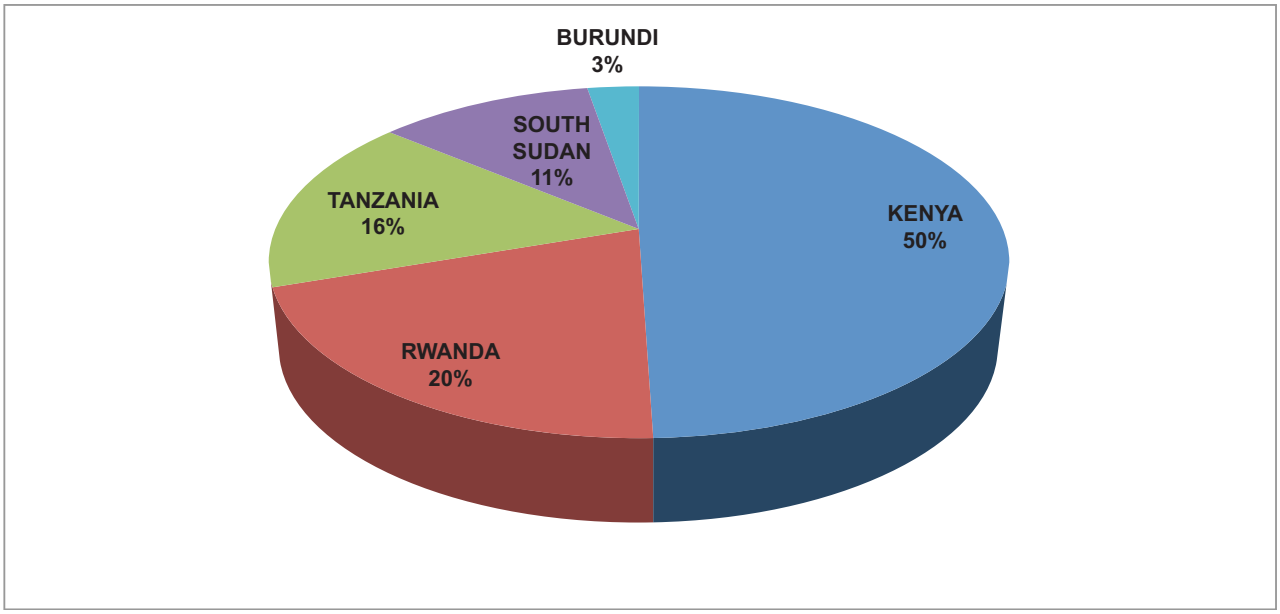
Figure 42: International mobility: Top ten destinations of Engineers (2008-2012)



7.5 Ugandan Engineers in the EAC

Engineer fraternities in the East African Community (EAC) have signed Mutual Recognition Agreements (MRAs) to facilitate the mobility of engineers across international borders. However, engineer mobility is still constrained by high costs of translocation, language differences and other structural differences across the different member states. These factors could explain this apparently low mobility rate.

Figure 43: Engineer mobility across the East African Community (2008-2012)



7.6 Time spent outside Uganda

About 40% of engineers had spent time outside Uganda. Almost 29% had spent up to six months outside Uganda while 3.3% had spent more than two years for training and capacity building. Generally, Ugandan engineers are not very geographically mobile. International mobility was in many cases a one-off and short-term, although a non-negligible share of the population also seems to travel abroad on a more frequent basis and for longer time periods.

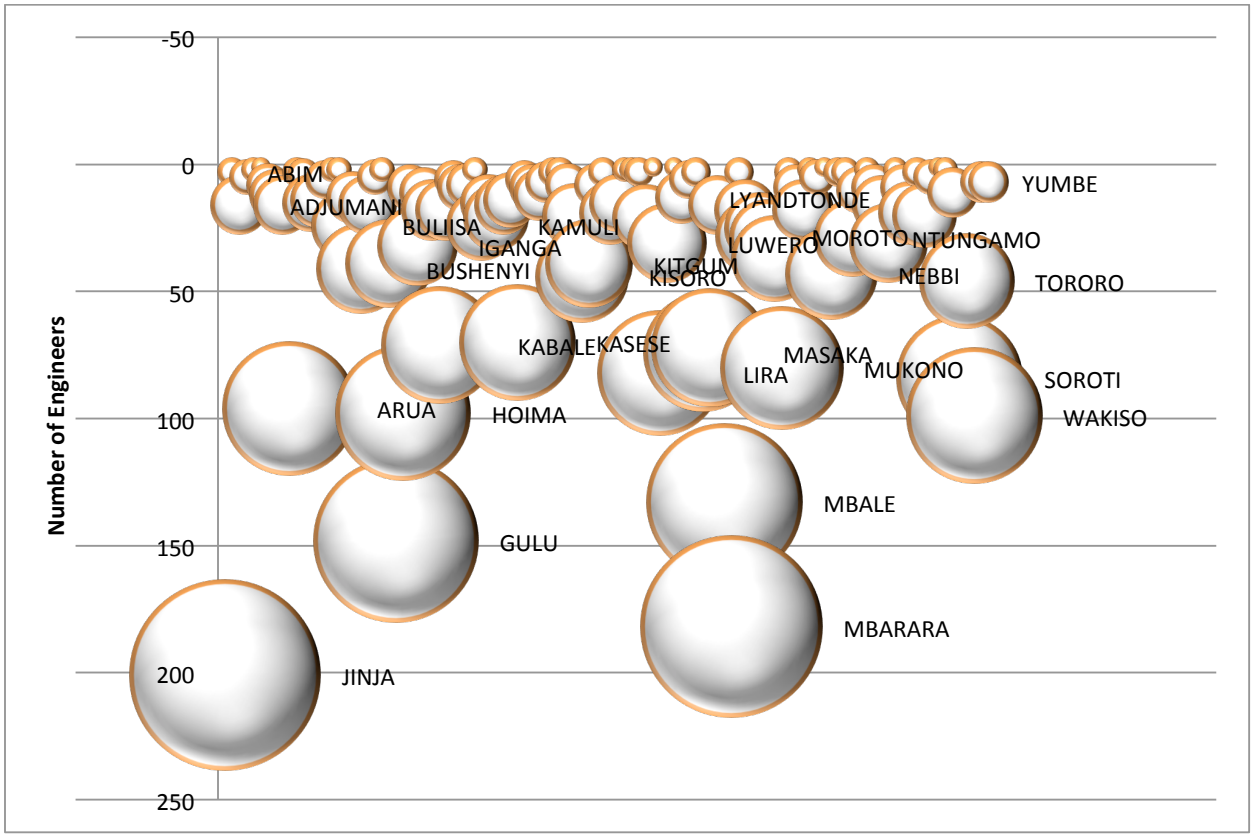
Table 15: Longest Time Spent Outside Uganda

Longest period spent outside Uganda	Number	Percentage
< 1 - 6 Months	360	28.9
6 – 24 Months	92	7.4
> 24 Months	41	3.3
Total	493	39.5
Not Moved	754	60.5
TOTAL	1247	100.0

7.7 Mobility across Uganda

Respondents were asked to indicate the districts in which they had worked (excluding Kampala). This was aimed at calibrating the geographical spread and presence of engineering capacity across the country. Engineers reported to having worked in 108 districts in Uganda. As shown below, most engineers were found to have worked in some of Uganda's major urbanised districts like Jinja, Mbarara, Gulu, Mbale, Hoima, Arua, Wakiso, among others, as shown in Figure 44.

Figure 44: National Mobility of Engineers across Major districts in Uganda (excluding Kampala)



7.8 National Mobility by Field of Engineering

Generally, civil engineers are the most mobile while software engineers are the least mobile (only one out of five software engineers moved out of Kampala for work-related purposes). Only 14.8% of female engineers are nationally mobile.

Table 16: National Mobility by Field of Engineering

Field of Engineering	Worked in jobs/ positions outside Kampala
Civil engineering	84%
Surveying	71%
Building economics	70%
Construction management	67%
Environmental & management engineering	65%
Bio systems engineering	63%
Industrial & management engineering	60%
Architecture	57%
Electrical engineering	56%
Agricultural engineering	55%
Mechanical engineering	55%
Automotive & power engineering	48%
Telecommunication engineering	47%
Land economics	46%
Computer engineering	38%
Software engineering	20%

7.9 Occupational Mobility

The rate at which engineers change jobs provides an indication of intra-occupational mobility. Three quarters (74.8%) of the engineers had been with up to two employers. Engineering graduates are generally stable in their chosen career.

Table 17: Occupational Mobility: Number of previous employers

Number of previous employers	Frequency	Percentage
0	187	15.0
1	399	32.0
2	347	27.8
3	193	15.5
4	56	4.5
5	11	.9
6	5	.4
7	1	.1
8	1	.1
TOTAL	1200	96.2

Those engineers who had worked with the same employer were the majority (57.5%). Fourteen percent had worked for over five years with the same employer.

Table 18: Occupational Mobility: Number of Years with current employer

Number of Years with present employer	Percentage
< 1 year	15.4
1.1- 2 years	23.3
2.1-3 years	18.8
3.1-4 years	14.4
4.1 - 5 years	7.2
> 5 years	14
TOTAL	93.1

7.10 Occupation by Gender

Findings showed that women engineers accounted for the majority in some occupations like construction supervisors. According to ISCO classification, this includes being involved in the construction and repair of buildings and structures. There were also more female engineers in software and application development occupations. ISCO-08 Classification shows that female engineers had branched off into other careers as biologists, botanists, zoologists and film stage entertainment. Similarly, male engineers had also gone into banking, financial systems management, horticulture, motor vehicle repair and software development. Some of these are new niche technology markets while others are clearly out of the scope of engineering training. The occupations with the largest gender gap included motor vehicle mechanics, software development and mathematical associate professionals.

Figure 45: ISCO Occupations by Gender

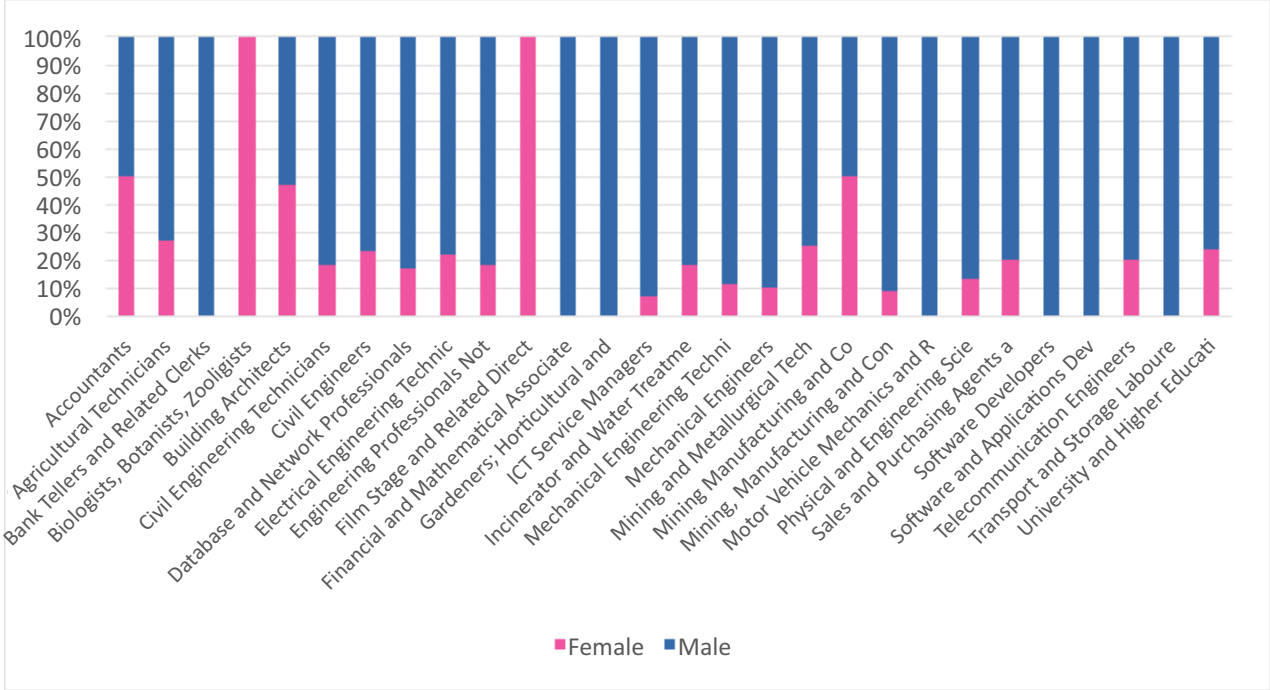
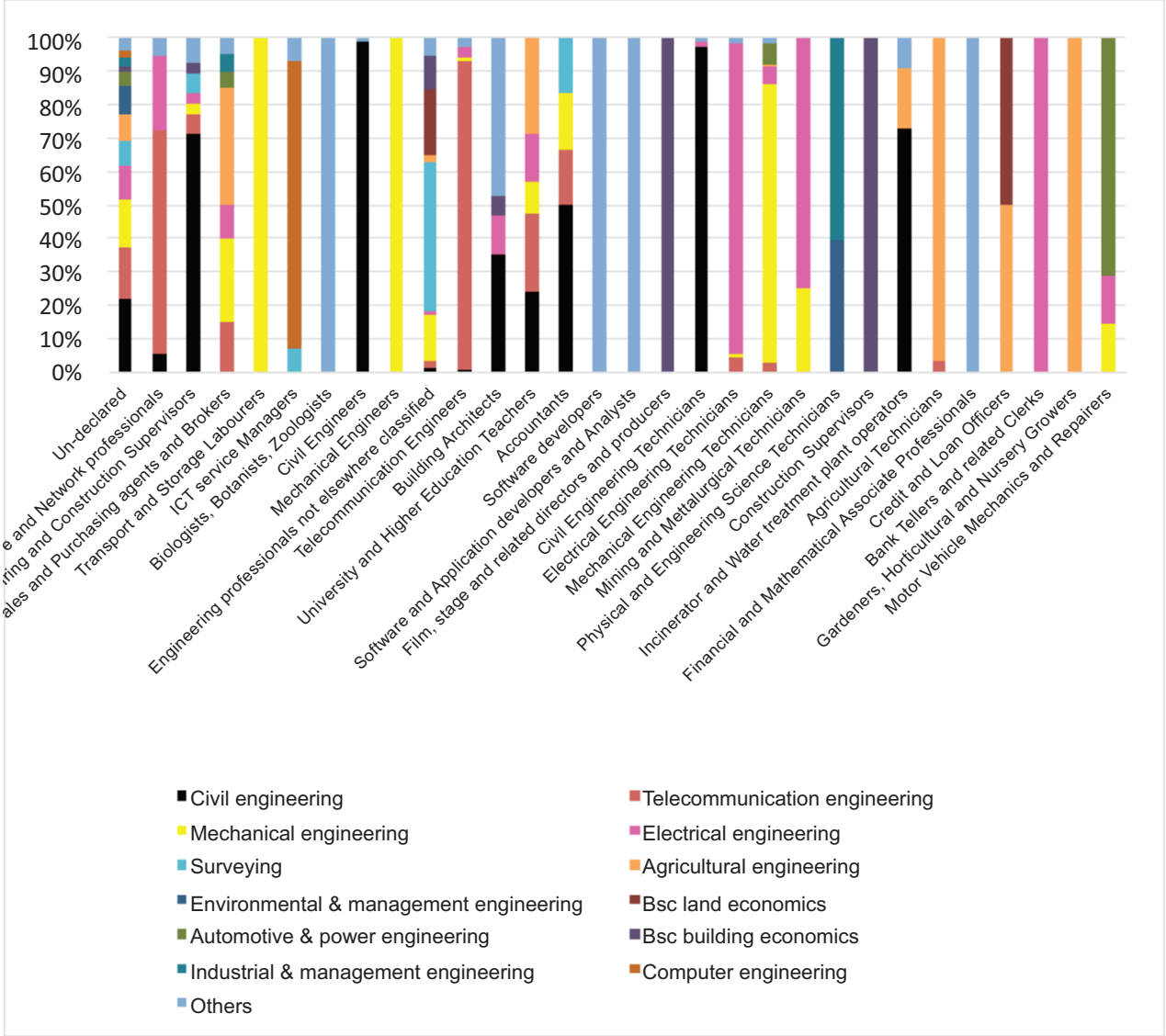


Figure 46: ISCO Occupations by Fields of Engineering



Changes in Occupation

Between 2008 and 2012 the number of graduate engineers becoming sales and purchasing agents and brokers had increased four-fold. Similarly telecommunication engineers had increased by 213% over the same period. There was a reduction in the number of engineers employed as university teachers and engineering science technicians (Table 19).

Table 19: Changes in Occupations of Engineering graduates 2008-2012

Occupation (ISCO)	Percentage growth between 2008-2012
Database and Network professionals	100%
Mining, Manufacturing and Construction Supervisors	42%
Sales and Purchasing agents and Brokers	400%
ICT service Managers	150%
Civil Engineers	87%
Mechanical Engineers	180%
Engineering professionals not elsewhere classified	370%
Telecommunication Engineers	213%
Building Architects	0%
University and Higher Education Teachers	-67%
Accountants	0%
Civil Engineering technicians	93%
Electrical Engineering technicians	140%
Mechanical Engineering Technicians	155%
Physical and Engineering Science Technicians	-14%
Incinerator and Water treatment plant operators	0%
Agricultural Technicians	50%
Bank Tellers and related Clerks	-100%
Motor Vehicle Mechanics and Repairers	100%

Chapter Eight: Emerging Issues

8.1 Sectoral Issues

Uganda's industrial sector is relatively small and is dominated by small and medium enterprises together with subsidiaries of multinational corporations. The sector is largely engaged in the production of basic consumer goods and is characterised by a low technology base. The manufacturing sector has played a peripheral role in Uganda's market-driven growth trajectory. The sector only contributes a small share of industrial GDP, averaging about 7% over the last decade and is below the average 11% for LDCs. The bulk of manufacturing firms in Uganda operate on a small-scale (84%) employing 35 persons or less. The medium-to-large-scale manufacturing sector is even smaller. This points to the sector's low absorptive capacity for trained engineers. As a result, manufacturing activities are either of the end-product assembling type, or (food) processing, both of which are characterised by low value added 'manufacturing'.

The prospect of agro-processing as an industrial development niche is dampened by low value addition with significant post-harvest losses as high as 40% for some commodities. The industrial sector has been hampered by several obstacles including poor infrastructure and an absence of technical/technological skills reflected in shortage of scientists, engineers and technicians who are specially trained for appropriate technology adoption and diffusion. This study shows that the more immediate challenge is putting to use the available capacity particularly in emerging fields of engineering. About 4% percent of engineering graduates remain either on the fringes of formal employment, inactive or altogether unemployed. This highly skilled human resource has not been adequately deployed especially given that Uganda has nascent and emerging sectors like petroleum, gas and transport where such skills can come to bear.

Trained engineers in Uganda are scarce. Over the past ten years, whereas there has been an increase in the number of trained engineers emerging out of Uganda's universities, there is an existing mismatch between the demand for and supply of certain types of engineers who have the necessary skills to drive Uganda's nascent manufacturing sector. In addition, a lack of regulation in relation to foreign engineering firms has also dampened local capacity.

> *"Local content laws do not appropriately enforce or ensure knowledge transfer from foreign companies to local engineers. This is exacerbated by the fact that governments often award contracts for public projects to foreign firms, who can offer lower rates than local providers. This is particularly common in the case of Chinese firms, which are often able to provide cheaper services than local contractors."*
>
> **Africa-UK Engineering for Development Partnership, 2012 Report**

8.2 Gender

Engineering in Uganda has been and remains male dominated. Whereas there are more women engineers being produced in the higher education system, women still comprise only a fifth of total engineering graduates. Attracting more women into engineering will not just lead to improved numbers, but will maintain the high standards the profession has set for itself. Moreover, as shown, women who obtain STEM degrees are significantly less likely than men to pursue a career in those fields. On average, 71% of male graduates from STEM subjects work as professionals in STEM fields, as compared to only 43% of female graduates. As such more needs to be done to support female engineers beyond graduation so that they can fully contribute through active engineering careers.

8.3 Further studies

The proportion of graduates going into postgraduate study on completion of their first degree tends to fall when the economy improves. About 68% of 2008-2012 engineering graduates had not undertaken any postgraduate training. Over half (51%) had a masters qualification after graduating, with the most popular subject being Project management. The pursuit of further training in core engineering increases the chances for specialisation and capacity strengthening in niche sectors. The high number of engineers pursing further training in management and finance points to the narrow set of skills undergraduate training in Uganda equips graduates with. There has to be an equitable balance in the nature of training to ensure that engineering graduates are competent enough to compete in a fast-paced global economy.

8.4 Where are the jobs?

An important consideration for many would-be graduate employees is, 'where will I work?' The study shows that engineering opportunities are spread around the country, but there were concentrated pockets in the populous and urbanised centres. To get a job, engineering graduates may have to consider working in stations outside the 'comfortable and convenient' urban centres. The opportunities in engineering are diverse although such opportunities are more skewed towards certain fields. For instance, civil engineers are more likely to get employed faster compared to other fields owing to the many available opportunities in business and government sectors. However, more jobs can be created in new niches like agro-value addition (for agricultural engineers), oil and gas (for petroleum engineering), pharmaceutics (for pharmaceutical engineering), among others.

8.5 What is in demand?

As the economy continues to grow, there is projected to be a greater demand for engineering graduates. However, skill shortages still abound in some sectors. This will require a re-adjustment

as to what engineering skill-sets the country needs to drive Uganda's transformation towards middle-income status. There needs to be a strong emphasis on tailored training that responds to Uganda's emerging economic and social transformation agenda. National and regional human capacity projections have to be consistent with national skills and training frameworks to ensure that there is no underutilised excess capacity as observed in this survey.

8.6 The future outlook

The real world requires 15% of knowledge and skills and 85% of attitude not competencies. But the current curriculum has an output that is exactly opposite with 90% knowledge and skills and 10% attitudinal competencies[12]. The demand for engineering graduates will remain high owing to their high-value skill base, high potential for mobility and high trainability attributes. However, local engineering training will have to keep pace with new and emerging engineering trends or risk the 'importation' of skills from elsewhere. The limited numbers of registered engineers also limit the level of regional and occupational mobility. Therefore, registration reform should keep pace with emerging trends in engineering practice.

8.7 University Industry Linkage

> *"Many telecom / electrical graduates from Ugandan universities don't have good computing skills. There is need to incorporate computer science courses in the curriculum to match the desired skills set since computer science has been incorporated in engineering practice"*
>
> **Graduate Telecommunications Engineering, 2004-2010**

Whereas engineering in the business sector remains very vibrant, companies are not actively partnering with universities to help train and to recruit engineering talent. As a result, many students are not following through to an engineering career which presents a real risk to Uganda's long term success as a nation of innovators. While the report shows that the overall outlook for engineers is positive, the Ugandan engineering market is not yet mature enough to absorb certain engineering specialists, which ultimately results in their relocation elsewhere to advance their careers.

12 New Vision May 3, 2017 "Why are Ugandan Graduate Engineers Leading the Trade?"

Chapter Nine: Conclusions

This report presents three overriding messages. Firstly, that engineering can make a significant contribution to the Uganda's economy. Secondly, that Uganda's human capacity potential in engineering has not been fully exploited to adequately respond to emerging local, regional and global challenges such as climate change, sustainable energy, food security and explicit engagement in competitive regional and global knowledge markets. Thirdly, that Uganda's education system does not effectively skill its engineers and technicians in a manner that can enable them to efficiently operate at the cutting edge of emerging fields of science, technology and innovation. These broad and overarching conclusions however, can explain the underlying narratives emerging from this survey under the following themes.

9.1 Engineering Education

Engineering educators must take a closer look at how engineering students are being prepared to enter the "real world" of work. Universities and other tertiary engineering training entities are not doing enough to proactively equip students with what they need to know to operate in a highly competitive market. Engineering training is generally disconnected from the problems or needs of communities. Community challenges like water provision and purification, sanitation, power production, shelter, site planning, infrastructure, food production and distribution, and communication, among others, are not adequately addressed in engineering curricula in Uganda. Engineers must complement their technical and analytical capabilities with a broad understanding of "soft" skills that are nontechnical but useful in making a palpable contribution to the common issues in the community.

> *"I would wish to work in my field of engineering but there is still low technological advancements in regard to methods, tools, equipment etc."*
>
> **Graduate Civil Engineering, 2003-2008**

Engineers of the future must be trained to make intelligent decisions that protect and enhance the quality of life in Uganda. They must also make decisions in a professional environment in which they will have to interact with people from both technical and nontechnical disciplines. Preparing engineers to become facilitators of sustainable development, appropriate technology and interlocutors of social and economic change is one of the greatest challenges faced by the engineering profession today. The engineer of the future applies scientific analysis and holistic synthesis to develop sustainable solutions that integrate social, environmental, cultural, and economic systems[13]. The training, registration and professional development of engineers should be futuristic to ensure that engineers pre-empt, and adequately prepare Uganda to meet, the challenges of the next decade.

---

13 Engineering of the Developing World: A Report for the National Academy of Engineering, December 2006 at www.engineeringchallenges.org.

9.2 Employment

Most engineering graduates have found employment after graduation. Whereas unemployment rates among engineering graduates have been generally low and fairly stable, there is a gradual increase in the number of unemployed engineers, particularly those who are recent graduates in particular fields. Study results also show that more engineers have found work outside their traditional fields of expertise. In addition, there is an increase in the number of engineers employed in part-time positions although this is more apparent among those who graduated recently (2012). The employment and deployment of engineers has to be harnessed to maximise the potential contribution this highly trained people can make to the economy.

9.3 Engineering fields with highest demand

In developed economies, the demand in particular areas of engineering (and thus salary levels) tends to have a cyclical trend; disciplines that are in high demand during one decade tend to become less attractive in the following years before "coming back" into demand. The areas of engineering that are in most demand will also vary from country to country. The survey shows that Civil engineering remains the most subscribed field owing to the number of opportunities in both the private and public sectors. More space within these sectors needs to be provided to the other fields of engineering. For instance, the deployment of different specialist engineers in the different districts can provide more opportunities for engineers in agricultural machinery, production, food processing and value addition.

9.4 Women and Engineering

There is nothing inherent in engineering that precludes women from enjoying a successful career in the discipline. In fact, success in engineering is based on ability and determination, not gender[14]. As shown in this survey, women engineering graduates often perform at par with their male colleagues. Even then, the number of women among career engineers is much lower than what most universities and companies would like to see, and large efforts are being made to invite young women to try engineering and enjoy the creativity and challenging environment that engineering offers its practitioners. Many schools, government agencies and private companies have created programs targeted at attracting women into engineering, and the participation of women in engineering has been growing in the last 20 years. Today, there are more programs than ever designed to attract women into engineering as well as help them succeed in the engineering environment. However, the current efforts seem to be observing the problem from a narrow lens. Women participation in engineering can only be catalysed by more upstream engagement of young girls with a view of presenting them with believable role models, opening up more opportunities in the engineering market place and widening female engagement in engineering academia.

---

14 "Is Engineering a Career for Women?" A Report at www.tryengineering.org

9.5 Policy

The National Vision 2040 underlines strategies to transform Uganda from a predominantly peasant low income country into a competitive upper middle country. The Vision encourages the country to pursue policies aimed at leapfrogging especially in the areas of science, technology and innovation. Engineering is an enabler for that transformation. Uganda must take advantage of its 'engineering dividend' by strategically aligning government policy to respond to the issues highlighted in this report. The current National Manpower Survey being undertaken will further show how engineers across the different fields can be supported to facilitate Uganda's development.

9.6 Structure of Engineering

Uganda's industrial sector is generally small. The sector is also characterised by a low technology base. In addition, the manufacturing sector has played a peripheral role in Uganda's market-driven growth trajectory. The bulk of manufacturing firms in Uganda operate on a small-scale (84 per cent) employing 35 persons or less. This point to the sector's low absorptive capacity for trained engineers. This study shows that the more immediate challenge is putting to use the available capacity particularly in emerging fields of engineering to ensure that engineers can gainfully contribute to the national human capacity discourse.

Chapter Ten: Recommendations

10.1 Policy

The Government of Uganda (GOU) needs to ensure that the education policies are 'joined-up' in order to deliver easy-to-follow academic and vocational pathways for our young people within schools and colleges. Whereas several strategies have been developed (like 'Skilling Uganda'), these have not been fully supported to ensure that support for science training ultimately translates into science and engineering careers. Currently the ratio of an engineer to population is about 1:50,000 against the preferred 1:25. The survey found that most engineers operate within the business sector. However, engineering entities are often run by businessmen who may not conform to standard engineering practices. Therefore streamlined management of engineering practice, mentoring programs, and industry policy reforms should be undertaken to enhance the contribution of engineering to the economy.

10.2 Higher Education

Tertiary education is delivered by over 45 licensed universities including Makerere University. Adaptation of university engineering education to address and promote industrial, economic and social needs is of paramount importance. There is an apparent mismatch between the engineering training and the market needs necessary to stimulate industrial development. This has resulted into the reliance on expatriate engineers in specific fields of engineering. Engineering training needs to be altered to respond to local and regional industrial demands for sustainable structural development. The Curricula of engineering courses also need to be revised to bring them up to date with current industrial practice, tailor them to local context and align them to international norms. As enrolments on some programs has increased, the teaching methodology also needs to undergo review to ensure that students are equipped with both the hard and soft skills (like good communication, team spirit, creativity, adaptability, project management, etc.) which are becoming key requirements for graduate employability. Engineering being a multi-disciplinary profession can no longer remain narrowly confined to a single discipline. Current engineering education has a strong foundation in science, mathematics and the engineering sciences. Undergraduate engineering programs pay little attention to design and technical writing. As such, engineering curriculum needs an overhaul that is consistent with the digital age; that reflects the broad range of concerns of environmental, political, social and economic actors.

10.3 Lower education

A shortage in skilled labour in engineering has the potential to halt Uganda's economic transformation to middle-income status by 2040. One of the strategies of addressing the shortfall

in expertise is to introduce primary school teachers and pupils to the problem solving principles of engineering. This ambitious goal of introducing engineering into primary school can inspire the next generation of innovators and problem-solvers. In addition, Government should come up with deliberate programs that reach secondary schools with a view of improving awareness about engineering and what engineers do among pupils, their teachers and parents; enthuse young people about engineering and the career opportunities available; encourage young people to make the subject choices that keep open the routes into engineering careers.

10.4 The Engineering Pipeline

In order to guarantee quality engineers, there needs to be improvement at all levels of education. Better teaching of mathematics in primary and physics and mathematics in secondary schools would result in a better equipped engineering students. Similarly, Continuous Professional Development should be improved to ensure compliance with defined engineering standards and practice. The government needs to at least triple the number of engineering graduates and other STEM-related graduates. This will be vital in meeting the demand for future engineering graduates and to meet the additional shortfall in physics teachers and engineering lecturers needed to inspire the next generation of talented engineers. The economy must also become more elastic to accommodate new and emerging fields of engineering through technology adoption and diffusion.

10.5 Gender:

In Uganda, engineering has been and remains to be a male purview. Whereas there are more women engineers being produced in the higher education system, women still comprise only a fifth of Uganda's total stock of engineers. Attracting more young women into engineering will not just lead to improved numbers, but will maintain the high standards the profession has set for itself. Gendered engineering will ensure that more young women are encouraged to pursue careers in engineering. Focused, targeted and deliberate action right from the early childhood level should be undertaken to break down perception and nuances that inhibit female students from pursuing engineering careers. This will ultimately increase the quality, reach, contribution and impact of women in engineering. Doubling the number of girls studying physics and mathematics at A' Level can potentially increase the take-up and progression by girls.

10.6 Availability of Engineers

Over the past ten years, there has been an appreciation in the number of trained engineers emerging out of Uganda's universities. However, despite this reality, there is a large gap between the demand and supply for certain types of engineers who have the necessary skills to drive Uganda's nascent manufacturing sector. In addition, Uganda is yet to benefit from its return from investment in engineering education and training. As shown in this survey, many engineers are seemingly underemployed or working in other fields besides engineering. With several

Polytechnics and Technical Colleges being upgraded to university status, the pool of engineering technicians is likely to reduce. More needs to be done to ensure that there is an adequate cadre of technicians to service and initiate small and medium industries in order to create employment and make fuller use of local resources.

10.7 University-Industry Linkages

These linkages can take different forms that involve industry in advising on curricula reform; inviting representatives from industry to serve on the faculty of engineering boards or using professionals from business and industry as adjunct professors. The industry players need the promotion of partnerships between universities and industries in continuing engineering education for professional engineers. Many engineers have not benefitted from continuous professional development platforms. The UIPE requires engineers to undertake such continuous professional development but this is mainly among its members who constitute less than 25% of the total number of engineers. It is clear that engineering training needs to be changed (or even reinvented) to address the contemporary challenges associated with emerging global and national problems. There is still a large disconnect between what is expected of young engineers in engineering firms and what skills they attain in universities.

10.8 The Role of Manufacturing

Generally, the manufacturing sector has played a peripheral role in Uganda's market-driven growth trajectory. Manufacturing activities are either of the end-product assembling type, or of (food) processing, both of which are characterised by low value added 'manufacturing'. Manufacturing firms in Uganda operate at small-scale capacity whilst employing 35 persons or less. Uganda's industrial sector is also characterized by low capacity utilization, standing at an estimated 50 per cent of installed capacity. Manufacturing is therefore arguably essential for a nationally embedded high-tech services economy and as such absolutely, necessary for a country's 'learning to compete' agenda. Close industry engagement with higher education engineering is very critical for Uganda to engage in global product and service markets. Industry players should therefore play a more visible role in enhancing engineering education curriculum, internships and visiting professor schemes.

10.9 Research and Development

Scientific, engineering and technological research and development can help Uganda boost its productivity and competitiveness in the short, medium to long term. Currently, Uganda's Gross Expenditure on Research and Development (GERD) is 0.5% of GDP. Establishing and driving forward a successful innovation economy will require substantial investment from government in higher and further education. The high-quality skills and radical innovation thinking necessary for engineers to deliver the innovation economy require corresponding innovation in the education that they receive. The survey showed the 'abandoned' innovations that fall by the

wayside due to lack of support. Innovative engineers need to be actively supported to ensure that more innovations reach the market.

10.10 Registration

The Engineer registration and accreditation system should spur innovation by making it a cardinal competency for registration. The limited number of engineers being registered has been due to several factors as shown above. However, there ought to be closer engagement and collaboration between the registration system and the training institutions to ensure that graduates from the latter are better prepared for employment to accelerate registration of young engineers. Engineering schools should seek advice of industry in the development and delivery of courses to enhance graduate outcomes, quality assurance and to ensure graduates are adequately prepared to enter professional engineering practice.

APPENDIX I: Firms, Enterprises, Ministries, Departments and Agencies

AB CONSTRUCTION (U) LTD	ATC UGANDA
ABB LIMITED	AURECON UGANDALTD
ABITEX UGANDA LTD	AVENUE INVESTIMENTS LTD
AC NIELSEN (U) LTD	AVSI FOUNDATION
ACHILLES UG LTD	AVYTEL GLOBAL SYSTEMS
ACMEO ENTERPRISES	BAGEINE & CO. LTD
ADVANCED ENGINEERING CO. LTD	BAGENDA UNITED LIMITED
AECOM(ROA PTY) LTD INTERNAL DEVRLOPMENT CONSULTANCY LTD	BAKER HUGHES LTD
AFRICELL	BALEMUGERA CONSTRUCTION CO LTD
AIG INSURANCE	BALTON (U) LTD
AIR OPTIONS (U) LTD	BAR & RESTAURANT KITALA
AIR WATER EARTH (AWE) LTD	BIG TIME EVENTS
AIRTEL UGANDA	BIKANDEME & PARTNERS
AIX CONTRACTORS (U) LTD	BIMCO CONSULT
ALLIANCE IN MOTION GLOBAL CO LTD	BIOMED SYSTEMS CENTRE LTD
ALLIED ENGINEERING SERVICES (U) LTD	BIOSCA CONSULTANTS LTD
ALLIED TEC ENGINEERS	BLUE PEARL COMPANY LTD
AMERICAN TOWER CORPORATION UGANDA	BANK OF UGANDA
ANCHOR ENGINEERING SERVICES	BUGIRI DISTRICT LOCAL GOVERNMENT
AOT CONSULTING	BUILD COST ASSOCIATES
AQWA IQ CONSULT LTD	BUKEDEA DISTRICT LOCAL GOVT
ARAB CONTRACTORS	BUKOWO DISTRICT LG
ARCH DESIGN LTD	BUSHENYI/ ISHAKA MUNICIPLITY COUNCIL
ARCH FORUM LTD	BUSITEMA UNIVERSITY
ARMS TECHNOLOGIES LTD	BUSOGA FORESTRY CO.
ARMSTRONG CONSULTING ENGINEERS	BWENSE WOOD PEEKERS
MAKERERE UNIVERSITY	CABLE CORP LTD ENGG. DIVISION (UGMA)
ASTER INTEGRAL	CAMUSAT UGANDA LTD
CAR AND GENERAL U LTD	CREATORS CONSULT AFRICA LIMITED
CARDOPLUS UK	CREEC

CENTURY BOTTLING CO. LTD	CROWN BEVERAGED LTD
CFAO MOTORS UGANDA LTD	DARLING UG. LTD
CHANGING INTERNATIONAL CONSTRUCTION CORPORATION	DATAM ENGINEERING LTD
CHARIS-CHEN GROUP OF COMPANIES	DAVIS & SHIRTLIFF (INTL) LTD
CHINA COMMUNICATIONS CO.	DEE ENGINEERS
CHINA NATIONAL OFFSHORE OIL COMPANY	DELTA INDUSTRIAL EQUIPMENT
CHINA NORTH COMPANY MACHINE CO. (U) LTD	DELTA PETROLEUM (U) LTD
CHINT ELECTRICALS LTD	KYAMBOGO UNIVERSITY
CIPLA QUALITY CHEMICAL INDUSTRIES LTD	DHL
CITI BANK UGANDA LTD	UGANDA POLICE
CITY OIL	DOTT SERVICES LTD
CIVICON LTD	DYNACO LTD
CIVIL AVIATION AUTHORITY UG	E. POWER LTD
CLEAN POWER SYSTEMS	E.AFRICAN GLASS WARE MART
CLUSTER INVESTIMENTS LTD	EAST AFRICAN CHAINS LTD
CNOOC UGANDA LIMITED	EAST AFRICAN CONSULTING SURVEYORS & VALUERS
COMATLAB LTD	EATON TOWERS (U) LTD
COMPUTEC (U) LTD	EDUCATE QUALITY SERVICES IN PALISA
COMPUTEC U LTD	EGY TRADING AND ENGINEERING PROJECTS
COMPUTER POINT LTD	EGYPRO
CONSERVE CONSULT	ELECTORAL COMMISSION
CONTINUUM ENGINEERING LTD	ELECTRICAL CONTROLS & SWITCHGEAR LTD
COOPER MOTORS CORPORATION	ELECTRICITY REGULATORY AUTHORITY
COURTS OF JUDICIARY	ELLAND ENGINEERS CO. LTD
CPS- SALTEC LTD	EN-GEDI CO LTD
CRANE BANK LTD	ENGINEERING SOLUTION U LTD
EPSILON (U) LTD	EONEL LTD
EQUITY BANK (U) LTD	HIMA CEMENT LTD
ESKOM UGANDA LTD	HOME BUILDERS LTD
EWEL	HUAWEI TECHNOLOGIES (U) LTD
EXCITE CONSTRUCTION LTD	HUB CONSTRUCTION SERVICES
FAIBLE COURTS LTD	I- ENGINEERING U LTD
FARM ENGINEERING INDUSTRY LTD	ICM CONSULTANTS
FBW GROUP	ICN SERVICES (U) LTD

FERDSULT ENGINEERING SERVICES	IITA
FIBER AID (U) LTD/ UIICT NAKAWA	ILABS@MAK PROJECT
FINEADGE SOLUTION	ILISO CONSULTING (PTY) LTD
FIRST INSURANCE COMPANY	IMK ENGINEERING CO LTD
FIRSTLAND SURVEYORS	INFOCOM LTD
FLYTXT MOBILE SOLUTIONS	INFRASTRUCTURAL DESIGN FORUM
FRED SEBYALA TRANSPORTERS LTD	INFRASTRUCTURES PROJECTS LTD
FRONTIER TECHNOLOGIES LTD	INTERFACE CONSULTING LTD
G. MESKE TEARE (U) PLC	MINISTRY OF INTERNAL AFFAIRS
GAUFF CONSULTANTS (U) LTD	INTERNATIONAL ENERGY TECHNIK
GEM ENGINEERING CO. LTD	INTRA-TECH CONSULTS LTD
GENERAL ADJUSTERS	ISON OTO U LTD
GEO-EARTH CONSULTANT SURVEYORS	IT SOLUTIONS
GIZ UGANDA	ITEC CONSULTS
GLOBAL VILLAGE ENERGY PARTNERSHIP	I-TELECOM
GT20 ENGINEERING CO.LTD	J.E NSUBUGA & ASSOCIATES
GULU UNIVERSITY	JEM ENGINEERING CO LTD
HALAI CONSTRUCTION	JENSUBUGA & ASSOCIATES
HAMILTON ENGINEERING CO	JESA DIARY FARM
HAMU & COMPANY	KIRA TOWN COUNCIL, WAKISO
JESANI CONSTRUCTION LTD	JOADAH CONSULT LTD
HEALTH INITIATIVE ASSOCIATION	JUDICIARY
JUNCTION SYSTEMS	KITGUM TECHNICAL INSTITUTE
K.I.U- WC	KLENEX ELECTROMECHANICAL ENG CO. LTD
KAABONG DISTRICT LOCAL GOV'T	KNIGHT FRANK UGANDA
KABALE UNIVERSITY	KOL SERVICES LTD
KABBS TECHNICAL SERVICES	KOLINI INSAAT A.S
KAGA ENGINEERING SERVICES	KRISHNA CONSTRUCTION CO. LTD
KAGGA & PARTNERS	KUNHOU MINING GROUP
KAKOOGE TOWN COUNCIL	KYAMBOGO UNIVERSITY
KALANGALA INFRASTRUCTURE SERVICES LTD	LABOREMUS UGANDA LTD
KALANGALA LOCAL GOV'T	LEADCOM-IS UGANDA
KALIRO DISTRICT LOCAL GOV'T	LION ASSURANCE
KAMOGA PROPERTY CONSULTANTS U LTD	LOCAL GOV'T KAMULI DISTRICT
KAMPALA CAPITAL CITY AUTHORITY	LOCAL GOV'T OF GULU

KAMPALA CEMENT CO. LTD	LTV UGANDA
KAMPALA INTERNATIONAL UNIVERSITY	LUGOGO VOCATIONAL INSTITUTE
KAMPALA PHARMACEUTICAL INDUSTRIES (1990)	LUWEERO INDUSTRIES LTD
KAMUSAT U LTD	M&E ASSOCIATES LTD
KATENDE ENTERPRISES, KIKUBO	M&E CONSULT
KEPLERIAN SURVEYORS & PROPERTY CONSULTANTS LTD	MIN OF LANDS, HOUSING & URBAN DEV'T
KFMG (U) LTD	MAKERERE UNIVERSITY
KIFRA GARRAGE LTD UN SUPPORT BASE, ENTEBBE	MALE CONSTRUCTION CO LTD
KIGUMBA TOWN COUNCIL	MALTEX U LTD
KIIRA MOTORS PROJECT	MAMA OMULUNGI WAY COMPANY
KINYARA SUGAR LTD	MANTRAC UGANDA LTD
MAAMA OMULUGI DIARY LTD	MARKH INVESTIMENTS CO.LTD
MAC EAST AFRICA LTD	MARTINM@ITELUG.COM/I TELECOM
KIRU GENERAL SERVICES	MBARARA ARCH DIOCESE
KISO CONSULTING (PTY) LTD	MBW CONSULTING LTD
KISORO DISTRICT LOCAL GOV'T	MCLEOD RUSSDL (U) LTD
MECHANICAL ENGINEERING SERVICES	MULAGO HOSPITAL
MEDICAL EQUIPMENTS (U) LTD	MULTI CHOICE UGANDA
MEDILIGHT (U) LTD	MULTI-KONSULTS LTD
MERIDIAN SALES & SERVICES LTD	MULTIPLAN CONSULTING ENGINEERS
MEYS CONSULT	MULTIPLE INDUSTRIES U LTD
MFI	MULTIPLEX LTD- CONSTRUCTION
MICROHAEM SCIENTIFICS & MEDICAL SUPPLIES LTD	NAKASEKE DISTRICT, KIWOKO TOWN COUNCIL
MILDMAY UGANDA	PEATFIELD & BOTGENER ARCHITECTS LTD
MIN OF EDUCATION & SPORTS	PEC (U) LTD
MIN OF ENERGY &MINERAL DEV'T	PERFECT MULTIPLE ENGINEERING
MIN OF FINANCE , PLANNING AND ECONMIC DEVELOPMENT	MTAC
MIN OF GENDER, LABOUR & SOCIAL DEV'T	MTN UGANDA
NAKASONGOLA DISTRICT LOCAL GOV'T	MUBENDE DISTRICT LOCAL GOV'T
NAKAWA VOC TRAINING INST	MUKWANO INDUSTRIES UGANDA LTD
NATIONAL ID PROJECT	NEPGUNUS INTERNATIONAL
MIN OF TRADE & INDUSTRY	NEW VISION GROUP
MIN OF LOCAL GOVERNMENT	NEWPLAN LTD
MIN OF WATER & ENVIRONMENT	NHCC

MIN OF WORKS & TRANSPORT	NIBW CONSULTING LTD
MM ASSOCIATES ENGINEERS	NICE HOUSE OF PLASTICES LTD
MM CONTRACTORS LTD	NILE BREWERIES
MOGAS UGANDA	NOKIA UGANDA
MONFRA ENGINEERING SERVICSES LTD	NSSF- UGANDA
MOROSOFT TECHNOLOGIES	OFFICE OF THE AUDITOR GENERAL
MOTA- ENGIL	OFFICE OF THE PRIME MINISTER
MOTOTCARE (U) LTD	OMEGA CONSTRUCTION CO. LTD - NALUKOLONGO
MOTT MAC DONALD	ONE SOLUTIONS LTD
MPG ASSOCIA METROPOLE HOUSE ENTEBBE ROAD	ORYX OIL (U) LTD
MPIGI DISTRICT LOCAL GOV'T	OTACOOL TECHNICAL SERVICES
PAMIKO U) LTD	RENEWABLE ENERGY BUSINESS INCUBATOR
PARAGON HOSPITAL KLA	RESEARCH & EDUCATION NETWORK FOR UGANDA
PARLIAMENT OF UGANDA	REWNZORI BOTTLING CO LTD
PEARL ENGINEERING CO. LTD	RIDGE CONSULTING
PEAS UGANDA	RIFT VALLEY RAILWAYS
ROHI SERVICES LTD	SMILE COMMUNICATION
ROKE TELECOM	SOLAR SUPPLIES (U) LTD
ROKO CONSTRUCTION LTD	SOLAR TECHNOLOGIES LTD
PERFECT MULTIPLE ENGINEERING- NAMANVE	ROOFINGS ROLLING MILLS
PHONE DOCTORS (U) LTD	RUBIRIZI DISTRICT LOCAL GOV'T
PIINTH TECHNICAL WORKS LTD	RUNWAY NETWORKS U LTD
PINNACLE ENVIRO CONSULTS	RURAL ELECTRIFICATION AGENCY
PKF UGANDA	RWANDA AGRICULTURE BOARD
PLANTECH ENGINEERING LTD	RWENZORI BOTTLING CO LTD
POWER ENGINEERING LTD	SABMILLE-NILE BREWERIES JINJA
PRECISION MACHINIG GROUP	SALINI CONSTRUCTION - BUJAHALI HYDRO POWER SYSTEM
PREMIER AGENCIES (U) LTD	SAMPAR LTD CONSULTING ENGINEERS
PRICE WATER HOUSE COOPERS LTD	SAN DIEGO SATE UNIVERSITY
PRIME CONTRACTORS LTD	SARICK CONSTRUCTION LTD
PRIO UGANDA LTS	SATELLITE TRACKING VEHICLES- SELF EMPLOYED
PROFESSIONAL ENGIONEERING CONSULTANTS (PEC)	SAVE THE CHILDREN INTERNATIONAL
PROME CONSULTANTS LTD	SBI INTERANTIONAL HOLDINGS, MUKONO
QUALITY SURVEYORS LTD	SCHWMBERGER LTD CO.

QUINTICA UGANDA	SCOUL
RURAL ELECTRIFICATION AGENCY	SEMA PROPERTIES LTD
REAL CAPITAL SERVICES LTD	SEROMA LTD
REALTEK CONSULT LTD	SGS, MEDIA PLAZA LEVEL 2
REGENT ESTATES U LTD	SHARK MEDIA LTD
REGENT GROUP	SIGNET UGANDA
SIMBA TELECOM LTD	TAMTECO
SINOHYDRO CORPORATION LTD - KARUMA HYDRO POWER	TECH-ENVIRONMENT & SAFETY ENGINEERING SOLUTIONS
SM CATHAN	TECHNOLOGY CONSULTS LTD
TECLAB LTD	ULTO ENGINEERING LTD
TERRAIN CONSULT	UNBS
TERRAIN SERVICES LTD	UNIVERSAL ASSOCIATED CONSULTS LTD
THE COOPER MOTOR CORPORATION UGANDA	UNIVERSITY MOUNTAINS OF THE MOON
THE COPY CAT (U) LTD	UNIVERSITY RESEARCH COUNCIL
SOLITON TELMEC	TOTAL (U) LTD
SPAN CONSTRUCTION CO.	TOUCH FM
SPENCON SERVICES LTD	TOUCH MEDIA
SPOT-ON ENGINEERING SERVICES LTD	TOYOTA (U) LTD
STANBIC BANK	TRICOM EA LTD
STANDARD CHARTERED BANK	TRIO CONSULTANTS
STATE HOUSE NAKASERO	TS CONSULTANTS
STEEL WORKS LTD	TULLOW OIL UGANDA OPERATIONS LTD
STEGS SOLUTIONS LTD	UAP PROPERTIES UGANDA LTD
STIRLING CIVIL ENGINEERING LTD	UBC
SUPREME GROUPS OF COMPANIES	UGANDA BREWERIES LIMITED
SURVEY TECH SOLUTIONS	UGANDA BUREAU OF STATISTICS
SWASS CONSULTS (U) LTD	UGANDA COMMUNICATIONS COMMISSION
SYLVER TECHNICAL SERVICES (U) LTD	UEGCL
SYNERGY SURVEYS & ASSOCIATES	UGA SURV SURVEYING & MAPPING CONSULTANTS LTD
SYNTAX ERA U LTD	UGANDA CLAYS LTD
SYSTEMS ENGINEERS	UGANDA ENERGY CAPITALISATION COMPANY
TADDEO.SSENYONJO@EABL.COM	UGANDA PRISONS SERVICE
TAL AUTOS	UGANDA TELECOM
TALKPOOL NETWORK SERVICES	UIICT- NAKAWA

TAMP BLESSED 3MS JV LTD	WAVAH WATER LTD
WESTERN GECO, SCHLUMBERGER OIL FIELD SERVICES	ZTE UGANDA LTD/ MTN
WILLTECK SYSTEMS SUPPORT CO. LTD	ZWWNODE (U) LTD
WLON MOTORS LTD	WARTSIRA UG
WORLD FEDERATION- INTERNATIONAL	WATER AID
YELX ENGINEERING CO.	WATER FOR PEOPLE
UGANDA INDUSTRIAL RESEARCH INSITITUTE	WATER MISSIONS UGANDA
UGANDA PEOPLES DEFENCE FORCES	WATOTO LTD
UGANDA REVENUE AUTHORITY	YUASA INVESTIMENTS LTD
URICON	URICON SERVICES
US EMBASSY	UTC ELGON MBALE/ UCU MUKONO
UGANDA TELECOM LIMITED	UGANDA WILDLIFE AUTHORITY
VEMBECO ENTERPRISES LTD	VERMA COMPANY
VICTORIA ENGINEERING CO LTD	VICTORIA IMPORTS & EXPORTS CO LTD
VISION GROUP	VIVO ENERGY UGANDA
VODAFONE UGANDA	WAPENG SOLUTIONS
WARTISILA (U) LTD	

APPENDIX II: Survey Questionnaire

UNCST Clearance

U	N	C	S	T	-	2	0	1	5	-	0	6

Uganda National Council for Science and Technology

The Uganda National Council for Science and Technology is responsible for the development and implementation of policies and strategies for integrating Science and Technology into the national development process.

THE REPUBLIC OF UGANDA

Ministry of Finance, Planning and Economic Development

The Ministry responsible for formulating policies that enhance development; providing oversight for national planning and strategic initiatives for economic growth

NATIONAL TRACER SURVEY OF ENGINEERING GRADUATES

Reference Period: 2008-2012

Please help us take stock of the National capacity in Engineering

May 2015

NATIONAL TRACER SURVEY OF ENGINEERING GRADUATES

A. Background

1. Introduction

The Uganda National Council for Science and Technology (UNCST) is conducting a comprehensive National Tracer of engineers who attained an undergraduate engineering degree between 2008 and 2012. This survey aims at collecting data on areas of training (specialisation), employment status and occupation mobility of engineering graduates.

2. What is the Legal Mandate to collect this data?

The UNCST is empowered to collect this data by the UNCST Statute CAP 209 of the Laws of Uganda. The information provided will be treated with strict confidentiality in line with the Uganda Bureau of Statistics (UBOS) Act of 1998 and will be used only in aggregated statistical format for analysis and policy formulation purposes. The personnel involved in this survey are under oath of secrecy not to disclose any entity-specific information to a third party individual/entity. The data/information collected will only be published in aggregate form.

3. Why do we need to collect this information?

The information from this survey will provide an insight into the employability and career trajectories of Science, Technology and Engineering (STE) graduates. The statistics will also provide a basis for manpower projections necessary to meet to Uganda's human capacity needs envisioned in the National Vision 2040.

4. How do you benefit?

The findings from this survey will ultimately inform national manpower planning frameworks. Findings will also inform the necessary reviews in engineering training, career mobility and ultimately strengthen the contribution of engineering disciplines to national development.

B. Guidelines

1. Which parts of the questionnaire do I have to fill?

Please complete all sections of the questionnaire that relate to your career path.

2. Do you need assistance?

Your assistance is essential to ensure that the results are meaningful. Our interviewers are available for guidance on how to complete this questionnaire. In addition, the following personnel may be contacted for further inquiries or clarifications:

Contact persons	Telephone/Fax	E-mail/Website
Sebbale Steven	T: +256 414 705 531 M: +256 774 438 372	s.ssebbale@uncst.go.ug
Noeline Basiime	T: +256 414 705 531 M: +256 788 706 804	n.basiime@uncst.go.ug

1. What do I do after completing the questionnaire?

The duly filled questionnaire will be collected by the interviewer or can be returned to the office of the Executive Secretary, Uganda National Council for Science and Technology: Plot 6, Kimera Road, Ntinda, Science and Technology House, P. O. Box 6884 Kampala, Tel: +256 414 705 531, Fax: +256 414 234 579 before or within **fourteen (14) days** from the date of delivery. Respondents submitting the questionnaire electronically should send completed returns to email: s.sebbale@uncst.go.ug and n.basiime@uncst.go.ug

2. Will there be any feedback?

Yes! As a way of promoting dialogue with our respondents, we will share with you the results of this survey in aggregate form and seek your further involvement in this exercise. Aggregated results will also be posted on the following website: *http://www.uncst.go.ug*.

Personal Information

1. Name

Surname	Middle Name	First Name

2. Gender

1. Male ☐ 2. Female ☐

3. What is your year of birth?

Year	

4. Contact Details

Postal Address	
Personal Phone number	
Personal Email:	
Organisation/Company (If employed)	

Undergraduate Studies

5. What is the title of your undergraduate degree?

6. From which university did you earn your undergraduate degree?

7. When did you start your undergraduate engineering program?

8. When did you complete your undergraduate studies?

Year	

9. Please state the class of degree attained

1. First ☐ 2. Upper second ☐ 3. Lower second ☐ 4. Pass ☐

10. Apart from the degree (mentioned in 5 above) did you possess any other Tertiary level qualification before enrolling for the bachelor's degree?

1. ☐ Yes →**Please indicate details below and GO TO 11** 2. ☐ No →**GO TO 11**

Title of Previous award	Awarding institution (s)	Year of Award

Postgraduate Studies

11. Have you undertaken further studies since completing your bachelor's degree?

1. ☐ Yes →**Please indicate details below and GO TO 12** 2. ☐ No →**GO TO 13**

Title of Award	Awarding institution (s)	Year of Award

12. Please provide two main reasons why you pursued further studies?

13. If you desire to pursue further studies, what have been your two main impediments to doing so?

Early Career

14. What type of job were you anticipating while pursuing your Bachelor's degree?

15. How long did it take you to find your first job after obtaining your Bachelor's degree?

1. <1year	2. 1 - 2years	3. 2-3years	4. >3years	5. Not employed

16. When did you start looking for a job? (Exclude search for casual and vacation jobs)

1. Prior to graduation	☐ months earlier
2. Around the time of graduation	☐
3. After graduation	☐ months earlier

17. What were the two main challenges you encountered in looking for the first job?

Current Employment

18. Are you a registered engineer/surveyor/architect?

1. Yes ☐ → **GO TO 20** 2. No ☐ →**GO TO 19**

19. Please provide the main reason why you are not registered.

20. What is your current labour status?

1. ☐ **Employed** →**GO TO 22** 3. ☐ **Inactive** →**GO TO 31** 5. ☐ **Employed AND Self-employed** →**GO TO 21**
2. ☐ **Unemployed** →**GO TO 29, 30, 31** 4. ☐ **Self-employed** →**GO TO 21**

21. When did you start your company/franchise/consultancy?

Year (yyyy)	

22. Which of the following best describes your current activity with regard to paid work?

Sector of Employment	☐ Business enterprise	☐ Government	☐ Higher education	☐ Private non-profit
Type of Employment	☐ Permanent	☐ Temporary	☐ Contract	☐ Other (specify below)

Occupation: e.g. Construction Engineer, Production engineer etc.	Please be specific as possible, including any area of specialisation:
Area of Specialisation (if any)	

23. Is your current position different from the entry level position you had just after graduation?

1. Yes ☐ 2. No ☐

24. To what extent is the work related to your undergraduate degree qualification?

1. ☐ Closely related 2. ☐ Partly related 3. ☐ Not related

25. Counting all jobs held, what are your current gross monthly earnings (UGX)?

1. ☐ <800,000 2. ☐ 801,000 – 1.8M 3. ☐ 1.8M - 2.8M 4. ☐ > 2.81M

26. Has your gross income increased ever since you started earning after your engineering undergraduate degree?

1. Yes ☐ 2. No ☐

27. Are you involved in any research and innovation activities?

1. ☐ Yes → **GO TO 28** 2. No ☐ No

28. Have those activities resulted into:

1. ☐ Successful Innovations 2. ☐ Ongoing innovations 3. ☐ Abandoned Innovations

Unemployed Persons

29. Are you currently looking for employment?

1. Yes ☐ 2. No ☐

30. If yes, how long have you been searching for a job?

1. ☐ < 6 - 12 Months 2. ☐ 12 - 24 Months 3. ☐ 24 - 36 Months 3. ☐ > 36 Months

31. If you are not available for work, or not searching for a job, what are the two main reasons for this?

Mobility

32. Please indicate how many employers you have previously worked for? (including your present post)

☐☐ Number of previous employers

33. If you are not self-employed, how long have you worked with the present employer?

Since (MONTH) _____ (YEAR) _____

34. During your career, have you worked in jobs/positions outside Kampala district?"

1. Yes ☐ 2. No ☐

35. Name the districts

36. Have you moved out of Uganda for career related reasons?

1. Yes ☐ → **GO TO 37, 38, 39** 2. No ☐ →**GO TO 40**

37. Please indicate the period spent outside the country

1. ☐ <1 - 6 Months 2. ☐ 6 - 24 Months 3. ☐ > 24 Months

38. Indicate the reasons for movement:

	Yes	No
Further Studies		
Sent abroad as employers' representative		
Job Offer		
Job search		
Others Specify)		

39. Please indicate the country (outside Uganda) where you spent the longest career-related period after your undergraduate graduation?

40. Why haven't you been able to move out of Uganda for career-related purposes? (Two main reasons).

41. Do you intend to continue working in your field of engineering?

1. ☐ Yes 2. ☐ No 3. ☐ Don't Know

42. Do you intend to leave the country in the next five years?

1. ☐ Yes 2. ☐ No 3. ☐ Don't Know

COMMENTS FROM THE RESPONDENT

Thank you for your co-operation

(Endnotes)

1 Successful in having resulted in the implementation of a new innovation (though not necessarily commercially successful)

2 Ongoing, work in progress, which has not yet resulted in the implementation of an innovation

3 Abandoned, before the implementation of an innovation

Uganda National Council for Science and Technology (UNCST)
Plot 6 Kimera Road Ntinda
P.O. Box 6884 Kampala - Uganda

Tel: +256-414- 705 500
Fax: +256-414- 234 579
E-mail: info@uncst.go.ug
Web: www.uncst.go.ug