PROCEEDINGS OF THE ZAMBIA ASSOCIATION OF PUBLIC UNIVERSITIES AND COLLEGES (ZAPUC) INTERNATIONAL CONFERENCE

Avani Hotel, Livingstone, Zambia
29th April to 3rd May 2018

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1. Introduction

The Zambia Association of Public Universities and Colleges (ZAPUC) hosted an international conference from 29thApril to 3rdMay 2018 at Avani Hotel, located at the banks of the Victoria Falls in Zambia's tourist capital, Livingstone. The conference brought together educationalists, researchers, policy makers, government officials and industry executives to reflect on the role of Universities and colleges in fostering sustainable national development. The conference availed the participants the opportunity to gauge how higher education could be harnessed into being a key contributor to the realization of the sustainable development goals within the Agenda 2030 and beyond.

CONFERENCE OBJECTIVE
The main objective of the conference was to provide a platform and stimulate discussion on the role of higher education in sustainable national development with particular reference to the Sub-Saharan Africa region. It was expected that the conference will bring out issues that our respective governments and higher institutions of learning need to consider for the repositioning and transformation of higher education to effectively contribute to sustainable national development. The theme of the conference was "**Repositioning the role of Universities and Colleges in Sustainable National Development**"

The outcomes of the Conference were:
1. Enhanced sharing of good practices, research results and collaboration initiatives in solving challenges that cross borders through the unlocking and harnessing of new knowledge as well as building cultural and political understanding resulting in the modelling of environments that promote dialogue and debate and positively contribute to national development.
2. Forging of mutually beneficial partnerships and collaboration networks among higher education institutions and with industry and government resulting in the adoption of new initiatives for co-financing of higher education and implementation of projects thereby complementing the limited government funding.

WHO ATTENDED?
Academicians, practitioners, consultants, researchers and policy makers with different backgrounds and experiences in higher education presented their papers at the conference and discussed their experiences, new ideas, research results, as well as any practical challenges encountered and/or the solutions adopted during their work. Postgraduate students also presented their research findings under the three sub-themes of the conference.

CONFERENCE MODALITIES
The presentations should addressed the following sub-themes:
1. The relationship between higher education and industry
This will be discussed under the following thematic areas:
   • Linking Higher Education to Industry/Private Sector
   • Industry Integration with Higher Education

• The Role of Research in Industry
• Entrepreneurship in Higher Learning Institutions
• Evaluation of the Impact of Industry on the Curricula of Higher Education
• The role of Higher Education in Policy Development and Analysis
• Relevance of Internship/Attachment/Practical Training in Skills Acquisition
• The Role of Government in Promoting Collaboration and Partnerships Between Industry and Higher Education

2. Transformation of Higher Education for Sustainable National Development
This will be discussed under the following thematic areas:
• Investment and Sustainability for Research in HE
• Curriculum for Sustainable Development in HE
• Financing Models for HE
• Public and Private Partnerships (PPP) Policy in HE
• Innovation and Patents for Sustainable Development in HE
• Leadership in Higher Education Transformation
• Policy influence on Higher Education Re-positioning

3. ICT in Higher Education
This will be discussed under the following thematic areas:
• ICT in Counterfeit Management (e.g. Plagiarism, Cyber crime)
• ICT in Governance Systems (e.g. Electronic Voting System)
• Commercialization of ICT for Starter Ups for National Development
• Using ICT Software in Teaching and Learning

Conference Local Organising Committee
1. Dr G Tambulukani – Chair (University of Zambia)
2. Dr. Rose Makano (Copperbelt University)
3. Mr Pondo (Mulungushi University)
4. Mr. O Tembo (Copperbelt University)

Conference Editorial Committee /Reviewers
1. Dr Douglas Kunda – Chair (Mulungushi University)
2. Dr. Christopher Chembe (Mulungushi University)
3. Mrs. Monde Kalumbilo-Kabemba (The University of Zambia)
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8. Dr. Meiya Nthoesane (University of South Africa)
9. Dr. Mayumbo Nyirenda (University of Zambia)
10. Dr. Adrian Phiri (Mulungushi University)
11. Dr. Jackson Phiri (The University of Zambia)
12. Prof. Owen Sichone (Copperbelt University)

13. Dr. John Simwinga (University of Zambia)
14. Dr Mayumbo Nyirenda (University of Zambia
15. Mr. O Tembo (Copperbelt University)
16. Prof. Kavwanga Yambayamba (Mulungushi University)

About Zambia Association of Public Universities and Colleges (ZAPUC)
The Zambia Association of Public Universities and Colleges (ZAPUC) a registered academic membership-based organisation comprising public universities and colleges in Zambia committed to quality service delivery to our students, government and other stakeholders by ensuring that our institutions follow ethical professional standards in the execution of their mandate.

Objective
The objective of ZAPUC is to promote high academic standards and collaboration among member institutions to foster synergies in higher education.

Activities

ZAPUC activities include, but are not limited to the following:

(i)   **Undertaking** staff and student exchange programmes to promote high academic standards;
(ii)   **Enhancing** quality assurance in academic programmes;
(iii) **Engaging** in joint research and consultancy projects;
(iv)   **Promoting** and participating in inter-institutional sports and Open days;
(v)   **Holding** joint activities in the promotion of culture, music, etc
(vi)   **Promoting** and **participating** in joint activities in the community outreach programmes;
(vii) **Promoting** and **holding** annual conferences for information sharing on new developments and innovations; and
(viii) **Participating** in relevant regional and international meetings and conferences.

MEMBERSHIP

Both full and associate membership is open to all public and private higher institutions of learning, respectively, which are accredited by the Higher Education Authority.

Membership fees:
Full membership: K10,000.00 per annum
Associate membership: K5,000.00 per annum

CONTACT DETAILS:
ZAPUC Secretariat
University of Zambia
Great East Road Campus
P.O. Box 32379
Lusaka
ZAMBIA

2. Opening Speech by Honorable Minister

Good morning and welcome to Livingstone – the tourist Capital City of Zambia

Dear Delegates

It is an honour to address you all at this inaugural International Conference which is being held under the auspices of the Zambia Association of Public Universities and Colleges (ZAPUC). I must admit that the conference theme "***The Role of Universities and Colleges in Sustainable National Development"*** is very catchy and contextually relevant.

In the past 50 years or so our higher education landscape has gone through major changes in form, shape and size and all these constitute the transformation and restructuring programme of our higher education system. For instance, we now have more female students enrolled at our higher learning institutions than we had at independence in 1964. Enrolments in scarce skills programmes such as Science, Engineering and Technology, and Business and Commerce have also improved to reflect the demographics of the country. Overall, student enrolments have since more than doubled and our programme offerings have somehow also multiplied.

Yet despite the enormous progress and changes made over the past 50 years, our institutional landscapes still, in some respects, reflect stagnation as a consequence of lack of innovation to offer industrial driven programmes. Disadvantaged institutions, and especially those in rural areas, are still in need of a lot of resources, including financial, human, infrastructural, as well as various facilities in order to make these institutions comparable to regional standards. There are still challenges regarding the need to build a larger, more diverse, and yet well-articulated post-school education and training system that includes but goes beyond universities and colleges. For example, our curriculums in almost all respects are still focused and tailored towards producing a cadre of a graduate who is schooled to be a 'white-collar-worker' and not to be an entrepreneur.

Dear Delegates

Taking cognizant of the above scenario, as part of a comprehensive reform of the Higher Education Sector in Zambia, my Ministry is in the process of repositioning priorities for higher education and training towards the following direction:

- a robust, coordinated post-school education and training system that will focus on sustainable survival skills, technology advancement and innovative/creative thinking in the learners;
- an extended access, improved quality and widened diversity of delivery;
- an enhanced collaborative relationship between the education and training institutions and all industrial sectors including the Government; and

- a post-school education and training system that is responsive to the needs of individuals, responsive to the specific needs of organisations (employers) in both the public and private sectors, as well as being responsive to the needs of the broader societal and developmental goals.

The Zambian government through my Ministry of Higher Education recognises explicitly that teaching and learning, research and innovation, and skills development are all integral parts of the work of higher learning institutions. It is therefore imperative that knowledge and skills production must be enhanced if Zambia's developmental goals, as espoused in the Seventh National Development Plan (SNDP) and other policy pronouncements are to be achieved. The government is indeed looking up to associations like ZAPUC to be the key facilitators and also drivers of change in the transformation process of the higher education sector for sustainable development – this international conference has therefore come just at the right time.

Dear Delegates

Let me take this opportunity to thank and commend the initiators of this international conference under the theme, "***The Role of Universities and Colleges in Sustainable National Development***" including the respective thematic areas which are:

- Investment and sustainability for research in Higher Education
- Curriculum for sustainable development in Higher Education
- Financing Models for Higher Education
- Public and Private Partnerships (PPP) in Higher Education
- Innovation and patents for sustainable development in Higher Education
- Leadership in Higher Education transformation
- Policy influence on Higher Education re-positioning

It is indeed a well thought out international conference and am confident that, looking at the spectrum of speakers and the paper titles, the outcomes from this conference will indeed provide useful input into the transformation process of the higher education sector in Zambia and beyond. As Minister in charge of higher education, I am now directing and NOT requesting or advising BUT directing all Colleges to join this Association (ZAPUC) so that there is concerted and effective participation in being Drivers of Change in Sustainable National Development. To that effect, institutions like NIPA, Evelyn Hone College, NORTEC, All Trades Training Institutes in Zambia, as a matter of necessity and national patriotism, are hereby DIRECTED to join and become prominent members of ZAPUC.

Some Universities and Colleges are doing so well that they do not need Government funding for survival. And yet others cannot even buy basic operational materials but have to always depend on

funding from the Government. Therefore by joining ZAPUC it is envisaged that universities and colleges will be able to share knowledge, skills, and experiences and ultimately learn self-sustainability strategies from each other. Thus joining ZAPUC has great synergistic advantages and as such, is the way to go.

Dear Delegates

Zambians and to a large extent the whole Africa in general is well known for being highly meticulous in idea generation and paper-presentations on foras like this one. And we academicians especially, are well known for just doing too much analysis which inadvertently leads to paralysis and ultimately to no action/results. This syndrome must stop forthwith and as such am now calling upon the convenors of this international conference – ZUPAC to rise to the challenge and ensure that the ideas and knowledge being presented here lead to tangible outcomes that will have desirable societal impact. It must not be 'business as usual'.

To the delegates especially those coming from across the boarders, let me join the convenors in welcoming you to this marvellous international conference and I now wish to make an official invitation to you all to make sure that you visit the mighty Victoria Falls and get showers of blessing from the smoke that thunders...!

With all said that I had planned to say, I now declare this inaugural ZAPUC International Conference officially open.

May God the Almighty Richly Bless You all, thank you!

3. Abstracts

Title: Implementation of the Sustainable Development Goals (SDGs) Through Education for Sustainable Development A Kwame Nkrumah University Case

Authors: Jive Lubbungu (Kwame Nkrumah University, Zambia)

Abstract:
Education has always been referred to as "a social and economic equalizer "perhaps because it can accelerate progress in people's lives. Probably that could be the reason it has been placed at the centre of the 2030 Agenda for Sustainable Development and essential for the success of all SDGs. The realisation of the significant role education plays in our communities, nations, continents, and in the entire world, the 2030 Agenda for Sustainable Development highlights education as a stand-alone goal (SDG 4). Kwame Nkrumah University, as one of the major players in the business of education, therefore, stands a high chance of embracing and nurturing the 2030 Agenda for Sustainable Development by domesticating Education for Sustainable Development (ESD). In its transition period into a fully-fledged University, Kwame Nkrumah University can take advantage by embracing the 2030 Agenda in its transformation process. There is enough room and a great opportunity for the institution to be ambitious and holistic in approach to matters of educational activities that can transform the lives of students and the community it operates from. The institution has already started identifying activities that are in tandem with the SDGs such as establishing a research centre, introduction of postgraduate programmes, formation of an Institution Art Society club, to mention but a few. This paper therefore delves into an exploration of the opportunities that exist for Kwame Nkrumah University for the implementation of the SDGs through ESD to achieve quality education.

Title: An Assessment of the Effectiveness of the Training Offered to Student Teachers in Colleges of Education in the Implementation of the Language Policy of Using Local Familiar Languages as Media of Instruction in Primary Schools. A Case of Colleges of E

Authors: Elliot Machinyise (Kwame Nkrumah University, Zambia

Abstract:
The recent revision to the national curriculum mandates that pupils in grades 1-4 learn in a familiar local language while English is introduced as a subject in the second grade. This means therefore that student teachers must develop competency in local languages during their training in order to effectively teach literacy and other subjects to early grade learners. This policy is however facing a challenge of acute shortage of teachers who speak or have communicative fluency in familiar local languages. It has been observed that a good number of public primary schools still use English as medium of instruction in the lower primary section. The study revealed that most of the teachers who are deployed to these primary schools lack communicative competency in local familiar languages, as a result, they resort to teaching in English. This study revealed that teacher training institutions do not prepare these teachers adequately in the communicative competencies in local languages. This study seeks to explore the role Higher education institutions or teacher training institutions can play to alleviate and mitigate the challenges faced by schools in the implementation of the familiar language medium of instruction policy in lower primary schools A survey was carried out in five colleges of education in Central Province and ten primary schools in the same province. The study made a number of recommendations to both ministry of education and teacher training institutions so as to consider teaching pre-service teachers communicative competencies in familiar local languages.

Title: Entrepreneurial Universities for Sustainable National Development in Zambia

Authors: Ali S (Mulungushi University, Zambia)

Abstract:
The objective of this paper is to define entrepreneurial university and its importance in the national development of Zambia. The 7th National Development Plan aims to achieve an average real GDP growth rate of above 5.5 percent, create 1000,000 productive and gainful job opportunities and increase the share of earnings from non-mining exports to about 50 percent. The concept of entrepreneurial university can help achieving these objectives in Zambia. Entrepreneurial learning is a key driver of economic development. The need for universities to meet the challenges of future has introduced the concept of "Entrepreneurial University", which is opposite to the teaching university. This paper presented the examples of entrepreneurial universities in the world, Africa and Zambia, including the Mulungushi University. The recommendations of this paper include: the universities in Zambia should offer innovative programs; the university administration should think in business terms; should play a major role of providing cutting edge research that can help create wealth; should integrate research based learning market sensitive teaching; the programs and research activities should be relevant to the needs of society; and should adapt the concept of 'academic capitalism' to ensure outside funding by following the market-type modes of action.

Title: Faculty Perception of Moodle Software as a Teaching Tool at the University of Zambia

Authors: Chewe Pailet (University of Zambia, Zambia)

Abstract:
In the existing educational milieu in the world today, there is an increasing application of electronic learning software in the delivery of tertiary education. However, one critical issue in the successful deployment of electronic learning platforms in teaching and learning depends on lecturers' ability and commitment to accept and use the systems. This study aimed to present faculty perceptions of MOODLE as a teaching/learning tool at the University of Zambia. A case study approach was adopted. Using a structured questionnaire data were gathered from 42 faculty members conveniently selected during the third term of academic year 2016-2017. Results of the study show low adoption levels of MOODLE software as a supplementary mode of lesson delivery. Nevertheless, they are willing to participate in programmes to equip them with the requisite skills that will make them proficient in using Moodle. Hindrances in its use include lack of knowledge of MOODLE use on the part of the faculty. The results may be used to develop e-learning support structures critical to an effective implementation of Moodle as an integral part of the teaching and learning process.

Title: Factors of Industrial Internship Effectiveness for University Distance Students: The University of Zambia Experience

Authors: Kimbo Shameenda and Inonge Imasiku (University of Zambia, Zambia)

Abstract:
This paper used a case study approach to identify and evaluate the strength of success factors of internship effectiveness. A purposive sampling method was used to identify a sample of 18 University of Zambia distance students who had undergone internships. Focus Group Discussions (FGDs) were used in this study to explore extent to which the characteristics of student interns and organisation practices accounted for internship success. Findings of this study revealed that organisational factors like effectiveness of supervision acted as the strongest contributing factor for internship success than individual factors. However, individual factors like self-initiative and academic preparedness were both important to internship success. The study concluded that internship was an effective approach to equip university students with preliminary job knowledge and experience, thus enhancing their employability in the competitive labour market.

Title: Capacity Building in Open and Distance Learning, A Response to Society Needs: A CASE STUDY OF KWAME NKRUMAH UNIVERSITY IN KABWE, ZAMBIA

Authors: Augustine Lumwanga (Kwame Nkrumah University, Zambia)

Key words: Society; Capacity Building; Working Class; ODL

Abstract:
The working class who need to further their education, upgrade their qualifications in order to acquire knew knowledge which can improve their lives and benefit their communities cannot leave their work unattended to. Every worker has the right to acquire knew knowledge in order to respond better to the needs of a given society(https//books.google.co.zm) Education as a process of teaching, training and improving one's taste is needed by almost every worker but sometimes circumstances cannot allow for each and every worker to go for full-time training because of space and other commitments. For instance, a serving teacher or a working class person who need to upgrade or further his or her studies on a full-time basis, cannot leave her or his work unattended to. In some situations, a worker is told to choose between his or her job and studies. A worker can even be asked to resign if he or she has to go for further studies. For that reason, capacity building for the working class through open and distance learning is of great importance. Therefore, this paper looks at how capacity building for the working class through open and distance learning can be a response to the needs of society.

Title: An Investigation of Information Security Threats from Organisational Insiders and How to Mitigate Them Using a User Awareness and Access Control Model

Authors: Melissa K. Chinyemba (University of Zambia & Engineering Institution of Zambia, Zambia); Jackson Phiri (The University of Zambia, Zambia)

Abstract:
Today, insider attacks are the most hazardous threats faced by most organizations and is an overwhelming task to avert because, employees need legitimate access privileges to organisational resources for their daily works. If they misuse this trust accidentally or intentionally, it can cause breaches in the confidentiality, integrity and availability of the resource, thereby, negatively impacting the corporations' reputation, productivity and eventually finances. Using the actor network theory (ANT) and the theory planned behavior (TPB) as a foundation for research on user awareness and training backed with access control, this study, addresses information security related threats from insiders and ascertains the circumstantial factors that gives inspiration to insider threat lead behaviors as well as what exactly motivates an employee to attack their own employers. The findings from preceding studies on Partial Least Square - Structural Equation Modelling (PLS-SEM) whose variables accounts for extensive discrepancies in intention to engage in a malicious behavior, showed that PBC is a dual-factor paradigm while attitude is a prominent intention predictor. These findings enriches the body of knowledge by backing a theory that explains mitigation of information security threats by insiders using an adaptive awareness model. This study also affords a procedural groundwork for future research to account for insider threat factors while helping a broad range of organizations in mitigating insider threats.

Title: Real Time Sensing and Monitoring of Environmental Conditions in a Chicken House

Authors: Hazael Phiri (Mulungushi University, Zambia); Jackson Phiri (The University of Zambia, Zambia)

Abstract:
In livestock farming in Africa, poultry was the second most consumed meat after beef between 2002 and 2007. In Zambia, poultry accounted for 50% of the meat consumed in 2015. The large market share provides increased income for the farmers and nutrition for the population. Despite the large market share, farmer's especially small and medium scale face challenges in meeting production targets and quality because of poor environmental conditions in chicken houses and theft of stock. The conditions in the environment such as increased carbon dioxide, very high and very low temperature, presence of ammonia gas in high volume and high humidity lead to disease and increase mortality rate. The manual methods used by farmers to monitor these conditions are reactive not proactive. In this paper we proposed the novel methods that can be used to sense and monitor real-time environment conditions in a chicken house for developing countries among the low income farmers. The proposed model is based on ZigBee, GSM and cloud storage for monitoring real-time environmental conditions and providing early warning against theft of chickens from the chicken house.

Title: Securing Grain in Transit for the Food Reserve Agency Based on the Cloud Model

Authors: Sipiwe Chihana (Mulungushi University, Zambia); Jackson Phiri (The University of Zambia, Zambia); Douglas Kunda (Mulungushi University, Zambia)

Abstract:
Despite the fact that Zambia is undergoing rapid development, it still faces food security challenges, Zambian government through FRA ensures national food security and provides market access for rural based small holder farmers by maintaining a sustainable national strategic food reserve. Unfortunately, despite the government of Zambia through FRA ensuring national food security almost every year huge quantities of food are lost due to many factors such as spoilage, infestations, theft and spillage during transporting, this is as reported by the auditor general's office. As a result of the challenges identified, there is therefore need for better management of the grain during transportation through automation of the process. As the world is trending into new technologies and implementations it is a necessary goal to trend up in agriculture as well. We proposed a solution that seeks to minimize on the theft at FRA that occurs during grain transportation from a particular depot to the storage facilities. Research proposed the use of geographical position system (GPS) to monitor and track the location of the vehicle in transit using a mobile application and the web application. Vital information about the vehicle carrying grain e.g. location will be gathered by the GPS fitted in the vehicle will be transmitted to the server in the cloud, this information will be made available to the authorized users using the web application anytime, anywhere. Another additional security feature that the research seeks to implement is Tele-cut off (weight of the truck) this is In a case that the trucks weight carrying the grain increases or decreases, one solution is to send commands from web/mobile phone and alert the authorities, then Track the location.

Title: The World Class University and Higher Education Expectation from Zambia

Authors: Luke Mumba (University of Zambia, Zambia)

Abstract:
Higher Education has a critical role to play in national development. As the famous saying goes, education is the equaliser. As President Mandela put it, investment in education is an investment into your future. The divide in levels of development across countries can be narrowed by giving the nationals education. Household poverty is often eliminated through creation of an educated community. There are so many social vices that can be corrected through education. The current cholera pandemic that disturbed social economic activities in Zambia in the first quarter of 2018 can be said to be an education issue. There is no other more potent method of controlling street vending than to pass on to the vendors higher level skills through education. The transformation of economies into different levels of development is done through education. The change agents are the human capital that enter into each sector and begin to create value, produce goods and offer services. It is not the human capital per se but the quality of education in the human capital that has power to change lives. Today, it is accepted that Universities are key in realizing society's potential for opportunity, social justice and prosperity. Different scholars have recognized this position. Aligaweesa (1987) discusses the contribution Makerere University has made to national development in Uganda. Manathunga (2016) discusses the position of science and humanities in national development in Australia and New Zealand. There are numerous examples that can be cited of the contribution other universities have made in their respective countries' national development. Arising from this, governments have responded by creating opportunities for more Universities to be set up. In the case of Zambia, the number of Universities has grown from one national University, in 1966, the University of Zambia to three predominant public Universities and over 61 private and public universities. The challenge we face is about identifying the character to attach to what we want to see in any institution that is named - University. Admittedly, we see in Zambia Universities being set up from any setting. Some look like Secondary Schools, Others look like a residential building. The concept of mass higher education as a response to the gaps in demand and access for higher education appear to have taken a more centre stage in importance and we perhaps do not often step back to contextualize a world class University we want to see. This paper therefore discusses the world class university from a critical perspective. In doing so, we attempt to look at the challenges higher education in Zambia faces from a different perspective. One of the questions to ask is, should Universities be comparable? If so, which measures of world class would best represent the desired character of a world class University in Zambia? Should we be pursing the ultimate of the Oxbridge University type character in our local Universities?

Title: The Role of Science, Technology and Innovation in National Social, Social and Economic Development with Specific Reference to Zambia

Authors: Luke Mumba (University of Zambia, Zambia)

Abstract:
This paper employs the inter-relationship of science, technology and innovation as key drivers to economic development. Specifically, it explains what science, technology and innovation are as they relate to economic development. It also addresses the need for enhanced investment in the area.

Title: The Role of Guidance and Counselling in Higher Education Institutions

Authors: Daniel Ndhlovu (University of Zambia, Zambia)

Abstract:
This paper interrogates the role of guidance and counselling in higher institutions of learning with particular focus on Zambia. It begins with a brief background on what constitutes guidance and counselling and relates these concepts to context within which higher institutions of learning operates in Zambia.

Title: Trends in Gender Biasness in Language Aspects That Can Affect Classroom Practices in Higher Institutions of Leaning

Authors: John Simwinga (University of Zambia, Zambia)

Key words: Classroom; Learning; Gender; Language

Abstract:
This study explores the influence of linguistic gender biasness in classroom practice in higher institutions of learning in Zambia. It commences with a definition of key concepts of language and gender, thereafter, it relates these concepts to language as used by teachers and learners according to gender in a real classroom situation.

Title: The Role of Government in Promoting Collaboration and Partnership Between Industry and Higher Education

Authors: Kashumba Kabombo (David Livingstone College of Education, Zambia)

Key words: Collaboration; Industry; Higher Education; Academia; Higher Education and Research

Abstract:
Academia-industry collaboration and partnership is very crucial in the development of any country. The collaboration and partnership between these two parties can only be made possible by the government intervention, without it, there can be little or no academia-industry collaboration and partnership. The government in the first place has to come up with the legal framework that should work as a platform on what academia-industry collaboration and partnership can be based. This legal framework should be clear to avoid ambiguities in the collaboration and partnership between higher education and industry. Therefore, it is from this framework that the role of the government in promoting academia-industry collaboration and partnership can be achieved.

Title: Investment and Sustainability for Research for Higher Education

Authors: Taulu Stephen (David Livingstone College of Education, Zambia)

Abstract:
The purpose of the paper is to investigate the investment and sustainability for research for higher education. The review of literature was done to come up with a compilation of data in this so as to arrive at the findings in this paper through comparing case studies in some universities. The findings in this paper show that there is a lack of an incentive structure for promoting change at individual level of colleges and universities is lacking. The connections of the higher institutions of learning and society or other coordinating bodies are missing among colleges and universities. The national legislative framework on investment in research in higher education is lacking. It has therefore been concluded that the interdisplinarity is to be encouraged as a strategic objective.

Title: Entrepreneurship Education and Its Role in Higher Education

Authors: Prophetor Simatende (Admin@dalice. edu. zm, Zambia)

Key words: Entrepreneurship; Innovation; Economic Growth; Teaching and Assessment Methods

Abstract:
Zambia's biggest challenges are low economic growth, and unemployment. And in villages across the country, people have become reliant on remittances - money sent by relatives working in towns - and this has destroyed local economies and economic activities, and therefore the ability of communities to lift themselves out of poverty. There is no other more potent method of alleviating poverty levels than to pass on to the people entrepreneurship education - the ability of people and communities to produce high levels of self-sustainability. This is about saying to people, 'your life is in your hands, and you would better take a grip'. It's about best practices, as imperfect as they are, and get them to scale, so they can get an increasing numbers of individuals and communities into an entrepreneurial framework .What is surprising is that, plans being put in place to teach entrepreurship courses in colleges of education and other higher institutions of learning in order to prepare its students for life upon graduation is not yielding the desired goals, yet entrepreneurship "is one of the important ingredients to economic growth, job creation and increased societal resilience" (Ekmekcioglu, p.6) .Although Universities and colleges have been driven hard to grow the production of entrepreneurial graduates there is still a gap between where entrepreneurship should be taking place and what's going on in colleges and universities. This study explores the provision of entrepreneurship education at Higher Education Institutions (HEIs) in Zambia with special reference to the levels of course objectives, contents, teaching and assessment methods to ascertain whether they are appropriately developed to prepare students for entrepreneurship as a career option. In doing so, we attempt to look at the challenges colleges of higher education in Zambia faces from a different perspective. One among some of the question is to what extent are colleges fostering entrepreneurship- making students more creative, opportunity oriented, proactive and innovative, adhering to a wide definition of entrepreneurship relevant to all walks in life?

Title: How Edible Native Plants Become Extinct and Ways of Preserving Them

Authors: Manianga Amabile (David Livingstone College of Education, Zambia)

Abstract:
Zambia and Africa as a whole possesses a huge diversity of edible native fruits including Baobab Tree - Adansonia digitate, Governor's Plum - Flacourtia indica, Horned Cucumber - Cucumis metuliferus etc. These fruits are found growing under various weather conditions. Their production has declined; and there is limited and undocumented information owing to the minimal or lack of research that has been conducted. Despite their nutritional and economic value, they offer, these fruits and their products are never commercialized. People gather these fruits from the bushes and trade informally within communities to generate income for their families. However, there is now a growing interest by the people about the value of these fruits. It is for this reason that this paper investigates on how edible native plants become extinct and ways on how we can preserve them .in order for this project to be a success, Universities and Colleges should innovatively spear head and come up with botanical gardens of these edible native plants and educate the students on how important they are to individuals as well as to the nation as a whole. Such can also be a way of preserving them.

Title: Digital Identity Modelling for Digital Financial Services in Higher Education

Authors: Inambao Wakwinji (Kwame Nkrumah University); Jackson Phiri (The University of Zambia, Zambia)

Key words: Digital Identity Modelling; Digital Financial Services; Higher Education; identity credentials; Euclidean Distance Geometry

Abstract:
Identification and verification have always been at the heart of financial services and payments, which is even more the case in the digital age. So, while banks have long been trusted to keep money safe, is there a new role for them as stewards of digital identity? Government should, in consultation with the private sector, develop a national identity strategy based on a federated-style model in which public and private sector identity providers would compete to supply trusted digital identities to individuals and businesses. Back when the world seemed smaller, slower and more local, physical identity documents were adequate for face-to-face transactions. However, the internet changed everything. It shrank distances, created new business models and generally sped everything up. From the innovation lifecycle to access to information, processes and the clock-speed on risk, the internet has accelerated everything. The use of Internet in doing business has grown over the years in Africa and Zambia in particular. As such, the incidences of online identity theft have grown too. Identity theft is becoming a prevalent and increasing problem in Zambia. An identity thief only requires certain identity information to decimate a victim's life and credit. This research proposes to identify and extract various forms of identity attributes from various sources used in the physical and cyberspace to identity users accessing the financial services through extracting identity attributes from the various forms of identity credentials and application form. Finally, design a digital identity model based on Shannon's information theory and Euclidean metric based on Euclidean Distance Geometry (EDG) to be used for quantifying, implementation and validating of extracted identity attributes from various forms of identity credentials and application forms, in an effective way.

Title: The Effects of Entrepreneurship on Colleges of Education

Authors: Simatende Prophetor (David Livingstone College of Education, Zambia)

Abstract:
The problems of entrepreneurship in higher learning institutions in colleges of education in Livingstone are found in education colleges all over the world especially in developing countries. Entrepreneurship as observed by Hofer and Potter (2010:5)," has been seen as a tool for stimulating job creation". It is form of self-employment that drives a person to work harder since one will not rely on personal skills, knowledge, and resources utilized. To address this issue in 1994 the department of Technical Education Vocational and Entrepreneurship Training (TEVET) has incorporated entrepreneurship Training in colleges, the essence of which is to promote entrepreneurship skills among the graduates. (OECD, 2012:172). This introduction of entrepreneurship as either course components in Business studies or as blended course in ICT and Entrepreuship is meant to, instil values that can help students think entrepreneurial so as contribute towards the individual and economic development of the country. Hofer and Potter (2010) argue that college graduates have enormous potential for innovation and economic development. Therefore, "mobilizing them for entrepreneurial careers, enhancing their entrepreneurial skills, and providing support for business start-up are important for higher education institutions." (Hofer and Potter, 2010:5) However, the college of education and other higher institutions of learning seem to be failing to achieve their objectives because, in the past few years unemployment has risen among college graduate. As a result, graduates have left and are leaving the country in search of employment. This has led to a loss of skilled labour that could have contributed to the development of technology and innovation, which are potentially important components of the nation's economy. Mtonga has described this situation as follows: "among graduates in Zambia very few will have opportunities to find stable employment soon after graduating, a situation that has led many students especially those studying abroad to remain for greener pastures" (Mtonga, 2010). Zambia's universities and other higher learning institutions, have over the years greatly contributed towards the training of skilled labour which is potentially an essential asset for the nation's economy. However, plans being put in place to introduce entrepreurship courses in colleges of education and other higher institutions learning in order to prepare its students for life upon graduation is not yielding the desired goals.

Title: An Assessment of the Factors Affecting the Use of Intellectual Property Protection Among Small and Medium Entrepreneurs in Zambia; A Case Study of Chililabombwe District

Authors: Patrick Kalyabanyama (Mulungushi University & Non, Zambia)

Abstract:
Despite good innovation for improved products produced among Small and medium Enterprises (SMEs), there is little use of intellectual property protection (IPP) to restrict other firm from producing similar products in Zambia. A study was done in Chililabombwe district in the Copperbelt province of Zambia to assess the factors that influence the use of intellectual property rights among SMEs. A sample of was 50 SMEs was randomly selected and a fully structured questionnaire was used to collect data. Using the linear regression model, capital invested in the business, quality and quantity of the product, methods of processing/production and size of the enterprise/firm were found to have a positive influence on the use of IPP while cost of registration was found to have a negative influence on the use of IPP and these factors were significant in the model. These factors were identified as the main factors that influence the use of intellectual property rights among SMEs in Chililabombwe. The findings suggest that most SMEs do not use IPP because most business are individually owned with less capital invested in the production and processing of their products, making registration cost for IPP become expensive.

Title: Using Network Simulation Tools in Teaching and Research for Networking Courses

Authors: Christopher Chembe, Brian Halubanza and Mulenga Mwenge (Mulungushi University, Zambia)

Abstract:
Information Communication Technology (ICT) has penetrated in all aspect of everyday activities. ICT relies on computer or end user device communication to share valuable information. Therefore, computer networking is one of the core courses offered by many institution of learning in their ICT programmes. Computer networking is one of the areas of ICT that demand a lot of practice from students in order to understand the theories taught in class. It is difficult for students to conceptualize the theories learnt in class such as protocols and understanding of the packet flow without visualization through practice. However, laboratory networking equipment such as Routers, Switches and cables are expensive for many institutions to acquire. Furthermore, technology changes rapidly hence students require up-to-date equipment embedded with new and advanced algorithm as well as new protocols. This can contribute to expense of running physical network laboratories. Therefore, teaching and research in computer networking can be enhanced through the use of simulation tools. Using network simulation tools, students can visually implement the core concept of networking theory learnt in class by constructing, tuning as well as analyzing network performance of various protocols. In addition, many simulation tools provide mechanism to simulate different networks ranging from local area network (LAN) to wide area network (WAN). Regardless, network simulation tools can be categorized into open source and commercial. In this paper, we give a general overview of commercial and open source simulation tools available for use in classroom and research environment with advantages and disadvantages of each category. Thereafter, we demonstrate the use of network simulation tool in implementing an example of coursework using Packet Tracer.

Title: Dilemma of Titling a PhD Thesis by of a Novice Researcher Within South-South Partnership, Sub-Saharan Africa

Authors: Francis Simui, Sophie Kasonde-Ngandu, Austin Cheyeka, Daniel Ndhlovu, Gift Masaiti and Boniface Namangala (University of Zambia, Zambia)

Abstract:
The title is the first statement that readers encounters in a thesis. As the saying goes, 'the first cut is the deepest,' hence the need for a title that grabs attention, accurately describes the contents of the thesis and makes people want to read further. Despite being the first item, arriving at a meaningful title posse a challenge as one novice researcher discovered. In this article, we reflect on the lived experience of a novice researcher during his doctoral studies at Sim University in Sub-Saharan Africa. The PhD programme was anchored within a partnership arrangement between two public universities from Zambia and Zimbabwe. Data was elicited in retrospect using Hermeneutics Phenomenology approach over a period of three years. Emerging from the study are eleven (11) variations of titles concomitant to knowledge growth of the novice researcher over a period of three (3) years (2014 - 2017). This then entails that though a thesis title appears first is the last to be developed. In addition, a title, though has fewer number of words (supposedly the easiest), yet it is the hardest part as it blends all the constituencies of the thesis. Therefore, novice researchers should be prepared to revise their research titles mercilessly concomitant to their level of knowledge discovery throughout the research writing process.

Title: ICT in Governance Systems: A Case Study of the FISP Farmer Registration System

Authors: Alinani Simukanga and Jackson Phiri (The University of Zambia, Zambia); Mayumbo Nyirenda (University of Zambia & Hokkaido University, Zambia); Monde M Kalumbilo-Kabemba (The University of Zambia, Zambia)

Abstract:
Use of enhanced Information Communication Technology is among the key targets set forth in the 7th National Development Plan. Absence of a rigorous approval process has seen an increase in the number of ghost farmers benefiting from the Farmer Input Support Programme. The lack of a single pool of farmer and marketing information for technocrats makes decision making a near impossible task. This paper proposes a system for the capturing and management of farmer information using cloud infrastructure. Having this information will bring efficiency to the activities of farmer-facing bodies such as the Farmer Input Support Programme and the Food Reserve Agency.

Title: The Higher Education in Africa Contexts Critics Debates Challenges and Opportunities

Authors: Chrysostome Kayombo (University of Lubumbashi, Democratic Republic of the Congo)

Abstract:
Earth stronger droughts and higher humidities, land of any mineral or any plant, land of wide horizons or land to vertical lines, Africa offers the world a range of contrasting realities. Exuberance of vegetation or near absence of vegetation contrary, constant rain and heavy or permanent aridity, dry season or rainy season, trays, depressed or highlands bold embossed basins; Africa coexist otherwise over the whole of its territory. This book starts from the premise that African states consider the University as a field of great importance. Evidenced by the large number of policies, reforms, strategic plans, changes and innovations promulgated by States for half a century, and the budgets for higher education and university. It was good enough, in an explicit way, not only answer the thorny question of unproductive African University, but also to ensure that this development is articulated in societal modernization requirements initially, globalization and competitive in a second. The university educational field, local, national and international, is not left behind by the leaders, as we shall see, when it promotes various forms of diversification of educational provision. The second observation is that despite this willingness to pursue an education policy at the African University in the 1960s, some dissatisfaction in terms of implementation and expected results expressed both among policy makers and within of society and asks therefore the dealings of States. The difficulty many times documented to faithfully implement a policy requires a close look at the whole process, not only the development and policy making. This process is often presented as logically linear, empirically it appears much more complex, more like a tangle of logical and actors who build together a policy that partially escapes them, rather than the exemplary embodiment of a rational resolution problems. This problematic situation is the source of what we call in this book, the turning point in the implementation "of reforms inappropriate." To better reflect this complexity, this book attempts a connection between policy analysis and a set of writings from the field management of change in higher and university education to better understand why it seems apparently so difficult to do safely. For example, a curricular renovation company or transformation of teaching practices. This junction has the effect that a large part of the writings discussed in this book would echo the diverse terrain of the implementation of policies, and concerns of African society and directions who work daily. In this work, we define the university educational model, as a coherent and articulated axiological propositions that clarify "who", "why", "what", "how", "by which" teach as part of a device established training emanating from political bodies organizing this device.

Title: The Role of Higher Learning Institutions in Fostering Social Adjustment Among Students

Authors: Yasmin Muchindu (Rusangu University, Zambia)

Abstract:
Higher institutions of learning have the responsibility to create an environment conducive for the all-round development of the learners - cognitive, affective and psychosocial domains (McNamara, 2000). However, the reality in Zambia is far from what is expected. This can lead to a dangerous social scenario, as we may run the risk of producing students with high intellectuality but low levels of social adjustment. Mangal (2009) attests that faulty socialization of a child results in disorganized personality and abnormal behaviour. Thus, providing inadequately in the development of the social aspect will endanger the potential of the students to be a fully productive member of the larger society (Jou & Fukada, 1996). Therefore, the overall aim of this study was to determine the factors influencing social adjustment and also to examine the relationship between social adjustment and academic performance of first year university students in Zambia. This study was founded on two theories, Urie Bronfenbrenner's ecological theory (Bronfenbrenner, 2000) and Erik Erikson's theory of social development (Erikson, 1968). This study implemented mixed methodology, using cross-sectional survey design. The participants included 556 first year university students. Findings indicated statistically significant relationships between social adjustment and the variables of age, gender, place of residence, program of study, family type and economic status of first year university students ($P<0.05$). The Pearson product-moment correlation coefficient (r) value between the social adjustment and academic performance variable of first year university students in Zambia was 0.815 ($r>0.01$), which was statistically significant. The tertiary institutions in Zambia must take responsibility to provide an environment conducive for better social adjustment among the students. It is the task of the contemporary educators to equip a child of today to become responsible social beings of tomorrow.

Title: An Exploration of a Higher Education Content and Language Integrated Learning (CLIL) Curriculum for sub-Saharan Africa

Authors: Bernard Nchindila, Prof (University of South Africa, South Africa)

Abstract:
Content and Language Integrated Learning (CLIL) is currently enjoying attention in both the European and American learning settings in its cross-curricula form. Whilst the efficacy and the structural curricula and implementation challenges of CLIL have been a legitimate site of scholarship outside of the African continent, there is little research of the applicability of a CLIL curriculum to multilingual sub-Saharan Africa. Focusing on this applicability of a Higher Education CLIL curriculum to multilingual sub-Saharan Africa, this paper critically explores the issue of CLIL curriculum to the sub-Saharan higher education context against some central claims of evidence of emerging research on CLIL, including the cautions stemming from theoretical and methodological shortcomings of poorly modelled CLIL curricula and implementations. The paper provides food for thought for policymakers on how to thwart potential limitations of CLIL reported in the literature.

Title: Assessing the Readiness of Students to Use Mobile Application-Aided Collaborative Learning A Case of Copperbelt University

Authors: Phillimon Mumba and Maybin Lengwe (Copperbelt University, Zambia)

Abstract:
To improve student performance and retention rates, higher institutions of learning are constantly researching on the approaches, tools and techniques to use. In recent times, concepts such as mobile learning, electronic learning, collaborative learning, flipped classroom and deep learning have emerged. These describe the different approaches that institutions are using to improve student performance and retention rates. However, the successful implementation of an approach largely depends on the willingness of the users (learners and educators) to use. Even the best approaches or techniques cannot yield fruitful results if the users are not willing to use them. This paper assesses the willing of students at Copperbelt University to use mobile application-aided collaborative learning in their studies.

Title: A Survey on Face Detection and Recognition Techniques for Application in Educational Institutions

Authors: Leena Jaganathan (University of Zambia, Zambia); Mayumbo Nyirenda (University of Zambia & Hokkaido University, Zambia); Jackson Phiri (The University of Zambia, Zambia); Clayton Sikasote (University of Zambia, Zambia)

Abstract:
Video surveillance systems continue to grow in importance and use. They monitor the behavior and activities of the people using electronic equipment. Consequently, video surveillance has emerged as a main component in ensuring public security at airports, hospitals, banks, government agencies, casinos and also educational institutions. Therefore, they have a great potential for enhancing security requirements in educational institutions. However, real-time detection and recognition of a human face from the video sequences is a difficult task due to the background variations, changes in the facial expression and illumination intensity. The ability to automatically recognize the faces in the surveillance video is highly important in detecting the intruder/suspicious person. Face detection and recognition are the two main stages of the surveillance process. Facial recognition has gained a lot of significance in commercial, finance and security applications. Various face recognition techniques are developed to improve the accurate recognition of the face in the image. However, the existing techniques suffer due to the variation in the illumination intensities, facial angles, low resolution, improper focus and light variations. This paper provides a survey of the face detection and recognition techniques. The survey presents the comparative analysis of the recent face detection and recognition techniques along with the merits and also discusses their applicability in the education sector. This is information is very important in choosing what techniques would best be applied in educational institutions putting into consideration the financial and technological constraints they operate under.

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Title: Soft Skills Imparted into Graduating Students of the School of Education at University of Zambia (UNZA)

Authors: Mubita Namuyamba (University of Zambia, Zambia); Friday Nyimbili (The University of Zambia, Zambia); Wanga Chakanika (University of Zambia, Zambia)

Abstract:
The school of education at the University of Zambia trains teachers and educators in different fields of education. The curriculum followed was one that provided hard skills and did not consider including a component on soft skills. This study looked at the genre of soft skills that final year university of Zambia students from the school of education possessed and entered the world of reality and employment with after their graduation. The study used a mixed methods design on a population of 150 respondents. The findings revealed that students possessed soft skills like; entrepreneurship, problem solving, lifelong learning and communication skills. The skills they acquired while in the university included; professionalism, maturity, verbal communication and planning. These were acquired through being involved in activities like group related work, peer teaching, internship, role play, membership at associations and presentations in the classes or lectures. The study concluded that the school of education should work towards refining the embedded curriculum being followed or to adopt the stand-alone curriculum. This would help the graduates not to look for employment but be employers if the new curriculum is to be implemented well so as to enhance the graduating students' contribution towards national development.

Title: Technological Challenges of the Zambian Industry: Are Universities the Solution?

Authors: Kavwanga Yambayamba (Mulungushi University, Zambia)

Abstract:
The aim of this paper is to examine the level of technology in Zambia, the technological challenges and the link between industry and the universities. Evidence from various documents shows that Zambia's industry can be described as mainly primary, with very little processing. From the works and surveys done by the Ministry of Commerce Trade and Industry, the manufacturing (processing) is largely characterized by low technology industries which are mainly processing of food and beverages. High technology products are virtually absent. Further, industries lack the absorptive capacity necessary for the identification and exploitation of scientific knowledge. This situation arises from the fact that there is no formal link between industry and academia. While both industry and universities conduct research, the former focuses on commercial success while the latter focuses on solving fundamental science questions. This role played by universities is extremely beneficial to industry firms as it increases their productivity. Evidence from advanced technologically advanced countries shows that collaboration between industry and universities is a necessity rather than a choice. Lack of collaboration between the two sectors impedes development of industry, with the consequence of low quality products. This is largely the case for Zambia. Further the Zambian government has not made any major investment in R&D, thus exacerbating the already weak links between industry and universities. It is concluded that unless there is strong collaboration between industry and universities, the former will not derive any scientific benefits from the latter and the status quo will continue.

Title: School Teaching Practice and Skills Acquisition Trainee Teachers Speak Out

Authors: Maureen Sinyangwe (Kwame Nkrumah, Zambia)

Abstract:
This paper presents and discusses findings from third year students who have been on school teaching practice as a formal and mandatory part of their undergraduate studies at University X*. The students taking Mathematics as a major or a minor course shared their perceptions of the contributions that school teaching practice made to the acquisition and development of skills with a special focus on soft skills. The data which was collected by use of a questionnaire with open-ended questions and in-depth follow-up interviews shows that School Teaching Practice (STP) is instrumental in skills acquisition especially soft skills. It also reveals that while the trainee teachers valued the contribution that the university made, through the courses they undertook before embarking on their STP, toward the development of their skills they greatly valued the experience of learning and developing the soft skills through their STP. They argued that the focus of the university time courses is largely the development of academic or technical knowledge and skills, at the expense of soft skills needed to help them cope with the realities of teaching in particular and life beyond university walls in general. One of the conclusions made is that the university should step up and assume more responsibility to supplement the training in soft skills especially that students spend more time at university than they do during STP.

Title: Zambia Business & Economic Model for Social-Economic Development

Authors: Moulen Siame (Mulungushi University & Zambia Entrepreneurs Forum, Zambia)

Abstract:
In order to achieve the 2030 vision, Zambia requires new innovative and responsive business and economic model (BEMo) for the socioeconomic development of the country. The current levels of Zambia's economic and social development can be attributed to the BEMo adopted in the 1970's as a result of the Mulungushi Economic Reforms of April 1969 and its associated modifications thereof to date. In 1969, Zambia was classified a middle-income country, with one of the highest per capita GDPs in Africa; three times that of Kenya, twice that of Egypt and higher than Brazil, Malaysia, Turkey, and South Korea. The business and economic model inherited from the colonial era and the Neolibelism economic policies were responsible for that level of socioeconomic development. The social, economic, political, institutional and administrative reforms that occurred in 1970's as well as those of the third republic 1991 to date) have taken longer to take Zambia back to a middle-income country. The country requires a new innovative BEMo, that brings about constructive destruction, to become a "Prosperous Middle Income Country…", or indeed to "upper-middle-income country ($3,958 to 12, 235 GNI)" and eventually higher-income country ($12,236 and more GNI). Zambia was once a prosperous middle income country; therefore, 2030 vision is a mundane target. The country needs similar business and economic model that propelled countries like Malaysia, Singapore and South Korea, where they are within a span of half a century. A BEMo is an economic and social development framework for creating, delivering and capturing economic and social values at national level. Just like any enterprise has a business model, every nation too has a business model for economic and social development. Zambia BEMo for socioeconomic development has been implicit rather than explicit. No wander there is anecdotal studies to date that look into or examine the effectiveness of Zambia's BEMo. This paper presents a tentative explicit business and economic model for Zambia. Specifically, the paper presents the concepts and conceptual BEMo. Central to BEMo, are anchor institutions for higher learning (universities) and the synergy between government, industry and universities - triple helix.

Title: Linking Higher Education to Industry/Private Sector in Zambia

Authors: Dickson Mwika (Kwame Nkrumah University, Zambia)

Abstract:
The link between higher education and industry/Private Sector is a critical component for increasing innovation systems in developing countries. Therefore, it is beneficial to study the experience of developing countries in the context of Zambia to understand the different types of higher education-industry linkages, motivations that drive this form of agreements, barriers to collaboration, as well as the role of government in encouraging such linkages. In Zambia, these agreements have been difficult to realize. Hence calling for a different approach, which can help in promoting university-industry collaboration.

Title: The Dynamic Triangle as a Tool for Harnessing Intellectual Capital

Authors: Ngande Mwanajiti (Energy Regulation Board of Zambia, Zambia)

Abstract:
The dynamic triangle, has three distinct legs, the one standing on Democracy, and another on Development and the third one on Human rights. To all these legs have many definitions and we see the major challenge as that of either identifying or developing a definition which mirrors our realities correctly! For instance, the well documented struggle for self-determination was classified as a struggle for independence and not a human rights struggle. We note that the Universal Declaration of Human Rights -UDHR (1948) was negotiated at a time when no African country was free from subjugation and serfdom and the rot of colonialism, notwithstanding the Charter, continued. It is also important to make clear that at the time of the lengthy discussions/negotiations in the United States of America, racism was a major problem, and so was discrimination and other vices elsewhere. In our view, we would do well to capture such realities as critical reference points that partly explain the way we interface and engage with our intellectual capital. This dignified gathering, has the necessary skill base and the necessary intellectual rigor, to make its case for dealing with such rudiments that lead to a better understanding of our societal challenges. I would go so far to hazard a view suggesting that such fora, be regular and our Zambian government be invited to buy in as a major stakeholder, with the necessary capacity and muscle to promote effective engagement. It is critical that policy positions and decisions, for instance be informed by relevant research. Herein we find a location for the interface between the Universities/colleges and society! It is our observation therefore that the synergies of the dynamic triangle tend to unleash either progressive/forward movement or the unfortunate stagnation, with its consequent challenges. In our view, these fundamentals are ripe for serious and incisive interrogation, because a template whose origins are suspect, or simply uninformed, may not be too useful. In the Zambian context though and given the many standard definitions of the dynamic triangle, we are tempted to ask: What is the Zambian understanding and possible interpretation of Democracy, Development and Human Rights (not withstanding its acclaimed universality)? There does appear to be an emerging pattern; wherein, the Dynamic Triangle, in its broadest sense, challenges nature. It does so in the context of societal dynamics wherein more often than not, mediocrity either subdues or eclipses merit. In our paper therefore, and in addition to the above, we shall endeavor to argue that it is irresponsible for intellectuals in Colleges and Universities, to give up their traditional roles of generating and disseminating knowledge. Second, that abilities, must not be downgraded to disabilities by our society. Third, Society must accept that intellectual capital is a tool that must be harnessed for national development. Fourth, that charity begins at home: We must appreciate our own and not prefer others whose understanding of Zambia may be quite remote. Instead, we must cherish, cheer, appreciate, and support independent thinking as an intrinsic property, so recognized by law. (Check our Bill of Rights on PROPERTY RIGHTS. See PACRA as well) Lastly, we shall make the point that by its design, nature does not allow for a vacuum. There is absolutely no need for our intellectuals in colleges and Universities, to take a "back seat". So without finger pointing, we must get back to the drawing board and let each party play their part. In fact; the disgraceful propensity and clamor for degrees earned, outside intellectual rigor, is a point in case.

Title: The Use of Open Source Tools in Research: A Case Study of the Mutation of African Cassava Mosaic Virus

Authors: Grey Chibawe (University of Zambia, Zambia); Mayumbo Nyirenda (University of Zambia & Hokkaido University, Zambia); Lillian Mzyece and Jackson Phiri (University of Zambia, Zambia)

Abstract:
Research continues to be a key to the successful systematic development of new knowledge and a fundamental aspect to the usefulness of all higher education. Particularly, higher education also aims to advance, create and disseminate knowledge through research. However, in many African countries, research is faced with numerous challenges. One of these challenges is the availability of affordable software tools. In this research we use the study of the rate of mutation of the African Cassava Mosaic Virus (ACMV) as a case study of how open source tools can be used in place of expensive proprietary tools. The study of ACMV mutation is hampered by fragmented and non-user friendly tools currently available. A number of the tools used also depend on network connection, especially the Internet, to access and analyse data. To help alleviate this problem this research proposes the use of open source libraries to generate solutions which are cost efficient and also user friendly. We further propose the use of an open standard using XML as a standard protocol to share data between applications used to analyse ACMV. Initial results show that its possible to use free tools to analyse data in the life sciences and consequently reduce the time and cost required to analyse ACMV. Based on this case study we propose the adoption of such open source libraries in order to make research much more affordable for scientists in the life sciences for researches that operate within a constrained budget.

Title: Digital Library as a Solution for Textbook Shortage Crisis in Zambia

Authors: Maja Zelihic (Forbes School of Business, USA)

Abstract:
The world of education is undergoing significant evolution which causes a significant shift in course delivery, access to resources and teaching technique. Many challenges within the educational arena are being addressed through new developments in technology, forever changing the framework of modern universities. Long gone are the days when a teacher, at the center of the educational process, provided a guide and a compass for students who were at times passive recipients. The notion of knowledge recipient was forever changed as the digital generation opened up new opportunities for educators and technological leaders to re-think their approaches. Students who were forced for centuries to have physical access to learning resources are now able to take advantage of ongoing changes in the world of education and technology by accessing content at their disposal, accelerating their own learning process. However, while the technological advancements are changing the world of education globally, there are still many areas of the world struggling to provide students with basic resources needed for an effective learning process to take place. This article will describe an ongoing exploratory study of different approaches to pedagogy due to the rapid technological changes focusing on the use of software which enhances the learning and teaching process. Furthermore, the article focuses on the significant textbook shortage crisis in Africa, addressing some of the innovative approaches several Zambian institutions pursue in order to solve this problem, creating a pathway for others in the Zambian educational arena to follow. Keywords— African textbook shortage, Zambian educational arena, educational software, digital library, e-library, digital learning, educational technology. , creating a pathway for others in the Zambian educational arena to follow.

Title: Appropriate Implementation of Computer Vision in Student Attendance Management Systems

Authors: Mulenga Mwenge and Christopher Chembe (Mulungushi University, Zambia)

Abstract:
Student performance is highly dependent on class attendance. Most institutions of higher learning in developing countries are currently grappling with the problem of efficient management of student attendance. There is currently a drive to do away with manual administering of student registers to electronic based systems. However, there seems to be a financial hindrance to the successful implementation of Information Communication Technology(ICT) based solutions for attendance management. Recent advances in computer vision offer a new horizon in implementing automatic student attendance management systems (SAMS) at a much lower cost, as compared to other ICT enabled approaches. However, various computer vision algorithms vary in their accuracy levels of face recognition. Therefore, this research seeks to propose an appropriate implementation of face recognition algorithms to improve their accuracy for use in attendance management. The research investigates frameworks such as OpenCV and Openface with respect to their underlying machine learning algorithms and seeks to find out how they can be augmented so as to improve face recognition accuracy in SAMS. The experiment based research will seek to explore the strengths and weaknesses of the frame wakes. In the quest to improve face recognition accuracy, various components of frameworks will be manipulated and their effects on the performance of the entire system observed. This will include the study of camera locations and how they impact results. The experiment will also seek to identify aspects of the training set that may be manipulated so as to improve the performance of the underlying algorithms. For example, since some face recognition algorithms tend to lose their accuracy as ones face changes of over time, it would very important to find interventions that can counter the resulting loss of accuracy.

Title: THE CURSE OF UNOKA: The Arts, Higher Education and National Development

Authors: Cheela Chilala (The University of Zambia, Zambia)

Abstract:
Chinua Achebe's seminal novel, Things Fall Apart, is famous not only for the finesse with which it was written, but also for the types of characters that populate its pages. One of the most intriguing characters in the novel is Unoka, the father to the protagonist, Okonkwo. While the latter is successful and has a number of titles of honour to his name, the former is a failure. Both are famous, however: Okonkwo for his wealth, bravery and hard work, Unoka for his music - for he is a gifted musician. Unoka represents the artist who, despite being talented and socially appreciated, is however a failure in life. Though the Ibo society loves Unoka for his artistic talent and is a popular performer at festivals, they however despise him for his lack of real achievement in economic terms. They call him an "agbala," a derogatory term referring to men without a title of honour. Unoka's problem, the curse which destroys his life, is his failure to be economically relevant to the society. The contradiction in Unoka's life, and his ambivalent relationship to society, can be related to many of Zambia's contemporary artists: musicians, actors, writers, among others. They live in a society which appreciates their talents but does not see them as an important part of economic development. In part they are to blame because, like Unoka, they think their role is just to entertain the society and not to be active players in its economic development. They fail to see that the arts and culture are a viable part of economic development. This paper, however, also explores the question of whether higher education in Zambia has been able to bridge the gap between the arts and culture on one hand and economic development on the other. Zambia, like most African nations, does not have an arts education policy, and this in itself reflects the challenge of making the arts relevant to the national economic agenda. Yet the arts and culture are an industry, or should be treated as such, and can contribute greatly to national development through such sectors as tourism. Has enough been done to make higher education responsive to the socio-cultural and artistic needs of Zambian society? Has higher education in Zambia helped produce artists who can contribute to the national development agenda, or the Zambian artist will remain burdened by Unoka's curse? Has enough been done to ensure that higher education produces arts practitioners who are contributing to the creative and culture industries?

Title: MORE THAN JUST A MIRROR: The Arts and Social Change

Authors: Cheela Chilala (The University of Zambia, Zambia)

Abstract:
The arts have been perceived as a mirror of society - that it is a means of reflecting society back to itself. This springs from the argument that there is a mutually beneficial relationship between the arts and society - and by the arts here we mean any all forms of artistic expression: music, literature, film, theatre, dance, among others. The argument further posits that art is a product of society - specifically, that each artistic expression is influence and shaped by a particular society at a particular place and time; and that there is also some sense in which society is also influenced by art. While acknowledging that the arts are a reflection of society, however, this paper further argues that the arts can actually foster social change. This is true now as it has been in African traditional history. Traditionally there was no such thing as arts for arts' sake. The arts served not only the purpose of entertainment but also fostering norms and beliefs; as well as fostering the socialisation process of children and young people. They were also a tool of education and social cohesion. In contemporary times, in Zambia and at any rate on the African continent, the arts have been used to foster social change. That art can bring about, or at least contribute, to change is exemplified by the fact that some songs, films and publications have been banned by politicians. Politicians are fully aware of the power of art in influencing human behaviour and thought. However, art is not only perceived as a potential negative force but also a positive one. To this end, for example, politicians have used songs and literature as a means of propaganda or a tool for political campaigns. In Zambia political parties have engaged musicians to compose campaign songs, and some of them have indeed had great effect on the society in general and voters in particular. This paper argues that higher education must tap into the power of arts as a tool of social change.

Title: Academic Freedom in Higher Public Universities in Zambia: Myth or Reality?

Authors: John Simwinga (University of Zambia, Zambia)

Abstract:
World-wide Universities as higher institutions of learning are set up for the common good and are mandated to search for truth and to disseminate it in order to inform teaching, to guide society, to motivate policy formulation and implementation and to serve as basis for further research, among other ends. Arising from these areas of university mandate, universities are expected to play the roles of teaching, research and community service whereby research informs both teaching and community service. No university can effectively execute this mandate in the absence of academic freedom. This paper explores the state of academic freedom in public universities in Zambia to establish whether or not it exists as reality or as myth. Data were collected from three universities and three university colleges through focus group discussions, interviews and document analysis. The findings indicate that while academic freedom does exist in the institutions investigated, its full enjoyment is compromised by a number of both internal and external factors thereby turning it into a myth in practice. A number of recommendations are made on how the enjoyment of academic freedom can be enhanced.

Title: Effectiveness of Communication Skills Courses in Developing Students' Proficiency in Academic Writing in Public Universities and Colleges in Zambia: An Exploratory Study

Authors: John Simwinga (University of Zambia, Zambia)

Abstract:
Since the mid-80s, public universities and colleges in Zambia have been teaching communication skills (sometimes referred to as communication and Study skills to first year students in a bid to introduce them to and equip the m with sufficient academic writing skills for advanced academic tasks at university and level. The course packages have included the skills of listening, reading, note-taking and writing. The courses were developed in order to provide an intervention, having observed that upon completion of secondary school and entry to university or college students did not have sufficient academic writing skills to effectively pursue tertiary education. In recent years, despite these interventions university and college lecturers have continued to observe lack of appropriate academic writing skills such as those relating to thematic progression, concept explanation and application, evaluation, assessment, drawing inferences, analysis and description resulting in low scores by students. The proposed study seeks to establish, in an exploratory manner, the extent to which the current communication skills courses contribute to the development of students' competencies in academic writing.

Title: Using Artificial Neural Networks for Seasonal Rainfall Forecasting in Zambia for Educational Purposes

Authors: Lillian Mzyece (University of Zambia & Computer Science, Zambia); Mayumbo Nyirenda (University of Zambia & Hokkaido University, Zambia); Monde M Kalumbilo-Kabemba (The University of Zambia, Zambia); Grey Chibawe (University of Zambia, Zambia)

Abstract:
Weather forecasting applies science and technology in order to predict weather conditions. Rainfall is one of the weather parameters whose accurate forecasting has significant implications for agriculture and water resource management. It is mainly done by experts who have gained sufficient experience in the use of appropriate forecasting techniques like modelling. Making models that capture this knowledge is often difficult. In this research, artificial neural networks are suggested as a model that can be 'trained' to mimic the knowledge of rainfall forecasting experts. This makes it possible for researchers to adapt different techniques for different stages in the forecasting process. We begin by noting the five key stages in the seasonal rainfall forecasting process. We then apply artificial neural networks at each step. Initial results show that the artificial neural networks can successfully replace the currently used processes together with the expert knowledge. We further propose the use of these neural networks for teaching such forecasting processes, as they make documentation of the forecasting process easier and hence making the educational process of teaching to forecast seasonal rainfall easier as well.

Title: Social Enterprises Skills Development: The Role of Higher Education in Rural and Urban Development

Authors: Jackline Nyerere (Kenyatta University, Kenya)

Abstract:
The issues that affect the African society such as poverty hunger and disease have always followed the classification of rural and urban segments of society. The statistics are provided segregating the urban (usually the less affected) and the rural (mostly the most affected) segments of society. The distinction usually follows the 'rural/agricultural/natural resources' sector and the 'urban/manufacturing and services/infrastructure' sector believed to or providing better quality jobs and access to quality basic facilities health and education. This classification however misses the important linkages that exist between rural and urban activities as well as the role of university education in and enhancing these linkages. The university plays a role as an agent or instrument of social change and social development which could be harnessed to create the link between rural and urban segments. Universities can contribute to social change by shifting their focus in training to influence social change through, among other things, incorporating social enterprises training and practices. The study reported in this paper therefore sought to investigate the role of higher education in the rural and urban development through the social enterprises skills development in Kenya. The study examined the level of students' exposure to social enterprise skills development in public universities in Kenya, as well as incubation and innovation opportunities available to them over the past 10 years.

Title: Redefining Development Model for African Nations from an Outside in to Inside Out Approach

Authors: Peter Chabinga (Mulungushi University, Zambia)

Abstract:
Africa needs a development model that is not only effective but consistent with its inner convictions for sustainability. Inner convictions drive the direction and destiny of its masters. Imposing direction and conduct on people with variant convictions has not only proven ineffective but a major drain of limited resources. This paper discusses fundamental issues upon which an effective paradigm that can drive sustainable development for Africans is founded. The paper looks at fundamental principles of existence that not only guide nature but decide the natural fate of human actions. The principles discussed in this paper are fundamental to development of ethics and a productive culture at all levels of society including individual, institutional and National levels. The paper exposes among other things forces responsible for; i. Keeping African Nations in development circus. ii. Keeping African Nations as development consumers and not initiators and iii. Poor governance Finally although the paper is written in simple to comprehend manner it is founded on proven scientific principles.

Title: Integration of the Arts in Zambia's Colleges of Education A Marriage of Convenience

Authors: Bibian Kalinde (The University of Zambia, Zambia); Katongo Moonga (University of Zambia, Zambia); Albert Kasapo (The University of Zambia, Zambia)

Key words: Historically; Educating Our Future; Zambia's Colleges of Education; Integration of the Arts

Abstract:
Historically, proposals for the integration of the Arts date as far back as 1899 by proponents such as Dewey and Kilpatrick. Dewey's thinking was that the treatment of subjects as distinct entities did not facilitate the linkage between knowledge and its application in human endeavours. In Zambia, the suggestion to integrate subjects is first noted in Focus on Learning of 1992 in which the curriculum was cited as overloaded and inappropriate. Thoughts of integrating the arts across the curriculum were later echoed in Educating Our Future (1996) as a means to teach other subjects. The Zambia Teacher Education Course (ZATEC) bulletin (2001:4), adopted the concept of study areas and brought together art, music, dance and physical education as Expressive Arts. This article analyses the implications of arts integration of the arts in colleges of education in Zambia. Data for the study was collected in 10 colleges of education involving 30 Expressive Arts lecturers. Findings of the study reveal the following: 1. a disjunction between policy intentions and teacher education, 2. A tension of differentiation and synthesis of arts teaching. 3.The implementation of Integration was not accompanied by adequate continuous development efforts and changes in the teacher education curriculum. Consequently, lecturers treat Music, Art and Physical Education (PE) singly with very subtle focus on the philosophy that unites these subjects. The article concludes by recommending a shift in policy implementation that considers conditions of teacher education as key in the success of curriculum reforms.

Title: The Use of Information and Communication Technology to Teaching and Learning in Schools

Authors: Phyllis Siyomunji (David Livingstone College of Education, Zambia); Nyambe Nyambe and Takuya Mabwe Chisanga (David Livingstone College of Education, Zambia)

Abstract:
Policymakers who have invested in the use of ICT in education are often motivated by its promise to realise pedagogical innovations. However, the unrelenting gap between the promise and performance of ICT has continued to prompt further research into how the affordances of technology can be better harnessed in schools. This three-year qualitative case study hopes to shed light into this matter by looking at the: 1) ecological factors of how an ICT-enriched Secondary school in Zambia had been using technology to support the pedagogical reform for student-centred learning; 2) conditions that led to its sustained use of technology for this purpose. Complexity theory was employed as the analytical framework for the study. By examining the inter-connectedness of systemic influences governing the use of ICT in the selected schools, educational leaders and policymakers can gain a holistic perspective of the factors that may promote or impede technology integration effort. Through the use of interviews, lesson and meeting observations as well as document analysis, the trajectory of the school's ICT journey was mapped out. The development history surrounding the use of technology for teaching and learning provided a precursor to investigate how the school organisation as the unit of analysis had created favourable conditions leading to the sustainability of ICT-related innovations. Specifically, five themes had emerged: 1) continuous scanning of environment; 2) multi-pronged capacity building efforts; 3) mitigating systemic tensions amongst stakeholders; 4) shared accountability and 5) systematic pacing. Based on the findings to the study, a complexity-informed model for technology leadership, stakeholders' dynamics and guidelines for policymaking were drawn up. The dissertation concludes with reflections on the use of complexity theory and recommendations for future research. The role Information Communication Technology (ICT) play in the educational and learning environment cannot be over emphasized. The use of ICT in modern learning environment ranges from slice use of computers in practical aspects to an online learning experience which enhances and improves students" intellectual and learning behavior (Smith, 2003). With the introduction of computers, the precursor of our modern-day ICT, and the promising potentials of computer-based instruction and learning, many researchers and funding agencies were led to invest much of their resources to investigate the possibility of computers replacing teachers in key instructional roles. Moreover, many people believe that computers should be brought into the education arena simply because "they are there" and the resultant perpetuation of the myth those students would benefit quantitatively from computers by simply providing them with the software and hardware for an effective learning process (Wheeler, 2010). We are living in a constantly evolving digital world. ICT has an impact on nearly every aspect of our lives - from working to socializing, learning to playing. The digital age has transformed the way young people communicate, network, seek help, access information and learn. We must recognize that young people are now an online population and Internet access is through variety of means, such as computers, TV and mobile phones (Tapscott, 2005). As technology becomes more and more embedded in our culture, we must provide our learners with relevant and contemporary experiences that allow them to successfully engage with technology and prepare them for life after school. It is widely recognized that learners are motivated and purposefully engaged in the learning process when concepts and skills are underpinned with technology and sound pedagogy. Learning and teaching aim to provide resources for practitioners, parents and pupils to engage with these technologies in order to inform and enhance the learning experience (Wesley, Krockover & Hicks, 2008). The use of ICT has a positive influence on students" achievement, motivation and learning process. Although classrooms are considered a face-to-face learning environment, yet the installation of ICT equipment such as web-based tools and other technologies positively influence students" blended learning situation. "Classrooms with ICT learning equipment whether completely online or blended, on average produce stronger learning outcomes and motivation than learning face-to-face alone" (U.S. Dept. of Education, 2009). In addition, ICT motivate both teachers and students. There appears to be some consensus that both teachers and students feel that ICT use in the class greatly contributes to students" motivation for and engagement in learning. "A very high 86% of teachers worldwide agree that students are more motivated and attentive when computers and the Internet are used in class... ICT has strong motivational and positive effects on students' learning behavior, communicationand process skills." (Balanskat, 2006). To this end, ICT can promote lifelong independent learning skills. Evidence exist that use of ICT in schools increase learner's autonomy and self -regulated learning. Students assume greater responsibility for their own learning when they use ICT, working more independently and effectively. This has great and positive influence on students" learning behavior and education system in general.

Title: The Role of Emmergent Literacy Practices in Children's Initial Reading Tages

Authors: Dennis Banda (The University of Zambia, Zambia); Geoffrey Tambulukani (University of Zambia, Zambia)

Abstract:
This paper explores the link between the initial literacy teaching and emergent literacy and numeracy practices that children come along with from their homes when they start conventional learning at school. The paper explores the nature and types of literacy and numeracy practices and behaviours that children exhibit in their homes, rural or urban, long before they start formal schooling. Using examples from different households of varying economic statuses in Lusaka, the paper problematizes aspects of teachers, parents and curricular developers ignoring the emergent literacy and numeracy practices children exhibit long before they start formal schooling. The paper identifies these as factors in the ever widening gap between the home culture and school culture. The paper concludes that there is need to sensitize, guide and empower the parents, teachers, curricula developers so that they take into account the literacy and numeracy practices children come along with from their varying homes as stepping stones to the provision of formal schooling. The paper further holds that curricula developers must get more involved in children's emergent literacy and numeracy practices for them to integrate these aspects in the curricula development and implementation if the gap existing between the school and home culture is to be narrowed. In addition, the paper argues that there is need to take another look at language in education policy, which currently, appears to favour former colonial masters' language to the detriment of indigenous languages in which emergent literacy and numeracy practices flow. Ultimately, issues of emergent literacy and numeracy practices children come along with to school from their homes need to be looked at in conjunction with issues of low literacy levels in our schools.

Title: Capacity Development for Policy Analysis Using Research Results and Field Knowledge for Quality Education: Lessons from Japan and Denmark

Authors: Dennis Banda (The University of Zambia, Zambia)

Abstract:
This paper is based on the training that took plane in Japan involving participants from over twelve developing countries from Africa and Asia and the Pacific Islands. The training highlighted four outcomes which shaped the discussions names: 1. explaining the implication of changing aid modality in favor of the result-based and a major shift in funding from access to quality education. 2. Explaining the consistency between main objectives of education policy and the corresponding process of education improvement in the participant's country using the Country Report and; to be able to explain the characteristics of participant's own country in education policy implementation in comparison with cases of other participants and Japan. 3. Explaining how to use research results and lessons from education practice and cooperation for informing the process of formulating the policy framework (bottom-up policy process); Explaining how to translate the policy objectives into policy measures (top-down policy process); Explaining how to apply this knowledge for the policy analysis including the preparation of the policy matrix and 4; Proposing an action plan to involve key partners and stakeholders in the process of policy discussions and in preparing for the policy implementation plan, include it in an interim report that summarize the learning, and revise it through consultation (in the final report after work in home countries) Issues raised in the various country reports were that the meaning of changing aid modality for the improvement of education quality had serious implications for developing nations whose focus in education had not shifted yet from access as many children cannot access schools in many of developing countries. Various country reports showed the true reflection of the challenges developing countries have and how little attention was given to research, with so many new policies implemented which are not supported by any research findings but merely on tours made by politicians. The training also emphasized the need to establish research units at Ministry of Education level to coordinate all research activities for informed policy formulation for quality education.

Full Paper Proceedings

The Dynamic Triangle as a Tool for Harnessing Intellectual Capital

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Abstract— **The dynamic triangle, has three distinct legs, the one standing on Democracy, and another on Development and the third one on Human rights. To all these legs are many definitions and we see the major challenge as that of either identifying or developing a definition which mirrors our realities correctly! For instance, the well documented struggle for self-determination was classified as a struggle for independence and not a human rights struggle. We note that the Universal Declaration of Human Rights -UDHR (1948) was negotiated at a time when no African country was free from subjugation, serfdom and the rot of colonialism. Notwithstanding the Charter, and probably highly dismissive, oppression, continued.**

I. INTRODUCTION

It is important to make clear that at the time of the lengthy discussions/negotiations taking place in the United States of America, racism was a major problem, and so was discrimination and other vices elsewhere. In our view, we would do well to capture such realities as critical reference points that partly explain the way we interface and treat our intellectual capital. This dignified gathering, has the necessary skill base and the necessary intellectual rigor, to make its case for dealing with such rudiments that lead to a better understanding of our societal challenges. I would go so far to hazard a view suggesting that such fora, be regular and our Zambian government be invited to buy in as a major stakeholder, with the necessary capacity and muscle to promote effective engagement. It is critical that policy positions and decisions, for instance be informed by relevant research. Herein we find a location for the interface between the Universities/Colleges and society!

It is our observation therefore that the synergies of the dynamic triangle tend to unleash either progressive/forward movement or the unfortunate stagnation, with its consequent challenges. In our view, these fundamentals are ripe for serious and incisive interrogation, because a template whose origins are suspect, or simply uninformed, may not be as useful.

In the Zambian context though and given the many standard definitions of the dynamic triangle, we are tempted to ask: What is the Zambian understanding and possible interpretation of Democracy, Development and Human Rights (not withstanding its acclaimed universality and popularity)?

There does appear to be an emerging pattern; wherein, the Dynamic Triangle, in its broadest sense, challenges nature. It does so in the context of societal dynamics wherein more often than not, mediocrity either subdues or eclipses merit.

In our paper therefore, and in addition to the above, we shall endeavor to argue that it is irresponsible for intellectuals in Colleges and Universities, to give up their traditional roles of generating and disseminating knowledge. Second, that abilities, must not be downgraded to disabilities by our society. Third, Society must accept that intellectual capital is a tool that must be harnessed for national development. Fourth, that charity begins at home: We must appreciate our own and not prefer others whose understanding of Zambia may be quite remote. Instead, we must cherish, cheer, appreciate, and support independent thinking as an intrinsic property, so recognized by law. (Check our Bill of Rights on PROPERTY RIGHTS. See PACRA as well)

Lastly, we shall make the point that by its design, nature does not allow for a vacuum. There is absolutely no need for our intellectuals in colleges and Universities, to take a "back seat". So without finger pointing, we must get back to the drawing board and let each party play their part. In fact; the disgraceful propensity and clamor for degrees earned, outside intellectual rigor, is a point in case.

For practical reasons most entities such as the United Nations, the World Bank, et cetera have elaborate working definitions of terms such as Development, Democracy and Human Rights. In the course of developing this paper, I have exercised my mental faculties and developed what I consider to be appropriate definitions, herein for further refinement.

A. DEFINITIONS

Development

The famous Brundtland report defines the term as thus: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[1].

On the other hand, national development is considered to be " the ability of a country or countries to improve its people by providing social amenities like, quality education, portable water (piped) , transportation infrastructure, medical care, etc" [2].

In addition to the above definitions, I would like to add a definition which captures imperatives of context, otherwise we shall be talking about a scene which exists very far away from Zambia. We could also find ourselves agreeing to the obnoxious understanding that in effect, there are two countries in Zambia, rural and urban Zambia.

It is important that this august house addresses itself to this artificial but real split of rural Vs urban because when we talk about human beings, we do not talk about what they have and what they do not have. Similarly, no society (to the best of my knowledge) formally agrees to discriminate between rural and urban. Villages in Europe, which is our defacto reference point [3], have basics of running water, health and education infrastructure, transport, support small industries, which all speak to the important aspect of inclusion and expanded human activity.

A cursory look at budgetary allocations in Zambia since independence, would suggest that the focus of development in Zambia, is about urban areas and that ought not to be the case [4]. All Zambians are equal before the law. Therefore, the inherent unfairness in the National budgeting process[5] presents a real developmental and democratic challenge.

B. Democracy

There are many definitions which go with this term, probably explaining why it is quite complex and has of late faced many challenges of legitimacy and relevance. As a result, because of the difficulties of appreciation and understanding, picking up any definition is neither appropriate nor advisable. We shall go with a definition that is practical and makes clear from the word go that democracy is neither a country nor a government. It is neither what politicians say nor what citizens say as reported in the media.

Our take is that "democracy is a way of thinking and interaction that places duties and responsibilities on each and every human being, irrespective of standing in society" [6] .

C. Human Rights

This too, has many definitions. For our purposes, we have taken an all-encompassing definition. " Human Rights are said to be rights that are inherent, inalienable, universal, indivisible and interdependent and available to all human beings, whatever our nationality, place of origin, sex, ethnic origin, color, religion, language or any other status [7]." Accordingly, we are all entitled to these rights, without discrimination.

Here are our thoughts: In this august house, we are all entitled to claim human rights by virtue of being human. We must underline that human rights are based on the principle of respect for the individual. A fundamental assumption is that each person is a moral and rational human being, who deserves to be treated with dignity.

II. THE TOPIC

Our topic for this conference is "the Dynamic Triangle as a Tool for Harnessing Intellectual Capital". We cast this against the conference objective, which "seeks to provide a platform and stimulate discussion on the role of higher education in sustainable national development, with particular reference to the sub Saharan Africa region. It is expected that the conference will bring out issues that our respective governments and higher institutions of learning need to consider for the repositioning and transformation of higher education to effectively contribute to sustainable national development. The theme of the conference is "Repositioning the role of Universities and colleges in Sustainable National Development"

In our view, this objective is loaded, holistic, hopeful and forward looking. It raises many issues namely:

1. To provide a platform for productive and purposeful dialogue

2. To stimulate a discussion on the role of higher education in sustainable national development

3. To bring out issues that respective governments and higher institutions of learning need to consider as they reposition and transform

4. To begin a process that leads to the repositioning and transformation of higher education; specifically the role of public Colleges and Universities

If we might add, this conference theme, ties in very well with the Spirit of the Universal Declaration of Human Rights [8] and we draw this august house to Article 1, which reads that: "All human beings are born equal free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood" [9].

A. ANALYSIS

From a Dynamic Triangle point of view, it is important to still draw this august house to the provisions of the Universal Declaration of Human Rights, as contained in Article 26. It reads "(1) everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit (2) Education shall be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms. It shall promote understanding, tolerance and friendship among all nations, racial or religious groups and shall further the activities of the United Nations for the maintenance of peace. (3) Parents have a prior right to choose the kind of education that shall be given to their children [10].

This was discussed and distilled in San Francisco, USA in 1948 seventy (70) years ago. Our question is: If truth is a factor, what has happened to these positive aspirations? This question, could form a topic of discussion on its own, but for our current purposes, it is a point inviting active interrogation. What happened?

Take note that, at that time, racial discrimination was rife in the United States, the Soviet Union then, (a key participant) had its gulag system, Africa, was a horde of colonies as if to communicate that the rights under discussion then, where specific to certain races to the exclusion of some, as subtly implied in some Articles of the Charter. The point to interrogate is not so much the absence of equity and equality in San Francisco, but that the various discussion points could not have fully taken into account what those who were absent could have contributed. Consequently, the resultant document, the UDHR, is said to be universal and applicable to all. Is this a fair classification?

With this gap of appreciation and understanding in mind, we are left wondering as to what has been done in intellectual circles to address either evident or acknowledged gaps. A cursory look at the international bill of rights [9][11] as fashioned, suggests a particular understanding and

appreciation, and it appears unfair and unrealistic for to us to "impose a particular understanding" on new countries regarding international instruments [12], which to the credit of the United Nations system, has elaborate provisions for amendments. Where thou then is Zambia, Africa, et cetera? Do we not have a reason for arguing for amendments or new inclusions [13]?

We hold the view that we need not wait for others to indicate to us that we need to begin interrogating our realities, practices and existing traditions, outside the box. Followers of the democratic movement, will appreciate that there are challenges of varying degrees that affect the practice of democracy and it is our considered view that refusing to do that which must be done, such as challenging old practices and definitions, only makes a strong case for sluggish inquiry. For instance, it speaks for itself that the human rights movement, a key component of the democratic tide, as we know it has been seriously compromised by double standards and ambivalence that constrain rather than expand its core mission. Put differently, the campaign for homosexuality, has simply complicated the situation, which as far as 1966, was a serious sexual offense in England but has now seriously undermined the human rights movement in general.

III.   WAY FORAWARD

This dignified gathering has the necessary skill base and the necessary intellectual rigor, to make its case for dealing with fundamental questions that may lead to a better understanding of our societal challenges. We wish to hazard a view suggesting that such fora, be not only regular but that our Zambian government, as representatives of Tax Payers, be invited to buy in as a major stakeholder, who should respond to a realistic program of action that will benefit from intellectual inquiry, beyond talk, without context.

It is not in doubt that the government has the necessary capacity and muscle to promote effective engagement and distillation of ideas. Our challenge to the Zambian government and all our leaders, beyond government therefore is:

"You have trained or caused to be trained thousands of citizens at a phenomenal cost. It is only fair, proper and reasonable to expect a good harvest, much as it happens with farmers. Fairness requires us to acknowledge the fact that at one point in our history, not going to school was not strange. There are plenty opportunities and drivers of change, that in our view must trigger a spirit of patriotism among beneficiaries. It is not in doubt that Universities and colleges a reservoir of skilled human resource and are well placed to incubate and promote innovation and great ideas".

In fact, in one of the columns that I write for a famous newspaper in Zambia [12] , I made an argument that we need to go back to basics. What are the basics in this context? Commonsense as defined by the standard of a reasonable man! A reasonable man knows that there is a country called Zambia. A reasonable man knows that every country has leaders, and a reasonable man knows that eating clean food and drinking safe water are important realities of living; a reasonable man will see a man for what he is and a woman for what she is!

That said, and bearing in mind our unique circumstances that require playing a "catch-up game"[13] it is critical that

policy positions and decisions, for instance be informed by relevant research. Take an example of industrial development in the context of investments, do we want equipment from anywhere and do we have a policy position [14], informed by research on how to deal with investments and investors?   Herein lies the interface between the Universities/colleges and society! It is expected that whether asked or not universities will undertake research for the benefit of society because collaboration with society makes a case for either alternatives or improvements, on the part of the researcher and the researched society.

Consequently, it is our observation that the synergies of the dynamic triangle tend to unleash either progressive and forward movement(s) or the unfortunate stagnation, with its consequent challenges. In our view, these fundamentals are ripe for serious and incisive interrogation, because a template [15] whose origins is suspect, or simply uninformed/ inadequate, may not be too useful. In this category are laws, culture disguised in religion and other harmful technologies and ideas. The provisions in international law which allows a state to enter a reservation or skip a particular obligation is a point suggestive of flexibility and the importance of domesticating practices or agreements from elsewhere. We are of the view that the practice of "cut and paste" has its place and/but, certainly not in national development that involves entrenched traditions.

We need to emphasize that by its nature and design, the dynamic triangle as articulated above, renders itself to several options and realities. Some of the options represent progress, which we must embrace. But others, represent stagnation and we think it is only fair to reject such options.

Inventions, artistic discoveries, improved cooking methods, represent among others, good attributes of the dynamic triangle. These must be supported. On the other hand, riots, destruction of property and other extreme forms of the right to expression [16] are negative elements, with no added value to the process of national sustainable development; and therefore the opposite and undesirable attributes. This last category, among others represents possible reversal and stagnation. Still staying with the dynamic triangle in its wholeness, it is important, and absolutely critical for institutions of higher learning to assist our society develop an indigenous or local template of what is good or bad. Since a totally new invention may not be within reach, we may be talking of refining the existing ideas or practices, so as to bring out the best of Zambian values. For purposes of emphasis, it is established by generations of human existence, that local knowledge is important, which we believe is the one of the reasons why history, is taught as a subject in schools!

In the Zambian context though and given the many standard definitions of the dynamic triangle, we are tempted to ask: What is the Zambian understanding and possible interpretation of Democracy, Development and Human Rights (not withstanding its acclaimed universality)? Are we prepared to adapt the various definitions and practices, so as to have a locally driven democratic project? [17].

This respected group of intellectuals and beyond, has a duty to both the fraternity and our country. Most literature that is readily available can be traced to outside sources. This may be understood or indeed justified. However, it remains a serious indictment to the academic community for letting the

country down after more than half a century of independence. In the same way that we raise issue, with the Zambian academic community, it is only fair and reasonable to raise issue with the Zambian business community, whose contribution to research and development, remains an insignificant fraction. There is so much that business can benefit from supporting research! [18].

The fact that business, such as the mining giants [19] may not come to the table can be explained and indeed, the mines and other corporates, will justify their not coming on Board. Inquiry and interrogation on sustainable national development, may not fit in the long term agenda of these business houses . Most if not all are comfortable supporting primary and secondary schools, which in reality offer no major intellectual challenges!

There is another triangle, which forms a separate axis of debate, but would clearly benefit from academic rigor. That is on the one hand, the State, then Civil Society and the Private Sector. This is a discussion for another day.

There does appear to be an emerging pattern though; wherein, the Dynamic Triangle, in its broadest sense, tends to challenge nature. It challenges nature in the context of societal dynamics wherein more often than not, mediocrity either subdues or eclipses merit. Here, we are pointing to a worrying trend, where intellectuals, are more and more playing second fiddle with the consequence that the arena of politics, has become a sanctuary and bastion for reactionary forces or at best individuals or groups seized with false consciousness.

The consequence of refusing to prioritize merit is seen in challenges in both delivery and process accountability [20]. Our country is based on several process, which require competence to navigate and equal abilities to deliver. Take any college or indeed university, you require a certain level of expertise to be able to manage internal process and you need to be appropriately trained in order for you to be able to deliver as per expectation. Beyond the systems, whoever is a Stakeholder must play their part so that finger pointing, is never an issue.

IV. PROVOCATIVE THOUGHTS

Thus far, we shall argue that it is irresponsible for intellectuals in colleges and universities, to give up their traditional roles of generating and disseminating knowledge [21]. Yes, one can leave the university or college to go and work either in government or elsewhere, but where ever you go, you are an ambassador who must never abandon or forget his/her roots!

We are persuaded to suspect that someone somewhere is not doing his/her job. This is because the public colleges and universities have their graduates dotted throughout Zambia managing important processes. Where exactly is the problem that affects delivery accountability? This platform, we submit, must see a turning point, which turning point must facilitate universities and colleges taking up their rightful position [22]. Gleaning in between, this is the desire of government and equally, the desire of the academic community!

We all know that one of the core functions of colleges and universities, is to generate and disseminate research findings. We find it totally unacceptable, unrealistic and unreasonable therefore that Academics who spend decades in

preparation, must allow mediocrity to play a significant role in our midst. It is the duty of the academic community to espouse and expand on the virtuous and values of education beyond "bare-foot" knowledge. "Bare-foot" knowledge is here used to confirm and accept the fact that almost everybody who has gone through school, even without any serious credentials, can read and articulate an opinion, based on common-sense. It is the duty of academia, to interrogate issues that affect and afflict societies.

This failure among many others is responsible for promoting get rich quickly schemes. Society, which as we know is dynamic, has been repositioning itself to present a situation. Members of the Academic community, when compared with other affluent sections of society, face potential poverty, which explain the desperation for getting rich.

This is a façade, which defeats commonsense. The question is, what is it that we ought to be doing to make our conditions attractive and purposeful? The grass, will be as green as you maintain it. If the grass in greener across, what are they doing which you are not doing? Our submission is that we must respond to these challenges, with sobriety. It can be done!

Second, that abilities inherent in academia, must not be downgraded to become disabilities by our society [21]. It just does not make sense. But, if it is allowed, it can happen and the consequences, are not good.

Third, Society must accept that intellectual capital is a tool that must be harnessed for sustainable national development [23]. The preparation of complicated and complex documents that inform National Development, require intellectual capital, which is in abundance in our institutions of Higher learning. It is incumbent upon the universities and colleges to make themselves relevant. Take the annual announcement on the budget preparation, do our institutions, respond? If they do, how far and how deep is the consultation process with the Treasury?

Fourth, that charity begins at home: We must appreciate our own and not prefer others whose understanding of Zambia may be quite remote. Instead, we must cherish, cheer, appreciate, and support independent thinking as an intrinsic property, so recognized by law.

The Zambian government, through the Ministry of Commerce and Trade, as supported by international law, recognizes intellectual property. The Zambian constitution adequately provides for protection of property, and the existence of the Patents and companies agency (Pacra) should be comfort and security enough to assure and encourage intellectuals to protect their ideas and inventions.

So instead of pointing fingers, and complaining, let's secure our exploits of intellectual capital so that those who specialize in using data without due acknowledgement and permission will find it difficult. Equally, since we are here making reference to property, it is a real window for income generation, to the extent it is fully and properly utilized.

Then, we can make a strong case for our government and industry to exhaust local remedies before looking elsewhere. We shall then be doing justice to the correct position that "charity", begins at home. There will be no finger pointing but encouragement for all stakeholders to have faith and confidence in each other. This is nothing new. It is up to this

august house to evolve and distill recommendations, which must be used to lobby both government and industry.

Lastly, it is important to accept the fact that by its design, nature does not allow for a vacuum. There is absolutely no need for our intellectuals in colleges and Universities, to take a "back seat". As indicated above, without finger pointing, we must get back to the drawing board and let each party play their part in sustainable national development. Laws are extracted from policy. From this stand point, it is essential that we pursue a holistic angle to ensure that we do not only have laws but have laws which are anchored on policy and followed to the letter. It happens in all functional societies. The Zambian society is functional and our collective task is to ensure that we improve on what exists.

The disgraceful propensity and practice of "buying" degrees earned, outside intellectual rigor, is a point in case. Here, intellectuals have seemingly conspired and "agreed" to take a back seat, replaced by what clearly, offends well baked intellectual capital.

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An assessment of the effectiveness of the training offered to student teachers in colleges of education in the implementation of the language policy of using local familiar languages as media of instruction in primary Schools: A case of colleges of education in central province of Zambia.

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Abstract— This study seeks to explore the role Higher education institutions or teacher training institutions can play to alleviate and mitigate the challenges faced by schools in the implementation of the familiar language medium of instruction policy in lower primary schools. A survey was carried out in five colleges of education in Central Province and ten primary schools in the same province of Zambia. The study also included some observation of familiar language medium of instruction teaching in selected primary schools. The recent revision to the national curriculum mandates that pupils in grades 1-4 learn in a familiar local language while English is introduced as a subject in the second grade. This means therefore that student teachers must develop competency in local languages during their training in order to effectively teach literacy and other subjects to early grade learners. This policy is however facing a challenge of acute shortage of teachers who speak or have communicative fluency in familiar local languages. It has been observed that a good number of public primary schools still use English as medium of instruction in the lower primary section. The study revealed that most of the teachers who are deployed to these primary schools lack communicative competency in local familiar languages, as a result, they resort to teaching in English. This study revealed that teacher training institutions do not prepare these teachers adequately in the communicative competencies in local languages. The study also made a number of recommendations to both ministry of education and teacher training institutions so as to consider teaching pre-service teachers communicative competencies in familiar local languages.

Keywords—Medium of instruction; teacher training institutions; communicative competence; familiar local languages.

I. INTRODUCTION

Zambia is a multiethnic and multilingual nation in which many languages and dialects are spoken. Selection of appropriate language of instruction in lower primary schools has been the point of debate by both policy makers and academicians. In order to meet this diversity, Zambia has developed an educational language policy with regional official languages as the medium of instruction (MOI) from grade one to four in public primary schools. According to the 2013 curriculum framework, English is taught as a subject at lower primary section and used as medium of instruction from the fifth grade to tertiary level while Zambian languages are introduced as subjects. However, in private owned primary schools, English has continued to be used as medium of instruction at lower primary level despite the new policy. However, both the public and private school systems view the other's medium of instruction as an obstacle to the child's learning process. It has been noted without doubt that one major advantage of using English as medium of instruction in schools is the availability of teachers to efficiently and effectively teach in primary schools. On the other hand, this policy of promoting the use of familiar local languages as media of instruction in lower primary schools is facing a challenge of acute shortage of teachers who speak or have communicative ability to teach children in familiar local languages. Despite the declaration of this language policy, a good number of primary schools, especially in urban areas, still use English as medium of instruction in lower primary sections.

According to the ministry of education policy briefs (2015), there is a danger of uncoordinated and unguided teaching approaches in private teacher training institutions with grave implications for the education system. This report reveals that most of the teachers who graduate from these mushrooming private colleges are ill prepared to teach in lower primary schools. Even in public teacher training institutions, pedagogical approaches to teaching literacy does not help pre-service teachers acquire competences in teaching these local languages.

This study seeks to assess the effectiveness of the training of teachers in colleges of education and what role these institutions can play to alleviate and mitigate the challenges faced by schools in the implementation of the familiar local languages medium of instruction policy in lower primary schools.

II. Aim of the Study

The aim of this study is to assess the effectiveness of the training of teachers and what role can colleges of education play in the implementation of the use of familiar local languages as media of instruction in lower primary schools.

III. OBJECTIVES

A. To establish whether teacher training institutions take into account the local language proficiency of applicants before admission
B. To establish whether or not posting of teachers to various regions takes into account the local language proficiency of those teachers before posting them.
C. To establish the availability of the recommended and prescribed reading materials in the various zonal languages used as language of instruction in colleges.
D. To establish whether or not teacher training institutions teach language competences in those zonal or regional languages.

IV. LITERATURE REVIEW

Globally, there are 50-75 million 'marginalized' children who are not enrolled in school. Children whose primary language is not the language of instruction in school are more likely to drop out of school or fail in early grades. Research has shown that children's first language is the optimal language for literacy and learning throughout primary school (UNESCO, 2008a). According to Cummins (2007), education in the mother tongue helps improve the academic performance of young learners. Studies have shown that children who had their mother tongue as the medium of instruction in the first three years of elementary primary school scored higher in English tests in the fourth, fifth and sixth grade, than those who learned most of their subjects in English from grade one. Arnold et al (2006) points out that in spite of growing evidence and parent demand, many educational systems around the world insist on exclusive use of one or sometimes several privileged languages. This means excluding other languages and with them the children who speak them. Bialystok (2001) report that abandoning children's mother tongue within the educational environment does not only affect the vitality of the home language but puts the children's cultural identity at the risk of extinction as well.

V. METHODOLOGY

A. Research Design

The study employed both qualitative and quantitative methods to collect and analyse data. This concept of combining methods is used bearing in mind that any method used on its own has limitations and bias which could be reduced by using many approaches.

B. Site Selection and Target Population

This study was conducted in five teacher training institutions and ten primary schools in Central Province of Zambia. The target population was 10 lecturers, 20 students training as primary school teachers five human resources officers from the District Education Board (DEB) offices and 20 primary school teachers from selected schools within the Province.

Random sampling was used to select the 20 students and 20 primary school teachers for the study. Purposive sampling was used to select primary college lecturers and Human resources officers from DEBS. Purposive sampling is the method of sampling based on the judgment of the researcher regarding the characteristics of a representative sample from the population.

The study used the questionnaires, interviews, and observations as research instruments. The questionnaires were distributed to students and serving teachers while interviews were carried out on lecturers and Human resources officers. The researcher also observed the use of medium of instruction in lower primary school lessons.

C. Data Analysis

Processing of the interview and questionnaire data included descriptive analysis and categorizing similar items into themes and sub-headings.

VI. FINDINGS AND DISCUSSIONS

The following are the findings of the study:

A. Pedagogical approach to language and literacy during teacher training.

When asked whether student teachers are taught language competencies in specific familiar local languages at colleges, all the 20 students indicated that oral communicative and other competences in zonal languages are not taught in primary school

colleges but general linguistic aspects and methodology. They pointed out that only examples in individual local languages are done during literacy lessons. They also felt that methodology without practical use and knowledge of the language is not adequate. Some lecturers interviewed suggested that local languages should be taught the same way French is taught in colleges and university where students are taught both language methodology and oral competencies in the language. Teachers in schools also responded that they were not effectively taught local language contents during training, therefore, could not effectively teach in the familiar local languages. They also suggested that primary school teachers' training institutions should make sure that language lecturers should be able to speak and teach at least two or three regional or zonal languages at college.

As revealed by the study, colleges of education can play a vital role in facilitating the effective use of local familiar languages in primary schools. Let primary teachers training institutions allow each student to use any of the familiar languages during literacy lectures. Every primary school student teacher should be assessed in at least one familiar language communicative competence so as to effectively teach in lower primary school sections.

B. Lack of language communicative competency consideration during teacher deployment

The study revealed that there is no familiar language competency consideration by the ministry of education during the deployment of primary school teachers. Responding to this question, all the District human resource officers stated that language proficiency is not a factor during recruitment and

deployment of primary school teachers to schools. Human resource officers in all the districts indicated that deployment of teachers is dependent and based on the need and vacancies available in schools. New teachers can be posted to any school regardless of the local language used in the region or district. As such teachers may not teach effectively because they may not be competent to teach in the language used to teach in that region. They suggested that teacher training institutions can help the ministry by indicating the familiar language studied on the students' statement of results so as to post the student teacher to the regions and schools were the studied language is spoken.

This problem of teachers failing to effectively teach in familiar local languages in primary schools is a serious crisis. District Education Boards should consider local language proficiency in student teachers when deploying them. As suggested by respondents, colleges should indicate the local language proficiency on the statement of result or testimonials in order to enable the DEBS deploy teachers to schools where individual teachers' familiar languages are used.

C. Availability of teaching and learning materials in the familiar languages

When asked about the availability of the recommended and prescribed learning and teaching materials in zonal languages, lecturers in public colleges stated that they have recommended books in various regional languages while those in private teacher training institutions revealed that they don't have adequate local languages books. However, students reported that books in all the zonal languages are available but are used for reference by students who are speakers of respective regional languages. The problem which students faced is lack lecturers who can fluently read and guide students in certain local languages.

As revealed by the study, private colleges of education lack recommended and prescribed books in various local familiar languages. This situation has perpetuated the failure by some teachers to teach in familiar languages in primary schools. The Provincial standards officers should strictly monitor mushrooming teacher training institutions in order to ensure that they have and use prescribed local language books.

VII. RECOMMENDATIONS AND CONCLUSION

More research is needed to assess the effectiveness of the implementation of the language policy of using familiar local languages as media of instruction in primary schools and make strong

proposal on how Zambian languages should be taught in colleges.

The ministry should in collaboration with colleges, consider teachers' local languages proficiency when deploying them to schools. To implement this, teacher training institutions should indicate on student teachers statement of results or testimonials the local language the teacher is familiar with.

This study has revealed that the training of primary school teachers in colleges does not take into account the communicative competence of trainee teachers in familiar languages used as media of instruction in lower primary schools. It has also been revealed that private teacher training institutions do not have adequate recommended books in various local familiar languages.

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Entrepreneurial Universities for Sustainable National Development in Zambia

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Abstract— **The objective of this paper is to define entrepreneurial university and its importance in the national development of Zambia. The 7th National Development Plan aims to achieve an average real GDP growth rate of above 5.5 percent, create 1000,000 productive and gainful job opportunities and increase the share of earnings from non-mining exports to about 50 percent. The concept of entrepreneurial university can help achieving these objectives in Zambia. Entrepreneurial learning is a key driver of economic development. The need for universities to meet the challenges of future has introduced the concept of "Entrepreneurial University", which is opposite to the teaching university. This paper presented the examples of entrepreneurial universities in the world , Africa and Zambia, including the Mulungushi University.**

The recommendations of this paper include: the universities in Zambia should offer innovative programs; the university administration should think in business terms; should play a major role of providing cutting edge research that can help create wealth; should integrate research based learning market sensitive teaching; the programs and research activities should be relevant to the needs of society; and should adapt the concept of 'academic capitalism' to ensure outside funding by following the market-type modes of action.

Keywords: *Leadership and governance, Organizational capacity, Entrepreneurial development in teaching and learning, Knowledge exchange, Internationalized institute, International mobility of staff and students, Academic capitalism*

I. INTRODUCTION

On 25th September 2015, the 193 countries of the UN General Assembly adopted the 2030 Development Agenda, known as, "Transforming Our World: the 2030 Agenda for Sustainable Development". There are 17 Goals with 169 Targets covering a broad range of sustainable development issues. These included ending poverty and hunger, improving health and education, making cities more sustainable, combating climate change and protecting oceans and forests [1]. The world growth is expected to rise from 3.1 percent in 2016 to 3.5 percent in 2017 and 3.6 percent in 2018 [2]. The rapid diffusion of technology and greater access to capital and world markets have enabled economic growth rates to lift over one billion people out of poverty [3].

Between 1980 and 2014, Zambia's Human Development Index (HDI) value increased from 0.418 to 0.586, an increase of 40.1 percent which put the country in the medium human development category. The decreased fiscal expenditure in health, education and social protection and weak access to rural health and education amenities, have together placed Zambia in the bottom quartile of the world's human development ranking – ranking 139th out of 188 economies [4]. In Zambia, there is high youth unemployment which is 14 percent and the youth under employment is wide spread [5]. In Zambia, youth unemployment rates by strict and relaxed definitions are 38 percent and 17.7 percent respectively and youth unemployment rate by level of completed educational attainment for primary or less; secondary and tertiary is 11.6 percent; 23.1 percent and 19.1 percent respectively. Lack of policies to stimulate entrepreneurship are the main reasons for youth unemployment in Eastern and South Africa [6]. The study by Shoof [7] also revealed that lack of entrepreneurial education is responsible for unemployment in sub-Saharan Africa. The gaps in skills and competencies are responsible for youth unemployment in Zambia [8]. The study by Ali & Jabeen [9] concluded that lack of required qualification and training are responsible for youth unemployment in Zambia.

The 7th National Development Plan in Zambia departs from the previous sectoral based planning to an integrated development approach under the theme, "Accelerating Development Efforts towards the Vision 2030 without leaving anyone behind". The goal of 7th National Development Plan is to create a diversified and resilient economy for sustained growth and socio-economic transformation driven. The realization of this goal will be achieved through the contribution of a number of developmental outcomes. The key outcomes include economic diversification and job creation; poverty and vulnerability reduction; reduced developmental inequalities; enhanced human development and an enhanced governance environment for a diversified and inclusive economy . The 7th National Development Plan wants to achieve an average annual real GDP growth rate of above 5.5 percent; create 1,000,000 productive and gainful job opportunities and increase the share of earnings from non-mining exports to about 50 percent [10]. The new concept of "Entrepreneurial Universities" can help achieving these objectives in Zambia.

II. ENTREPRENEURIAL UNIVERSITY

There is no one-size-fits-all definition of the Entrepreneurial University. The definition given by European Commission and [11] covers major aspects of different definitions of the entrepreneurial university. The Entrepreneurial University has the following features:

- Leadership and Governance: In order to develop an entrepreneurial culture in an institution, strong leadership and good governance are crucial. Entrepreneurship is a major part of the university strategy. A university has a working mission statement with an entrepreneurial vision for the future

of the institution. The university is a driving force for entrepreneurship development in the wider regional, social and community environment.

- Organizational Capacity, People and Incentives: The university's entrepreneurial objectives are supported by a wide variety of funding resources/investment, including investment by external stake-holders. The university has a sustainable financial strategy in place to support entrepreneurial development. There are clear incentives and rewards for staff who actively support the university's entrepreneurial agenda.

- Entrepreneurship development in teaching and learning: The university is structured in such a way that it stimulates and supports the development of entrepreneurial mind sets and skills. Staff takes an entrepreneurial approach to teaching in all departments, promoting diversity and innovation in teaching and learning. The university collaborates and engages with external stake-holders as a key component of teaching and learning development in an entrepreneurial university. Research results are integrated into entrepreneurship education and training.

- Pathways for Entrepreneurs: The university supports the pathways taken by would-be entrepreneurs (staff and students) from ideas to market growth or into employment. The university provides opportunities to experience entrepreneurship. The university provides access to business incubation facilities.

- University – Business/External Relationships for Knowledge exchange: The university commits to collaboration and knowledge exchange with industry, society and public sector. The university provides opportunities for staff and students to take part in entrepreneurial activities with business/the external environment.

- The entrepreneurial University as an Internationalized Institution: Internationalization is a key part of the university's entrepreneurial strategy. The university explicitly supports the international mobility of its staff and students. The departments and faculties of the university actively participates in international networks.

- Measuring the impact of the Entrepreneurial University: The university assesses the impact of its entrepreneurial strategy and the strategy is responsive to change. The university regularly assesses the impact of entrepreneurship teaching and learning. It carries out regular monitoring and evaluation of the university's knowledge exchange activities and the impact of the start-up support..

III. IMPORTANCE OF ENTREPRENEURIAL LEARNING IN UNIVERSITIES

Entrepreneurial Learning in Universities is a key driver of economic development. The need for the universities to meet the challenges of future has introduced the concept of "Entrepreneurial University" which is opposite to the teaching university. There is need for co-ordination between University, Industry and the Government. Etzkowitz [12] called it a "tri-institutional model of society or "triple helix

model". This new concept gives rise to an academic revolution in which the university becomes an increasingly important platform for social transformation. Entrepreneurial culture will maximize individual and collective economic and social development on a local, national and global levels. Entrepreneurial learning has recently emerged as a new practice involving both entrepreneurship and higher education process. Cope [13] observed that a better theoretical grasp of entrepreneurial learning is imperative, as it is through learning that entrepreneurs develop and grow. Entrepreneurial learning is needed to recognize and act on opportunities. According to Bailey [14] entrepreneurial learning is regarded as an experiential process in which entrepreneurs develop knowledge through four distinctive learning abilities: experiencing, reflecting, thinking and acting. Entrepreneurial learning will help students develop skills and competencies. Universities should provide the programs of entrepreneurship.

IV. EXAMPLES OF ENTREPRENEURIAL UNIVERSITIES

Clark [15] revealed the results of five entrepreneurial universities studied in Europe. These universities were: University of Warwick in England, Twente University in Netherlands, Strathclyde University in Scotland, Chalmers University in Sweden and University of Joensuu in Finland. The results of the study showed that these universities transformed themselves into entrepreneurial universities as a way of responding to change. A major transformation started at the top and trickled down to other departments of the universities. A more interesting finding was that even non-business-oriented departments were able to transform themselves. Thus, departments offering humanities were able to become more entrepreneurial in their approach. As a result they attracted people and formed partnerships with people from business and industry. The Universities also attracted students from the whole world and were able to raise additional revenue to fund various academic projects.

Entrepreneurial operations by Universities in the United States of America have made higher education a very important export commodity. The Universities like Harvard University, Yale University, Stanford University, MIT, Princeton University and many state universities such as Indiana University, The Ohio University, Texas A & M, Louisiana State University, Pennsylvania, etc., recruit students from all over the world. American Universities are entrepreneurial since they encourage diversity in the programmes they offer and try to be as inclusive as possible. For example, online and distance learning programmes, evening programmes, weekend programmes, executive MBA porogrammes etc.,

Kangaslahti [16] studied the Nanyang technopreneurship Centre (NTC) in Singapore and revealed that the most important entrepreneurship programme was a four-month post-graduate diploma course called the technopreneurship & Innovation Programme (TIP). This programme is based on placing students inside several entrepreneurial ecosystems, i.e. education in enterprise. They are given lectures by successful local entrepreneurs as well as enterprise development experts and visit numerous start-up companies. Their studies are based on making commercialization business plans for technological business ideas. This programme is practical, offers hands-on experience in all

facets of entrepreneurship and focuses on giving the students a network and other tools for starting their own business.

Jones and English [17] revealed that the University of Tasmania has focused on developing the psychological skills of students and teaching them to recognize new business opportunities. The programme has instruction on opportunity recognition, commercialization, marshalling resources in the face of risk and initiating a business venture.

Taatila [18] studied the Laurea University of Applied sciences and found that different types of entrepreneurial learning environments are offered. The environments are based on the "Learning-by-Developing pedagogical approach. According to this approach learning takes place when students personally experience authentic and creative development situations in which they have to investigate the root causes of a business situation and work in partnership with stake-holders.

Romer-Paakkanen and Pekkala [19] revealed that Haaga-Helia University of applied Sciences has created an entrepreneurial learning environment for turning the hobbies of their students into new business ventures. Creating a business out of a hobby resulted in students being enthusiastic and highly motivated.

V. EXAMPLES OF ENTREPRENEURIAL UNIVERSITIES IN AFRICA

The most successful examples of entrepreneurial universities in Africa include Makere University in Uganda [20]; the University of Nairobi in Kenya [21] and Mulungushi University (MU) in Zambia. This paper focuses on Mulungushi University as an entrepreneurial university.

Mulungushi University in Zambia As a Success Story: Mulungushi University (MU) was established in 2008 under public sector with the principles of private sector. It generates 80 percent of its expenses through entrepreneurial activities, like attracting students with demand- driven programmes, running business center, poultry farming , etc. The total number of students registered for 2017-18 academic year Semester I were 5,607, comprising 3,142 male and 2,460 female. Of the total number of registered students, 2,960 were on Fulltime and 2,647 were under Open and distance learning. The vision statement of Mulungushi University is linked to the vision 2030, MDGs/SDGs and national mandate as MU pursues the frontiers of knowledge, i.e., "The leading innovative, relevant and reputable university of excellence in Africa and globally". The Mission of MU is to provide high quality academic programs, research and consultancy services through stake-holder engagement. MU has seven strategic goals: Produce high quality graduates that are relevant to the local and international market; Carry out innovative research for development; Promote community engagement and partnership; Enhance capacities and competences for running the university effectively and efficiently in line with the principles of corporate governance; Develop appropriate infrastructure to support institutional activities; Enhance viability of business and commercial ventures to contribute to the university's revenue and expand and promote the use of ICTs. MU has six schools i.e., School of Agriculture and Natural resources; School of Business studies; School of Social Sciences; School of Education; School of Science, Engineering and Technology and the School of Medicine and Health sciences. There is shortage of engineers, doctors, pharmacists and other technical personnel in Zambia. Overall national development is not possible without them. MU is moving towards entrepreneurial university to achieve the goals of National Development Plans, which are in line with the Vision 2030.

VI. RECOMMENDATIONS

- The Universities should offer innovative programs such as separate MBA program for doctors, lawyers, engineers, etc. The programs should meet the needs of students and other stakeholders. For example, online and distance learning programs, evening programs, weekend programs, etc.

- All the departments should be equipped with computers and internet facilities to improve the research quality of professors and lecturers.

- The university administrators should think in business terms.

- The universities should play a major role of providing cutting edge research that can help create wealth. The universities should award grants to researchers on a competitive basis.

- The universities in Zambia should strive to recruit students from all over Africa and rest of the world.

- The universities should encourage entrepreneurial activities among faculty through several actions, like developing income-generating products and marketable services, consultancy, business linkages, inter-disciplinary partnerships and knowledge production in ongoing enterprises and producing income from technology transfer activities.

- The university should integrate research-based learning, market sensitive teaching and life-long learning programs, professional, tailor-made and short courses and project based courses with inter-disciplinary groups and action-learning programs. Learning by discovery and teaching and learning by means of research processes must become the norm.

- The university should shift from "higher education institution in society" to "higher education institution of society". The programs and research activities should be relevant to the needs of society.

- The university should adapt the concept of "Academic Capitalism" to ensure outside funding by following the market-type modes of action.

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AN INVESTIGATION OF INFORMATION SECURITY THREATS FROM ORGANISATIONAL INSIDERS AND HOW TO MITIGATE THEM USING A USER AWARENESS & ACCESS CONTROL MODEL

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Abstract - **Today, insider attacks are the most hazardous threats faced by most organizations and is an overwhelming task to avert because, employees need legitimate access privileges to organisational resources for their daily works. If they misuse this trust accidentally or intentionally, it can cause breaches in the confidentiality, integrity and availability of the resource, thereby, negatively impacting the corporations' reputation, productivity and eventually finances. Using the Actor Network Theory (ANT) and the Theory Planned Behavior (TPB) as a foundation for research on user awareness and training backed with access control, this study, addresses information security related threats from insiders and ascertains the circumstantial factors that gives inspiration to insider threat lead behaviors as well as what exactly motivates an employee to attack their own employers. The findings of the research, enriches the body of knowledge by backing a theory that explains mitigation of information security threats by insiders using an adaptive awareness model. This study also affords a procedural groundwork for future research to account for insider threat factors while helping a broad range of organizations in mitigating insider threats.**

Keywords: Insider confidentiality, integrity, availability, ANT, TPB and Theory.

I. INTRODUCTION

Information Security has become an integral part of both public and private organisation's business processes, in maintaining the confidentiality, Integrity and availability of information, because ICTs play an important role in business operations [1][2]. Majority of these business and or organisations can no longer be imagined without the underlying digital systems and technological infrastructure for information handling [3]. Protection of information from unauthorised access and misuse, including resilience of the underlying ICT infrastructure to various sorts of attacks, has become one of the main technological challenges faced by business houses today [3][4]. This is because ICT has become more prevalent and complex, meanwhile the increase in the sophistication and volume of cyber-attacks by both insiders and outsiders are at an alarming rate [2].

A. Insider

An insider is an existing or former stakeholder with unrestricted access rights to sensitive organisational resources, who with or without intent compromise the resource security [3]. Insider threats are grouped into two categories including; malicious (intentional) and non-malicious (accidental) [3].

B. Threat

In information security threats are deemed to be any malicious act that attempt unauthorized access to organisational information, communication systems, network and or infrastructure, with or without the consent of the system or process owners. This access can be directed from within an organization by trusted users or from remote locations by unknown persons using the Internet [3].

C. Malicious insider

A malicious insider is a current or former employee or any business associate who has or had access rights to the network system and intentionally abuse the same privileges in a manner that adversely affects the organisation's information systems confidentiality, integrity or availability [4]. Malicious insider threats includes; IT sabotage, Fraud and IP theft [5][6]. Basically, one does not become a malicious insider until they abuse their access rights and or committed a crime [7]. They are simply an insider, however, it is worthy probing the track taken from being an insider to malicious insider [8].

D. Non Malicious

These insider threats includes; unintentional, voluntary rule breakers, self-benefiting without malicious intent [3]. These are insiders who can cause damage to an organisations resources by their actions unintentionally, through negligence, ignorance and lack of training and or awareness. Insiders are capable of incidentally putting the organisational information at risk due to the fact that the accepted work processes they operate, are risky or simply because there are no right tools in place or the right training and awareness has not been provided. For instance, it may be a common practice that employees put alternative email addresses on their business cards and also carbon copy their work to themselves on these consumer grade web based email systems including Yahoo, icloud, Hotmail or Gmail. They can also share documents with others using personal storage solutions like Google drive,

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Evernote, Icloud, Dropbox. These personal Internet hosted systems takes the organisational resources beyond the system of control which can put it at risk of compromise [8]. There is also a substantial impact from unintentional acts such as sending sensitive documents to a wrong recipient, as well as less-frequent mistakes by system administrators and programmers [8].

The Computer Emergency Response Team (CERT) states that, non-malicious insiders cause ICT security incidents accidentally for different reasons that includes; human error, lack of user awareness, drugs, fatigue, stress, moods, gender issues, drugs, age and or cultures. These accidental threats are referred to as "Unintentional Insider Threat (UIT)" the most common examples includes security incidents, which insiders can cause such as excessive access rights being granted to wrong users, introducing vulnerabilities during software development when Systems Development Life Cycle (SDLC) steps are bypassed, leaving an unencrypted portable storage device unattended to, system configuration errors, inactivating security controls [8].

These risks are aggravated when the attack is targeting a specific individual or organisation, they are referred to as an Advanced Persistent Threat (APT). These are created to specifically enhance the success of the likelihood by impersonation, where an attacker sends an instant message or email to a user purporting to be a friend because it contains specific information and or is written in such a conversational style which the user uses so often. The targeted user is likely to trust the communication and be tricked into executing an act which may lead to a security breach unintentionally [8].

II. BACKGROUND

In the recent past, organisational insider attacks has grown exponentially. Take for instance, in 2007, a study by KPMG reviewed that only 4% of the total recorded cyber incidents were instigated by malicious insiders [9]. Three years later the figure increased to 20% and 2013, Verizon's extensive review stated that 69% of information security incidents were ascribed to insider threats [2]. The growing dimension of threats to insider can be evidenced by the revolution of internet and the growth of Internet of things (IoT). However, knowing what exactly motivates inside threats is the right path in finding a strategic solution of how to mitigate the problem to an acceptable level [10].

One of the well-known insider related cyber-attack of a growing spectacle involved Target in 2013, in which 40 million customers' credit card number and about 70 million of personal data was stolen by cyber criminals. This incident saw the Chief Information Officer (CIO) and Chief Executive Officer (CEO) out of employment as well as company reputation for competitive advantage [10]. The worst case scenario is that, despite the fact that the perpetrators were outsiders, the accessed the system using credentials of an insider being one the organisations refrigeration's vendors [9]. Considering the fact that every business house has its trusted employees, business associates, contractor, vendors and all related stakeholders, with whom corporations do business with and are have access to the systems and high opportunity. If not well mitigated, they may cause so much damage or harm to the corporation. According to a review of the Danger from within by Harvard Business review, it is clear that most organisations admit that they don't have enough security

controls to detect, prevent and mitigate insider attacks due to the fact they are yet to accept the degree of the Risk [10] Insider threat which is motivated by the technology complexity and Internet of Things (IoT) as stated above is growing by the day cannot be left unattended to. This is the simple most reason behind this study [10].

Insider threats are a progressive attack vector that requires an integrated defense-in-depth strategy due to the intricacy of technology and human beings today, this makes handling insider threats, one of the most critical challenges in addressing Information Security. This calls for a lot more than just technology alone, but an integration of people, processes and technologies. An insider threat is considered to be the most difficult threat to detect, prevent and mitigate due to the fact that an insider has access to systems and is a trusted agent with knowledge that can be leveraged to exploit a system, privileges that an outsider does not have.

A statement by Dr Eric Cole in the SANS survey report of 2015 states that [11]: "Preventing insider attacks is important and a key part of security; however, organizations often fool themselves into believing that they can stop all such attacks. Repeat the following sentence three times: "Your organization is and will be compromised by insiders." Insiders, whether malicious or merely negligent, are a continuous and constant problem for IT security; thinking otherwise is naïve."

Looking at the number of researchers who have labored so much in the past in search of the solutions to mitigate insider threats from various countries confirms that insider threat is a global problem that requires considered efforts to mitigate [12][13][14][15][16]. Needless to say, Zambia is not an exception and hence the reason to address this common problem.

The ability of an ICT Technologist, Engineer and System administrator to monitor and audit device logs can potentially lead to the discovery of illicit insider activity, or perhaps to indicate that an insider is about to go rascal. However, given the advancement of mobile technology, the number of devices connected to the network, number of employees with access to sensitive information, potential insider threats, as well as time and labour required to thoroughly investigate logs both in real time and historically, such monitoring becomes an overwhelming challenge in an absence of effective ICT security controls that requires coordinated efforts to implement.

Insider Threat Mitigation has not been fully catered for in most organisations, leaving ICT assets vulnerable which could lead to organization's loss of revenue, organisational reputation, embarrassments, Compromise of organizational networks, forced strategic goal shift, loss of information, legal fines and loss of competitive advantage. The issue can continue and be costly to the organization if not attended to, because compliance to the inadequate security controls in place particularly to do with Insider threats is not easy to achieve due to the absence of the required policies. This is because most of the organisational implementations of Information Security Management Systems (ISMS), such as International Standard Organisations (ISO) 27001, are conventionally focused on preventing external attackers by protecting the digital perimeter, access management, policy compliance and managing vulnerabilities [16].

Recent surveys showed that internal fraud risks, being an area that has long been managed using forensic data analytics,

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had been ranked as the top use case at 77%. While Cyber breach and sabotage is ranked the second-highest risk area use case at 70% [17, 18]. It is therefore, common knowledge that internal attackers, generally accounts for approximately more than half of the risks that an organisation is exposed to whist the external threats accounts for approximately above a third of the risks despite the gravity of the external consequences to an organisation [19].

With the above insider threat highlights, it was sort prudent that an investigation on Insider Threat Mitigation be carried out to ensure that the mitigation model be of high priority for all organisations.

All employees have a degree of trust invested in them by their employers and have been granted physical and logical access to the organisation's Information and Communications Technology (ICT)s, in order to fulfil their duties. Most of these employees are gratefully honest, however, there also exist the risk that some will abuse their inside position to commit crimes against their organisations [20][21]. These threats can take the form of a malicious employee downloading sensitive or confidential information and divulge to the public domain, or an unhappy employee destroying data before quitting. In April 2008, an insider at the Sumitomo Mitsui Banking Corporation in London, gained access to the bank's computer network in an attempt to pull off what would have been the biggest bank theft in the UK [22].

Insider Crimes and Motivation behind insiders to attacks

One would wonder what exactly motivates an employee to attack their own employers. The probable impact of an insider crime arrays from trivial irritant to the disastrous in ratio, which can feasibly have an outcome of bankruptcy, death, regulatory contempt, environmental adversity, countered weapons systems, damage of reputation, loss of customer confidence, incurred legal costs, collapsed stock market among others [23].

The five known main categories of insider crimes being, Facilitation of 3rd party access to sites/information, Unauthorised disclosure of information (either to a third party or the media), financial and process corruption (defined as illegitimately altering an internal process or system to achieve a specific, non-authorised objective), Sabotage (electronic or physical) and theft of materials or information. These are re-organized in three main categories which summarize the five categories above including: IT sabotage, Fraud and Theft of Intellectual Property (IP) [11]

A. *IT sabotage*

These are incidents with which an insider uses ICT to direct specific harm at an individual or organisation. Some of the recorded means for misuse of organisational information by potential insiders includes but not limited to printing, emails, copiers, web posts, blogs, and social media chats [12].

Analyzing Sabotage using Actor Network Theory (ANT) and the Theory Planned Behavior (TPB) it is deduced that sabotage is motivated by revenge and often caused by employees who become disaffected with their company, boss, or co-workers, including dissatisfaction with compensation, arguments with co-workers, reprimands, or job termination [7] [23]. Additionally hostility can arise when employees feel underappreciated, stressed, overworked, unfairly treated and or isolated such that they exert their anger or revenge by performing an inside attack[9]. Sabotage is usually executed

by employees with high technical skills and access to critical assets, like ICT technologist, engineers and System Administrators who have the ability to cause implausible damage. Mitigation is the process of reducing the threat and or risk to an acceptable level considering an organisations risk appetite [23].

B. *Fraud*

These are incidents with which an insider uses ICT for the unauthorised modification, of an organisation's data for personal gain, or information theft that leads to an identity crime. Fraud motivated by financial gain is often caused when insiders see a chance to make a profit by abusing privileges or when outsiders offer money to steal personal information for identity crime and or modify information [13].

C. *Theft of Intellectual Property (IP)*

These are incidents with which an insider uses ICT to steal proprietary information of an organisation. Theft of intellectual property is usually motivated by business advantage. This can be when insiders steal property for a competitor or their own business. In the early 2000s all the way to 2004, IP theft from U.S.A companies due to espionage only was predictable to be costing $250 billion per year, despite the fact that it wasn't specified to what extent insider action contributed to the figures. The correct figure might not be known because most of the organisations do not realize when they have been compromised, and majority of the few that are aware do not report the attacks for fear of losing customer confidence and competitive advantage [13].

A vital note from the CERT research states that it's prudent to look at these three crimes unconventionally and conspicuously because their nature, as well as the mechanism for detection and prevention, can be diverse. For instance, about 24% of IT sabotage incidents are usually committed by system administrators and engineers mostly after termination of contracts, whereas 16% of IP theft incidents are usually committed by those whose job, once had something to do with that IP then 44% of Frauds are normally committed by lower management employees such as service desk, frontline and or customer services personnel [8].

III. LITERATURE REVIEW

This study addresses only insider threats and any aspect of outsider threats is out of scope. The insider threat problem necessitates an understanding of Actor ANT so as to know the connection between human and circumstantial factors being the technological, sociological and social-technical domains, in which they operate, considering the fact that technology alone can potentially intensify the problem than otherwise. This predicament has headed many researchers to study TPB and individual behavior, in an endeavor to manage insider threats. Despite the scholar efforts and the findings at an international level, no much efforts has been employed to address the Insider threat in Zambia to ensure that while the indispensable privileges are provided insider threats are also mitigated.

Some of the recorded means for misuse of organizational information by potential insiders includes but not limited to printing, emails, copiers, web posts, blogs, and social media chats etc. [18]. The Defense Personnel Security Research Center (DPSRC), has a record of numerous incidences by insider attackers among others including:

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- *WikiLeaks:* The case for US Army soldier Bradley Manning who in his role as intelligence analyst, leaked through WikiLeaks organisation, the largest set of classified documents and videos to the public ever in the history of US military Army [18][21][24].
- *SCADA:* In a case of an electrical supervisor who developed an application for a SCADA system which was being used by the water firm. He installed a malicious programme on one of the organization's critical systems, after his contract termination, and damaged the SCADA system.
- *Cell Phone Clones:* In a case of a group of insiders at a wireless telecommunications company who cloned more than 16,000 customer cell phones. The insiders made approximately $15 million worth of unauthorized calls for a period of six months.
- *POS System:* In a case of a secretary who worked at a youth organization for over 20 years used a point-of-sale system to issue at least 500 fraudulent refunds totaling over $300,000 to the insider's own bank account over a 5-year period.
- *Banking:* In case of a manager for a branch of a banking institution who stole over $225,000 from business accounts after running into family health problems, gambling and unforeseen expenses.

IV. METHODOLOGY

The researchers used questionnaires and interviews for data collection and assessments of the selected Company.

A. *Interviews:*

The interviewees were given the liberty of countenance on what they knew and felt about the current security controls in place in the organisation, in relation to the security of their Personally Identified Information (PPI) as well as that of the organisation

B. Questionnaires:

Extensive Questionnaires were generated in line with the required research information. The questionnaires design consisted of the ISO 27001:ISMS Annexure A domains that includes: Security Policy, Organization of information security, Asset Management, Human resources security, Physical and environmental security, Operations Security, Access Control, Information systems acquisition, development and maintenance, Information security incident management, Business continuity management and Compliance[25].

The obtained results were analyzed using Microsoft Excel for statistical values. An insider mitigation model concentrated on User awareness and access control was developed to address the negative impact of Actor Network Theory (ANT) and the Theory Planned Behavior (TPB) that leads to Insider Crime.

V. SUMMARY OF FINDINGS

This section describes a case study of a utility company in Zambia. The organisation serves an approximate of 1 million customers and seven thousand internal clients, including both commercial and residential. Financial and private information of the clients are processed, as well as the medical and personally identified information (PII) for the employees. This results in bulky financial, customer, medical and PII

transactions where several billions of kwachas are involved. This organisation strives to focus especially on the confidentiality, integrity and availability of information.

As part of the high level assessment of the current state the following activities were performed. Then ISO 27001:2013 Annex A yielded the results in figure 4.

Fig. 1.   Assessment activities

The assessment Clauses 4 to 10 of ISO 27001 as in figure 3.
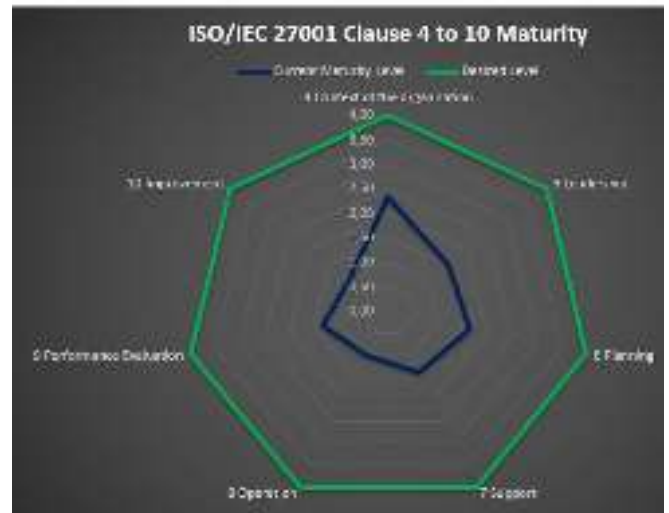
Fig. 2.   ISO 27001 Assessment of clauses 4 to 10
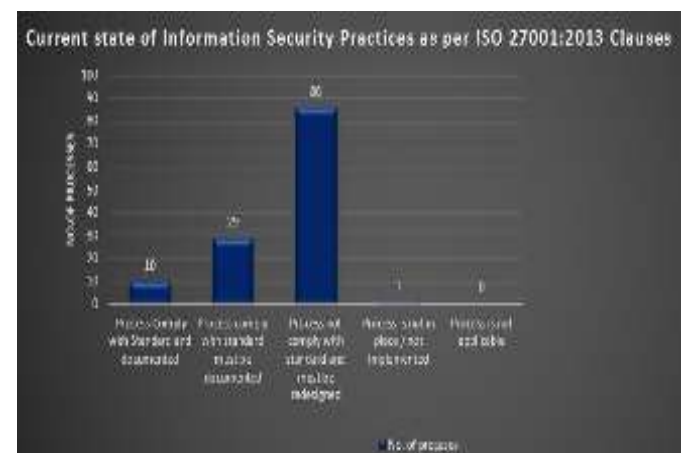
Fig. 3.   Results: ISO 27001:2013 Clause 4 to 10 assessment

The organisation is precisely aware of the importance of information security and concedes the possible threat that are likely to be caused by insiders. The responsibility of the information security process lies with the Head of Cyber Security. There is a Cyber/ICT Security Policy that describes security norms and measures. The organisation needs improvements on the traditional requirements of the security departments' documents that would address the negative impact of ANT and TPB as it relates to Insider Crimes propagation. These documents includes: ICT Security strategy that aligns to the corporate objective, ICT Security procedures, Information classification procedure, information assets classification, incidence handling procedure, employee

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screening policy, exit/leavers policy, Comprehensive Non-disclosure agreements and accompanying handling procedures.

Fig. 4.   ISO 27001 Assessment of Annex A Controls for maturity level.

Fig. 5.   Results of the current state of the ISO 27001:2013 Annex A

The organisation is implementing several measures and standard including ISO 2700, ISO 9001 and Control Objective for Information and Related Technologies (COBIT) 5.0. These standards needs compliance and minor improvements coupled with the need to be applied more consistently to decrease the number of insider threats. The standards also require that certain procedures, guidelines, policies and process flows be in developed, documented, approved and communicated to users continuously for awareness purposes, but was not the case in the utility company.

a) It was also noted during the baseline assessment that the access control policy is not fully implemented and complied with. This leaves the other source of the information being protected vulnerable, thereby making the whole infrastructure vulnerable to insider threats through ANT and TPB.

b) The utility Company has an approved information security policy, but the procedures are not in place. ICT Security objective has been developed but no Key performance indicator (KPI's).

c) There is a lack of alignment between information security and strategic ICT risk management. ICT Risk planning for assessments and treatment options are not clearly defined and documented. While many standards exist, the policies procedures and processes have not been completely documented and approved, leaving gaps for insider threat mitigation.

d) There is a lack of enforcing and incorporating information security controls as required by ISO 27001:2013 in various processes which includes

architecture, incident management, change management, operations, access management, business continuity, human resource, physical security, asset management and project management.

e) The evaluation of information security performance and the effectiveness of the information security management system is not clearly documented or being performed. The utility Company's current ICT security product portfolio covers the minimal ISO 27001:2013 requirements and need to be reviewed

f) The above are the identified gaps in the existing policies, procedures and processes in the management of ICT security in the organisation leaving it vulnerable to the negative impact of Actor Network Theory (ANT) and the Theory Planned Behavior (TPB) that leads to Insider Crimes.

VI.   DISCUSSIONS

Based on the findings above, it is clear that processed organisational information is not secure from insiders due to the lack of critical processes. Despite the fact that the organisation puts in efforts to prevent misuse of the critical data, there are spills that ends up in the hands of the unauthorised, because users are not aware of these controls.

The results of fraud, sabotage and espionage would not just result in direct loss or disclosure of information, but would also be devastating for the image of the organisation.

A.   Mitigating and countermeasures

Although the ICT security department provides advice and implementation of measures to avert vulnerability exploitation by insider threat agents, below are the proposed steps of measures that must be considered in order to avert the insider threat with the top being User awareness.

1) *Pre-employment screening*: Necessities on integrity and confidentiality of insiders, both employees and externally hired personnel, must be applied. The insiders must sign a secrecy agreement and need a certificate of good conduct.

2) *Legally binding documents*: Currently, employee contracts should contain paragraphs that cover non-disclosure-requirements, non- compete-requirements or other statements on the confidentiality and integrity of the information that the organisation processes and users must be made aware on a continuous basis.

3) *Security education / awareness:* Employees must be informed about the rules of ICT security and integrity at entry into the their roles and on a continuous basis through trainings and broadcasted security tips

4) *Punitive Actions:* The consequences of being found to be an insider must be well spelt out and should be very grave so as to deter users from engaging in insider crimes and users must be made aware on a continuous basis.

5) *Access Control:* All access to both the systems and premises must be well structured and monitored with automated rules, and for system access, users well trained and aware, access should be Role Based and strictly monitored

6) *Revocation of authorizations*: There must be a checklist for functional changes and retirement of

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personnel. Logical and physical authorizations are withdrawn at the latest on the last working day.

7) *Registration of information security incidents*: ICT security incidents must be registered, analyzed, watched over and reported to the persons in charge as stated the security guideline and users must be made aware on a continuous basis.

8) *Third party contracts:* In case outsourcing the services or activities, there is need for the supplier to be made aware of the policies so as to comply with the stated procedure for information security.

9) *Guidelines for Information Security:* There is need for one central document that describes the rules for Information Security and users must be made aware on a continuous basis.

B. Reccommendations

We further recommend that senior management demonstrate leadership and commitment with respect to the information security management system by ensuring the ICT security strategy and objectives are established, enforced and monitored. All the missing ICT related policies, standards, processes and procedures need to be developed, implemented, enforced, complied to, updated regularly and communicated to the users.

There is need to define, approve and apply an ICT security risk assessment process that establishes and maintains information security risk criteria. Management need to ensure that information security is an integral part of all processes throughout the organisation when it comes to the management and protection of company information, for to achieve its information security objectives.

A comprehensive user security awareness program for employees, customers and business associates need to be implemented to raise awareness of information security, social engineering and Cyber/ICT-crime. There is also need to implement a comprehensive, robust, effective and continual information security program and be able to evaluate the information security performance and the effectiveness of the information security management system.

VII. CONCLUSION

Considering the criticality of the utility service provisioning to the nation, and the required privacy of Customers and PII that the organisation processes, the identified gaps confirms that the organisation is vulnerable to Insider threats. The current implemented information security solutions and controls are not effective and well alignment to the ISO 27001:2013 required technical solutions. Senior management needs to assure total support in the implementation of the ISMS and compliance to the requirements of the adopted international standards and frameworks. All aspects of ICT security reporting, needs to be significantly enhanced to raise focus and inculcate a culture of high awareness of information security.

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6

Real Time Sensing and Monitoring of Environmental Conditions in a Chicken House

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Abstract – **Environmental conditions in a chicken house require regular monitoring to guarantee the quality of chickens produced and reduce the mortality rate. In addition, prevention against theft of chickens in a chicken house is equally important as it safeguards against revenue losses. Poultry farmers in Zambia, especially small and medium scale face challenges in meeting production targets and quality because of poor conditions in chicken houses and theft of stock. The conditions in the environment such as increased carbon dioxide, very high and very low temperature, the presence of ammonia gas in high volume and high humidity lead to disease and increase mortality rate. The existing methods used to monitor environmental conditions within the chicken house have proved to be ineffective as they are mostly manual. The manual methods used by farmers to monitor the environmental conditions are reactive, not proactive in dealing with extreme chicken rearing environmental conditions. In this paper, we propose the novel methods that can be used to sense and monitor real-time environmental conditions in a chicken house for low-income farmers. The proposed model is based on ZigBee, GSM and cloud storage for monitoring real-time environmental conditions and providing early warning against theft of chickens from the chicken house.**

Index Terms - Poultry; Environment conditions; Security; Wireless Sensor Network; Cloud; GSM.

I. INTRODUCTION

The demand for meat and milk worldwide is expected to rise by 50% between 2015 and 2050 [1]. In Africa, poultry was the second most consumed meat at 2.9 million tonnes after beef and southern Africa's share was at 40.6% for the period 2005 to 2007 [2] [3]. The projected consumption of poultry in Africa has been placed at 11.8 million tonnes by the year 2050 [3]. In 2015, poultry was the highest consumed meat in Zambia and accounted for 50% of the total meat consumed [4]. The poultry industry in Zambia is important at providing nutrition in both urban and rural settlements. The poultry industry does not only provide nutrition but, also provides direct and indirect employment to 80,000 people with 50,000 in permanent jobs based on statistics for 2014 from the Poultry Association of Zambia [2] [5]. The poultry industry growth rate from the years 2000 to 2014 has been increasing at 8% per annum for broilers and 10% for layers [2]. Estimates for the year 2015 were projected to be between 8% and 10% [6]. The high growth rate has seen an increase in the number of poultry farmers.

The farmers use manual methods to monitor environmental conditions within chicken houses. To monitor the environment more efficiently, farmers can make use of low-cost wireless sensor networks that can collect data such as temperature, humidity, and illumination in real-time [7]. The real-time information can help to send alerts to the farmer before parameters such as temperature reach critical levels. The collected information can be sent to monitoring centres where farmers can retrieve the information in real time or later for purposes of data analysis. Public surveillance systems can also make use of such information for decision-making purposes and policy formulation. Wireless Sensor Networks (WSN) are made up of connected sensor nodes and other devices that are equipped with radio transceivers usually designed to consume less power [26] [29]. The wireless sensor networks for monitoring environmental conditions in livestock are classified under precision livestock farming. Precision farming has the ability to react to changes in the production environment to reduce economic losses, waste, and impact on the environment [8]. The wireless sensor networks make use of wireless communication protocols to exchange information among the sensor nodes and other devices on the network. ZigBee is one of the prominent protocols used in wireless sensor networks for exchange of data within short distances [37]. The reach of Wireless Sensor Networks can be extended by incorporating the Global System for Mobile Communication (GSM) standard. The amount of data that is generated from wireless sensor networks is huge and cloud computing provides a solution to accommodate the data generated [20]. Cloud computing is a technology that brings together users and provides on one platform where resources are shared. The transfer of data to the cloud from a wireless sensor network that supports the GSM standard is achieved by using the global packet radio service (GPRS).

The objective of this paper is to review the challenges of monitoring poultry among low-income farmers and propose novel methods to sense and monitor real-time environmental conditions in a chicken house for low-income farmers. This paper is organized as follows: section ii provides an overview of poultry farming and its challenges. Section iii provides related works of wireless sensor networks in agriculture. Section iv provides the methods used to sense and monitor environmental conditions in the chicken house and section v presents a theoretical model of sensing and monitoring chicken house environment conditions.

A. Poultry Farming in Zambia

Poultry farming is popular among small-scale farmers in Zambia. The farmers produce broilers, layers, village chicken and others such as quails, ducks, guinea fowls, and ostrich. The number of farmers and chickens produced are increasing. In 2005, the number of broiler chickens produced was 36 million [9]. By 2014, the number of broilers produced was estimated to be 73.9 million birds and the number rose to 78.9 million birds in 2015 [4] [10]. According to Ministry of Agriculture estimated statistics for 2016, broilers are the highest produced type of chicken. Broilers require more investment than village chickens to produce and are more popular among urban small to medium-scale farmers than rural farmers. There are over 1.1 million small and medium scale poultry farmers in Zambia compared to the 0.1 million commercial farmers [2]. The largest proportion of poultry meat is produced by small and medium-scale farmers.

B. Chicken House Environment Conditions and Challenges

The poultry-rearing conditions begin from the design of the chicken house which is set facing east-west direction to avoid sunlight from shining directly into the house and prevent strong winds and draughts. The north and south sides should be open to allow for ventilation. The orientation is a guide but the actual orientation can vary after extensive study of the location where the chicken house is to be set up. The size of the chicken house is dependent on the number of birds whose stocking density should be 8 to 10 birds per square metre. The conditions in the environment of the chicken house especially temperature should be critically be monitored in the first four weeks. The temperature for brooding should be at $31^{o}C$ at the start and this should be lowered by three degrees every week until it reaches $21^{o}C$. However, the ideal temperature for rearing broiler chickens is $23^{o}C$ [11].

Some of the challenges of poultry farming include high ammonia gas concentration, increased carbon dioxide, high and low temperature, high humidity and theft of stock. Toxic gases such as ammonia are harmful to poultry as they can affect the growth and quality of poultry products [12]. However, evidence suggests that broilers are able to avoid effects of ammonia at 20 ppm and higher even after long periods of exposure [13]. The high humidity combined with high temperature which can range from $27^{o}C$ to $35^{o}C$ in the hot season causes heat stress in chickens that result in death [9] [14] [11]. The high temperature and wet litter is a breeding ground for disease-causing organisms. The very low temperature, on the other hand, can cause diseases such as Pneumonia. In addition to the environmental challenges, farmers are also affected by the theft of chickens. A study conducted by [15], showed that theft of chickens accounted for 52% of the list of constraints affecting poultry farmers.

The methods farmers use to respond to the challenges are manual and require the physical presence of the farmer in the chicken house to determine the state of the environment. Currently, farmers have to check for these signs physically without using measuring instruments that can take accurate measurements of temperature. The farmers usually look for the behaviour of the chickens to determine the physiological state. For example, decreased feed intake and panting indicate high temperature while huddling of chickens indicate low temperature [16] [1]. The farmer reacts after the effects are already felt by the chickens and if the farmer is not present in the chicken house the conditions will not be noticed. To respond to theft, a homestead is usually placed near the chicken house. A study conducted by [17], revealed that traditional methods of monitoring animals have failed to provide the correct levels of thermal comfort required by livestock.

C. Animal Monitoring Technologies

Animal monitoring technology utilizes smart sensors to obtain physiological parameters about livestock [18]. The animal monitoring technologies can be standalone or can be part of fully integrated systems that provide ultimate solutions for the farmers. The data collected using animal monitoring can be used to improve various aspects of rearing livestock. Integrated Animal Monitoring technologies have advanced capabilities for decision-making and forecasting [19]. Most animal monitoring technologies make use of Wireless Sensor Networks [20]. Using Animal monitoring technology based on wireless sensor networks can minimize the Challenges faced by farmers [7].

III. RELATED WORKS

[21] Proposed a prototype system to measure soil moisture in four plots of land and trigger alerts via SMS to the farmer for low moisture levels. The system used waspmote for sensor nodes which consisted of Atmega 128 microcontrollers, ZigBee transceiver, and a soil moisture sensor. The sensor nodes were connected to a Meshlium gateway using 802.15.4 protocol. The gateway was responsible for collecting all the sensor data, storing and sending the data to the cloud using GPRS network in JSON format. Ubidots was used for cloud storage and it offered data visualization and analytical tools. The system was tested on four plots of land to prove the concept.

[22] designed a prototype to monitor temperature, humidity, CO2 concentration and NH3 concentration from a chicken house using a wireless sensor network. Their main concern was the reliable transfer of the values measured by the monitoring system. To provide reliability of transferred data, software and data fitting methods provided the correction and compensation of the data. In addition, data loss recovery strategies and online filling in methods were also employed based on the features of the sensor nodes. A novel data frame recovery protocol was designed for recovering lost packets.

[23] proposed a prototype Agricultural Intrusion Detection (AID) system to deal with the overlooked matter of unauthorized intruders who can steal crops in an agriculture field and cause significant loss to the farmer. Multiple sensor nodes were placed in a field to detect the presence of intruders and animals. Each sensor node had a microcontroller, an LCD, Passive Infrared Sensor (PIR), an ultrasonic sensor and Xbee transceiver. When a suspected intruder entered into the

agricultural field, the sink node would send a message through a GSM modem to sound an alarm in the farmers' house and an SMS to the farmers' phone to alert the farmer. The system proposed was low cost and energy efficient.

[24] presented a smart system that farmers could use to manage their greenhouses and interact with other farmers. Using the sensors the system was able to measure temperature and humidity both inside the greenhouse and outside to determine variations. The other parameter that was measured was the wind speed. The system was able to send notifications to farmers when there were problems in the greenhouse. The farmers were required to access the web interface of the system to view any notifications that had come from the system. The web platform also enabled the farmers to exchange information among themselves. The data collected by the system could also be used as archive data for later analysis. The sensor nodes and the web exchanged information using REST web services and the data was in JSON format. The data could be viewed on less powerful devices that had slow response time without user complaints during testing.

[25] proposed an automated irrigation system for optimizing water usage in rural parts of Mexico. The system was had moisture and temperature sensors on the sensor node to record the said parameters. The sensor node was also equipped with a microcontroller and ZigBee wireless module for sending the data from the sensors to the gateway. The other functions of the gateway apart from receiving data from the sensor nodes were to trigger the actuators for irrigation and send the data to a web application. To send and receive data from the web application the gateway used GPRS technology. The system was able to achieve water savings up to 90%. The gateway and sensor nodes were solar powered. The use of solar power and low cost made the system to be suitable in rural areas where there is no power grid.

IV. EXISTING METHODS OF SENSING AND MONITORING

A. Wireless Sensor Networks

The sensor nodes and other devices within a wireless sensor network can be mobile or stationary depending on the application [26] [27] [29]. There are five types of wireless sensor networks and they are underground Wireless Sensor Network, underwater Wireless Sensor Network, terrestrial Wireless Sensor Network, mobile Wireless Sensor Network and multimedia Wireless Sensor Network [30] [31]. Wireless sensor networks do not rely on fixed infrastructure, do not have centralized methods of organization and can be used to monitor vast areas that span several kilometres [31] [32]. A Wireless Sensor Network consists of sensor nodes that have sensors to record the parameters to be monitored and a coordinator or sink node that collects and aggregate the values received from the sensor nodes. The network can also have actuators that connect to the sensor nodes and can be connected to other applications such as web applications and mobile apps. The nodes communicate with each other using any of the communication protocols shown in Table 1.

TABLE I
WIRELESS SENSOR NETWORK COMMUNICATION PROTOCOLS

Reference	Technology Standard	Range	Power	Security
[32] [33]	Wi-Fi (IEEE 802.11,a,b,g,n,ac,ad)	100m	1 W	Yes
[18] [34]	Bluetooth (IEEE 802.15.1)	100m	1 W	Yes
[35] [36]	Bluetooth Low Energy (BLE)	200m	10mW	Yes
[37]	ZigBee (IEEE 802.15.4)	10m -300m	1mW	Yes
[53]	Z-wave	30m	1mW	Yes
[20] [38]	Sigfox	30-50Km	-	No
[20]	LoRaWAN (IEEE 802.15.1)	2-15Km	-	No
[39] [40]	RFID	10 -22m	1mW	Possible
[20]	GSM, 3G, and 4G	10Km – 28Km	1W – 5W	Yes

The existing protocols and algorithms that were initially developed to be used in wireless ad-hoc and wired networks are not suitable for wireless sensor networks [26]. The algorithms and protocols are unsuitable because the characteristics of wireless sensor networks are different in terms of energy requirements, structure, memory requirements and level of computation. The literature identifies GPRS, Wi-Fi, Bluetooth, and ZigBee as the four main ways for providing wireless communication among sensor nodes [31]. Of the four, ZigBee is the most promising as it is less complex, cheaper and has low power consumption. In addition, ZigBee has a higher level of accuracy although it may be costly for some applications [28][41]. Our proposed design of a wireless sensor network uses ZigBee for communication among the sensor nodes and as it is secure and uses less power. The reach of the network is extended by using the GSM network [49]. The GSM network allows the farmers to have access to the real-time data from the chicken house using the mobile phone.

B. Cloud Computing

Sensor nodes have the ability to generate large volumes of data at a high rate and that poses a challenge because more storage space is required to keep the data. Big data and cloud storage provide a solution to this challenge [20]. The cloud offers massive computation power and big data provides sufficient tools for analysis of sensor data and storage [20] [35]. The combination of cloud and big data provides a unique solution to handle the volume, variety, and velocity of data generated from sensors. An ideal sensor network solution that uses cloud must be scalable, simple to operate, affordable and easy to maintain [42]. Having these features can increase the success of implementation among low income earning farmers

as they may be less skilled technically and require an affordable product.

Added to these features are the benefits that can be derived from using the cloud [42]. Firstly, the cloud can support the scalability of physical sensors according to the demands of the application and allow multiple users to have access to the same data. Secondly, the users pay less due to economies of scale. Sensors connected to the cloud can be configured to have sleep mode to conserve power to increase the lifetime of the entire system to months and years [31] [42]. The cloud also enables users to easily switch between different types of services to accommodate growth. Another benefit of using the cloud is security for users accessing sensor data. The security can be implemented for various levels of users subscribed to the service. Security can not only be applied to information but can be extended to the hardware, in this case, referring the sensor nodes. The sensor nodes can be equipped with sensors that can detect intruders and send alerts to the users via the cloud service [43]. The cloud can also offer other advanced security tools that can detect anomalies in the data coming from sensors thus improving the integrity of the data obtained from the sensor [29] [30]. Competition for customers among cloud service providers can also bring about an improvement in the quality of service offered to the subscribers.

Traditional web applications can be used in place of cloud services to store data coming from sensors [44]. For users to easily understand data from sensors visualization is a useful way to achieve the task [45]. Visual data is more convenient for users to work with and easy to understand. The fact that data from sensors is numerical in nature makes it ideal to be visualized in form of graphs. Visualization tools can be part of web applications used to process the data so that the features can easily be accessed from various platforms with Internet access. Making visualization tools part of the cloud also frees up the users from issues to do with deployment, maintenance, and upgrade of systems providing the service [42]. Our proposed approach uses a web application running on a web server to store the data from the sensor nodes. The data from the sensor nodes is sent to the web application using GPRS that is part of the GSM network. The web application has visualization features to present the data in form of graphs for easy interpretation. The farmers can access the web application from any device equipped with Internet access.

C. Mobile Applications and SMS

Mobile applications or simply apps are application software that runs on mobile devices such as smartphones and tablets [46]. Agriculture has not been exempted from use of mobile applications and mobile phones to support different fields in the sector [47]. Some systems have been proposed based on mobile computing for sending product and weather information to farmers [47]. Mobile applications can be designed to provide access to a Wireless Sensor Network for monitoring environmental conditions and even control actuators. The use of mobile applications in Wireless Sensor Networks also provides the user with the ability to store some of the data from the sensor network. The data can be accessed later even when the connection between the application and the sensor network is broken. Mobile applications can also have other value added services such as weather, access to market information and general information about livestock from associations or government departments. In our model, we propose to use an android app that farmers can use to access information from the cloud. The app has other value-added services that include poultry-rearing guides and access to other useful electronic information sources.

SMS enables two-way transmission of data and was a revolutionary way of communicating that was a variant of one-way communication called paging [48]. SMS applications have been used in many applications such as health, agriculture, education and other sectors. The popularity of SMS can be attributed to wide network coverage and the affordability of the service by the users [51] [52]. Some applications that use SMS are capable of delivering tailor-made messages, especially in health applications. In agriculture, many applications are there that use SMS such as marketing, insurance, irrigation control and environmental monitoring [50]. Incorporating SMS is in a Wireless Sensor Network enables users to receive alerts from the gateway that is connected to the sensor nodes [51] [52]. SMS can be used even on low-end devices and that can make SMS to be more popular among the farmers. Therefore, our proposed model incorporates SMS to send alerts about the conditions in a poultry house to accommodate the farmers that may not have access to smartphones.

V. PROPOSED MODEL ARCHITECTURE

We propose a model to monitor temperature and presence of the intruders within the chicken house as shown in Figure 1. The sensor nodes are made up of a temperature sensor, ultrasonic sensor, PIR sensor, ZigBee antenna and a microcontroller. The temperature sensor measures the temperature while the PIR and ultrasonic sensor detect the presence of an intruder within the chicken house. The information from the sensor node is sent to the gateway using ZigBee protocol. This is made possible by the ZigBee antenna attached to both the sensor node and the gateway. The gateway has a microcontroller, an LCD screen, and a GSM shield.

Fig. 1 Chicken house sensing and monitoring model.

The microcontroller processes the data from the sensor nodes and displays the values on the LCD Screen. The LCD screen provides the farmer with information from the chicken house without the need for the farmer going into the chicken house. When temperature values are beyond the set threshold or when an intruder is detected, the gateway notifies the farmer via SMS using the GSM shield [51]. The values of temperature and status of the security are also sent to the cloud for storage. The farmer can access the values stored in the cloud via an Android app or web browser. The combination of ZigBee, GSM, Cloud storage, mobile apps and open-source microcontroller boards provides a solution to the farmer's challenges. ZigBee provides the low cost, a range of 100 metres, low power consumption, security, and control capabilities. GSM extends the range in which data can be accessed to kilometres via SMS and GPRS with greater coverage for areas that can be monitored. The cloud offers storage and analytical tools for analysing the data from the sensors. Mobile applications can extend the convenience of the users as they monitor the conditions and come with value-added serves in addition to just monitoring environmental conditions. Lastly, the open source boards offer flexibility in designing the hardware and software for the application at a cheaper cost.

VI. CONCLUSION AND FUTURE WORK

In this paper, we have proposed novel methods of sensing and monitoring temperature and presence of intruders in the chicken house. The methods provide a single system to cater for security from theft of chickens and monitoring temperature. The methods are based on ZigBee, GSM, GPRS, SMS, cloud computing and mobile applications. The methods provide real-time access to temperature and security status of the chicken

house. In future, we will build a prototype to test the model and obtain empirical data concerning the performance of the system. The future work will also include reducing the power consumption of the nodes on the sensing side to enable them to be solar powered.

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Securing Grain in Transit for the Food Reserve Agency Based On the Cloud Model

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Abstract- **Despite the fact that Zambia is undergoing rapid development, it still faces food security challenges. Zambian government through FRA ensures national food security and provides market access for rural based small holder farmers by maintaining a sustainable national strategic food reserve. Unfortunately despite the government of Zambia through FRA ensuring national food security almost every year huge quantities of grain are lost due to many factors such as spoilage, infestations, theft and spillage during transporting, this is as reported by the auditor general's office. As a result of the challenges identified, there is therefore need for better management of the grain during transportation through automation of the process. As the world is trending into new technologies and implementations it is a necessary goal to trend up in agriculture as well. In this paper we proposed a solution that seeks to minimize on the theft at FRA that occurs during grain transportation from a particular depot to the storage facilities. Research proposed the use of geographical position system (GPS) to monitor and track the location of the vehicle in transit using a mobile and web applications. Vital information about the vehicle carrying grain e.g. location will be gathered by the GPS fitted in the vehicle and will be transmitted to the server in the cloud, this information will be made available to the authorized users using the web application anytime, and anywhere provided there is internet connectivity.**

Keywords— FRA; Food Security; GPS; GSM; Cloud Computing; Tracking.

I.   INTRODUCTION

Food is a fundamental human need [26] and as such food security is cardinal in any country. The Food and Agriculture Organization (FAO) defines food security as a condition whereby all people at all times have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life [22]. However, in Zambia government through FRA ensures national food security and provides market access for rural based small holder farmers by maintaining a sustainable national strategic food reserve [11]. The FRA also acts as a macro-economic stabilizer for food grown in the country, such as maize which is the nation's staple crop. Unfortunately despite the government of Zambia through FRA ensuring national food security, almost every year huge quantities of food are lost due to many factors such as spoilage, infestations, theft and spillage during transporting [3] [24] in [26].it has also been

noted that FRA faces challenges in efficient management of inventory, this is according to the audit [30] that was carried out between 2006 and 2009 by the Auditor General to review the performance of FRA. According to the audit report, during the period of 2006-2009 the Agency experienced maize shortages of 115, 516 × 50kg bags valued at ZMK4, 274, 092, 000 (old currency) at various depots. These losses were due to theft and grain spoilage at the warehouse depots [30].Most of these challenges are as a result of poor monitoring and a poor inventory management approach which is largely manual and paper based [26]. The report further stated that FRA faces challenges to effectively monitor and inspect its storage facilities. Further, the report stated that organized crime was another factor leading to shortages, usually at the time of dispatch. A baseline study carried out by [12] further adds that FRA had challenges such as manual report generation, no connectivity to remote warehouses, inability to track stock on demand, theft, spoilage of stock due to lack of environmental monitoring. According to [27], many difficulties exist that have to be overcome to attain food security. These include climate change, water scarcity, energy requirements and reducing the huge amount of food losses. Efforts to raise farmer's income and improve food security consequently reducing hunger especially in the world's poorest countries should give priority to the issue of crop losses [23]. It is hardly possible to ensure food security in the absence of efficient delivery, control and tracking mechanisms across the supply chain. As a result of the challenges identified, there is therefore need for better management of the grain transportation through automation of the process. As the world is trending into new technologies and implementations it is a necessary goal to trend up in agriculture also [25] .Therefore there is need to have a precise, and appropriate technique of tracking of the grain bags. This shall be done in order to reduce theft of the grain and ensure management and monitoring of the grain that is being transported from one location to another in a credible and efficient manner. Hence, we are proposing a model based on Cloud and GPS technologies in the development of a secure tracking system for the FRA.

II. TRACKING TECHNOLOGIES

It is nearly impossible to ensure food security in the absence of efficient delivery, control and tracking mechanisms across a given supply chain. [2] Notes that a Tracking system refers to the ability of tracking the path of a particular unit or a batch of products from upstream to downstream along a supply chain. According to [7] Tracking allows the base station to continuously track the vehicle without any interference of the driver or the method of continuously collecting the co-ordinates of moving vehicle that is getting from GPS receiver. On the other hand [21] adds that a Vehicle Tracking System is a device that is fitted in a vehicle, to enable the vehicle owner to identify the vehicle's location. Currently, there are several tracking solutions of different [29] forms, some operate in client-server architecture while some others work in standalone mode. Most of the client-server solutions are designed to provide tracking only. While a client-server system is a better solution when considering cost, a standalone solution will give better performance in terms of speed of response. However in Vehicle Tracking System for tracking the vehicle any tracking device is required. Now a days, three navigation systems are available and people use those for tracking any object. The GNSS (Global Navigation Satellite System) consists of three main satellite navigation systems. They are GPS (Global Positioning System), GLONASS and Galileo [31].

TABLE 1 [31]
GNSS LOCATION TRACKING TECHNOLOGIES

Parameters	GPS	GLONASS	Galileo
Satellites per complete constellation	32(Block III)	24	27+3 spares
Orbital Planes	6	3	3
Plane Inclination	55 deg	64.8 deg	56 deg
Radius of Orbit	26650 km	14100 km	23222 km
Period required for complete cycle	12 hrs	11 hrs 15 min	11 hrs 15 min
Civil Data Rate of Satellite	50 bps, up to 100 sps	50 bps	50 bps, up to 100 sps
Accuracy	5-20 m	50-70 m	Claimed 1 m
Operation Bands of Satellite	L1,L2,L5	L1,L2,L3,L5	E1,E5,E6

Table 1 shows the three GNSS technologies from which it can be seen that GLONASS and Galileo provide more precise location than GPS but they are costly. GPS (Global Positioning System) is highly available GNSS technology. With regards to the proposed system, GPS is the best technology considering its availability and receiver cost. In our proposed system we decide to use GPS.

III. GLOBAL POSITIONING SYSTEM (GPS)

According to [29] GPS is a navigation technology providing accurate location and information. Preserved by the U.S, GPS is a space-based satellite system, granting contact to anyone owning a GPS supported receiver. Global Positioning System (GPS) technology has provided an essential tool for management of agricultural and natural resources. [6]Adds that The Global Positioning System (GPS) is a satellite-based navigation system consists of a network of 24 satellites located

in the orbit. The system provides essential information to military, civil and commercial users around the world and which is freely accessible to anyone with a GPS receiver. GPS works in any weather circumstances at anywhere in the world. [19] Also notes that The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites, GPS satellites rotate twice a day around the earth in a specific orbit. These satellites transmit signal information to earth. This signal information is received by the GPS receiver in order to measure the user's correct position. The GPS receiver compares the time a satellite transmits the signal with the time the signal is received. The time difference calculated enables us to know the distance of the satellite. By measuring the distance of few more satellites, the user's position can be verified and displayed on the unit's electronic map. GPS is a satellite and ground based radio navigation and locational system that enables the user to determine very accurate locations on the surface of the Earth. Remote sensing technologies are used to gather information about the surface of the earth from a distant platform, usually a satellite or airborne sensor. Most remotely sensed data used for mapping and spatial analysis is collected as reflected electromagnetic radiation which is processed into a digital image that can be overlaid with other spatial data.

In our proposed system GPS will be the main module, as the vehicle location will be tracked using GPS technology. This is so that it could get the exact location of respective vehicles carrying grain in transit from the source to the destination.

IV. CLOUD COMPUTING

Cloud computing is a computing paradigm in which real-time scalable resources such as files, data, programs, hardware, can be shared via the Internet to users [33]. Cloud computing is assumed to be the solution that overcomes the problem of processing large amounts of data [34]. By using cloud computing the cost of implementing software solutions and storage of data is reduced considerably. Cloud solutions have desirable features such as high scalability, agility, high availability and reliability and multi-sharing [34]. Clouds offer different service models, the service models include; software, platform and infrastructure as service [33]. In the Infrastructure as a service (IaaS) service model, providers offer physical or virtual machines with the capability to fulfill customer needs to implement software solutions on them [34]. In the Platform as a service (PaaS) service model, software applications such as an operating system, a programming language, a web server, are already installed [34]. PaaS facilitates the implementation and testing of software solutions and provides the needed resources for an application to run. Finally, the Software as a service (SaaS) service model is described as a pay-per-use service where the providers offer clients a fully configured hardware and software solution [19]. The advantage of SaaS is that clients don't have to worry about any maintenance, hardware or software [33]. Cloud computing has been implemented in various spheres such as healthcare [10], education [18], smart grids [1], etc. Recent

publications have demonstrated the benefits of cloud computing for intelligent transportation systems [20]. The architecture of the proposed system shall be a 3 tier cloud computing client- server model were the application will be run on a laptop or mobile device from which the client will interact with the system. Unlike a 2 tier, 3 tier will have a business layer which is added to the model and act as an intermediary between the presentation and data layers.

V. RELATED WORKS

The research domain is not presently very popular, but there are a few of such systems in the literature which were thoroughly reviewed to define the scope and requirement of this work. Their special features were also studied, [28] Notes that the Rapid growth of technology and infrastructure has made our lives easier, the researchers proposed the Design and Implementation of Real Time Vehicle Tracking System model, for the vehicle tracking unit with the help of GPS receivers and GSM modem, GPS for tracking and GSM for SMS's and google earth maps.

According to [16] the researchers propose a security system that would help prevent Vehicle theft, Design and Implementation of Vehicle Tracking System Using GPS, Automatic Vehicle Location system using GPS for positioning information and GSM/GPRS or information transmission. Tracking vehicle using GPS, GSM/GPRS and a web based application by displaying the location of the vehicle on the map, this was to curb vehicle theft.

[13] proposed a GPS based Advanced Vehicle Tracking and Vehicle Control System vehicle tracking system that employs a GPS module and a GSM modem to find the location of a vehicle, the focus was also on the control system of locking and unlocking the vehicle door remotely.

Real-Time GPS/GPRS Based Vehicle Tracking System, in this paper a vehicle tracking system based on GPS and GPRS is proposed [4]. The location of the vehicle was retrieved using embedded GPS sensor. Technologies used for Vehicle Tracking, GPRS, GPS, GSM, Data Coding.

An efficient vehicle tracking system was designed and implemented for tracking the movement of any equipped vehicle from any location at any time this is according to [13] .The proposed system made good use of a popular technology that combines a Smartphone application with a microcontroller. Design and Implementation Of Vehicle Tracking System Using GPS system using GPS/GSM/GPRS Technology and smartphone application and uses GPS and GSM/GPRS to track the vehicle and Google Maps. In a related study [8] proposed paper on vehicle tracking system based on GPS and GPRS, the location of the vehicle in this system is retrieved using embedded GPS sensor. A modified coding method is used to encode and compress location data before it is sent to offer cost effective usage of network traffic. The privacy of the transmitted data is guaranteed using a simple security mechanism. The encoded and encrypted location data is then sent to a tracking server using GPRS technology. The authorized user can then track a vehicle using a secure web interface [8]. A number of papers has been published on the

development of vehicle tracking system using GPS and GSM Modem which include these [9] [17] [5].

A. FRA Current Business Process Process-Stock Receipt Business Process Transaction

Figure 1 FRA stock receipt business process [26]
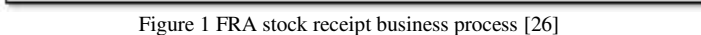
In a stock receipt business process transaction, FRA buys stock from small scale farmers. FRA then delivers the stock to FRA warehouse depots for storage [26].

VI. PROPOSED MODEL ARCHITECTURE

We propose a model that seeks to address some of the gaps in the reviewed literature, in a paper presented by Cynthia and Jackson [26], Mulima and Jackson [12], both authors brought out the need for curbing theft of grain in the FRA circulation but there focus was automating other FRA business processes, therefore our proposed paper seeks to address monitoring vehicles responsible for transferring of grain in the FRA circulation in order to curb grain theft.

Tracking of grain in transit from the source to the destination using Global Positioning System shall enable monitoring of grain when it is not stationary at the warehouses. This is so as to aid in deterring thefts along the way if the inventory is being transported from one depot to another within FRA circulation. In the proposed model the vehicle under tracking shall be fitted with a tracking device that contains GPS, GSM modem and GPRS functionality. This device will be used to transmit data directly to the tracking server and database in the cloud. The tracking device will continuously request to the GPS satellite for its location information and at the same time GPS satellite will provide the location information to tracking device installed in vehicle that's in transit. The tracking device will send the location information back to the server through GPRS and continuously update the database. Monitoring and tracking server shall be housed in the cloud. The GSM/GPRS module shall be responsible of establishing connections between a tracking device in the vehicle on transit and a remote tracking server in the cloud for transmitting the vehicle's location information, using TCP/IP connection through the GSM/GPRS network.
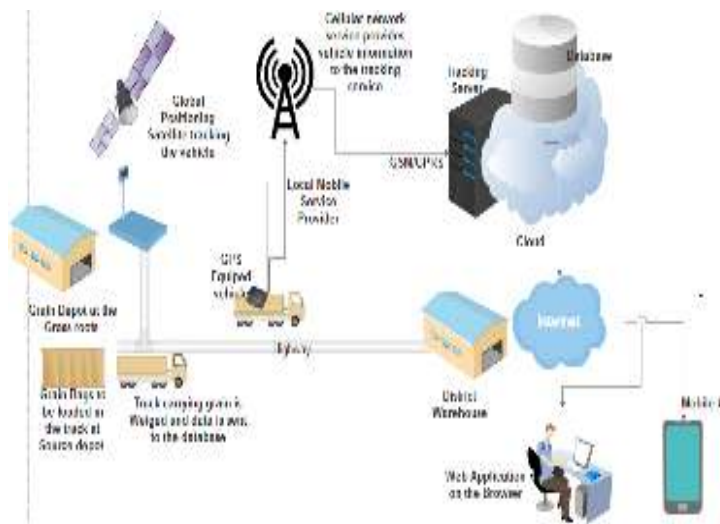
Figure 2 Proposed System Model

A web interface has also been proposed as it will be directly connected to the database which will allow the system admin at FRA to view vehicle location using google maps and other tracking related issues, the mobile application will also be another platform that will be used to track the vehicles using google maps.
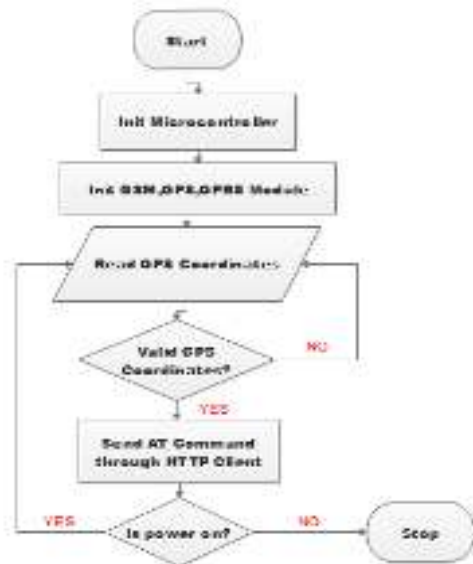
A. Proposed Tracking flow chart

Figure 3 Proposed Tracking Flow Chart

The flow chart depicts the proposed working of the tracking module. The application shall make use of the Arduino microcontroller that shall be fitted with a GPS, GSM and GPRS module. The microcontroller will communicate with the GSM using AT commands, AT commands are merely instructions that are used to control a modem whose abbreviations stand for ATtention. Then an HTTP client will be programmed through the microcontroller that shall utilize a parameterized URL to send GPS data and other related information to the remote server in the cloud using the underlying GPRS data network. Then the application shall be

used to display real-time GPS data as received in form of a binding on the satellite map.

B. Preliminary Results

As part of the main project below is a web application for FRA that is mainly concerned with mapping of the depots, farms and generating reports as well as managing detailed information for small scale farmers. The application is being housed in the cloud.

Figure 4 storage facilities mapping

Figure 5 farm mapping

VII. CONCLUSION AND FUTURE WORKS

In this paper we have proposed a cloud model for tracking vehicle carrying grain in transit that could be used by FRA to curb on theft that occurs during grain transportation from one depot to another until the storage facilities within the FRA circulation. The model offers a novel approach that incorporates both security from theft of grain in transit within the circulation as well as monitoring the vehicle transferring the grain. The model is based on the Cloud, GPS, GSM/GPRS, web and mobile applications. The model shall provide real time tracking and location of the vehicle in transit within the circulation. For the future works, we shall develop a software prototype to test the model and thereafter obtain pragmatic data regarding the performance of the system. As part of the future works we also propose a tele-cut off (weight of the truck) this Is to further enhance the security of the grain by weighing the truck carrying the grain through sensors, in case of the weight of the truck changing one of the solutions is to send an alert to the authorities through sensors and track the location.

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INVESTMENT AND SUSTAINABILITY FOR RESEARCH FOR HIGHER EDUCATION

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Abstract—The purpose of the paper is to investigate the investment and sustainability for research for higher education. The review of literature was done through the review of the secondary data sources to come up with a compilation of data in this study so as to arrive at the findings in this paper. This was done through comparing case studies in some universities. The findings in this paper show that there is a lack of an incentive structure for promoting change at individual level of colleges and universities is lacking. The connections of the higher institutions of learning and society or other coordinating bodies are missing among colleges and universities. The national legislative framework on investment in research in higher education is lacking. It has therefore been concluded that the interdisplinarity is to be encouraged as a strategic objective

Keywords—sustainable development; investment;higher educatione; sustainability;

I. INTRODUCTION

Through their pivotal and influential role in society, universities are key stakeholders in achieving a sustainable future (. Cortese, 2003). As respected thought leaders, universities have the opportunity to elevate the importance of sustainable development (SD) through scholarly and public discourse. As complex organizations themselves, universities can also model for the community how an organization committed to sustainability ought to operate. In addition, universities have the opportunity to provide their communities with graduates who have the knowledge and skills necessary to help transform their workplaces and live as responsible global citizens. There are promising signs that universities around the world are responding to these opportunities and beginning to engage in activities related to SD, whether through campus "greening", development of special courses on sustainability, or offering collaborative research opportunities. But what is really required is radical innovation rethinking within universities (e.g. van Weenen, 2000; Lozano, 2006), both in their internal organization and operation as well as their interaction with external stakeholders. Rather than looking at individual innovations in the classroom or facilities that constitute important incremental changes (see other articles in this issue for more

on curriculum), the focus of this article will be on the transformations that would enable a university to more rapidly shift course.

II. INVESTMENT

The differences between nations, in terms of development, are shown not only in what each country produces, but in what each of them does with the resources generated through the productive process, resources of which Zambia has in abundance.

Thus, investment in education becomes an integral part of development. Education is an important dimension of human development, and plays a determinant role in expanding the many choices that people make. (Kalifungwa.P, 2015). Education investment yields virtuous circles of dividends, not vicious cascades of hopelessness and desperation. Education expands the horizon of knowledge and for tides we all have the duty to be part of the investment. This type of investment will contribute to the wealth and prosperity of the generations to come.

III. PRINCIPLE OF SUSTAINABILITY

Among the many definitions of sustainability, Sustainable development is the development that meets the needs of the current generation without compromising the ability of the future generations to meet their needs (UN, 1987).

Therefore sustainability is understood as a process of getting there.

In the sustainable society, nature is not subject to systematically increasing:

- concentrations of substances extracted from the Earth's crust;
- concentrations of substances produced by society;
- degradation by physical means; and, in that society;
- People are not subject to conditions that systematically undermine their capacity to meet their needs.

These four system conditions can be more concretely translated into the principles of sustainability. So that to become a sustainable society, we must eliminate our contribution to:

- the progressive build-up of substances extracted from the Earth's crust (for example, heavy metals and fossil fuels);
- the progressive build-up of chemicals and compounds produced by society (for example, dioxins, PCBs, and DDT);
- the progressive physical degradation and destruction of nature and natural processes (for example, over harvesting forests and paving over critical wildlife habitat); and
- Conditions that undermine people's capacity to meet their basic human needs (for example, unsafe working conditions and not enough pay to live on).

The integration of sustainable development (SD) has become a relevant topic in higher education and increasingly, higher education institutions (HEIs) are attempting to take responsibility as agents in promoting SD principles (Lozano et al ,2015). HEI can contribute significantly to fostering the transition towards a sustainable society due to their double role: 1) creating knowledge and transferring this knowledge to the society, and 2) preparing students for their future role in society (de Lange, 2013).

IV. KEY CHARACTERISTICS OF A SUSTAINABLE UNIVERSITY

What does a sustainable university look like? In the literature we can find different identifications of key characteristics (van Weenen, 2000; Leal Filho, 2000; Holmberg and Samuelsson, 2006; Adomssent, 2006; Adomssent et al., 2007). The authors, coming from three continents and seven institutions, came up with the following list of concepts, though there are undoubtedly others: . Transformative education rather than merely transmissive education to prepare students capable of addressing complex sustainability challenges. Rather than being a one-way process of learning, it must be more interactive and learner-centric with a strong emphasis on critical thinking ability (Sterling, 2005; Wals and Corcoran, 2006). . A strong emphasis on effectively conducting inter and transdisciplinary research and science (see, e.g. Max Neef, 2005; Van Dam, 2006). Societal problem-solving orientation in education and research through an interaction through multiple interfaces to be pertinent to societal goals. As a result, students must be able to deal with the complexities of real problems and the uncertainties associated with the future. . Networks that can tap into varied expertise around the campus to efficiently and meaningfully share resources. . Leadership and vision that promotes needed change accompanied by proper assignment of responsibility and rewards, who are committed to a long-term transformation of the university and are willing to be responsive to society's changing needs (Lozano, 2006).

V. CURRENT SITUATION

Environmentalists and researchers challenge is the development patterns that are harming the environment and social patterns problems that are emerging. On the other hand, Higher Education institutions focus on learning and planning processes rather than developing specific outputs. What then must the Higher Education do in terms of Investment and Sustainability in research?

VI. HIGHER EDUCATION INVESTMENT AND SUSTAINABILITY IN RESEARCH

The high level policy forum of the African Union stressed that meeting the Sustainable Development Goals requires real investment and innovation in higher education.
Business as usual will not produce the breakthroughs in social and economic development the world needs. Innovation in how we deliver education as well as what that education is focused upon is needed for all of our futures (African Union conference 2003).

Many universities now blend problem-based learning that transcends disciplinary boundaries into the learning experience on campus. For example, Aalto has incorporated problem-based learning into its Nordic Case Competition, challenging students and stakeholders to develop the Otaniemi water front at Aalto University main campus. ETH Zurich has incorporated a new and innovative one-week interdisciplinary course where groups focus on a major societal develop their capacity for critical thinking work sustainable behavior.

Experiential learning with outside partners offers students valuable insight into current challenges and a hands-on approach to developing solutions. The Sustainable Campus Leadership Program, a partnership between Hong Kong University of Science and Technology (HKUST) and the Shanghai Commercial Bank provides students with the opportunity to work directly with professionals in Hong Kong to develop, design, and implement sustainability projects that physically transform campus spaces for long-term environmental benefits for the HKUST community. In partnership with mentors and partner organizations, the University of British Columbia Sustainability Scholars are immersed in real-world learning where students apply knowledge and research skills gained on-campus to addressing the pressing issues facing our partners, cities, and society at large. Ozyegin University has introduced"sectoral solutions" to get students out of the classroom and into the field to experience different industries and functional departments through planned internship opportunities. KTH Royal Institute of Technology has integrated sustainability into education, research, and operation and has developed approaches and learning outcomes to gauge progress. Measurement and assessment of sustainability skills and capacities are evolving and present an opportunity for future collaboration between institutions.

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VIII. CONCEPTUAL FRAMEWORK FOR TRANSFORMATIONS

One way that can be described and assessed the necessary transformation is through FLA analysis, which provides a simplified approach to exploring the main paths of change (but does not aim to replace a sustainability assessment system). This method was recently proposed and is described elsewhere (Ferrer-Balas et al., 2008) based on the concepts developed by Jansen (2003). According to Jansen system renewal is a concept integrating technological, cultural and structural elements, in which three interacting dimensions (framework, level and actors) can be distinguished in the process of change to more sustainable patterns of development. The framework (F) dimension relates to intensive interacting changes in culture, institutional structure and technology (means to satisfy the needs). The level (L) dimension describes the level of change that is required. Finally, the third dimension refers to actors (A), or those stake-holders who are involved in the transformation process

IX. WHAT ARE THE CHALLENGES AND OPPORTUNITIES FOR IMPLEMENTING SUSTAINABLE DEVELOPMENT

The lists of common challenges can be summarised as being internal and also external. They can be summarised as follows:

(a) Internal factors

- Lack of strategic leadership in HEIs and government

    Most universities are bottom-up institutions where individual faculty members make decisions on how best to achieve research and education goals. As such, it is difficult for an administrator to propose changes and achieve consensus among groups of faculty at any level. Such freedom can be beneficial, however, in empowering early-adopter sustainability champions as well as by providing insurance against too much of an instrumentalist and prescriptive view "which would serve only to inhibit the possibilities for sustainable development" (Scott and Gough, 2003).

- Incentive structure (salaries, promotions, and granting of tenure).

    That does not recognize faculty contributions to sustainable development. Since most universities present resistance to even the most minor perturbations, such as changes in class size or in expectations of research support, an overly rigid incentive structure can be a barrier to amply rewarding faculty and staff participating in the university's sustainability transformation.

- Lack of desire to change.

    Building quality educational and research facilities requires a great amount of time and investment, and once established, these activities may stay the same for years as long as the university is attracting good students, and faculty members are conducting successful research. In such institutions, it may be especially difficult to gain support for a major transformation.

- Visionary leadership

    Leadership in institutions is also critical in an institution if institutions are to be effective. Leaders must have appropriate assignments and responsibilities. This often requires university arrangements that promote cooperation and collaborative efforts rather than **competition** between units. Leadership may also be a driver when the leader sees transformation as a way to leave his or her legacy on the organization.

- Sustainability champions

  It is often seen that the sustainability champions are "lone wolves" or "innovators" (Lozano, 2006) at their universities even though these can be important agents for change. By neglecting to provide institutional support to them to fuel continued work, universities run the risk of losing their most valuable supporters.

- .Lack of existing connections among Universities and Colleges
  Connections refer to existing networks of people such as interdisciplinary research groups that reach across the university to include a critical mass of campus actors. The connector may help tender the shared language that is needed for interdisciplinary work, or give incentives for engaging in interactions between departments or to the greater society.

- Low demand from most internal and external stakeholders, including students and employers.

- Academic and professional silos which inhibit cooperative efforts across disciplines and institutions.

(b) External Factors

- Pressure from peer institutions or top-tier universities can serve as examples to promote change.

- Sources of funding and employment availability. University activities are often driven by its sources of funding – both its external research funders and its fee-paying students.

- Pressure from society.

  Unless society demands major changes in the desired characteristics of graduates and research, a university may find little reason to make transformations and may continue with the status quo.

X. METHOD OF DATA COLLECTED

The data for this study was collected through the review of the secondary sources of data from the case studies that have done in some universities. These were used to come up with conclusive information on this study The analysis was carried out using a simple method (FLA-analysis).

XI. FINDINGS

The results show that no common path for the universities is found. Overall none of the three dimensions of change is predominant over others.

In general, the main barrier to be overcome is the lack of an incentive structure for promoting changes at the individual level, unless they have rooted interdisciplinary from the design of the structure itself. On the other hand, as drivers, the presence of "connectors" with society, the existence of coordination bodies and projects, and the availability of funding seem to be keys for any progress. Trans- and interdisciplinary is being declared as a strategic objective in almost all universities, while transformative learning is less present. Regarding the relationships within important actors for universities (internally and externally), a common characteristic for most of the institutions is establishing and supporting networks of expertise within the universities. At a lower level, establishing connections with society is also present as an increasing trend. Almost all universities show important strategic efforts and initiatives that drive and nucleate change for SD, which are the result of a combination of drivers more than based on personal leadership.

Other findings shows that:
- Universities have made progress on sustainable development, particularly environmental aspects, in spite of the lack of a national legislative framework, HEIs focused mainly on environmental aspects.

- Limited activity in social or economic aspects of sustainable development. Adherence to sustainable development objectives and principles is both an opportunity and challenge. It is an opportunity to transform institutional practices and activities, but a challenge in making comprehensive changes.

- Initiating and maintaining sustainability in the classroom, on the campus and in the community remains a major challenge on a global scale. In order to protect and preserve natural resources, sustain a vibrant economy and cultivate a high quality of life,

- Higher Education Institutions (HEIs) must respond rapidly and create momentum for the movement. HEIs can achieve all this and contribute to "green growth" of economies.

- Progress without external factors and policy should be addressed.

XII. ROLE OF UNIVERSITIES AND COLLEGES IN INVESTIMENT AND SUSTAINABILITY FOR RESEARCH (RE-POSITIONING)

Higher Education (HE) needs to:
- integrate the principles, values and practices of sustainable development into all aspects of education and learning
- encourage the changes of behaviour
- re-orient research activities and enhance outreach in colleges and universities ie Individual institutions

must take steps towards reduction of carbon emissions and adopt energy efficiency policies.

- come up with International Sustainable Campus network and Global Higher Education Sustainability Partnership (GHESP)
- provide transformative education rather than merely transmissive education to prepare students capable of addressing complex sustainability challenges.

Generally the different geographical regions require greater support from university administrators and management. In particular the willingness of leaders , policy makers and decision makers to envisage a sustainable future inside universities is often missing.

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Entrepreneurship Education and its role in Higher Education

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ABSTRACT

Zambia's biggest challenges are low economic growth, and unemployment. And in villages across the country, people have become reliant on remittances – money sent by relatives working in towns – and this has destroyed local economies and economic activities, and therefore the ability of communities to lift them out of poverty. There is no other more potent method of alleviating poverty levels than to pass on to the people entrepreneurship education – the ability of people and communities to produce high levels of self-sustainability. This is about saying to people, 'your life is in your hands, and you would better take a grip'. It's about best practices, as imperfect as they are, and get them to scale, so they can get an increasing numbers of individuals and communities into an entrepreneurial framework .What is surprising is that, plans being put in place to teach entrepreurship courses in colleges of education and other higher institutions of learning in order to prepare its students for life upon graduation is not yielding the desired goals, yet entrepreneurship "is one of the important ingredients to economic growth, job creation and increased societal resilience" (Ekmekcioglu, p.6). Although Universities and colleges have been driven hard to grow the production of entrepreneurial graduates there is still a gap between where entrepreneurship should be taking place and what's going on in colleges and universities.

Keyword: economic growth, entrepreneurship, Universities, colleges, graduates

This study explores the provision of entrepreneurship education at Higher Education Institutions (HEIs) in Zambia with special reference to the levels of course objectives, contents, teaching and assessment methods to ascertain whether they are appropriately developed to prepare students for entrepreneurship as a career option. In doing so, we attempt to look at the challenges colleges of higher education in Zambia faces from a different perspective .One among some of the question is to what extent are colleges fostering entrepreneurship- making students more creative, opportunity oriented, proactive and innovative, adhering to a wide definition of entrepreneurship relevant to all walks in life?

Keywords—entreprenuership;innovation;entrepreneurial. economic growth.

I. INTRODUCTION

1.1 CONTEXT

Like most countries of the world, Zambia by 2030, aspire to live in a strong and dynamic middle-income industrial nation that provides opportunities for improving the wellbeing of all, in 1994 the Government of the Republic of Zambia began to review the 1968 post-independence policy on Technical Education and Vocational Training. In 1996 the new policy was adopted. The policy incorporated and mainstreamed entrepreneurship, and as such became known as the Technical Education, Vocational and Entrepreneurship Training (TEVET) policy. The aim of the policy was to create a national system of providing TEVET that would satisfy the labour market, address socio-economic concerns and exploit resource based opportunities in the economy. The objective of the new policy was to promote entrepreneurship and economic participation in both the formal and informal sectors with the aim of increasing the efficiency of the national economy. Besides, it was meant to acquire a culture of entrepreneurship and promote self-reliance in the Zambian society. Like many African countries, Zambia has been working towards building a middle-income nation. This is stipulated in its first national policy document Vision 2030. One of the conditions for building a middle income nation mentioned in the document is having strong entrepreneurial capabilities, self-reliant, outward looking and enterprising, where nationals take advantage of potential and available opportunities (Government Republic of Zambia, 2006).

In the past higher learning institutions, have over the years greatly contributed towards the training of skilled labour which is potentially an essential asset for the nation's economy. Hofer and Potter (2010) argue that college graduates have enormous potential for innovation and economic development. Therefore, "mobilizing them for entrepreneurial careers, enhancing their entrepreneurial skills, and providing support for business start-up are important, and often new, tasks for higher education institutions that are only now being fully recognized" (Hofer and Potter, 2010:5). A common conception according to Gartner (1990) is that entrepreneurship is about entrepreneurial individuals creating innovative organizations that grow and create value, either for the purpose of profit or not . Stevenson and Jarillo (1990) define entrepreneurship as "a process by which individuals - either on their own or inside organizations - pursue opportunities without regard to the resources they currently

control" (p.23). But the problems of entrepreneurship in higher learning institutions in colleges of education are found in education colleges all over the world especially in developing countries. Different scholars assume that entrepreneurship does have a positive impact on an individuals and societies economy. It is believed that if entrepreneurs are successful, their innovations may improve the people's standard of life .The purpose of this study is to explores the provision of entrepreneurship education at Higher Education Institutions (HEIs) in Zambia with special reference to the levels of course objectives, contents, teaching and assessment methods to ascertain whether they are appropriately developed to prepare students for entrepreneurship as a career option.

II. LITRETURE REVIW

A. BACKGROUNG TO THE STUDY

*Entrepreneurship education is a new field in the academia but has achieved a growing recognition that it can contribute toward the creation of an enterprise culture among learners (Kuratko, 2003; Solomon, Duffy, and Tarabishy, 2002). According to scholars and researchers, there is a good possibility to increase entrepreneurship ability through education (Gorman, Hanlon, and King, 1997; Ronstadt, 1987). Therefore, considerable academic efforts have been focused upon entrepreneurship education in recent yearshelping the field to develop and to gain momentum. Presently, entrepreneurship is taught at more than 1500 colleges and universities around the world (Menzies, 2003; Charne and Libecap, 2000).Increased academic research efforts have been concerned with the nature, relevance,content and appropriateness of entrepreneurship education (Leitch and Harrisson, 1999).Leitch and Harrisson (1999) suggest that "the most difficult and costly research on entrepreneurship education will involve the examination of different programme contents and pedagogical methods used to accomplish educational objectives".It appears as if the appropriateness of entrepreneurship education is related to Programme content and pedagogical methods.Entrepreneurship is a concept for which more than a hundred definitions are currently in use.Two common aspects are that entrepreneurship applies both to individuals and organisations, and that it concerns the innovative, forward looking and value-creating utilisation of resources. It is form of self-employment that drives a person to work harder since one will not rely on personal skills, knowledge, and resources utilized. To address this issue in 1994 the department of Technical Education Vocational and Entrepreneurship Training (TEVET) has incorporated entrepreneurship Training in colleges, the essence of which is to promote entrepreneurship skills among the graduates. (OECD, 2012:172). This introduction of entrepreneurship as either course components in Business studies or as blended course in ICT and Entrepreuship is meant to, instil values that can help students think entrepreneurial so as contribute towards the individual and economic development of the country. Hofer and Potter (2010) argue that college graduates have enormous potential for innovation and economic development. Therefore, "mobilizing them for entrepreneurial careers, enhancing their entrepreneurial skills, and providing support for business start-up are important for higher education institutions." (Hofer and Potter, 2010:5) However, the college of education and other higher institutions of learning seem to be failing to achieve their objectives because, in the past few years unemployment has risen among college graduate.*Entrepreneurship has been seen as a tool for stimulating job creation in most parts of the world. It is against this background that the study analyses how colleges are preparing their students for life upon graduation. Are the institution instilling values that can help students think entrepreneurial? Graduate entrepreneurship can be expected to not only reduce unemployment levels among graduates, but also contribute towards the individual and economic development of the country.

B. RELEVANCE AND JUSTIFICATION

The findings of the research aim to address whether the college of education and other higher institutions of learning are instilling values that can help students think entrepreneurial. . In addition, to generate practical information that will inform curriculum developers so that they are able to understand how best they can reframe the curriculum to benefit a graduate after leaving college because it is believed entrepreneurship has been seen as a tool for stimulating job creation in most parts of the world.

The results of the study will contribute to the body of knowledge in understanding why college of education are failing to produce graduates with entrepreneurship skills to be a driving force behind economic growth. This study therefore, will add to the body of knowledge on the rationale of provision of entrepreneurship education in the college of education and other higher institution of learning

III. PROBLEM STATEMENT

Entrepreneurship is unique business venture that is innovative. In today's society being an entrepreneur can take you to the next level within an industry. It is about taking an initiative to present something new or make an improvement on something already in existence. Others see it as a different form of self-employment that drives you to work harder since you will rely on personal skills, knowledge, and resources utilized, As a global economic driver, entrepreneurship adds real value through the creation of new jobs and the production of innovative products and services. In short, entrepreneurship promotes the generation of wealth.

Wickham (2006: 223) refers to an entrepreneur as "the individual who lies at the heart of the entrepreneurial process, that is, the manager who drives the whole process forward". Another definition formulated by Chell and Ozkan (2010: 1, cited in Ekmekcioglu) refers to an entrepreneur as "someone who is willing to bear the risk of a business venture where there is a significant chance for making profit". Yet another definition refers to an entrepreneur as "a person who creates a new business in the face of risk and uncertainty for the purpose of achieving profit and growth by identifying significant opportunities and assembling the necessary resources to capitalize on them" (Zimmerer and Scarborough, 2005:3). Alberti, (2004) refers to the active and cognitive processes individuals employ as they acquire, retain and use entrepreneurial competencies.

Different scholars assume that entrepreneurship does have a positive impact on an individuals and societies economy. It is believed that if entrepreneurs are successful, their innovations may improve the people's standard of life .The concern of this presentation is to address the impact of entrepreneurship on college education and other higher education graduates after school.

D. SIGNIFICANCE OF THE STUDY

The study will be vital in many ways. It would reveal:

I. Help tertiary institutions understand the shortcomings of current entrepreneurship programmes and raise awareness about developing suitable entrepreneurship programmes to prepare students for entrepreneurship as a career option;.

II. Contribution to the body of knowledge in understanding why entrepreneurship courses should be allowed in college of education.

III. Challenges related to entrepreneurship for graduates in colleges.

IV. Serve as a documented source on entrepreneurship education for curriculum developers in Zambia, thus it might inform Zambian educators to integrate curriculum and teaching methods that foster entrepreneurial competencies, skills and attitudes.

V. Finally, the findings and insights of this study are relevant to all stakeholders involved in graduate entrepreneurship and job creation. It is hoped that some issues and concerns raised in relation to entrepreneurial activities in colleges of education can to some extent be used to improve and facilitate graduate entrepreneurship and job creation in the country.

E. ISSUES IN ENTREPRENEURSHIP EDUCATION CURRICULUM

It is evident that entrepreneurship education is a field of interest for universities and colleges. Therefore, curriculum for entrepreneurship education is being developed, refined and debated. The rationale for developing and refining the curriculum is based on empirical evidence that not only the curricula have concentrated on preparing the students towards the "take-a-job" option instead of the "make-a-job" option (Kourilsky and Walstad, 2000) but also that venture creation is a possible and a desirable optio (Brenner, Pringle and Greenhaus, 1991). There is also evidence that the inclination towards entrepreneurship as a career option is associated with several personal characteristics (values and attitudes, personal goals, creativity, risk -taking propensity, and locus of control) that might be expected to be influenced by a formal education programme (Gorman, Hanlon and King, 1997). The challenge for educators is to develop creative curricula that meet the rigours of academia whilst keeping a reality based focus and entrepreneurial climate in the learning experience environment (Solomon, Duffy and Tarabishy, 2002

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How Edible Indigenous Plants Become Extinct and Ways of Preserving Them

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Abstract— **Zambia and Africa as a whole possesses a huge diversity of edible indigenous fruits including Baobab Tree – Adansonia digitate, Governor's Plum – Flacourtia indica, Horned Cucumber – Cucumis metuliferus etc. These fruits are found growing under various weather conditions. Their production has declined; and there is limited and undocumented information owing to the minimal or lack of research that has been conducted. These fruits are found growing under various weather conditions. Their production has declined; Despite their nutritional and economic value, they offer, these fruits and their products are never commercialized. People gather these fruits from the bushes and trade informally within communities to generate income for their families. However, there is now a growing interest by the people about the value of these fruits. It is for this reason that this paper investigates on how edible native species become extinct and way on how we can preserve them .in order for this project to be a success, Universities and Colleges should innovatively spear head and come up with botanical gardens of these edible native species and educate the students on how important they are to individuals as well as to the national as a whole. Such can also be a way of preserving them.**

Keywords: *botanical gardens, edible indigenous species, weather conditions, Universities and Colleges*

INTRODUCTION

An indigenous plant is a plant that is living in an area for entirely natural reasons with no human intervention involved. This may be because the plant evolved in that environment or it may have been brought through by natural causes. Such kinds of plants are endangered and go extinct. Extinction is the end of an organism or a group of organisms. Guttman (1983:48) states that "extinction is the process by which a species dies out."It can be certain that a plant has gone extinct if there are no surviving individuals that can reproduce and create a new generation; hence a plant ceases to exist in the chosen area of study.

Edible indigenous plants are very important worldwide. They provide food and shelter to other organisms in the ecosystem. There are a number of factors that cause extinction of plants; above all, humans are the major cause.

According to Kent (2000:55), "extinction is a natural part of the evolution of life on earth, but in recent years, it has taken place at unprecedented rate mainly as a result of human activities. Little have we realized the great natural heritage we possess. Instead of preserving and restoring it, we have destroyed it with our own hands.

The purpose of this presentation is to highlight how Edible indigenous plants become extinct and ways on how we can preserve our natural heritage, the indigenous plants.

OBJECTIVES

The overall objective of this project is to understand the various causes of indigenous plant extinction and to find ways to overcome them; hence we can manage and maintain the plants. In order to obtain more information, the following are the objectives

To investigate human activities that have caused indigenous plant extinction. To determine how natural calamities have contributed to the extinction of indigenous plants. To determine how natural selection among organisms has contributed to the extinction of indigenous plants. To evaluate the importance of some indigenous plants and ways of protecting them to prevent them from extinction

HUMAN ACTIVITIES THAT HAVE CAUSED EXTINCTION

Humans are now responsible for causing changes in the environment that hurt plant species. We bring exotic plants into habitats. All of these activities take resources and habitats away from the indigenous plants. Human activities often changes or destroys the habitats that plants need to survive. over two thirds of the plants that once lived on Earth are now extinct.

> *Habitat loss.* Human activities destroy or change habitats so that it no longer supports the growth and reproduction of indigenous plant species. This is widely acknowledged as the most important direct threat to biodiversity worldwide.

- *Introduced species.* Humans have introduced exotic plants. Some species are endangered

because exotic or non-indigenous plants are introduced to their habitats.

- Most of the worst pests have been introduced from other countries by people. These animals and plants do not have any natural predators so they often spread very fast and take over habitat and food sources from indigenous plants. Rabbits, are an example of introduced species who mostly depend on plants. Many indigenous plants have become endangered or go extinct because they have been destroyed, had inadequate nutrients or lost their habitat due to introduced species.

- Human harvesting—hunting, gathering, of wild fruits and so on—removes individual plants more quickly than they can be replaced by natural reproduction. E.g the **masuku** tree (Uapaca kirkiana) common in southern province of Zambia.

- Clearing forests, turning grasslands into farming areas and putting human structures in the natural environment, all remove natural habitats. Most plants are adapted to a specific habitat and cannot grow anywhere else.

- *Pollution.* Wastes generated by human activities change habitat conditions or threaten the health of plants directly. Nutrient pollution, for example, is a global problem that harms the diversity of aquatic and some terrestrial communities. Pollution of the atmosphere by greenhouse gases generates climate change, a problem so complex and severe that it is often counted as a separate threat category.

- Acid rain forms when sulfur dioxide and/or nitrogen oxides from industry are released into the atmosphere. The chemicals get absorbed by water droplets in the clouds, and eventually fall to the earth as acid precipitation. Acid rain increases the acidity of the soil which affects plant life. It can also disturb rivers and lakes to a possibly lethal level.

- Humans are a source of wildfires; hence some plant species are not as abundant as they used to be.

- Other indigenous plants have been killed by pesticides from runoff waters from nearby fields due to agricultural activities.

  The rate at which us humans are depleting indigenous plants is higher than the rate at which we are conserving therm. each year the fruits are picked from the forests and sold in the markets.

(fig 1.0. wild fruits being sold in Livingstone town. Photo by A. manianga, David Livingstone College of Education)

Natural calamities

- Natural fires help keep shrubs low and clears the areas of plants that can take over the area and create too much shade for some low plants to grow.

- Natural calamities such as earthquakes have destroyed native species. Miller (1991:1065) explains that "a native species that was once quite common can be hunted until few remain, with so few individuals remaining, again a harsh winter, a disease epidemic, may be observed."

- Cosmic radiation hit the earth with extreme force. The reverberations can be felt around the world. The impact site is completely destroyed. Cosmic Radiation is radiation being emitted from outer space and the Sun. It is hypothesized that being exposed to too much cosmic radiation can mutate genes, which can potentially weaken a species' gene pool in the future. Since the radiation comes from space and the Sun, it is extremely difficult to avoid the radiation. Supernova remnants is one source of cosmic radiation.

Natural selection

- Natural selection in terms of competition among plants of different species make the weak ones to go extinct, competition for resources among species lead to extinction, the weaker species are selected against.

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- In other cases, environmental changes within an ecosystem can also cause extinction. Invasive plant species have colonized most of the native habitats, hence plants compete for sunlight and nutrients.

- Pickering (2000) investigated on how organisms adapt themselves in order to survival. He concluded that individual species that are most successful in their struggle for existence, the best suited, and adapted to their environment are more likely to survive than those without these advantages."

Extinction is forever, once a species become extinct, it will never exist again.

Importance of some edible native species
Masuku tree (Uapaca kirkiana)

(fig 2.0 photo of masuku plant)

Masuku is a small evergreen tree. It is a very hardy plant and can tolerate even shallow or gravelly soils. It can be propagated by seed, cuttings or root suckers as ex-plants.
The fruits are eaten both by children and adults. These are used to make products like sweetmeats and jam. A sweet beer is also made from masuku fruits which is sold at some places

Flowers of masuku make very good honey. The wood is fairly durable; it is termite resistant. It is used to make furniture, for domestic uses such as spoons, and as timber.

Mubula tree (Parinari curatellifolia)

Importance

Ripe fruit is edible and it can be cooked as porridge or fermented into beer. The crushed pulp of the fruit is an ingredient in making juice. They can also be used as dried food. The oil-enriched nuts are eaten alone or mixed with vegetables and are considered as almonds substitutes. The edible oil is used for cooking.

Preservation of edible indigenous plants

The rate at which indigenous fruits are taken out of their natural environment is higher than the rate at which they are retained.

One key measure is the establishment of protected areas where human activities that lead to the extinction of these native plants is restricted in order to conserve the existing native plants. Well-planned and well-managed reserves, such as forests can help to safeguard and restricting deliberate introduction of invasive species.

Never turn botanical gardens into dumping sites of weeds that may endanger indigenous plants.

As mentioned earlier, universities and colleges being the correct grounds where knowledge is imparted, should come up with strategies of preserving these wild fruits, such as having botanical gardens. They can become seed banks to promote industrialization as one way of commercializing native plants. Native fruits from botanical gardens can also be sold to both small scale and large scale traders who may later process them into other different forms such as drinks, jam, medicine etc. Older plants that can no longer bear fruits can be sold for timber.

Planting indigenous edible plants helps in times of droughts, unlike exotic plants, that are short lived, native plants are long lived and adapt to harsh environmental conditions.

Fig 3.0: 62 seeds from seven varieties of indigenous plants were planted on 16th November 2017. photo; A. Manianga, David Livingstone college of education

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Fig 4.0: After about four weeks ,43 seeds from five species germinated and grew into young plants. This project is being carried out at David Livingstone college of education. Photo: A. manianga ,David Livingstone college of Education

CONCLUSION

As colleges and universities, we need to play a major role in increasing the biodiversity in campuses by turning certain areas into native wildlife refuge such as native orchards. Such increases innovative minds in our students and in the nation as a whole.

Having imparted the knowledge in our learners, such ideas can be extended to homes were people will plant edible native plants at their backyards, not only for shed but also for refreshments as they enjoy the wild fruits. The advantage is

that, indigenous plants allows homeowners to use less water and fertilizer, because these plants may be already in the ideal conditions to grow well. Using indigenous plants around the house is definitely the most effortless choice! Ecological communities that nurture native plants retain the unique characteristics that meet the needs of its various plants an. Indigenous plants existed for thousands of years prior to the disturbances caused by humans hence can be retained with our own hands.

Additionally, some of these unique plants may have uses that are already well known or are yet to be discovered. Some native plants may provide useful and delicious food sources for humans or animals. Flowers, seeds, bark, roots, sap, and other plant products can provide medicinal benefits or cures for various diseases and disorders. Such possibilities will be lost forever if invasive plants are allowed to replace our native plants.

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An Assessement of The Factors Affecting The Use of Intellectual Property Protection Among Small and Medium Entrepreneurs In Zambia; A Case Study of Chililabombwe District

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ABSTRACT

Despite good innovation for improved products produced among Small and medium Enterprises (SMEs), there is little use of intellectual property protection (IPP) to restrict other firm from producing similar products in Zambia. A study was done in Chililabombwe district in the Copperbelt province of Zambia to assess the factors that influence the use of intellectual property rights among SMEs. A sample of was 50 SMEs was randomly selected and a fully structured questionnaire was used to collect data. Using the linear regression model, capital invested in the business, quality and quantity of the product, methods of processing/production and size of the enterprise/firm were found to have a positive influence on the use of IPP while cost of registration was found to have a negative influence on the use of IPP and these factors were significant in the model. These factors were identified as the main factors that influence the use of intellectual property rights among SMEs in Chililabombwe. The findings suggest that most SMEs do not use IPP because most business are individually owned with less capital invested in the production and processing of their products, making registration cost for IPP become expensive.

EU	European Union
FAO	Food and Agriculture Organisation
IP	Intellectual Property
IPP	Intellectual Property Protection
IPRs	Intellectual Property Rights
PACRA	Patents and Companies Registration Agency
R & D	Research and Development
SMEs	Small and Medium-sized Enterprises

1.0 INTRODUCTION

Intellectual Property (IP) is used everywhere in the economy. It supports innovation and creativity in the market place. A well-functioning intellectual property system encourages innovation in the market (Kitching and Blackburn, 1999). From the view point of developing countries, intellectual property protection may not bring many benefits if they cannot create and utilize their own intellectual property. At an earlier stage in economic growth, catch-up economies tend to pursue an imitation-oriented technology strategy and are passive in protecting intellectual property. However, in the later stages of economic development, as their technological capabilities grow, they start to develop a well-functioning intellectual property system (Hanel, 2006). In the long term, a well-functioning intellectual property system provides a favourable environment for innovation and economic growth. The creation of new processes and technology - in a word, innovation - is a powerful factor that determines the progress of economies. The creation of new processes and technology can be accelerated by Intellectual Property Rights (IPRs) (Hanel, 2006).

In most developing countries, Small and Medium-sized Enterprises (SMEs) represent over 60 percent of enterprises. Small and Medium-sized Enterprises (SMEs) are often the driving force behind a large number of innovations and contribute to the growth of the national economy through employment creation, productive investments and value added exports (Sedifu, 2014). However, many Small and Medium-sized Enterprises (SMEs) do not get the most out of their use of the intellectual property, even though they represent over 60 percent of enterprises in most developing countries such as Zambia (Sedifu, 2014).

The fact that SMEs have a huge innovation potential in Zambia and furthermore are increasingly affected by global competition, there is need to emphasise the importance of IP management for them too. However, SMEs in Zambia engage little in the active management of Intellectual Property (IP) and little research has been done to assess the

factors affecting the use of IP protection among SMEs. Therefore, this research study will assess the factors affecting the use of IP protection among SMEs in Zambia, a case study of SMEs in Chililabombwe district located in the copperbelt province.

2.0 LITERATURE REVIEW

2.1. Small and Medium Entrepreneurs in Zambia

An enterprise is considered to be any organized effort intended to return a profit or economic outcome through the provision of services or products to an outside group (Nuwagaba, 2015).The operation of an enterprise traditionally requires the investment of capital and time in creating, expanding or improving the operations of a business. Small to medium enterprises are considered those enterprises which have fewer than 250 employees. In distinguishing between small and medium sized enterprises, the small enterprise is defined as an enterprise which has fewer than 50 employees (Nuwagaba, 2015). These businesses are associated with owner proprietors and an SME owner is an individual who establishes and manages a business for the principle purpose of furthering personal goals. The business is their primary source of income and will consume a majority of the owner's time and resources. The owners perceive the business as an extension of their identity and are intricately bound with family needs and desires (Nuwagaba, 2015).

Small and Medium Enterprises (SMEs) have economic significance in Zambia and requires attention from policy makers. SMEs constitute a significant portion of the private sector, in that they participate in overall investment, production of goods and services, taking risks, perceiving and utilizing new economic opportunities and developing business in the economy (Nuwagaba, 2015).

2.2. Intellectual Property

Intellectual property (IP) refers to the creations of the mind, inventions, literary and artistic works. Owners are granted certain exclusive rights to a variety of intangible assets, such as musical, literary, and artistic works; discoveries and inventions; and words, phrases, symbols, and designs (Friesike, et.al. 2010). The common types of intellectual property include inventions and patents, industrial design rights, trademarks, trade secrets, copyrights which includes literary and artistic works such as novels, paintings, music and songs, and architectural designs (Blackburn, 2003).

2.3. Intellectual Property Protection

An IP Protection is a set of measures formulated and implemented by a government with inputs from the private sector and universities and research institutions to encourage and facilitate effective creation, development and management of intellectual property (Moulin and Lie, 2005). It outlines how to develop infrastructures and capacities to support inventors of IP to protect, develop and exploit their inventions. An IP strategy may also be defined as a comprehensive national document which outlines how all the policy developments and implementation take place in a coordinated manner within a national framework (Friesike, et.al. 2010). The goal of an IP strategy is the creation, ownership and management of IP assets to meet national needs and to increase economic growth, to promote and strengthen scientific and technological research, development and commercialization (Blackburn, 2003).A basic IP strategy would include at least the following: Policy on IP Acquisition, on IP Exploitation, IP Monitoring, IP Enforcement (Yoon, 2015)

2.4. Intellectual property and Small and Medium Entrepreneurs

One of the pillars of the world economy, especially of transition economies, is small and medium enterprises (Kitching and Blackburn, 1999). They provide majority of jobs and create new ones, have the biggest share in added value, turnover, profit, and in the most developed economies, in exports (Sedifu, 2014). Today, in the conditions of dynamic development competition, small and medium enterprises are looking for a chance to survive, to grow and to develop on available specific knowledge and skills, flexibility, invention, and in the quickness to respond to market signals and changes in business environment (Friesike, et.al, 2010). Considering different stages in development of a product or service and the number of actors in business environment, intellectual property and its protection are more and more significant in daily business operation of SMEs (Dublin, 2001).

Development of competitiveness at domestic and foreign markets has become an imperative for SMEs. Development of innovation in SMEs is practically inseparable from intellectual property. Intellectual property and protection of its rights presents capitalisation of innovation through creation of a new product, service, process or mark, but this does not have value and meaning if it is not commercialised on the market (Dublin, 2001).

According to Moulin and Lie (2005), lack of using intellectual property rights acts as barriers for the growth of smaller firms, considering that relatively larger companies easily imitate their products and large companies introduce Intellectual Property Rights effectively in these products.

Therefore, this research assess factors affecting the use of IP protection among SMEs in Zambia, a case study of Chililabombwe district in the copperbelt province.

3.0 RESEARCH METHODOLOGY

Research area

This research was conducted in Chililabombwe district in the Copperbelt province in Zambia. The area was chosen because of the high number of Small and Medium Enterprises. Therefore this area was suitable for this research to assess the factors affecting the use of Intellectual Property Protection among SMEs in Chililabombwe.

3.1 Data collection

Both primary and secondary was collected and used in this research. Primary data was collected through key informant interview with Small and Medium Entrepreneurs who included small agriculture processing dealers, architectures, carpenters and artists in different markets in Chililabombwe district. Key informant interviews also known as semi-structured interview using a structured questionnaire was the main source of information for this study. Some secondary data was collected from key stake holders such as PACRA as well as published literature on Intellectual property and protection.

3.2 Sampling and Sample Size

In this research, the research sample size was 50 SMEs and random sampling technique was used to come up with the sample size. The study population was 250 SMEs involved in agriculture processing, architectures, carpenters and artists which was gotten from the District Marketers association, district cooperative office and community development office. The 250 SMEs on the consolidated listed where then put in their respective categories according to what they were involved in, for example the artists were put in a group, and the same was done to those in architecture, carpentry and agriculture processors. Then random sampling was conduct per each category. In this random sampling, 150 numbers were written on the pieces of papers according to the total number of agriculture processing dealers, 55 for artists, 15 for architectures, and 30 for carpenters. The small pieces of paper were then put in different plastic bags labelled agriculture processing dealers, artists, architectures, and carpenters respectively. From agriculture processing plastic 30 respondents were picked out of 150 representing 60% of the 50 respondents, from artists 11 respondents were also pick out of 55 representing 22% of the 50 respondents, while from architecture and carpentry 3 and 6 respondents were pick out of 15 and 30 representing 6% and 12% of the 50 respondents respectively.

3.3 Data Analysis

Data analysis was done using the Statistical package for social scientists (SPSS). Descriptive statistics was used to analyse demographic characteristics of the respondents. To assess the factors affecting the use of Intellectual Property Protection among Small and Medium Entrepreneurs, Linear regression was used to find out whether dependent variables such as size of the firm, quantity produced or processed, quality produced or processed, processing or production cost, method of production or processing, and operating capital determine the use of intellectual property protection among SMEs.

The regression function used was;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7$$

Where Y = Quantity of Products with Intellectual Property Right,

β_0 is the intercept term, and β_1, β_2, β_3, ………., β_7 are the coefficients associated with each socio economic variable X_1, X_2, X_3,………, X_7. The variables in the linear regression and their a priori expected signs are shown in Table below.

Table 3.1 Description of Variables in Linear Regression

	Variable	Type	Expected sign
X1	Capital Invested	Continuous	+
X2	Time Taken to process/produce the Product	Continuous	+
X3	Promotion/Advertisement of the product	Dummy	+/-
X4	Quality of the product processed/produced	Continuous	+
X5	Quantity of the product processed/produced	Continuous	+/-
X6	Methods of processing/producing the product	Dummy	+
X7	Size of the Enterprise/Firm	Dummy	+

4.0 RESULTS

4.1. Socio-Economic Characteristics of Surveyed respondents

The socioeconomic profile in table 4.1 shows that 66 % of the respondents were male and 34% were female. According to age group, 54% of the respondents were aged between 36 to 55years while those between 18 to 35years and above 55years were 18% and 5% respectively, with the youngest respondent aged 18years and the oldest 64years old. The average age for the respondent was 41years old.

Table 4.1: Selected Socio-economic characteristics of Surveyed respondents

Variable	Category	Total sample (50)	
		No	**%**
Gender	Male	33	66
	Female	17	34
Age	18 – 35 years	18	36
	36 – 55 years	27	54
	>55	5	10
Marital Status	Single	4	8
	Married	37	74
	Others	9	18
Education	None	1	2
	Primary	31	62
	Secondary	15	30
	Tertiary	3	6
Ownership of SMEs	Sole Business Owners	30	60
	Family Business	16	32
	Partnership	4	8
	Cooperatives and clubs	11	22
Capital Invested in the business	Less than K10, 000	15	30
	K10, 000 to K30, 000	25	50
	K30, 0000 and above	10	20

Source: Field Survey 2017

Product Processed	Frequency	Percen
Peanut Butter (Groundnuts)	15	30
Cooking oil (Sunflower)	18	36
Mealie-Meal (Maize)	13	26
Music Production	11	22
Furniture	6	12
Building Plans	3	6

Source: Field Survey, 2017

4.3. Regression Results on Factors influencing the use of Intellectual Property rights

The regression results in table 4.5 shows some factors affecting the use of intellectual property protection among small and medium entrepreneurs in Chililabombwe district. The linear regression model was used and R^2 was 0.672, meaning 67.2% of the variability of the output was explained by the independent variables included in the regression model while the F-values was 6.610 and the model was significant at 1%.

Table 4.5: Regression results

Variable	Coefficients	T
Constant	(5.944)	2

Table 4.1 also shows that regarding education, 62% of the respondent's attained primary education, 30% and 6% had reached secondary and tertiary level respectively while 2% of the respondents did not go to school. The majority of the respondents (74%) were married while 8% were single and 18% were divorced, separated or widowed. According to Ownership of SMEs, 38 % were owned by Sole Owners while 32%, 8% and 22% were owned by family, partnership and cooperatives respectively.

4.2. Types of Processed Product by SMEs

The results in table 4.2 shows the different types of products produced or processed by the respondents. The table shows that 30% were involved in processing Peanut Butter (Groundnuts), 36% Cooking oil (Sunflower), and 26% Mealie-Meal (Maize). Furthermore, 22% were involved in music production, 12% furniture, and 6% building plans.

Table 4.2: Products produced and processed by SMEs

	Coefficient	t-value	Significance
Capital Invested	0.183	2.967	0.041**
Processing period/time	-0.007	0.723	0.475
Promotion/Advertisement	0.034	0.400	0.692
Quality and quantity of the product	0.573	3.593	0.015**
Cost of registration for property rights	-0.645	3.288	0.035**
Methods of processing/production	0.352	4.243	0.024**
Size of the Enterprise/Firm	0.757	4.320	0.000
R-Square (R^2)	0.672		
Adjusted R-Square	0.571		
F-value	6.610		
Significance	0.000		

Source: Field Survey 2016. Note: *=significant difference at 10%; **=significant different at 5%; ***=significant different at 1%

The results in table 4.5, the regression results shows that Capital Invested, Quality and Quantity of the product, Methods of processing/production and Size of the Enterprise/Firm are statistically significant and there coefficients are positive. This implies that the variables have a positive influence on the use of intellectual property protection. The results also show that cost of registration has a negative influence and is statistically significant in the model. Processing period/time and Promotion/Advertisement are non-significant in the model which indicate these factors do not influence SMEs on the use intellectual property right.

4.4. DISCUSIONS

5.1. Factors influencing the use of Intellectual property rights among SMEs

Table 4.6 shows that Capital Invested in business is statistically significant in the regression model and has a positive influence on the use of intellectual property rights amongst SMEs. This indicates that if there is an increase in capital invested in the SMEs production or processing of products, the use of intellectual property rights will also increase among SMEs. This is because when SMEs owners have invested a lot of money in their business, they would prefer to protect the product produced or processed so that they get more profit from the sales and restrict other firms from copying their products. This indicates that SMEs with lower investment in the business are not likely to use intellectual property rights because they know that several other firms or SMEs may start the same business because of easy capital to invest in that particular business. These results are similar to MacMillan (2015), who found that most SMEs in Australia do not use intellectual property rights because they produce homogenous products which do not need them to invest a lot of capital in their business. The results in the regression model also reveal that the quality and quantity of the products processed or produce is statically significant and have a positive influence on SMEs to use intellectual property rights for their products. This means that as the quality and quantity of the products increases, SMEs are expected to use intellectual property rights for their products. This could be like this because in order for the quality and quantity of the products to increase, SMEs could have used a lot of resources for these products and to obtain more profit from these products, use of intellectual property rights is considered to be one of the method to act as a barrier for other firms to produce similar goods. These results are similar to Parboteeah (2010), who found that firms producing high quality good and in large quantity mostly use intellectual property rights.

The results also indicate that cost of registration for the use of intellectual property protection has a negative effect on SMEs to use intellectual property protection. This means that as the cost of registration increases, there is a reduction in the number of SMEs and products using intellectual property protection. This is similar to the finding of (Sedifu, 2014) who reported that most SMEs in Southern Africa do not use intellectual property rights because of high cost of registration for intellectual rights.

The regression results also show that the method of processing or production of the products has a positive influence on the use of intellectual property protection among SMEs. This means that as SMEs use more advanced processing or production method for their products, there will also be an increase on the use of intellectual property rights. This could be like this because more advanced processing and production methods require more investment capital and results to high quality and quantity products to be produced. These results collate with the finding of Jeremy and Armstrong, (2012) in South Africa who reported that firm that use advanced methods of processing usually acquire property rights for their products to act as barrier to entry for other firms.

5.0   CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The objective of this study was to assess factors affecting the use of Intellectual Property protection among Small and Medium Entrepreneurs (SMEs) in Chililabombwe district in Zambia. The results show that the capital invested in the business has an influence on the use of intellectual property right. This factor is affecting SMEs in Chililabombwe as most of the SMEs have invested less than K30, 000 in their business as shown in table 4.1. This means that due to little capital invested in their business most SMEs in Chililabombwe are not able to purchase advanced

equipment for production or processing quality product and this affect most SMEs to use IPP.

The regression results also show that cost of registration has an influence on the use of intellectual property rights among SMEs. This correspond with the responses from SMEs in Chililabombwe who strongly agreed that the procedure for registration contribute to use IPP when it is expensive and long as shown in table 4.6 results. This shows that most SMEs in Chililabombwe do not use IPP due to perceived high cost of registration.

The size of the firm is another factor which affects the use of IPP. In Chililabombwe 60% of SMEs business are solely owned which means they are owned by individuals as shown in table 4.1 results and 30% are in business because of easy entry to start business as shown in table 4.4 results. This indicates that most of these SMEs in Chililabombwe are affected to use IPP because they are small firms and due to easy entry each SMEs can produce similar good without IPP.

6.2. Recommendations

Based on the findings in this study, the following are some of the recommendation which can help SMEs in Chililabombwe to use IPP for their products:

i).   SMEs can pool their resources together to obtained IPP for specific products which they are involved in to reduce on cost of registration. For example, SMEs who are engaged in peanut butter processing can come together as a group and obtain IPP for the products they are producing. This will restrict other SMEs from other places to produce similar products.

ii).   SMEs can pool their resources together and operate as a joint company to increase on the size of the firm which can make it easier for them to obtain IPP. For example SMEs involved in music production can pool resources together and establish a bigger music production studio and obtain IPP.

iii). Pooling of resources together amongst SMEs will also help to boost their capital invested in the business and allow purchase advanced equipment to produce high quality products that requires IPP.

Acknowledgement

iv).   REFERENCES

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Lived Dilemmas of Titling a PhD Thesis by a Novice Researcher in Sub-Saharan Africa: Implications for Higher Education

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Abstract - **If Higher Education is a catalyst to Sustainable development, then research at doctoral level should be viewed as the frontier of that development. At the same time, thesis titles at doctoral level represent a synthesis of what a particular research is about. However, reviewed literature is silent on the area of title-thesis making process. This study underscores the value located in titles making process of research thesis using a Hermeneutics Phenomenology approach as the highest order as reflected in the revised Bloom's Taxonomy. Whereas changing from one thesis title to another could be a demanding task, it is during those moments that researchers begin to penetrate their personal worldview of knowledge creation and become innovators. Short of this, novice researchers may operate at lower order of the revised Bloom's Taxonomy. Consequently, novice researchers are bound to remain 'copy-paste' type of researchers and not innovators and transformers. This then entails that novice researchers and their supervisors should be prepared to move from mere surface to deeper layers of learning.**

Keywords - Thesis Title; Novice Researcher; Sub-Saharan Africa; Hermeneutics; Phenomenology; Dilemma

I. Introduction

This paper is part of the principal researcher's doctoral thesis. In this article, we reflect on the lived experience of a novice researcher in his quest for knowledge during his doctoral journey. In this paper, a 'novice' researcher refers to any researcher engaged in a research at doctoral level for the first time [1] while the term 'dilemma' represents a situation requiring a choice between equally undesirable alternatives as well as any difficult or puzzling situation or problem encountered during the research process [2].

Whereas many studies have been conducted on the lived experiences of novice researchers during doctoral studies such as [3] and [4], very few exist if any, that focus on the thesis title generation process later on in Sub-Saharan Africa. In this discourse, we provide a context within which the study was conceived, supported by theoretical underpinnings, literature review and methodology applied. Later we provide the research findings and discussion that emerged and implications of the study generated.

A. Motivation behind the initiation of the research topic

In developing this research paper, a number of influences were responsible in the conceptualization of the study. These included:

i). Academic Experience in Education

The principal researcher was an educationists with a major in educational studies at undergraduate and postgraduate levels where high premier was on evaluation of learning outcomes using Bloom's Taxonomy. In particular, Bloom's Taxonomy's higher order cognitive domain includes a synthesis category rebranded as 'Create' category by Anderson and Krathwohl 2001 [5]. For details on Bloom's Taxonomy see figure 1 below.

ii). Professional Experience in Education sector

In terms of professional orientation, the six authors of this paper were all clustered within the higher education sub-sector. In this sub-sector students at undergraduate and postgraduate were actively engaged in dissertation and thesis research writing process. Thus, research title setting was a daily activity for students and lecturers alike.

iii). Doctorate of Philosophy Experience

The Principal researcher happen to be doing his doctoral studies whose thesis development was stagnated at proposal stage for two years. During the two year prolonged proposal development period, the title had changed painfully more than 10 times. Hence, the principal researcher was inspired to develop a journal article meant to share lived experiences with other novice researchers the dilemmas involved in titling a thesis.

B. Context

The study is located in the southern part of the Sub-Saharan Africa represented by two public universities namely Sim University (Pseudonym) and Sam University (Pseudonym) from two countries who collaboratively worked on a joint project to offer postgraduate programmes. The

period within which the study was conducted was from 2014 to 2017. The names of universities and countries were not disclosed for anonymity purposes, given the sensitivity of the research topic. Thus, Sim University (Pseudonym) was used to represent the university where the study was carried out. Within the South-South postgraduate partnership was a Doctorate of Philosophy (DPhil) or otherwise referred to PhD programme where the principal researcher under-took his doctoral studies whose mode of delivery was through the distance learning mode.

The South-to-South collaboration represent a rare opportunity where countries of the south successfully collaborated to offer join programmes on an equal footing. While Sam university provided curriculum and study modules, Sim university provided a comprehensive learner support services. The proceeds realised were shared on an agreed ratio based on individual university input in the collaboration. Consequently, students who graduated from the collaboration were 100% owned by the two universities as exemplified by two logos from the two universities on their graduation gowns and degree certificates.

The researcher happen to be part of an inaugural cohort of PhD students. Whereas the student was learning how to engage with his studies, the two universities were equally learning how to work as partners. Thus the learning process was both at individual and institutional levels. For instance, whereas both universities had postgraduate regulations in place to guide the development of research proposal development process, the two had not fully harmonized their regulations. Here, students were at lose to know which regulation to follow while developing their research proposals. Equally, it took time for the research supervisors to be appointed by the two universities, as they had to deal with bureaucratic public systems within. Thus, time was lost as students kept on oscillating from one institutional regulation to the other. For this particular researcher, the first two years were spent developing the research proposal while the third year was devoted to data generation and thesis write-up. During the 2014 – 2017 period, the researcher kept on changing one research topic to another for eleven times.

C. Statement of the Problem

While we acknowledge that to arrive at a meaningful thesis title is a demanding task, it is not clear what lived experiences exist among novice PhD researchers regarding the thesis title-making process. In addition, it is not clear why the process of arriving at a meaningful thesis title takes long. Further, there are no documented lessons from those who have done their PhD studies that other novice researchers could adopt to mitigate the title-making dilemma.

D. Research Objectives

This study was guided by the following research objectives:

i). Explore dilemmas that exist in title-making process, and

ii). Document lessons learnt while engaged in title-making process.

E. Significance of the Study

The significance of this study lies in its emphasis on establishing the lived experiences of novice researchers on title-making process. In this regards, the study may illuminate the discourse on the role of metacognition on thesis title-making process. In addition, the study findings may contribute to the discourse on the revised Bloom's Taxonomy higher order reasoning dabbled 'Creation,' previously referred to as Synthesis level. Consequently, the study could aid novice researchers and research supervisors navigate their way to arrive at meaningful research thesis titles.

II. Theoretical Underpinnings of the Study

The underpinning theoretical framework that largely guided this study was the revised Bloom's Taxonomy as espoused by Anderson and Krathwohl [4].

F. Revised Bloom's Taxonomy

In this study, the underlying theoretical framework that guided it is the revised Bloom's Taxonomy as advanced by Anderson and Krathwohl [6]. The revised model represents a shift in thinking from the 1956 Benjamin Bloom's Taxonomy to that of Anderson and Krathwohl's (2001). According to Bloom's Taxonomy within the cognitive domain in its original sense, at lower level consist of Knowledge and Comprehension while the higher order starts with Application, Analysis, Synthesis and Evaluation stages as illustrated in figure 1 below.

Figure 1: Revised Bloom's Taxonomy; Source: Anderson & Krathwohl (2001)

Anderson and Krathwohl revised bloom Taxonomy. In their study, Anderson and Krathwohl (2001) revised Bloom's (1956) classical study on cognitive, affective and psychomotor domains. Within the cognitive domain, they renamed Blooms Knowledge strata with Remember, Comprehension with Understand, Application with Apply and Analysis with Analyse. In addition, they transformed Bloom's Synthesis into Create at the very top of the cognitive pyramid as illustrated in figure 1 above.

Pohl (2011) elucidated Bloom's Revised Taxonomy as follows [7]. Remembering as the first level of the thinking process. It takes place when students describe, make lists, tell, and name aspects of the topic. Understanding level indicates that the student understands what they have read. It happens when they retell, infer, interpret, explain and outline

knowledge. Applying is the stage of making use of knowledge in a new situation. It occurs when the student demonstrate, implement, carry out, or describe a similar situation. Analysing represents processes of breaking information into small segments. It occurs when the student organise information and determine relationship between their previous knowledge and newly acquired knowledge. Evaluating is to advance reason to support decision. It happens when the student judges, chooses, recommends, justify, critique about the text. Finally, Creating is the highest level. It occurs when the students design, construct, plan, and produce the new ideas Pohl (2011). Higher order thinking skills are reflected by the top three levels (Analyze Evaluate and Create); lower order thinking skills are reflected by the lower three levels (Remember, Understand, and Apply) [8]. In our current study, title-setting belongs to the higher order cognitive domain referred to as 'create'.

III. Literature Review

In this segment, we review related literature on thesis title development. Key within this section is a justification on why thesis titles matter, classification of thesis titles, challenges associated with thesis development and finally, strategies involved in title-making process. Generally, there are very few studies in this area dedicated to learning from the lived experiences of novice researchers on the subject of thesis title-making process. To this end, the literature reviewed are limited to a few isolated researchers gathered through the google search engine over a period of 3 years (2014 - 2017).

G. Why Thesis Titles Matter

According to Bavdekar (2016) a title is the gateway to the contents of an article. It is typically the first segment of a manuscript that the editors and reviewers read. After publication, it is the first part of an article that readers see. Based on their understanding of the title, readers decide if the article is relevant to them or not. In addition, readers who are glancing through a database get to see only the title. The first impressions generated by the title, help them decide if there is a need to take a detailed look at the article [9].

For Hairston and Keene observe that a good title helps the reader to predict content, captivate reader's interest, reflects the tone of the piece of writing and contains keywords that makes it easy to access by a computer search [10].

H. Classification of Thesis Titles

Admittedly, there are various ways of classifying thesis titles. For instance, Vasilev (2015) categories thesis titles in three broad domains namely (i) declarative, (ii) informative and (iii) interrogative. According to Vasilev, Declarative titles highlight the core finding or conclusion stated in the paper [11]. Descriptive titles define the article theme, but without divulging its findings or conclusions For example, "Investigation of grade one, Zambian Children and their ability to learn from paper based instructions. A case of Lusaka District of Zambia." Even though, this makes the title

rather long; it has certain advantages too as the readers get complete information about the article content.

Informative titles on the other hand contains several key words to inform the key findings emanating from the study. For instance, 'the dilemma of titling a PhD thesis' sends a signal to the reader in advance on the anticipated dilemmas in the article. Finally, Interrogative titles usually restate the research question in part or in full. For example: "Does lead paint exposure lead to intellectual impairment among pupils?" Here, the title points the reader to the key area of investigation where knowledge gap is situated.

In general, descriptive titles are preferred, as they inform the reader about what a study entails but not about the study result. This helps maintain the suspense about the outcome. On the other hand, a declarative title states the outcome and it is assumed that a casual reader may then not have much curiosity left for reading the entire paper.

I. Why Title-making Process is a Challenge

One reason to explain why novice researchers face challenges arriving at a meaningful thesis title process is the lack of higher order thinking skills. It has been observed that higher order thinking skills do not come easily for many students. For example, Healy (1999) argues that the influences of the digital age have led to a generation that is more distractible, has reduced math and verbal skills in spite of higher academic results and has diminished ability to make discriminations between shades of gray when answers are not clearly black and white [12]. The 21st century student may think that all the answers one really needs to know are found on the internet and there is no need to memorize a basic knowledge which forms a foundation for higher reasoning. Further, since cell phones mean that Mom or Dad can always be easily reached to help with decisions, 'helicopter' parents may have inadvertently trained millennial children to use electronic gadgets as a substitute for thinking for themselves Somers & Stettle 2010) [13].

In addition, title-making process demands for the application of higher order thinking skills which are challenging. In the revised Bloom's Taxonomy, Anderson and Krathwohl (2001), argue that to 'create' is to put elements together to form a coherent or functional whole. To create entails that users put parts together in a new way. It is to synthesize parts into something new and different creation. This process is the most challenging mental function in the revised taxonomy and represents the art of title-making process [14].

J. How to develop a Thesis Title

According to Bavdekar (2016), title is commonly one of the last segment to be written [15]. Although this could be true, the work on the title could begin when a paper is being

developed. For instance, it is a good practice to make a note of a few sentences, phrases or ideas that define the main theme of the paper; which could be later used in the title (Hamlin, 2015). one could go on refining these phrases, as new versions of the manuscript are written. By the time writing of the manuscript text is completed the author could have a working title consisting of at least two or three key terms that can give readers a sense of the content and angle of the research paper. Such a strategy has another advantage: it helps the author to maintain and regain focus. It is not uncommon for the author to wander away from the main research theme, while writing and revising manuscript versions [16].

Building a working title while the manuscript is being developed could be useful in preventing the author from going astray. Those who wish to begin only after the entire manuscript text is ready can also write a one-paragraph summary of the manuscript as a starting point for selecting a title. They can then formulate a couple of sentences (working title) with key words and key terms that provide description of what the paper contains. The next step is to compress the title by getting rid of redundant words and refining it by making it easier to read, concise and catchy. Further, according to the University of South California Libraries (2015), a title can be made attractive in several ways [17]. These include using a famous quote in the title, twisting or playing with a quote, making a provocative statement and creating a new acronym or anagram, among others. The title should not be finalized in a hurry. Further, it is worth asking for colleagues' and friends' opinion. Their suggestions could help improve the title [18].

IV. Methodology

This study was guided by Hermeneutic phenomenology which is concerned with human experience as it is lived [19]. The focus is to illuminate particulars and seemingly trivial aspects within experience that may be taken for granted in our lives, with a goal of constructing meaning and achieving a sense of understanding. In addition, Langdridge (2007) argues that our experiences can be best understood through stories we tell of that experience. To understand the life world we need to explore the stories people tell of their experiences, often with the help of some specific hermeneutic (interpretation) [20].

K. Research Design

A case study research design was applied to study the lived experiences of a novice researcher using Heideggerian Hermeneutics Phenomenology lenses [21]. Heidegger's thesis is on 'Being and Time', as advanced by Martin Heidegger and further expanded by van Manen's four reflective thematic areas on lived experiences as follows: (i) lived space – Spatiality; (ii) lived body – Corporeality; (iii) lived time – Temporality; and (iv) lived human relation – Relationality [22].

L. Sample Size and Selection Criteria

According to Neuman (2003), qualitative research works focus on non-probability or a non-random sample, which

entails that they seldom determine the sample size in advance [23]. To this effect, sample size consisted of one PhD candidate whose thesis had been submitted for examination. In order to choose research participants purposively, an inclusion/exclusion criteria was developed adapted from van Manen (2007). The case study chosen conformed to the set boundary advanced by Manen [24]:

i). Lived with a PhD title-making experience (Corporeality).

ii). Lived with a PhD title-making experience for three years (Temporality).

iii). Lived with PhD title-making experience in a target university (Spatiality)

iv). Lived with a PhD title-making experience in a company of supervisors and peer reviewers (Relationality)

M. Research tools

In this study, the researcher used two main research tools namely: document review guide and reflective journal. Use of multiple tools strengthened the validity and reliability of the study findings as evidence was collaborated and triangulated from different viewpoints.

N. Data generation procedure

Data generation procedure assumed a four steps approach as follows:

i). At step 1, developed PhD proposal files were saved on the personal laptop and as email attachments sent to the supervisors over a period of three years (2014 to 2017).

ii). At step 2, revisited and searched for saved PhD proposal versions on both the laptop and email attachments and then download and saved in a single folder on the laptop.

iii). At Step 3, constructed a reflective journal matrix with the following heading as presented in table 1 below.

TABLE I.   SAMPLE OF REFLECTIVE JOURNAL MATRIX

Date PhD thesis Title conceived	Why title	Identified Dilemma	Lessons generated

iv. Step 4, reflected on the data and documented emergent themes on the phenomenon.

O. Analysis and interpretation

The analysis of data in this study was concurrently done throughout the data gathering process using Inductive Data Analysis. Emergent reflection notes were reviewed from time to time to identify the emerging themes and patterns. The data were coded and analysed thematically and the identified themes were cross-checked by the co-researchers for validation purposes in line with Clarke and Braun [25].

P. Trustworthiness

The study applied Guba's (1981) four criteria as follows: (i) credibility, (ii) transferability, (iii) dependability, and (iv)

confirmability [26]. Data generation process was triangulated using observation, reflective journal matrix and document review guide. The researchers used reflexivity approach to decipher meaning from generated data. In addition, data generation procedure and boundaries were documented for the purposes of ensuring transferability of the study findings to different settings. Further, given that the findings were presented verbatim coupled with participant checks on the research, the study meets the dependability and confirmability criteria as well.

Q. Ethical Considerations

In carrying out this study, ethical issues as guided by Cohen et al. (2000), such as verbal and/or written consents from all participants were followed. Therefore, pseudonyms were assigned in place of actual names, to assure confidentiality and privacy [27]. The pseudonym given were as follows: 'Sim' University and 'Sam' University. The pseudonym were assigned to hide the identity of the respondents involved in the initial research study.

V.   *Findings and Discussion*

After a three-year period of documentation of PhD research proposal title evolution, 3 major themes that emerged were: (i) dilemmas and (ii) metacognitive strategies. What follows below is a detailed presentation of findings based on the two themes as guided by the research objectives.

R. Dilemmas

   i).   Positivism vs Interpretivism dilemma

The first research proposal had the title 'Examining the Learning Styles of Distance Education Learners using Instructional Material Designers' Lenses at the University of XXX' (03/11/14). The Principal researcher having been illuminated by literature review on Learning Styles [28]. The chosen study area was situated within the principal researcher's work practice i.e. distance education where he was motivated to establish the learning styles in use among distance learners in order to enhance the learning process [29]. The intention was innovate strategies of improving the quality of learner support available to distance learners informed by learners' learning styles [30]. In the title, while to 'examine' and 'learning styles' called for the application of quantitative approaches, the researcher on the other hand was driven by qualitative axiological values [31]. The researcher faced a dilemma of reconciling quantitative phenomenon using qualitative approach. Consequently, the proposal title had to be changed.

   ii).   Academic background vs professional practice

In the second revised research proposal, the title was 'Making Open Distance Education inclusive [32] in Southern Africa' (23/10/15). The principal Researcher was illuminated by conference proceedings exposure on making education inclusive attended at the University of Malawi. Whereas the researcher's educational background was inclusive education, his day-to-day operations bordered on distance education. This then resulted in a dilemma of researching on professional practice [33] while retaining postgraduate academic orientation of the researcher.

   iii).   Research pitched locally vs international prospect ambitions

The third title was 'Transforming an exclusive education into inclusive Open Distance education: Southern Africa's Experiences' (20/11/15). The study title was motivated by the principal researcher's education experience generated at University of Manchester on inclusive education at masters level and work experience in ODL with a desire for a regional opportunities once done with his PhD. Whereas the researcher wanted to solve an identified problem of 'exclusion [34] among some distance learners' within his professional practice, he still had hidden ambition to provide a research output at regional level to enhance international job prospects. In this regards, the principal researcher faced a dilemma of combing education orientation in 'inclusive education', while researching on professional practice 'distance education' and creating a job niche 'Southern Africa.'

   iv).   Metaphoric language vs Academic Language

The fourth title was 'Exclusion through the lenses of the marginalised in Distance Education in Zambia' (05/12/15). This researcher was motivated by a desire to make the title easily discoverable [35] once published online by introducing a metaphor within the title [36] and also wanted to scale-down the topic from southern Africa (regional) to Zambia (local). However, this led to a dilemma of combining a metaphoric language 'lenses' in an academic paper which a number of critical friends could not approve.

   v).   National   representation   vs   meagre   research operational resources

Another research proposal title developed was 'Inclusive education through the lenses of learners with disability [37] on distance education programmes at selected Public Universities in Zambia (02/02/16). At this stage, the researcher narrowed the topic to public universities since they were charged with a responsibility of educating the public using public resources. Whereas the topic was much more narrow compared to the former, the researcher still faced a dilemma of pitching his study at national level while forgot about the available meagre operational research resources for data generation.

   vi).   Heterogeneous target research group vs geographical distribution

Yet another title that emerged was 'Inclusive Education through the lenses of learners with disability on distance education programmes at University of XXX' (02/03/16). The topic was narrowed down to one from many public universities. However, the researcher still maintained inclusive education and distance education as part of the themes [38]. In this particular title, the dilemma was manifested through researching on 'disability' phenomenon, which was heterogeneous in nature with target learners distributed across Zambia. The meagre operational resources available compounded this for data generation to cover the country (rural/urban). Eventually, a specific group of participants was identified as reflected in the final research title: 'Lived Experiences of Students with Visual Impairments (SwVI) at Sim University in Sub-Saharan Africa: A Hermeneutic Phenomelogical Approach' (08/09/17) [39].

vii). Objectivism vs Subjectivism within Phenomenology

Late in the second year, the researcher tilted the title towards phenomenology. The research proposal was entitled 'Exploration of the Lived Experiences of Learners with Disabilities on Distance Education Programmes at the University of XXX: A Phenomelogical Approach' (08/09/17). Nevertheless, phenomenology [40] proved to be a diverse subject area with its origins leaning on positivism (objectivism), yet the researcher value system remained in interpretivism (subjectivism). Hence, researcher had challenges on bracketing researcher prior knowledge as espoused by Husserlian school of thought [41]. In other words, the researcher faced a dilemma of reconciling Transcendental Phenomenology of Edmund Husserl (objective) with his subjective research values. Hence, title was further transformed to lean on the works of Martin Heidegger's Interpretive (Hermeneutics) phenomenology (subjective)[42].

viii). Disclosure of research site vs confidentiality of participants

With further literature review, it became apparent that whereas the researcher wanted to be explicitly with the research location site, it was clear that a research on participants with disabilities was a sensitive subject [43]. Most of the titles devised identified the location where the research participants were drawn from. The researcher yet again faced another dilemma as he had wanted the study to reflect the location yet on the other side was mindful of the negative implications of disclosing the research site on ethical grounds [44]. Further, principal researcher of the current study faced a dilemma to undisclosed participants on one hand yet had to include background to the study where research study rationale emerged. While researcher succeeded in not disclosing the identity of participants and their location, he still had a challenge on how much background information to disclose in the introduction chapter without disclosing the identity of the institution.

VI. Study Implications on Higher Education

Emanating from the study discourse above is a clear lesson that partnerships in higher education in their initial phase could be plagued with unforeseen difficulties during planning and implementation stages. In the current study the teething challenges had an impact on the learner as could be attested by the stagnation of student at proposal stage for 2 years. Consequently, contributed to the revision of the research proposal 11 times. Hence, if partnership are to thrive, partners, should be ready to learn through the implementation process and amend their rules to the benefit of their clients herein referred to as students.

Hence, if partnership in HE are to thrive, partners, should be ready to learn through the implementation process and amend their rules to the benefit of their clients.

Further, divergent views among supervisors bordering on paradigm stances regarding what constitutes knowledge at PhD level does contribute to slow progression of PhD students' academic progress.

Furthermore, researching on practice while attempting to blend it with divergent academic experience equally contributes to prolonged arrival at meaning thesis title.

While inter-divergent views on what constitutes knowledge by PhD research supervisors and intra-divergence views within the PhD students all appear to slow progress of research process among students, paradoxically, therein lies innovation needed if higher education is to contribute to sustainable development through research.

Short of inter-divergent and intra-divergent views could render novice researchers perpetuate 'copy-paste' type of research and not innovation and transformers needed for sustainable development to take root.

VII. Conclusion and Recommendations

In conclusion, while 'Sim' and 'Sam' Universities took time to nurture and harmonise their institutional regulations the novice researchers were grappling with their research proposals. In the process, as typified by the principal researcher in the current study, the novice researcher had to navigate his way through 11 thesis title from shallow to deeper layers before his study became meaningful. At each of the eleven stages, the novice researcher faced dilemmas, which had to be resolved before he could realise the need to transform thesis title further. We now know from this lived experience that the process of developing a meaningful thesis title is plagued with dilemmas. Therefore, novice researchers should be prepared to mercilessly revise their thesis titles throughout the length of their doctoral study. Whereas changing from one thesis title to another could be a demanding task, it is during those moments that researchers begin to penetrate their personal worldview of knowledge creation into innovators. Short of this, novice researchers operate at lower order of Bloom's Taxonomy. Consequently,

novice researchers are bound to remain 'copy-paste' type of researchers and not innovators and transformers. This then entails that novice researchers and their supervisors should be prepared to move from mere surface to deeper layers of learning. It is at deeper layer of learning where higher order thinking skills such as analysis, synthesis and evaluation reside. This then justifies the longer period it takes to arrive at a meaningful thesis title as it represents the highest order of cognitive reasoning referred to as 'create' stage as advanced in the revised Bloom's Taxonomy.

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ICT in Governance Systems: A Case Study of the FISP Farmer Registration System

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Abstract—Use of enhanced Information Communication Technology is among the key targets set forth in the 7th National Development Plan. Absence of a rigorous approval process has seen an increase in the number of ghost farmers benefiting from the Farmer Input Support Programme. The lack of a single pool of farmer and marketing information for technocrats makes decision making a near impossible task. This paper proposes a system for the capturing and management of farmer information using cloud infrastructure. Having this information will bring efficiency to the activities of farmer-facing bodies such as the Farmer Input Support Programme and the Food Reserve Agency.

Index Terms—agriculture; cloud computing; farmer registration; governance systems; automation; Information Communication Technology; ICT for Development.

I. Introduction

Lately, the Farmer Input Support Programme (FISP) has seemed to be synonymous with problems [1] [2]. Time and again, officials from the Ministry as well as farmers have complained of its shortcomings [1] which have not been solved over the past few farming seasons [1] [2] [3] [4] [5] [6]. With the constant stories of ghost farmers [1] and inputs from FISP being sold by recipients, some citizens have grown disillusioned with the programme [6]. Food Security is a combination of availability, access and use [7]. The presence of ghost farmers impacts availability in that subsistence farmers missing out on inputs will have lower yields [2].

Cakmak and Tas [8] concluded that Information Communication Technology (ICT) usage has a huge importance at strategic level. This involves using ICT to provide support in data collection, developing databases and automation of repetitive tasks. This is proof of the role that the implementation of ICT can have on a business. Having a centralized store of data puts real-time data in the hands of decision-makers.

This paper describes a project funded by the National Science and Technology Council (NSTC). The project involved the creation of an agricultural information system to assist in the registration and verification of farmers. The system will also allow officials in the Ministry of Agriculture to closely monitor the state of the farmer register and ensure fraudulent activity is minimized.

The rest of this paper is as follows. In Section II, an overview of the Farmer Input Support Programme is provided.

In Section III, related work is listed. Section IV contains the methodology and Section V contains the results and discussion. Lastly, Section VI contains the conclusion and future works.

II. Farmer Input Support Programme (FISP)

The Goverment of the Republic of Zambia developed the Fertilizer Support Programme (FSP) in 2001 [9] with the view of providing inputs to small-scale farmers and in the process prop up the private sector. It was a three-year programme that involved progressive disengagement. This means that subsidy level would begin at 50% in the first year, before dropping to 25% in the second year. It would then fall to 0% in the third year [10]. In 2009, FSP was reworked and renamed to FISP. Part of the reworking involved reducing the quantities of inputs provided from eight 50kg bags of fertilizer to four 50kg bags and from two 10kg bags of seed to one 10kg bag [9]. This was done to increase the number of recipients.

1) FISP Electronic Voucher: The electronic voucher (e-voucher) system was initially piloted in 2015 [11], targeting 13 districts in Central, Copperbelt, Lusaka and Southern provinces. It was created to augment FISP by providing recipients of the programme a wide number of options of agro dealers they could buy inputs from. In collaboration with the Zambia National Farmers Union (ZNFU) [11] and a number of banks [12] the E-Voucher programme used the existing VISA card system that was used by ZNFU in the LIMA Credit Scheme. Upon completion of the registration and approval process in each farming season, a VISA debit card would be provided to each beneficiary of the input programme. The card would only be activated upon payment of a fee. And as a security mechanism, these cards could only be used at the various registered agro dealers.

2) Ghost Farmers: 'Ghost farmers' [2] [3] [1] have proven to be a recurring problem since the introduction of the e-voucher system. The term refers to individuals registered in the system who are not peasant farmers. It also covers cases where deceased individuals appear [4] in the system. According to a news article by Muwanei [2], some of the ghost farmers are officers from the Ministry of Agriculture. According to Mulenga [4] the ghost farmers use FISP as a social cash transfer benefit. The individuals receive the inputs and immediately sell them [4] [6].

III. Related Work

1) Better Rice Initiative Asia (BRIA) Database System: The BRIA database system [13] was developed with the objective of eliminating the use of paper and managing complex work related to the handling of farmer data in Indonesia. Basic data was collected from farmers in each district. An administrator then entered the data into the system, after verification by BRIA coordinators. During data collection the BRIA coordinators were equipped with an android tablet, with the BRIA mobile surveyor application installed, and a handheld GPS device. Locating a farmer's land parcel is a key pre-requisite to gaining financial services from the initiative.

The system being developed is very similar to the BRIA database system. The objective of managing farmer data in a web application is shared between the two systems. The only difference is that at present, the proposed system is not managing spatial data, although this is proposed in a future module.

2) Database of Livestock Farmers - Punjab: The Punjab Information Technology Board (PITB) [14] developed a database of Livestock farmers on behalf of the Livestock and Dairy Development Department of Punjab, India. The objective of this system is to provide the Department of Livestock and Dairy Development a unified platform through which to access farmer and farm profiles. This platform helps the department identify the distribution of farmers in the province and view land and crop information.

The system being developed only differs in terms of the type of farmer being targeted. At present, the focus is on registration and verification of farmers leading to the receipt of inputs. The Punjab system on the other hand seems to be a decision support system for internal department operations.

3) Agriculture Information Service Built on Geospatial Data Infrastructure and Crop Modeling: The paper by Honda et al. [15] describes an agricultural information platform called FieldTouch. A team of 100 farmers in Hokkaido, Japan, participated in the development of the platform. The platform assists farmers in planning their agricultural activities by suggesting where fertilizer should be applied.

4) Access to crop prices and information: Simelane [16] describes a mobile application created to provide farmers in marginalized rural areas with a platform on which to sell their produce as well as get access to vital information. Following a study in Northern KwaZulul-Natal, South Africa, the researcher found that the majority of farmers in this area owned feature phones. Feature phones are mobile devices that lack the more complex features of smart phones. These devices are typically only capable of voice calling, sending and receiving of SMS messages and in some cases internet access. That information was useful in deciding what technologies were used during development of the application.

Figure 1 is a depiction of the Market screen in the mobile application. The farmer is can search for a particular commodity and view its current price. Having access to commodity prices would ensure that farmers get the right price for their

Fig. 1. Application for market access [17]

goods. This is important if marginalized farmers are to be lifted out of poverty.

5) Real-time Monitoring of Grain Warehouses: In his paper [18], Chibuye presents a model to be used to collect real-time data using the Android Things platform and cloud technologies. The model proposed had to be low cost, have minimal power requirements and be extensible. To meet these limitations, the Raspberry Pi was proposed as the hardware framework on which to base the model on. The Raspberry Pi is a card-sized computer developed for educational purposes. It has proven to be a capable hardware platform for hardware prototype creation by providing the necessary processing power while being low cost and consuming minimal power. Various peripherals such as temperature, humidity and motion sensors make up the remainder of the model. The model described by Chibuye would allow the conditions within a grain warehouse to be monitored remotely through an internet enabled device.

6) A Wireless Sensor Network Based Grain Inventory Management System for Zambia's Food Reserve Agency: To assist in solving the problem of food security in Zambia, this work [19] proposed a wireless sensor network model for use the grain storage warehouses of the Food Reserve Agency of Zambia. The author went to great lengths to carry out a thorough investigation of technologies related to wireless sensor networks. Apart from that, the baseline study conducted gives an interesting view of the facilities available at most of the storage depots. A new set of business processes were also proposed by Muyunda, ensuring that the stock purchase and stock selling process are captured in the wireless sensor model.

7) Using the Cloud Architecture to Automate the Farmer Input Support Programme (FISP) Inventory System: As a precursor to this work, Chomba [20] looked into how information is currently being held. Chomba found that at the time, 61.76% of records were being stored on spreadsheets or manual systems. This finding was a huge motivation to this

work.

IV. METHODOLOGY

Qualitative data was gathered through numerous interviews with the relevant staff from the Ministry of Agriculture as well as a thorough document sampling process. The sampling process involved skimming through the numerous documents and manuals provided that cover the activities being modelled. The outcomes of the data gathering process were:

1) System requirements
2) Design of the model

During the analysis and development process, the Object-Oriented Systems Development Methodology (OOSDM) [21] is used. This involves the use of various diagrams to represent the system at varying levels of detail.

A. Current Business Process

According to the FISP Implementation manual [22], the application process begins at the farmer group level. The lowest agricultural grouping in each area, which is a camp, forms a Camp Agricultural Committee (CAC). The CAC is tasked with picking the location and date on which details of the application process will be communicated to the applicants. Each farmer organization (cooperative) will receive applications from farmers who intend to receive input support.

Upon receipt of the applicants from each farmer organization within a camp, the respective CAC carries out an appraisal process as is depicted in Figure 2. This involves scrutinizing each application, making sure the criteria laid out by the Ministry of Agriculture is met.

Fig. 2. Appraisal Process

The screening process occurs again with the Block Extension officer. He/she will examine the applications before passing them on to the District Agricultural Committee. A similar process occurs here. The process then ends with the Provincial Agricultural Coordinator. At this point, an approval list will be sent down to the CAC to be shared with the farmer organizations.

B. Proposed Business Process

The proposed process seeks to augment the current process of data capture. It would involve using a web application for both the registration and approval processes. Like the current process, applicants would have to go through the process sequentially.

C. System Architecture

The proposed architecture depicted in Figure 3 includes a dedicated database and web server hosted on networked infrastructure. Due to the lack of infrastructure at satellite depots, the Camp Extension Officers would have to access it using one of many mobile connectivity options (3G/4G or WiFi) on a tablet or smartphone. Officials at Block, District and Province level would also be able to access the system. It would provide each of them with statistics pertaining to their particular area. Apart from that, they would be able to view the profile of each applicant as well as approve them. The connectivity options are similar to that of the Camp Extension Officers. Although they have the added option of accessing the system using desktop computers where the required infrastructure is available.
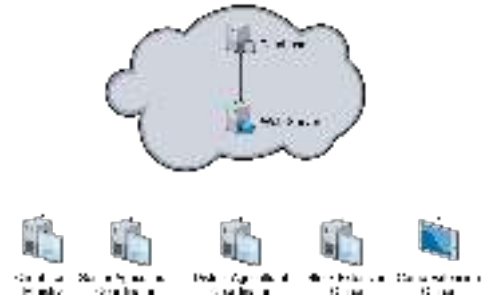
Fig. 3. Proposed System Architecture

D. System Modelling & Design

Use case models depict how a particular user interacts with a system. Figures 4, 5, 6 and 7 show the specific functionality that is available for the specified user types.
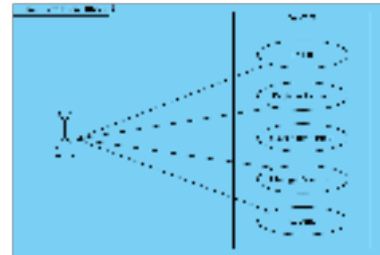
Fig. 4. Camp Extension Officer Use Case Model

V. RESULTS & DISCUSSION

At the time of writing, a basic system prototype has been created. This includes both the registration and approval processes. Figures 8 and 9 depict the Registration form and Farmer Registry.

Upon completion of a separate module, displaying of spatial data, the possibility of a pilot study will be explored. The input collected at this stage will be vital in the eventual transformation of the prototype to a market ready product.

3
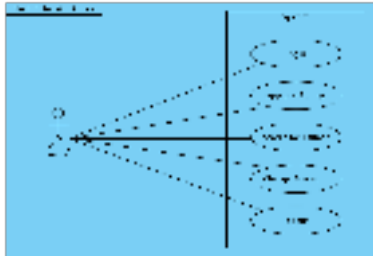
Fig. 5. Block Extension Officer Use Case Model
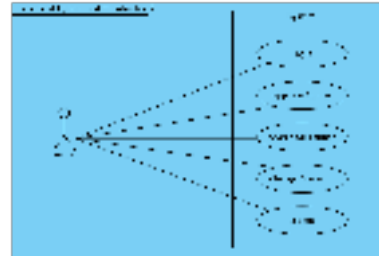
Fig. 7. Provincial Agricultural Coordinator Use Case Model
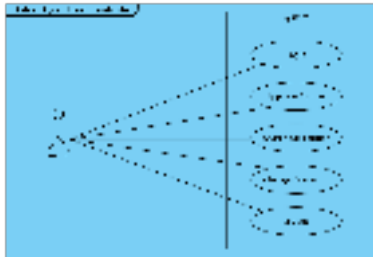
Fig. 6. District Agricultural Coordinator Use Case Model

VI. CONCLUSION & FUTURE WORK

In conclusion, a prototype has been developed to assist in the FISP Farmer Registration process.

This system forms part of larger Agricultural Management System. The next modules to be worked on are:

1) Inclusion of spatial data for farmer land parcels and warehouses.
2) Grain inventory management module for the Food Reserve Agency (FRA).
3) Grain bag identification using mobile technologies.

Fig. 8. Screenshot of Farmer Registration Interface

Fig. 9. Screenshot of Small-Scale Farmer Register

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5

Digital Library as a Solution for Textbook Shortage Crisis in Zambia

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Abstract— **The world of education is undergoing significant evolution which causes a significant shift in course delivery, access to resources and teaching technique. Many challenges within the educational arena are being addressed through new developments in technology, forever changing the framework of modern universities. Long gone are the days when a teacher, at the center of the educational process, provided a guide and a compass for students who were at times passive recipients. The notion of knowledge recipient was forever changed as the digital generation opened up new opportunities for educators and technological leaders to re-think their approaches. Students who were forced for centuries to have physical access to learning resources are now able to take advantage of ongoing changes in the world of education and technology by accessing content at their disposal, accelerating their own learning process. However, while the technological advancements are changing the world of education globally, there are still many areas of the world struggling to provide students with basic resources needed for an effective learning process to take place. This article will describe an ongoing exploratory study of different approaches to pedagogy due to the rapid technological changes focusing on the use of software which enhances the learning and teaching process. Furthermore, the article focuses on the significant textbook shortage crisis in Africa, addressing some of the innovative approaches several Zambian institutions pursue in order to solve this problem, creating a pathway for others in the Zambian educational arena to follow.**

Keywords— African textbook shortage, Zambian educational arena, educational software, digital library, e-library, digital learning, educational technology.

I. INTRODUCTION

Many variables are changing the educational framework, such as, instructor's newly developed roles in reference to the learning process, movement of students from passive to active recipients of knowledge, different motivational goals of new digital generation of students, technological developments, and overall changes in educational culture (Husbands & Pierce, 2012). The shift of ideas within the global educational arena impacts what students and educators do in class (Wagner, 2012). As much as schools appear to be pursuing a higher order of thinking, the technological development, especially in the developing world, is not aligned with the desire of educators and students (Richland & Simms, 2015). Focusing on the Sub-Saharan African region, while some institutions can pursue the highest technological advancements, many others are struggling to address the shortage of quality learning materials. As per the World Bank report, very modest investment in addressing the shortage of textbooks would create a tremendous amount of difference when it comes to student achievements in the Sub-Saharan African region (Kihuria, 2015). The question if African nations can be competitive with others when it comes to quality of education, not to mention educational delivery, without addressing the severe shortage of resources, textbooks, in particular, remains open. This paper will attempt to address this shortage, and alternative tools students and educators may have at their disposal in order to be competitive with those nations with an abundance of educational software and advanced learning tools.

II. LITERATURE REVIEW

Despite many improvements in all areas of life, Former UN secretary-general, Kofi-Anan indicates that African illiteracy rate is still alarming. As of 1990, there were 133 million illiterate adults in the sub-Saharan region, this number grew to 182 million by 2011 with youth literacy in the sub-Saharan region being the lowest on the continent at 70% (African Literacy Rate, 2018). While the adult literacy percentage is slowly going up, the gender differences are still present in this area with lack of books being the biggest obstacle for this problem to be sufficiently addressed (Africa Literacy Facts, 2018). As hard as it may be to address some of the facts pertaining to the literacy rate in Africa, the situation on the ground level is such that out of the 11 countries with the lowest recorded literacy rate, sadly 10 are African nations (Africa Literacy Facts, 2018).

As of 2010, fewer than 8% of South African public schools have fully equipped functional libraries with books needed for students to successfully master the required curriculum (Paton-Ash & Wilmot). The authors are citing an alarming study by Zinn who indicated that, "in schools ranging in size from 750–1500 learners, no school library held more than 2000 books" (p.133). Nikosi (2013) feels that the South African region is hiding its textbook shortage problem. He points out that no matter the rhetoric of many government and educational officials in the South African nations, the funding

to address the shortage is simply not increasing, the prices of books are going up, and the number of learners is on the rise each year- this simple math predicts devastating results in the years to come (Nikosi, 2013). For example, if one focuses on just one region in South Africa, within 18 schools of Limpopo's Vhembe district there is a shortage of 10,000 units of textbooks in 18 schools (2017). This statistic is more severe in some other regions. Fredriksen, Brar & Trucano warn that, "Challenges associated with low textbook availability include lack of (1) resources for transportation to schools, (2) in-school textbook storage and access, (3) teacher use, and (4) school libraries" (2005, p.21). The authors indicate that while each challenge is hard to overcome, the main issue is that appropriate textbooks are simply not available.

A. Zambia's Textbook Shortage

Lee & Simmons Zuilkowski (2015), raise a concern that student-textbook ratios are nowhere near the Zambian government's mandated 2:1, leaving teachers to address the shortage on their own through use of alternative materials, at times not fully correlated with the course content. The World Bank report indicates a severe shortage when it comes to textbooks especially at the secondary level, which is left unaddressed causing course syllabuses to be unchanged for the most part since 1980s (1980). Based on the study of high schools in Zambia, the severity of the textbook crisis leaves teachers at times as the only ones with a textbook in the entire class, which clearly leads to a conclusion that the Zambian education arena is in dire need of the emergency "book flood" (p.36). The issues of this magnitude cannot be solved only by the government and ministry of education. Instead, both private and public sector have to get involved to help within textbook development, distribution and accessibility/ One may argue that a quick solution is impossible without cost leveraging, sustainably support, and local commitment (Textbooks and Learning Materials Program Zambia, 2009).

At the Book Publishers Association of Zambia, several key decision makers outlined the need for Zambian public and private stakeholders to support the publishing industry, enabling a good market conditions for local book publishers. This was pointed out as the only path for Zambians to address the current global economic movements, finding their nations' place in the midst of developing countries through quality education (Books play an important role in mitigating global economic crisis – Lungwangwa, 2009).

Unlike some other African countries, Zambian textbook shortage does not appear correlated to its literacy rates. In comparison to some of its neighbors Zambian literacy rate is quite solid at 80.6% (total population) and 74.7% (female) (Major Problems Facing Zambia Today, 2017). Despite the optimistic literacy results, 64% of the population lives below the poverty line and while Zambians pursue higher education at rapid rates, the lack of learning resources hinder their progress upon graduation preventing them from acquiring the required application skills and adjusting to the demands of the global workplace (Major Problems Facing Zambia Today, 2017). This issue is partially caused by the lack of proper teaching and learning resources, textbooks (Major Problems Facing Zambia Today, 2017).

III. PROBLEM STATEMENT

One cannot enter the 21st-century workforce having access to textbooks written in the last few decades of the prior century. The shortage of textbooks needs to be addressed immediately in order for Zambian students to be compatible with their Western counterparts. Zambia does not lack good quality teachers and motivated student force. Zambia lacks access to relevant, current, teaching and learning resources, textbooks in particular in order for courses to be more relevant and applicable to the current market conditions. While some experts "accuse" Zambian teachers of not being as proactive as they should be in updating their course plans and syllabus, those issues are hard to address if one has to use a textbook which is on average 30-40 years old (Ash & Wilmot, 2018).

IV. RESEARCH QUESTIONS

- How can technology be leveraged to effectively address Zambia's textbook crisis?

- Which ICT solutions can address the Zambian textbook shortage?

V. E-LIBRARY-A TEXTBOOK CRISIS SOLUTION?

Breaking out of poverty is a challenge for every nation, Zambia being no exception. While big strides are being made in order to push the country's economic development establishing it as one of the leaders in the region, Zambian education system is still lagging in comparison to its developed world's counterparts. Focusing on all variables that cannot be addressed momentarily or in the near future is not productive. However, there is one clear solution for the key education crisis variable within the Zambian educational system- textbook shortages. That solution is a comprehensive digital library.

In order to outline what digital libraries may do for Zambian education, one should sort through various definitions of e-libraries in attempt to properly define this ICT concept "Digital libraries are perceived as libraries in which all information resources are available in computer process through which acquisition, storage, preservation, retrieval and dissemination of resources are carried out using digital technologies" (Gani & Magoi 2014, p.5). The authors conducted several case studies within the Nigerian university system concluding that digital libraries emerging as a result of the ICT revolution provided Nigerian universities with a chance to compete with their Western counterparts while enhancing their nation's development through university education. While the terms digital library, virtual library and e-library are used interchangeably, there are some slight differences between those concepts. Despite those slight technical differences, at its very core, the library with digital resources accessed online is fully defined by Rosenberg (2005) as "a library where information resources are made available and accessible electronically, frequently over the internet" (p.8). Gani and Magoi (2014) urge private establishments to assist and support funding for the digital library projects highlighting the benefits for those organizations in a long run. Working in sync with federal and state governments, private corporations can be crucial as more countries realize the importance of textbook

access for not only the educational framework of Africa but nations' economic progress as well.

With the developments in the technological arena, e-libraries are emerging within the vast majority of Western universities. Let's keep in mind that Western countries have not really struggled with access to good quality textbooks beforehand, yet they are readily embracing the new technology of textbook access. Considering the rapid emergence of technologies within Africa, can one hope that Africans can skip a few technological steps and address the textbook shortage with access to e-libraries? The success demonstrated within Nigerian universities gives a resounding yes to this question!

Major changes in the education setting are associated with the significant shift in the arena of course delivery from a traditional to the online modality. This change resulted in a significant amount of challenges, one of which is associated with the concept of relationship building in an online setting. E-libraries do go hand in hand with online education, but they are not the exclusive privilege of online students. Many traditional schools have e-libraries as one of their components.

Online education aside, even traditional students enjoy accessing resources from the comfort of their own homes. Also, the new learner is far from a "traditionalist". The demographics of a "typical" digital generation student is different than his/her traditional counterpart: older than traditional undergraduates, already with family commitments, jobs, female students with children being a significant majority (Matthews, 1999). The new generation of students can benefit from e-libraries even in the counties where the textbook shortage is a non-issue.

There may be several concerns pertaining to implementation of e-libraries within the Zambian educational arena:

- Lack of funding
- Training issue
- Comfort level with online modality
- Internet access

A. Lack of funding

In the prior section of this paper, the author discussed the shortage of funds on behalf of both Zambian governmental and educational sector preventing them from addressing severe textbook shortage throughout the country. Luckily, investing in e-library infrastructure is quite cost-effective. Dunn and Martin (1994) researched the average cost of operating a library. Their study focused on some huge public libraries and some smaller scale school libraries, triggering them to review the cross - section of operating budgeting, operating costs included. The authors concluded that libraries in the Western hemisphere are not self-sufficient requiring significant governmental and public support (Dunn & Martin, 1994). In the developed nations, that support is provided, yet at times slow coming. Similar skyrocketing costs can be expected when it comes to evaluating maintenance costs of traditional libraries in Zambia, under the assumption that textbook shortage can be miraculously addressed. Focusing on the simple math of cost comparison, the e-library costs are a fraction of the cost of traditional library establishments, putting a far lesser strain on Zambian public and private sector.

B. Training

Digital native generation is already heavily represented within global school systems. Digital immigrants are slowly disappearing from the educational arena with each new graduate (Prensky, 2005). Considering that the clear majority of students, African students being an exception, are becoming more comfortable with the use of technology, the emergence of e-libraries can be easily embraced by the masses. As a matter of fact, research has shown that the clear majority of students prefer to access learning resources online (Prensky, 2005). There is a segment of teaching population in need of some additional training, but considering the current progress many Zambian institutions are making in the online and distance learning arena, that should not pose a major obstacle.

C. Comfort Level with Online Modality

Many skeptics continue implying that online courses" threaten the quality of instruction delivered", primarily focusing on "the natural limitations of instructional technology such as the perceived lack of social interaction and immediate feedback, inability to address the learning needs of a diverse group of students, and lack of transparent academic activities" while other experts see it as "a great opportunity to overcome the limitations of face-to-face classroom instruction" (Gayton, 2007, para. 7 -8). Be it as it may, as of 2011 more than 6.7 million students are taking at least one online course creating a scene where online learning is "the cutting edge of pedagogical innovation and educational outreach" (Stern, 2015, p.483). Zambian educators and students joined the online educational arena several years ago with some Zambian institutions having programs delivered fully online using reputable online platforms, such as, the Astria Learning Management System. Due to this, it is the assessment of the author that transition to e-library modality may be quite streamline even within the institutions who are not offering full online programs.

D. Internet Access

The last area of opportunity within the realm of e-library is addressing the issues with Internet access due to power outages, technical difficulties, and sporadic availability in some rural areas. This is sufficiently addressed through ICT solutions, offered by limited prominent e-library providers, with Internet component not being required if students are accessing textbooks previously downloaded. Offline access is a game-changer in the e-library arena. This solution enables students to access their learning material from the comforts of their homes, while traveling, and without Internet access. This is a revolutionary concept equivalent of student having his/her own physical textbook library with relevant, current, and easily accessible resources. Even with access to a physical library, students would not be able to replicate the same ideal conditions due to the shortage of relevant textbooks in Zambia. The E-library is resolving that major problem providing wide

masses of students with unlimited access to the course materials. One book is now accessed by thousands of students at the same time. Meanwhile, on the other side of the spectrum, one may find only one copy, if that in the physical library. For example, the Astria Digital Library emerged to provide a comprehensive solution for students offering unlimited online and offline access to a database of over 172,000 books and millions of academic journals and articles addressing all core variables within the parameters of textbook shortage.

VI. CONCLUSION

Decisions about technology and higher education are, ultimately, academic decisions impacting all aspects of public life. These decisions have an impact on valued and respected practices and interactions among Zambian educators, students, and public. In the past decade and a half, one has seen the emergence of an environment in which people learn and adapt to change at a rapid rate. The Internet has made it possible to access information in a manner and speed never previously observed in human history.

Textbook shortage within Africa cannot be addressed overnight. However, as with some other areas of opportunities, Zambia is in a unique position to "skip a few steps" leveraging the emerging technologies and ICTs advancements. Zambia can choose not to address the shortages within the traditional school and public libraries at all. That venture would be too costly and frankly with the emergence of online education and new digital solutions somewhat pointless. Addressing the shortages through the robust online / e-library platforms would provide an expeditious approach to the problem area addressing it within a few months versus years.

The author recommends a comprehensive comparative study to be conducted based on a few sample institutions: the ones currently utilizing e-libraries, the ones who just started, and the ones who are addressing the textbook shortage in a traditional "old-fashioned" way. The technological advancements luckily create an environment in which some problem areas previously unaddressed for decades can be resolved quickly. Zambian students and educators cannot afford to wait on cumbersome solutions, E-libraries can provide immediate solutions enhancing Zambian's ability to resolve textbook shortage in a few short years.

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An exploration of a Higher Education Content and Language Integrated Learning (CLIL) Curriculum for sub-Saharan Africa

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*Abstract —*Content and Language Integrated Learning is currently enjoying attention in both the European and American learning settings in its cross-curricula form. Whilst the efficacy and the structural curricula and implementation challenges of Content and Language Integrated Learning have been a legitimate site of scholarship outside of the African continent, there is little research of the applicability of a Content and Language Integrated Learning curriculum to multilingual sub-Saharan Africa. Focusing on this applicability of a Higher Education Content and Language Integrated Learning curriculum to multilingual sub-Saharan Africa, this paper critically explores the issue of this curriculum to the sub-Saharan higher education context against some central claims of evidence of emerging research on Content and Language Integrated Learning, including the cautions stemming from theoretical and methodological shortcomings of poorly modelled Content and Language Integrated Learning curricula and implementations. The paper provides food for thought for policymakers on how to thwart potential limitations of Content and Language Integrated Learning reported in the literature.

Keywords—Content and Language Integrated Learning; language across the curriculum; in sub-Saharan Africa; quality education

I. Introduction

Content and Language Integrated Learning (CLIL) has been defined by [1] as a dual-focused educational approach in which an additional language is used for the learning and teaching of both content and language. By this they mean that in the teaching and learning process, there is a focus not only on both content in subjects and courses as wide as science, history, medicine, geography, maths culture and language like English and other mother tongue local languages but that both content and language are interwoven, even if the emphasis is greater on one or the other at a given time.

Although [2] argues that there is no single blueprint that can be applied in the same way in different countries, Eurydice [3] has posited that CLIL is found in context-bound varieties of programmes such as the following:

• immersion (Sweden)

• bilingual education (Hungary)

• multilingual education (Latvia)

• integrated curriculum (Spain)

• Languages across the curriculum (Austria)

• language-enriched instruction (Finland)

Nevertheless, even in contexts where CLIL has been practised, research on CLIL has tended to focus on primary and secondary school learning sectors with very little attention paid to the application of a CLIL approach in Higher Education (HE) institutions [4].

II. Research Problem

A concern among researchers in Africa is that being taught in English which is a foreign language is recipe for ineffective learners' knowledge, skills, and understanding of the subject. Since in such contexts the medium of learning is less perfectly known than the first language (L1) of both teachers and learners, it is feared that this will lead to diminished content competence arising from either imperfect understanding or the fact that teachers pre-empt this problem and simplify content. An even more acute problem is that research on the applicability of a CLIL curriculum to sub-Saharan Africa either at school or tertiary level is seriously lacking. The aim of this publication therefore is to reformulate discourse around the role of language in education and literacy by exploring the applicability of the CLIL curriculum in HE institutions to the sub-Saharan Africa region. The purpose is to examine the relevance of CLIL approach to HE institutions in sub-Saharan Africa in order to add to early literature on CLIL approaches in the context of sub-Saharan Africa. Focus on the CLIL curriculum stems from the view that the provision of curriculum content in a second language (L2) can be beneficial in terms of building both subject knowledge and L2 proficiency [5]. I therefore argue, in this publication, that when it comes to the treatment of the English language, past

research that has been critical of using English in the context of sub-Saharan Africa has been unable to offer alternative methodologies of fostering L2 English proficiency to the concerns of the hegemonic nature of English as impetus for championing the use of African languages mother tongue in African schools and universities. I believe that since most of African countries are multilingual by nature, students need to be equipped with the necessary tools, which should allow them to effectively negotiate their schooling trajectories within their multilingual learning contexts especially in most urban settings where students' medium of learning will have to be an L2, including English, even if national policies advocate use of African languages as media of learning. Compounding the problem is the reality that in sub-Saharan Africa, some higher education teaching and research staff have no explicit training in educational methodologies, including English language teaching expertise because of justifiable colonial sensitivities to the English language. This is consistent with what [1] observes for certain countries that:

higher education teaching and research staff have not been explicitly trained in educational methodologies. In these cases, higher education has been viewed as characterized by transactional modes of educational delivery (largely imparting information), rather than the interactional modes (largely process-oriented) characteristic of CLIL.

What [1] state above is critically important because the language used for academic and specific purposes exerts different demands on linguistic processing and production – what [6] has termed as Basic Interpersonal Communication Skills (BICS) to describe "conversational fluency in a language" and Cognitive Academic Language proficiency (CALP) to describe "access to and command of the oral and written academic registers of schooling." What this means is that academics need to have sufficient educational methodologies in order to reap the benefits of higher education teaching and research as an interactional mode which characterises CLIL instead of seeing it as a transactional one which has characterised traditional higher education. Applying a CLIL approach to sub-Saharan Africa should therefore serve as a timely response to the genuine problem of sub-Saharan Africa education where multiple first languages lead to the adoption of a second language, usually English, as the language of instruction in HE institutions. This is in tandem with what [1] postulate that a CLIL approach has potential to "convert a language problem into language potential." The goal of CLIL is to develop critical literacy and critical language awareness in both students and academics of higher learning institutions, which will allow both students and academics to actively explore, research and solve complex problems through a deepened understanding of core academic concepts.

III. BRIEF REVIEW OF LITERATURE

When it comes to foreign language tuition at tertiary level, research and practices, even in Africa, have tended to focus on Language for Specific Purposes(LSP) and Language for Academic Purposes (LAP) approaches on different issues, since these fields have had long-standing traditions in universities and colleges. Research related to CLIL in HE sector is therefore scanty mainly because there is no agreement on whether LSP or LAP approaches can be classified as CLIL. Insights from [1], for example, take CLIL in the context of HE to mean an umbrella term which includes LSP, sheltered instruction and adjunct model which share the use of content to teach language or provide language support for courses that run parallel to content courses. Likewise, CLIL is used to define teaching subjects in foreign languages where language support is provided and the teaching of subjects "in foreign languages without any language support or language sensitive teaching methodologies" [4]. However, [1] is of the view that these kinds of teaching cannot be classified as CLIL because they do not apply language sensitive methodologies and do not consciously pursue language learning objectives. Clearly, the issue of content in CLIL is different from that of the context of LSP or LAP where content from the students' field of study is used for developing linguistic competences of the learners. An unanswered question is also the basis of the content selection as the content curriculum usually includes a number of different, specific topics which in traditional LSP approaches are determined by needs analyses championed by [7], among others. Needs analyses have, however, been found to be problematic as there is often a mismatch between what students consider as their needs and what academics regard as suitable needs for students, even in situations where both students and academics are involved in determining the needs. Another problem that has been identified in LSP and General Language (GL) is that:

The choice of topics to be followed in LSP curriculum is often random, determined by the teacher's own interest. Some of the content in both GL and LSP is used to illustrate certain language points. In LSP the content is often not 'new' and already known in the first language, it is cognitively less demanding and consequently less challenging and motivating [4].

A further problem is that LSP specialists tend to be language specialists who do not take on responsibilities of teaching content discourse because of different cognitive demands of the content subjects in HE contexts. Likewise, a subject specialist is less equipped with appropriate language proficiency due to a lack of collaborative ventures with language specialists, which is fostered in CLIL approaches. Nevertheless, despite huge CLIL promises, cautions about CLIL approaches have been sounded. For example, language specialists have expressed legitimate concerns that language is not covered systematically, considering the reality that exams grade content and language separately. On the one hand, where English has been used, insistence on using English only in multilingual contexts has been feared to limit students' cognitive ability and activities. On the other hand, sense-making which has been thought to be at the centre of CLIL has been thought to interfere with social aspects, especially enjoyed on socio-media platforms, as well as thought to uproot those who recognise the value of Western education in human development from their own cultures. Other concerns have been that inter-didactic collaboration advocated in CLIL

approaches is time consuming, making specialist academics uncomfortable teaching what they view as other subjects they never specialised in. However, advocates of a CLIL approach point to these perceived concerns as proof of poorly constructed CLIL curricula and delivery. Emphasising the value of CLIL, [8] observes that: "CLIL programme implementation often causes disjuncture – a tension between one's current way of doing things and a new approach." Advocates of CLIL therefore maintain that the benefits of CLIL outweigh any concerns expressed.

IV. THEORETICAL OVERVIEW OF CLIL

A CLIL theory hinges on principles of self-organization as espoused by [9], among others, in that it resembles theories of emergence as it takes into account cognitive and brain aspects as well as motivation theory.

In an outline for CLIL theory, in which [10] addressed the questions of attitudinal and motivational approaches, whether the CLIL approach leads to better language proficiency in the target language compared to traditional approaches, whether it leads to better subject matter knowledge than traditional learning and how CLIL affects brain development as compared to traditional (foreign) language learning approaches, it was shown that learning in a CLIL environment was a better way of learning a foreign language. The findings echoed cognitive development bilingual research of [1] as they resulted in discrete brain activity or plasticity, thereby creating what [11] have referred to as better brains for young multilingual learners than for the monolingual ones. Thus, theoretically, [12] believe that CLIL encompasses most of the aspects which 'good', modern education contains, which are active learning and teaching methods, use of authentic tasks and materials, student-centeredness, focus on project work and task-based learning. In this sense, CLIL is seen to be based on a constructivist learning philosophy in which knowledge is constructed by learners while working cooperatively in groups. It is therefore a manifestation of holistic education philosophy which advocates integrating the learning process and not separating language from content subjects and skills [13].

When it comes to the principles underpinning a CLIL curriculum, [14] have distinguished three levels of curriculum integration whereby there is multidisciplinary integration in which the same topic of the curriculum is presented from different subject perspectives, an interdisciplinary integration in which integration occurs both at the topic level and at the interdisciplinary skills level, such as literacy, cognition and research and the transdisciplinary integration level whereby the curriculum is based on the issues raised by the students and integrating those issues in the real life context (negotiated or task-based curriculum). The key principle underpinning the CLIL curriculum especially in HE environments is therefore that the content of what is taught in a course relates to the discourse of the content and not the content itself [15]. To that end, [4] notes that:

One of the ways of solving the "content" issue for the language specialists in HE is to rely more on project or problem based teaching and to co-operate with subject specialists. An exploration of a CLIL curriculum for sub-Saharan Africa builds on the work of [4] and the earlier seminal work of [16] in which he has convincingly posited that:

university education in Africa should attach special importance among its methods of instruction to project assignments, for a number of complementary reasons: to afford students an opportunity to test formal theories against reality; to prepare students for the practical challenges they will face at work after graduation; and to invite students to compare and, if possible, integrate academic theories and perspectives with indigenous interpretations of experience.

Much as [16] can be considered a work in progress towards achieving curriculum transformation of university education in Africa that includes project work, as research is not available showing that what is recommended is implemented in the context of the research, what is recommended here constitutes a clear leadership calculus, much needed in African university heads, given, as [16] reveals, that the work was done when the researcher was a Vice Chancellor of an African university, the University of Zambia. Exploring the applicability of a CLIL curriculum to sub-Saharan Africa is therefore of critical importance because it elevates discourse on the value of higher education in sub-Saharan Africa. I further opine that this is constitutive of the meaning of good quality education.

In a wide-ranging study on criteria for producing CLIL learning material, [8] asserts that:

It is important that learning materials help students to understand their role in the family and other groupings, and in society at large so that students can make a positive contribution in those contexts. Quality materials encourage students to treat others with respect, and promote behaviour that reflects an educated, rational and active sense of responsibility. Quality learning materials progressively promote students' sense of belonging and engagement as a citizen of their own country.

An even more compelling point made by [8] is that good quality materials explain the relevance of intended learning and how such learning is interconnected with their lives, their interests and their communities. They draw on cross-curricula, incorporate cross-curricular projects, foster critical thinking including applying, analysing, evaluating and creating, cooperative learning, offer choice and control thereby deepening previous learning and this is applied to language, content and learning skills in a CLIL approach. Seen from this perspective, the theoretical basis of a CLIL curriculum integrate language and content, typifying a higher level interdisciplinary integration of four main principles articulated by [17] as 4Cs, namely, content, communication, cognition and culture. What the four principles of [17] do here is not just to integrate language with content but also to mobilise knowledge on the interconnectedness of education and society, including the world of work. Such coalition of knowledge is of relevance to sub-Saharan Africa.

The work of [16] is dedicated to challenging the "orthodox western higher education [that] tends to decontextualize the learning process by extracting learners from everyday life into a detached mode of full-time reflection, with an emphasis on structured exercises and analytical review of authoritative disciplinary texts," including the wisdom of students using English from inception in contexts where parents hardly use English instead of using mother tongue African languages. However, in a balanced reflection, [18] has also interrogated the challenges of aligning the western institution of university education to the needs and aspirations of African postcolonial states, arriving at the concession that:

English language is today a passport to international mobility, such that where the choice is available, many parents who seldom speak any English at home will rationally opt to enrol their children in English-medium schooling [18].

An important point to note in this nuanced reflection is the notion of 'rationality' on the part of the parents for choosing to register their children in English-medium education, even if they do not use English themselves. At the centre of the wisdom of the parents therefore is the reality of the power of English for enabling those who acquire it to access employment, not just for international mobility. Employability has been defined as the acquisition of knowledge and the development of personal and proto professional aptitudes and academic skills which occur as part of a process as students enter, progress through, and exit higher education. The sites of these aspects of learning lie both inside and outside the lecture rooms. In light of this, the experiences of students during their tertiary studies are usefully considered in terms of a developmental continuum constituting what has been termed as a 'student lifecycle.' In fact, recent developments in the Western world, point to revisions of what [16] refers to as orthodox western higher education. For example, the United Kingdom HE academy currently situates its learning research within an international student lifecycle based on pre-arrival and pre-sessional support; induction; teaching and learning in the lecture rooms (teaching context, teaching approaches, learning, curriculum and intercultural competencies); life outside the lecture rooms (adjustment, social and emotional well-being, making friends and building networks, engaging with the broader community, etc.), and finally employability and the next steps. Conceptualising curricula in this way shifts focus away from the lecture room to a more holistic understanding of the diversity of experiences that constitute student learning. Such continua are useful not just in describing the diversity of the sites of learning, but also the manner in which proficiencies develop and mature as students develop through higher learning.

Since English is used as L2 in much of sub-Saharan Africa, placing it within a CLIL curriculum is also consistent with the important work of [5], among others, which recognises that "the provision of a curriculum in L2 can be advantageous in terms of enhancing both subject knowledge and L2 proficiency" [19]. Therefore, if applied to the multilingual region of sub-Saharan Africa, CLIL promises to be an educational life-changing approach, capable of bringing about not just the necessary industrial revolution in sub-Saharan Africa [20] but also employability of the graduates as touched on by [16]. Unfortunately, mere enrolment in English-medium of schooling does not, in itself, offer a guarantee of learners' success in English for employability. I argue in this publication that little has been done to confer L2 learners with the necessary English for employability once they enrol in English medium schools and institutions of higher learning. It is thus important that an exploration of the curriculum of a CLIL curriculum, applicable to the context of sub-Saharan Africa, is conducted.

V. METHODOLOGY

For the purpose of this paper, a qualitative method relying on a review of the literature was deployed in order to fill the literature gaps regarding an informed CLIL curriculum, relevant to the context of sub-Saharan Africa higher education and learning.

Justification for relying on published literature stems from the fact that research on methods of curricula and innovation rely on published documents of best practice in a specific field. To that effect, a purposive sampling of the published literature on CLIL curricular facilitated a rigorous identification of the major issues and findings on the potential benefits of a higher education CLIL curriculum for sub-Saharan Africa. In that regard, the approach was exploratory and by no means exhaustive of curricula content of CLIL.

As [21] proposes, the aim of a CLIL approach is to shift away from the traditional model of a literature-heavy syllabus towards more relevant, vocational models and broader socio-cultural curricula, influenced by area studies, cultural studies and media studies whose objective is to change the status of language proficiency as an objective in and of itself to a utilitarian focus on applied linguistics, communicative competence. In the work of [22], it is noted that this calls for a cross-language and cross-discipline teaching provision where traditional language department divisions should dissipate and academics should find themselves forging close alliances with "modern linguists and non-linguists in developing cross-departmental and interdisciplinary courses". One distinct benefit of a CLIL curriculum is that it leads to increased institution-wide language programmes (IWLP).

VI. FINDINGS

In defence of the CLIL approach, no adverse impact on content learning outcomes in the subjects where it is used properly has been reported. CLIL has also been reported to reduce the impact of socio-cultural status and mobilises lower ability students' performance. Similarly, CLIL students have been known to be more motivated towards independent study thereby increasing their self-confidence as they take risks and deal with 'real issues' at the centre of their study.

Since CLIL has been known to create a sense of self-regulation among students, it presents affordances to students to appreciate limitations of the education and knowledge they have of their societies and the world. It therefore empowers them to fill their knowledge gaps as they seek solutions to real-world problems. Findings from well conceptualised and implemented CLIL approaches have indicated that CLIL betters cognitive development, cultural awareness and motivation to learn languages (including foreign languages like English) without any detriment to content learning in the subjects where it is used. Findings also reveal that by possibly attracting more motivated learners, a CLIL approach may also trigger better results.

VII. RECOMMENDATIONS AND CONCLUSION

The aim of this paper was to explore the applicability of the CLIL curriculum in HE institutions to the sub-Saharan Africa region, and the purpose was to examine the relevance of CLIL approach to HE institutions in sub-Saharan Africa in order to add to embryonic literature on CLIL approaches in sub-Saharan Africa. An exploratory qualitative method using a content analysis approach was deployed to address the problem of a lack of awareness of an informed CLIL curriculum relevant to the context of sub-Saharan Africa higher education. Although this paper is limited to the exploration of literature on the CLIL curriculum, tentative findings point to the possibility of the applicability of a CLIL curriculum to the sub-Saharan Africa's multilingual higher education learning context which has not been spared by the hegemony of the English language as a medium of learning content subjects. Therefore, if the promised CLIL benefits are to be harnessed in the sub-Saharan context, it is critical for policy makers to:

- Allow higher learning institutions to enjoy their academic freedom in organising and delivering CLIL, tailored to their needs, and in a flexible way;

- Conduct collaborative research on CLIL ventures across Europe and African HE institutions of learning, within the framework of 'Africanisation';

- Create awareness of CLIL benefits to managers, leaders and to the international collaborating partners which can fund the CLIL approach in order to improve the quality of education across primary, secondary and tertiary institutions;

- Develop supportive national guidelines on CLIL curriculum implementation;

- Provide initial teacher training opportunities in a content subject while fostering English language competences, in contexts where English is used as a medium of learning;

- Offer relevant continuing professional development for CLIL for both teachers and academics in CLIL environments;

- Support staff to organise communities for sharing resources and methods for teaching CLIL effectively.

All else being equal, providing CLIL to students in HE institutions is likely to be a game-changer of industrialisation and creating pathways for graduate students in sub-Saharan Africa to make a successful transition to the labour market and build on the benefits of increased language competences.

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A Survey on Face Detection and Recognition Techniques for Application in Educational Institutions

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Abstract—**Video surveillance systems continue to grow in importance and use. They monitor the behavior and activities of the people using electronic equipment. Consequently, video surveillance has emerged as a main component in ensuring public security at airports, hospitals, banks, government agencies, casinos and also educational institutions. Therefore, they have a great potential for enhancing security requirements in educational institutions. However, real-time detection and recognition of a human face from the video sequences is a difficult task due to the background variations, changes in the facial expression and illumination intensity. The ability to automatically recognize the faces in the surveillance video is highly important in detecting the intruder/suspicious person. Face detection and recognition are the two main stages of the surveillance process. Facial recognition has gained a lot of significance in commercial, finance and security applications. Various face recognition techniques are developed to improve the accurate recognition of the face in the image. However, the existing techniques suffer due to the variation in the illumination intensities, facial angles, low resolution, improper focus and light variations. This paper provides a survey of the face detection and recognition techniques. The survey presents the comparative analysis of the recent face detection and recognition techniques along with the merits and also discusses their applicability in the education sector. This information is very important in choosing what techniques would best be applied in educational institutions putting into consideration the financial and technological constraints they operate under.**

Index Terms—**Face detection, Face recognition, Feature Extraction, Video Surveillance**

I. INTRODUCTION

Video surveillance systems are applied in airports, police stations, government buildings, military field, and banks for the security purpose to detect and track people and identify their faces and actions [1]. With current advances in technology and the reduced related cost, video surveillance systems are also growing in use in the educational sector. Fundamentally the growth in the use of inexpensive cameras and the availability of high-speed wireless networks [1] has led to the popularity of video surveillance systems as an add to security requirements in educational institutions. Face recognition system includes three main modules for face detection, tracking and recognition. The Viola-Jones method [2] is used to detect single and multiple faces in a real-time video. Face detection approaches are generally classified as:

- *Feature invariant* approaches aim to find the facial structure features that are robust to the pose and lighting variations.
- *Template matching* techniques utilize the face templates to determine whether a face is shown in an image.
- *Knowledge-based* methods employ the human knowledge-based rules for face detection.
- *Appearance-based* approaches study about the face models from a set of training images for face detection.

Automatic face recognition is used for the identification of individuals captured on the surveillance cameras. However, the recognition of face suffers from errors due to the changes in the illumination conditions, resolution and posing angles [3]. Various face recognition methods such as Linear Discriminant Analysis [4, 5], Artificial Neural Network [6], Eigenfaces [6-8], Independent Component Analysis [9], Principal Component Analysis (PCA) [10, 11] and Fisherfaces [8] have been developed.

Facial recognition uses a biometric technique that involves an automated method for recognizing the person based on physiological characteristics. Face verification is the one-on-one matching of the query face image with the default face image. Face recognition is one-to-multiple matching by comparing the query face image with all original images in the

database to identify the query face. Face recognition has become an active topic in image processing, computer vision, neuroscience, pattern recognition, psychology, defense and identification of illegitimate person in banks, ATM and border points. Face recognition in videos has become a significant topic, as the videos contain spatial and temporal information than the images. The information about the multi-frames and multi-poses of the faces are to be combined to obtain accurate recognition of face in videos.

This paper surveyed about the face detection and recognition techniques along with the merits. The paper is organized in the following manner: Section II presents the overview of the face detection techniques and face recognition techniques. Section III provides the comparative analysis of the face detection techniques and face recognition techniques. Section IV shows the challenges of existing techniques. The survey work is concluded in Section V.

II. RELATED WORKS

A. Face detection techniques

Jun et al. [12] proposed local transform features such as Local Gradient Patterns and Binary HoGs to detect local intensity and pose variations for face detection. Accurate face detection is achieved without requiring much computation time. Sun et al. [13] introduced a method for estimating the positions of facial key points using three-level convolutional networks. The local minimum caused by the uncertainty and data corruption due to the extreme lighting conditions, occlusions and pose variations are avoided. Ghimire and Lee [14] developed a method for detecting face based on the information about the edge and skin tone of the input color image. The faces of different sizes and in different poses and expressions are detected efficiently under unrestricted illumination conditions.

Zou et al. [15] presented a combined method of background subtraction and Viola-Jones face detector to detect faces from a video sequence. The false positive rate and computational cost are reduced. Yan et al. [16] introduced a structural context model for encoding the output of body and face detectors. The proposed method achieved maximum precision of about 96.5%. Gunasekar et al. [17] presented a face detector based on QualHOG features to yield high tolerance against image distortions. The face detection performance is improved. Gunasekar et al. [18] suggested a set of QualHOG features for detecting faces on the distorted images. Al-Allaf [19] conducted a review of face detection systems based on Artificial Neural Network (ANN) algorithms along with the merits and limitations. Chatrath et al. [20] described a technique for detecting and tracking a human face using a modified Viola-Jones algorithm. The algorithm is highly flexible to adapt according to the changing imaging conditions.

Li et al. [21] proposed a cascade architecture built on Convolutional Neural Networks (CNNs) for quicker face detection while minimizing the number of candidates at the later stages. Accurate face detection is achieved and bounding box quality is improved. Farfade et al. [22] introduced a Deep Dense Detector for detecting faces in an extensive range of orientations based on the deep CNNs. The faces from different angles can be detected easily and occlusion can be handled efficiently. Klare et al. [23] introduced a benchmark dataset for combined face detection and recognition. Zafeiriou et al. [24] surveyed about the recent advancement in the real-time face detection techniques based on the rigid and deformable templates. Orozco et al. [25] presented a cascade deformable part model based face detector. The proposed model can efficiently deal with extremely expressive and partly occluded faces.

Zhang et al. [26] developed a deep cascaded framework employing the correlation between the face detection and alignment. Superior face detection accuracy is achieved. Chen et al. [27] proposed a cascaded CNN for efficient face detection regardless of the large pose variations. The face and non-face patterns are differentiated using the automatic selection of the best scale through the supervised learning. Zhao et al. [28] developed a method for studying the prominent features for the detection and recognition of face. The face verification performance can be improved by controlling the false responses.

Jiang and Learned-Miller [29] applied Quicker Region-based CNN (R-CNN) for face detection. The face detection performance of the faster R-CNN is improved by considering the special patterns of faces. Yang et al. [30] developed a deep CNN for detecting face under severe occlusion and huge pose variations while leveraging the facial attributes based supervision. The attributes are classified from the uncropped face images without requiring any supervision. The responses of the facial parts are scored based on their spatial structure and arrangement. Hou et al. [31] developed a method for learning object specific channel features to filter the non-face regions. This resulted in the significant improvement in the face detection efficiency in unconstrained settings.

B. Face recognition

Liao et al. [32] developed a method for representing face based on the Multi-Keypoint Descriptors for face recognition regardless of the alignment. Klare and Jain [33] proposed a Heterogeneous Face Recognition (HFR) framework for representing the images to a collection of face images. Drira et al. [34] presented a geometric framework for analyzing three-dimensional (3D) faces by comparing and matching the shapes of faces. Li et al. [35] derived an algorithm for face recognition using a low resolution 3D Kinect sensor. The holes are filled and noisy depth data generated by the sensor

is smoothened. The recognition rate of the Red, Green and Blue-Discriminant (RGB-D) color space is 96.7% and noisy data is 88.7%. Cui et al. [36] developed a learning approach for combining the descriptors of face region of all image blocks. Better face recognition is achieved. Yi et al. [37] proposed a method for recognizing face under unconstrained environments. A group of Gabor features is extracted according to the pose and shape of the face image. The redundancies are removed by applying PCA on the Gabor features.

Chan et al. [38] developed a method for efficient recognition of face according to the local phase quantization. Multiple scores from different face image scales are combined together to improve the face recognition accuracy. Galbally et al. [39] developed a method for detecting different types of fraudulent access attempts and improve the security in the biometric systems. The proposed method required a low degree of complexity. Best-Rowden et al. [40] studied the usage of face recognition systems in the unrestricted face recognition situations. The probability of the accurate identification of the target person using different fusion schemes is enhanced. Chai et al. [41] developed a method for extracting facial features by combining the Gabor features and ordinal measures. Better face recognition is achieved. Xu et al. [42] reduced the ambiguity in the face representation by generating the virtual training samples. Higher face recognition accuracy and minimum computational complexity are achieved. Xu et al. [43] introduced representation-based classification method for the face recognition. Higher face recognition accuracy is improved.

Schroff et al. [44] presented a system for learning the mapping from the face images to a small Euclidean space. A DCN is used for the direct optimization of FaceNet embedding. High accuracy of about 99.63% is achieved and error rate is reduced by 30%. Sun et al. [45] proposed two deep Neural Network (NN) architectures that are reconstructed from the stacked convolution and inception layers for face recognition. The proposed architecture achieved maximum face verification accuracy of about 99.53% and face identification accuracy of about 96.0%. Zhu et al. [46] proposed a technique for filling the hidden region produced by the self-occlusion. Better face recognition performance is achieved in the constrained and unconstrained environments. Lu et al. [47] introduced a method for learning the face descriptor feature for efficient face representation and recognition.

Lu et al. [59] presented a new localized multi-kernel based learning algorithm for the better exploration of complimentary information for face recognition. The proposed methods extract different statistic features from the face image sets for efficient face representation. Our methods are highly robust to the outliers and the noise effect can be largely alleviated. Xu et al. [60] proposed a structured Dictionary Learning (DL) framework for the video-based face recognition. The invariant structural information is learnt from different videos of each subject. The DL and low-rank approximation are applied to preserve the invariant structure of face images. The proposed framework outperformed the subject DL and non-structured DL. Zhao et al. [61] proposed a new Set-to-Set (S2S) distance measure for calculating the similarity between two image datasets to improve the face recognition accuracy in the extreme poses or illumination conditions. Huang et al. [62] introduced an enhanced multi-scale LBP feature for addressing the variations in the dramatic pose and expression. He et al. [63] developed a structured ordinal measure method for efficient VFR using minimum features and samples. Duan et al. [64] presented a Context-Aware Local Binary Multi-Scale Feature Learning (CA-LBMFL) method for the combined learning of numerous projection matrices in heterogeneous face recognition.

III. COMPARATIVE ANALYSIS

The comparative analysis of the face detection and face recognition techniques along with the advantages is presented in Table I.

TABLE I COMPARATIVE ANALYSIS OF THE FACE DETECTION TECHNIQUES

Face detection				
Author and References	Year	Techniques	Advantages	Performance Metrics
Jun et al. [12]	2013	Local transform features	1. Accurate face detection 2. Minimum computation time	1. Miss rate 2. Training time 3. Detection rate
Sun et al. [13]	2013	Deep convolutional network	1. Reliable face detection 2. High prediction accuracy	1. Average error 2. Failure rate 3. Relative improvement
Ghimire and Lee [14]	2013	Skin color and edge detection	1. The proposed method is invariant to the lighting condition. 2. The proposed method is robust and efficient under varying conditions, such as pose and expression.	1. Total faces 2. Correct detection rate 3. False detection rate 4. Missing rate

Zou et al. [15]	2014	Background subtraction and Viola-Jones detector	1. Minimum computational cost 2. Low false positive rate	1. Computation time
Yan et al. [16]	2014	Structural context model	1. High accuracy 2. Maximum precision	1. Average precision 2. True positive rate
Gunasekar et al. [17]	2014	QualHoG features	1. High face detection performance 2. High tolerance to quality impairments	1. Area under precision recall curve (AUPR) 2. NIQE indices
Gunasekar et al. [18]	2014	QualHoG features	1. The proposed method yields acceptable face detection performance at much higher levels of visual impairments.	1. AUPR 2. NIQE 3. Precision
Al-Allaf [19]	2014	ANN-based algorithms	1. Merits and limitations of various face detection systems are discussed.	1. Detection rate
Chatrath et al. [20]	2014	Modified Viola-Jones algorithm	1. Faster face detection and tracking.	
Li et al. [21]	2015	CNN cascade architecture	1. Accurate detection 2. Faster processing rate	1. Precision-recall 2. True positive rate
Farfade et al. [22]	2015	Deep CNN	1. Better face detection performance	1. Precision 2. True positive rate
Klare et al. [23]	2015	Janus Benchmark dataset	1. Accurate face detection and recognition	1. True acceptance rate 2. Retrieval rate 3. False negative identification rate 4. Face detection accuracy
Zafeiriou et al. [24]	2015		1. The comparison between the rigid and non-rigid face detection algorithms is done.	1. Region Of Characteristics (ROC) curve 2. Number of false positives
Orozco et al. [25]	2015	Cascade deformable part model	1. The proposed model can efficiently detect the extremely expressive and partly occluded faces.	1. Precision 2. True positive rate 3. Proportion of images
Zhang et al. [26]	2016	Multitask cascaded convolutional networks	1. High runtime efficiency	1. Validation loss 2. Precision 3. True positive rate
Chen et al. [27]	2016	Supervised transformer network	1. Better face detection 2. Minimum recall drop	1. True positive 2. Precision 3. Recall rate 4. Total time
Zhao et al. [28]	2016	Saliency Features	1. Effective face detection	1. Saliency loss 2. Accuracy
Jiang and Learned-Miller [29]	2017	R-CNN	1. High detection performance 2. Low computational burden	1. Detection rate 2. True positive rate
Yang et al. [30]	2017	Deep Facial region responses	1. Promising face detection performance under severe occlusion and pose variations	1. Detection rate 2. Precision 3. Recall
Hou et al. [31]	2017	Object specific deep features	1. Simple and compact	1. Percentage of remaining pixels 2. Precision 3. True positive rate

TABLE 2 COMPARATIVE ANALYSIS OF THE FACE RECOGNITION TECHNIQUES

Face recognition				
Author and References	**Year**	**Techniques**	**Advantages**	**Performance Metrics**
Liao et al. [32]	2013	Multi-Keypoint Descriptors	1. The proposed method, achieved superior performance in recognizing the holistic and partial faces without requiring alignment.	1. Detection and identification rate 2. Genuine acceptance rate 3. Area under ROC curve
Klare and Jain [33]	2013	Kernel prototype similarities	1. High recognition accuracy 2. Excellent matching accuracy	1. Recognition accuracy
Drira et al. [34]	2013	Geometric framework	1. Better face recognition performance	1. Recognition rate 2. Rank-one score 3. Verification rate 4. Face matching 5. Comparison time 6. Accuracy
Li et al. [35]	2013	3D Kinect sensor	1. Robust face recognition	1. Recognition rate 2. Accuracy

Cui et al. [36]	2013	Learning approach	1. Better face recognition is achieved.	1. True positive rate 2. Accuracy
Yi et al. [37]	2013	Gabor features	1. High accuracy 2. Low computational cost	1. Rank-one recognition rate 2. Mean classification accuracy 3. Standard error 4. Computational cost
Chan et al. [38]	2013	Multiscale local phase quantization	1. High recognition accuracy 2. Low computational cost 3. Better verification rate	1. Mean recognition rate 2. Relative difference of mean recognition rate 3. Rank-one recognition rate 4. Verification rate 5. System accuracy 6. True positive rate 7. Mean score
Galbally et al. [39]	2014	Software-based fake detection method	1. High speed 2. Low complexity 3. Low computational load	1. Average execution time 2. False Fake Rate (FFR) 3. False Genuine Rate (FGR) 4. Half Total Error Rate (HTER)
Best-Rowden et al. [40]	2014	Media Fusion	1. The probability of correctly identifying the person is enhanced.	1. Accuracy 2. True acceptance rate 3. Closed set identification accuracy 4. Detection and identification rate
Chai et al. [41]	2014	Gabor features and ordinal measures	1. Higher face recognition accuracy	1. Recognition rate 2. ROC curve 3. Verification rate
Xu et al. [42]	2014	Data uncertainty	1. High face recognition accuracy 2. Lower computational complexity	1. Recognition accuracy 2. Running time
Xu et al. [43]	2014	Conventional and inverse representation	1. High recognition accuracy 2. Robust to noise	1. Classification accuracy
Schroff et al. [44]	2015	Unified FaceNet embedding	1. High recognition accuracy 2. Low complexity	1. Mean validation rate
Sun et al. [45]	2015	Deep NN	1. Efficient face verification and identification	1. Accuracy 2. True positive rate 3. Verification accuracy 4. Detection and Identification rate (DIR) 5. False Alarm Rate (FAR)
Zhu et al. [46]	2015	High-fidelity pose and expression normalization	1. Improved face recognition in the constrained and unconstrained environments.	1. Recognition accuracy 2. True positive rate
Lu et al. [47]	2015	Compact binary face descriptor	1. Better face recognition 2. Low memory consumption 3. High computational speed	1. Rank-one recognition rate 2. Computational time 3. Area under curve 4. ROC curve 5. Accuracy 6. Verification rate
Lu et al. [48]	2016	Localized multi-kernel based learning	1. More robust to the outliers 2. Noise effect is highly reduced 3. High recognition accuracy	1. Average classification accuracy 2. ROC curve 3. Recognition accuracy 4. Convergence rate
Xu et al. [49]	2016	Structured Dictionary Learning framework	1. High recognition performance 2. High convergence rate	1. Average accuracy 2. Average recognition rate
Zhao et al. [50]	2017	Set-to-Set (S2S) distance measure on deep learned features	1. High face verification and identification accuracy	1. True accept rate (TAR) 2. Correct retrieval rates (CRR) 3. False negative identification rate (FNIR) 4. False accept rate (FAR) 5. FPR
Huang et al. [51]	2017	Landmark-based features	1. Better face identification and verification	1. Identification accuracy 2. ROC curve
He et al. [52]	2017	Structured ordinal measure method	1. High recognition rate	1. Recognition rate 2. Compressed rate
Duan et al. [53]	2017	Local binary feature learning	1. High recognition accuracy 2. Low computational time	1. Binary code length 2. Dictionary size 3. Bitwise shifts 4. Mean verification rate

				5. Area under ROC (AUC)
				6. Memory cost
				7. Computational time
				8. Recognition accuracy
				9. Standard error

IV. CHALLENGES OF EXISTING TECHNIQUES

Most promising face recognition approaches still suffer from a number of challenges such as poor image quality, scale variations, low resolution, illumination variations, pose variations, motion blur and occlusions due to the movement of subjects in video. Hence, face recognition in the unconstrained scenes remains an open issue.

(i) The pose and illumination invariant models are not integrated directly into the face recognition module to manage the time complexities essential in integrating and maintaining separate solutions for pose and illumination variations and face recognition in the unconstrained scenes.

(ii) Software complexity metrics are not adopted to evaluate the soft complexities and performance of the face recognition systems.

(iii) Most of the approaches are computationally expensive to implement and use in practice and the accuracy is highly dependent on the number and quality of the facial features.

Existing video-based face recognition systems perform poorly in practice due to the complex environments that change during the video capturing process and facial models during a preliminary enrollment process. The human recognition abilities have outdated the operations of public security organizations due to the poor visual quality, low resolution, pose and illumination variations of the face images.

V. CONCLUSION

The importance of facial recognition in educational institutions is increasing. However, the implementation of face recognition techniques is not that wide spread in developing countries. As a possible starting point this paper presented a survey about the existing face detection and recognition approaches. Automatic recognition of face has emerged as an active research topic in the biometric systems, pattern recognition, computer vision systems and surveillance applications. Due to the user-friendly effect, the face recognition system is effective than the fingerprint analysis and iris recognition schemes. The face recognition techniques are developed based on the image intensities. Recognition of faces from a video sequence is a challenging task due to the low quality of the video. Also, robust facial recognition is difficult due to the illumination variations and different pose angles. The automatic face recognition system can easily identify multiple faces regardless of the occlusion of the face. For future work we plan to analyze which techniques would best suite the environment in developing countries putting into consideration financial and technological constraints.

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Soft Skills Imparted into Graduating Students of the School of Education at University of Zambia (UNZA)

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Abstract— The school of education at the University of Zambia trains teachers and educators in different fields of education. The curriculum followed was one that provided hard skills and did not consider including a component on soft skills. This study looked at the genre of soft skills that final year university of Zambia students from the school of education possessed and entered the world of reality and employment with after their graduation. The study used a mixed methods design on a population of 150 respondents. The findings revealed that students possessed soft skills like; entrepreneurship, problem solving, lifelong learning and communication skills. The skills they acquired while in the university included; professionalism, maturity, verbal communication and planning. These were acquired through being involved in activities like group related work, peer teaching, internship, role play, membership at associations and presentations in the classes or lectures. The study concluded that the school of education should work towards refining the embedded curriculum being followed or to adopt the stand-alone curriculum. This would help the graduates not to look for employment but be employers if the new curriculum is to be implemented well so as to enhance the graduating students' contribution towards national development.

Keywords—Soft skills; School of Education; University of Zambia; National Development

I. INTRODUCTION

The study of clearing incorporating soft skills in the main curriculum for hard skills has been a call for a number of scholars in the field of education yet little is being done. The study of soft skills gained ground in the 1970s with Katz. In 1974, Katz placed the required skills by effective managers into three categories as being, technical, human and conceptual.[9] noted that technical skills are detail oriented skills that are required for entry level managers. Human skills are those interpersonal skills needed to be able to manage a group of people or interact in a one-on-one format. The two revelations brought about the categorization of hard and soft skills in the world of employment and training. In respect to [7] and [13], hard skills are associated with the technical aspects of performing a job. These skills usually require the acquisition of knowledge which is mainly cognitive in nature and are influenced by the person's education and acquired knowledge in a specific field or specialization.

On the other hand, the term 'soft skills' has been defined by [12] as cited in [1] as follows;

> *Soft skills is a sociological term relating to Emotional Intelligence Quotient (EQ) consisting of clusters of personality traits, social graces, communication, language, personal habits, friendliness and optimism that characterize relationships with other people.*

Most researchers have come to understand that soft skills compliment hard skills. For an organization to flourish and get recognized, the workers ought to have the needed soft skills to sell the products in their positions.[3] and [11] wrote that a person's soft skills are a significant part of his individual contribution to the success of an organization. This is particularly true for those organizations dealing with customers on face-to-face basis. The school of education at the University of Zambia is the production hub of administrators in government and private companies in this country [14]. The products of the school of education are charged with the responsibility of ensuring that they nature and tender the young generation to acquire the necessary skills needed for their survival as they grow up in the different Zambian societies.

The huge responsibility that graduates shoulder requires no question as to why they need to attend interviews to explain the soft skills they have acquired while in the university for them to perform effectively in their positions. The curriculum at the University of Zambia provides students with the necessary skills that enable them interact, share ideas of different opinions in lecture rooms and outside the lecture rooms. Through the mutual interaction that occurs, students acquire knowledge, skills and abilities (KSAs) that every employer looks for in an employee [10]. Another definition worth noting is one given by [19] that soft skills are personal transversal competences such as social aptitudes, language and communication capability, friendliness and ability of working in teams and other personality traits that characterize relationships between people. Traditionally soft skills are considered complementary of Hard Skills, which are the abilities to perform a certain type of task or activity [2].

Recent studies have come to question the curriculum which the various universities and other institutions were

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offering to the people with regards to the relevant skills acquisition. In a study by [13] it was found that curriculum activities that should be incorporated in higher institutions of learning include clubs and associations, preventive maintenance and production units. Indeed, the University of Zambia has such student movements and others which are lecture related. The born of contention has been the genre of soft skills they were acquiring as being students.

A. Statement of the problem

Graduates of the school of education handle young learners and adults in different learning institutions of the ministry of education and the private sector. It is then pertinent that the products of these schools should highly possess soft skills if they are to perform effectively in these complex institutions. What was not known was the genre of soft skills that final year University of Zambia students from the school of education possessed and entered the world of reality and employment with before graduation.

B. Specific objectives

The study was anchored on the following specific objectives, to;i) identify the type of soft skills that the final year UNZA students possessed in the school of education. ii) establish the activities the students get involved in to acquire the soft skills in the school of education. iii) find out what challenges students go through in the acquisition of soft skills; and iv) determine solutions to the smooth acquisition of soft skills.

II. LITERATURE REVIEW

A. Soft skills curriculum

There is scanty literature in the field of soft skill development in line with student preparation. However, general literature provided clear guidance on the gaps which needed to be filled. The literature has been discussed as a whole without any partition into regions and countries of interest.

Soft skills are competencies which are significant to every learner in school; it is important that they are planned for and infused in the national curriculum. Many countries have considered soft skills education to be extra-curricular activities. The Nigerian education system offers two possibilities of curriculum options. These are standalone curriculum and embedded or infused curriculum. [1] and [14] explain further on the two types of curriculum. In relation to the curriculum [11] is of the view that should consider transversal competences -soft skills- and interdisciplinary of utmost relevance. As a matter of fact, we propose the implementation of diverse pedagogical practices, focusing on interpersonal relationships, communication and personal development as concluded in a study conducted in India. However, the current study was conducted in Zambia across the globe thus the need to fill the gap on soft skills at the University of Zambia.

Application of Adult learning theories in the Job Readiness Workshop draws from the transformational theory through the four main components of the learning process [5]. Reference [5] further explained that the transformational theory 10-phaseinvolves four components: "experience, critical reflection, reflective discourse, and action". Andragogical learning theories assume that adult learners bring to the learning process their own body of experiences that will impact their view of how the world works curriculum was an aspect suggested in the findings of [5].

B. Stand alone curriculum

Conversional subjects in this curriculum are taught like independent subjects. The students study deeper in the subject area. The subject might count on the student's passing and certification and is worthy considering in all entries to colleges and universities. The only disadvantage is that it puts additional pressure to the maximum number of subjects prescribed [18]. The assumption has been that if soft skills subjects were offered alone or as separate activities, they will be more time consuming and less effective than if they are integrated into the existing curriculum [15]. It is not clear how the University of Zambia and school of education in particular have developed the soft skills curriculum they are imparting into the final year students.

C. Embedded curriculum

The embedded curriculum has soft skills developed and infused into the different subjects which the learners cram. The duo mentioned that soft skills education curriculum is well taught when it is embedded into the different subjects which the curriculum of a country offers. Many countries have the extra-curricular activities as supplements to the embedded curriculum [12]. This embedment has been compared with the secondary school level of education. The fact of the matter has been that the secondary curriculum is broader hence enables the introduction of soft skills in the subjects. The truth of all the theories is that the curriculum of soft skills cannot be embedded promptly but has to be gradual, systematic and continuous. The sustainability of the soft skills embedment needs government and stakeholder's involvement.

D. Soft skills education

Soft skills education demands many factors in their implementation. Among others is that a dedicated team of teachers and tutors needs to be developed for their success. In developing economies, soft skills education is an emerging issue. Lack of qualified teachers and tutors to foster this education system is supposed to be an issue of priority in the developing countries. The world is changing rapidly and children need to be prepared for this. The jobs that the children in school will take up are not even there on the current market today and they are likely to change jobs at one time [6]. For this reason, children need teachers and tutors who will provide them the skills and attitudes to cope with the unforeseen future, to be able to deal with setbacks and disappointments in a positive way and continue to learn from their life [4]. The school of education is mandated to train teachers and tutors who work in various educational institutions. What was not clear was the amount of soft skills training they acquired being in their final year to enable them

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provide the needed education to the younger generation in Zambia.

Studies conducted in an Indian school have identified a number of soft skills that are offered in their curriculum and education system. In the views of [18], about seven skills have been identified to be taught in the Indian schools and these include; Communicative skills, Thinking skills and problem solving, Team work force, Life-long learning and information management, Entrepreneurship, Ethics, morals and professionalism as well as Leadership skills.The teachers are therefore taught these skills and more in their colleges and universities hence they have the confidence to teach them in the secondary schools of their country.

The researchers did not come across a record on the type of soft skills that teachers possess. It was therefore the basis for this study to fill this gap in the Zambian context with reference to the University of Zambia's final year students in the school of education. A study was conducted by [15] on practical survival skills for music at Laramic Country College in Cheyenne. The study established a list of five soft skills that the music teachers should possess after completing their training in colleges or universities. These included; adaptability, adapting to the environment and understanding what it means to be a teacher. Second is on character. This entails showing the best attitude at all times and being the most dependable member of staff. The third skill is data collection. To always have sufficient information for your work and provide reliable data to the administrators when asked to speak [11]. Communication skills were fourth. This involved keeping the administrators, class and other members of staff in the knowing of the happenings all the time and to never fuel conflict but resolving them as they emanate. The last one was personality. It is important to wear a friendly and smiling face when in difficult times to keep the mood of your audience alive. Over reacting was not the best way but swallowing pride when working with the public is hard yet fruitful. The study did not reveal the methodology used to come up with such findings. This study will employ a mixed method in its quest to achieve the set objectives.

A study conducted by [15] found that Without soft skills, every university graduate faces various challenges in their professional live. With university education, the graduates can practice their profession; they can design a machine, they can cure an illness, they can develop economic growth models but cannot communicate effectively, do teamwork or solve problems. Hence, thousands of dollars are spent for soft skills training in corporate life .An exploratory study on identifying soft skill competencies in entry-level managers was conducted by [16]. The researchers gathered their subjects using career fair participants at one major southeastern university. The sample comprised of college students who worked in the hospitality industry. The findings provided the following list of soft skills. Turns negative situation into a positive/learning situation, handles objections, sees a big picture as well as details, shows a vision, adjusts messages to the audience, holds others accountable for their decisions, holds self-accountable for actions, sets goals, compromises, shows accessibility/approachability, considers the consequences when making decisions, observes the

situation and others' behavior, admits mistakes, resolves conflict, exercises judgment, acts decisively, develops a strategy/plan, listens to concerns, defuses a situation/confronts issues, develop reports. The ability of these potential recruits to communicate with others and to understand others on an emotional level is referred to as having soft skills. Having these soft skills usually determines the difference between success and failure.

III. METHODOLOGY

A. Research Design

In order to fulfill the objectives of the study, a mixed method design was used and the instruments of data collection were be triangulated. Explains that a mixed method combines both qualitative and quantitative methods of data collection and merges them at some point. The qualitative part allowed the researcher to carry out an in depth investigation using focus group discussions so as to understand the soft skills the students possessed in the school of education. A questionnaire was used to collect data for the quantitative objective.

B. Target Population

The target population for the study was the final year students in the school of education at the University of Zambia.

C. Sample Size

The sample size for this study was 150 respondents representing about 10 percent of the fourth year students in the school of education. These were students in the school of education and in their final year of study.

D. Sampling Procedure

The study employed two techniques, namely; purposive and random sampling. Purposive sampling was used to identify 10 sections out of the departments in the school of education. Random sampling was used to draw final year students (respondents) from the 10 sections of the school of education. 15 respondents were sampled from each section.

E. Research Instruments

The study used two instruments of data collection. These were a focus group discussion guide and a likert scaled questionnaire. The two were used in order to do away with the short comings of using one instrument.

F. Focused Group Discussion Guide.

Focus group discussions were held with 8 respondents from each section in the School of Education. This helped the researcher to collect first-hand information from the respondents in an interactive manner. The researcher was able to see and hear from the respondents the various soft skills they have acquired throughout their university life as they enter the world of work.

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G. Questionnaire

A structured questionnaire was used to collect the views of respondents on the types of soft skills they have acquired while attending university education in the School of Education. 7 respondents from each department answered the questionnaire.

H. Data Collection Procedure

Permission was sought from the relevant authorities in the university of Zambia structures to enable the study be carried out.

I. Data Analysis

Qualitative data was analyzed according to themes that emerged in line with the research questions. Responses were grouped and a detailed interpretation was given in line with the main research question. Quantitative data was interpreted through bar charts and pie charts from the given responses using Microsoft excel.

J. Limitations of the Study

Some departments did not have updated records containing the contact details of their students. This limitation was overcome by the researchers' persistence in the search for contact details and actual locations of the students and utilizing a considerable degree of soft skills as researchers.

IV. FINDINGS AND DISCUSSIONS

A. Types of soft skills final year UNZA students possess in the School of Education

The first question sought to establish the types of soft skills that the final year University of Zambia students possess in the school of education.

The study established a number of soft skills that the students in the School of Education possessed. These included; entrepreneurship, problem solving, communication and long life. Qualitative findings added team work and professionalism as the soft skills which the students in the School of Education acquired while in the university. This finding agrees with the study conducted by [2] identified the soft skills which were taught in India as being; communicative skills, problem solving, team work, long life and entrepreneurship skills. One respondent said, "being in the school of education, we are supposed to be told how we ought to dress and behave from the start. However, this does not happen hence we graduate without appropriate professional behavior and conduct." Another respondent added that: "the dressing of a few of our lecturers was not a reflection of the ethics teaching profession. So we fail to copy from them." The study further established that the school of education did not give enough time to the students to be in schools for teaching practice so that they could learn from the reality in schools.
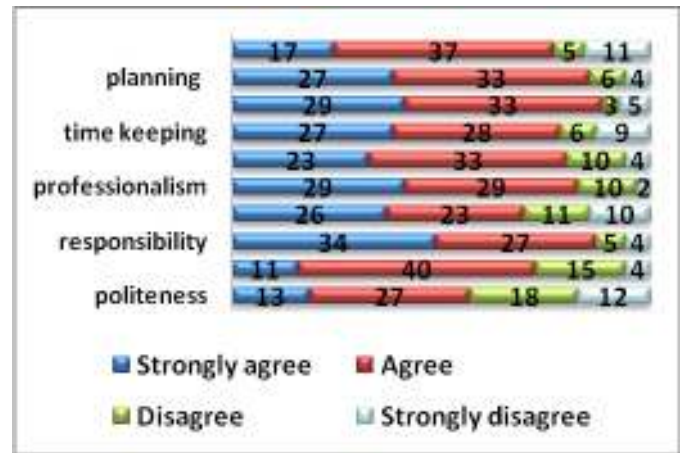

Fig. 1. The types of activities students got involved in to acquire soft skills in the School of Education.

It was therefore, reasonable that these soft skills were identified by the students. These skills seem to be building on the soft skills which they learnt whilst in secondary schools. The above discussion is in agreement with the mental model theory which holds that learning is a process of building mental models from the lower level to the highest level. Students have been depending on each other in their group hence building confidence to be team leaders. Such has enabled them perfect the soft skill of team work as they graduate from the university.

Qualitative findings from focus group discussions reviewed a number of interesting details. Respondents indicated that few of their lecturers had soft skills which were worth acquiring unlike the majority. The respondents established that students learnt to communicate within the university when they were frustrated by their lecturers. One respondent said

"*I have learnt how to write letters of appeal for missing exams and failed tests.*" Another respondent mentioned, "*our lecturers give us group assignment to enable us work in groups.*" Such deliberate assignments enabled learners acquire the art of team work and depend on each other.

On the contrary, One respondent noted, that

"*I see students always going on riots when their allowances are delayed. I wonder if they have problem solving skills.*" Another respondent explained, "*when things are wrong in the university, we expect students to dialogue with management and government so as to solve the problem. The riots are sometimes incited by lecturers.*"

The study also established that lecturers were far from being entrepreneurs because most of them depended on their salary. However, students noted that they became entrepreneurs by assisting 'mature' students with their assignments who paid them handsomely. This finding implies that graduating students are sometimes found lacking in terms of the necessary soft skills needed for the world of work and the ingredient for Sustainable National Development. These findings cement sentiments echoed by [16] that, "*their curriculum is specifically designed to make them technically*

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very sound but they lack in soft skills. This lack of soft skills learning reflects when they face interviews, presentations and public speaking occasions." With regards to communication skills, respondents mentioned that some lecturers were not effective in communicating to the student populous. A respondent recalled, "one lecturer likes pasting notices on the main notice board on changes regarding his lecture time instead of using our class representative." Another respondent pointed out, "it is the reason we go to the road when we have issues because communication is usually a problem."
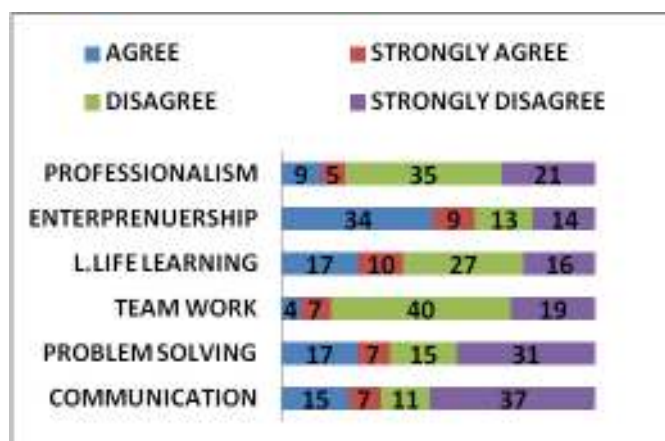

Fig. 2. Respondents' views on the soft skills they had acquired as a result of being a student at UNZA

The study revealed that peer teaching was the most common activity which was used to impart professionalism, maturity, verbal communication and planning into students. Further findings established that students were involved in activities like group related work, peer teaching, internship, role play, membership at associations and presentations in the classes or lectures. These findings tally with [5] who asserted that acquiring basic skills needs practicing the skills being sought for in groups of interest. Deliberate activities like group work and individual presentations which are well designed were a better catalyst to the effective acquisition of soft skills. Teachers involved learners in group tests and assignments and students leant to be responsible through interaction in groups. This finding is married well to the mental model theory because students acquired the soft skills by gathering and putting together the small pieces of ideas into theory and then into practice [16]. The group activities like peer teaching, group presentations and internship were a model for learning how to lead others and eventually actual professionalism in the field of study develops. Exposing students to relevant activities enabled them acquire the needed soft skills in the School of Education.

B. Challenges students go through in the acquisition of soft skills in the School of Education

The respondents outlined a number of challenges which they faced in the process of acquiring soft skills while in the university. A number of respondents were quick to mention that, *"the soft skills were not in the curriculum yet they*

mattered to the students". The respondents established that, *"the university does not hold orientation during the first days to tell the new students what is expected of them, how to behave and conduct themselves socially and academically."*

The study also established that the university does not hold well co-ordinated orientations during the first days to tell the new students what they expect to do, behave and conduct themselves socially and academically. They study also revealed that the soft skills were not planned or enshrined in the curriculum. The study findings are in line with [3] who mentioned that soft skills curriculum can be either embedded or stand alone. In this scenario, the school of education followed the embedded curriculum which never specified the actual skills to be taught in a course. It has been up to the lecturers to use certain activities to enable students interact and acquire the intended skills. This leaves students in suspense because they do not clearly follow and conceptualize what the lecturer is up to in the teaching process. This type of curriculum does not agree with the model since learning is fragmented into unpredictable pieces of knowledge which are sometimes difficult to put together.

Some lecturers were not good examples worthy learning from. The study further pointed out that some lecturers did not display professional conduct in relation with dealing with students, language, dressing and leadership. This left learners wondering what a teacher ought to be if he or she has to be called a teacher and role model to the children. The finding is supported by [21] who noted that an embedded curriculum is widely used in universities because it gives an overload to the students on the courses they take. He further added that professionalism was best acquired from a stand-alone curriculum which had specific courses that trained a student about professional conduct.

C. Solutions to the smooth acquisition of soft skills

The respondents proposed a good number of solutions to the problems they faced in the process of acquiring soft skills whilst in the university and school of education in particular. One of the respondents alluded to the point that,
There the ministry of Higher Education should introduce a soft skills component in the university and college curriculum. This is in line with [12]'s sentiments that, "The Ministry of Higher Education, Malaysia recently announced that the said soft skills are to be introduced to undergraduates of Institutes of Higher Learning in Malaysia. Suggestions on how these elements are to be incorporated in the undergraduates program are also put forward." Another study by [13] is also in tandem with the need to help students to hone the relevant soft skills as employers place significant importance of soft skills. Soft skills training strategies should be tailored to meet the needs of the future.
Other respondents emphasized the need to create robust Information Communication Technology facilities to enhance the acquisition of soft skills. One respondent categorically pointed out that*"The solutions included effectiveness in communication, through provision of unlimited internet access to all halls of residences so that every piece of information is sent via email unlike wasting paper and time to walk to the notice boards."* They also unanimously proposed that teaching

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practice should start in the third year for a full term and end in the fourth year if teachers are to be well trained and acquire enough professionalism skills. They also elaborated that communication skills should be a compulsory course for every first year student. These findings are supported by [12] who argued that communication is a key element in any industrial organization and they deserve high attention from the Human Resources management, not only in the recruitment phase but also during the whole professional career of employees. The importance of enhancing the acquisition of soft skills cannot be overemphasized as can be seen from the current findings. The quality of the industry, in terms of quality of the product, of the organization, of the services and of the workers' life, strongly depends on the Soft Skills possessed by personnel at any level [18]. In a nutshell, the solution to all these challenges was the introduction of a stand-alone curriculum which should have compulsory courses that impart specific soft skills into students.

V. Conclusions recommendations

From the findings and discussions above on the soft skills that the University of Zambia final year students possesses in the school of education, the following conclusions were drawn. a) The soft skills students possessed included; entrepreneurship, problem solving, communication, team work, professionalism and lifelong skills. b) Peer teaching internship, role play, membership at associations and presentations in the classes or lectures were the most common activity which were used to impart professionalism, maturity, verbal communication and planning into students. c) The challenges were that; the University did not hold well co-ordinated orientations during the first days; some lecturers displayed unprofessional conduct in relation to dealing with students, language, dressing and leadership. This left learners wondering what a teacher ought to be if he or she has to be called a teacher and role model to the children. d) The solution was the introduction of a stand-alone curriculum in tshe School of Education and introduce compulsory subjects that directly impart soft skills.

In view of the afore mentioned conclusions, the following recommendations were. a) that the school of education should work towards refining the embedded curriculum being followed or to adopt the stand-alone curriculum so as to embrace the component of soft skills and consequently prepare graduates adequately for their participation in Sustainable National Development .b) that a variety of activities should be used by lecturers during the student lecturer interactions so that students can experience and use the soft skills willingly. c) Peer teaching and school based

internship should be enhanced so as to expose students to the realities which are involved in education. This will help students learn more soft skills from the established mentors and experienced educators.

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Technological Challenges of the Zambian Industry: Are Universities the Solution?

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Abstract – A desk study was conducted to examine the level of technology in Zambia, the technological challenges and the link between industry and the universities. Descriptive analysis was done based on the evidence of works done by various researchers. The study showed that Zambia's industry could be described as mainly primary, with very little processing. The manufacturing (processing) is largely characterized by low technology industries which are mainly processing of food and beverages. There is lack of industry's absorptive capacity necessary for the identification and exploitation of scientific knowledge. This situation arises from the fact that there is no formal link between industry and academia. Evidence from technologically advanced countries shows that collaboration between industry and universities is a necessity rather than a choice. Lack of collaboration between the two sectors impedes development of industry, with the consequence of low quality products. The current study also demonstrates that the Zambian government has not made any major investment in research and development, thus exacerbating the already weak links between industry and universities. It is concluded that unless there is strong collaboration between industry and universities, the former will not derive any scientific benefits from the latter and the status quo will continue.

Key words: Zambian industry, Universities, Collaboration, Technology level

I. INTRODUCTION

Technological advancement is one of the key parameters used in the classification of world economies. This is because technological development can directly be linked to Gross National Income (GNI) and eventually to the incidence of poverty in a country. According to the 2017 reclassification of world economies, Zambia is a lower middle-income economy [1]. This classification puts Zambia in the bracket of those countries whose GNI is between USD1,006 and USD3,955. With this GNI for Zambia, the incidence of poverty is stubbornly high, particularly in the rural areas. The 2015 Living Conditions Monitoring Survey Report shows that 54.4% of the Zambian population (76.6% in rural areas and 23.4% in urban areas) is living below the national poverty line [2]. The report further shows that 40.8% of the population (60.8% in rural areas and 12.8% in urban areas) is extremely poor.

One of the overarching factors for the above situation for Zambia could be the low technological capacity resulting from low investment in research and development (R&D) pertaining to science, technology and innovation (ST&I). The objectives of the present study were:

a) To examine the current technological challenges for Zambia and the nexus between industry and universities; and

b) To recommend how the identified gaps could be bridged to enhance capacity of the Zambian industry to become more productive.

II. RESEARCH METHODOLOGY

The study utilized secondary data that was collected through reviewing various studies conducted within and outside Zambia. The information was synthesized and descriptive analysis done.

III. RESEARCH FINDINGS

a) Current Status of Zambia's Technological Development

Zambia's economy is mineral based, particularly copper production. For decades now, government has been encouraging diversification of the economy by supporting agriculture through the farmer input support programme (FISP). This support, however, has not resulted in tangible job creation since the programme mainly targets resource-poor communities in rural areas, with each household having only 0-2 ha of land. In essence, the FISP is a social security pack rather than an economic package.

In any case, concentration on primary production (for example copper in the mining industry and maize in the agricultural industry) has tended to discourage job-creating sectors such as manufacturing. It has been observed that while Zambia's growth in the economy has been impressive, it has not been accompanied with adequate job creation [3]. It has further been observed that the long-term job creation in copper production has been small and the links to the rest of the economy has tended to be weak [3]. Finally it has been argued [3] that in order to be sustainable and to create productive employment, growth needs to be accompanied by structural transformation. By structural transformation is meant a growing share of manufacturing output in the economy.

While the manufacturing sector exists in Zambia, it is mainly characterized by low-technology industries [3]-[5]. At the global level, Zambia's share of the manufacturing industry is insignificant. This can be concluded from the observation that Sub-Saharan Africa's share of global light manufacturing has dwindled to less than 1% and preferential access to markets in the EU and US has made little difference [3]. Light manufacturing in Sub-Saharan Africa is characterized by a few formal products for niche or protected markets and a vast number of small informal, low-productivity firms providing low quality products for domestic markets. In fact, it is concluded that without structural transformation, Sub-Saharan Africa is unlikely to catch up with more prosperous countries such as China and Vietnam which were not so different economically in the 1980s relative to Sub-Saharan Africa today [3].

As mentioned earlier, the manufacturing sector in Zambia is mainly characterized by low technology industries, particularly processing of food and beverages which takes up about 63% of the manufacturing industry [4]. Other low technology industries that dominate the sector include textiles and leather subsectors, wood and wood products, fabricated metal products, basic metal products, non-metallic mineral products, and paper and paper products. In a survey conducted in the early 2000s, it was reported that the Zambian manufacturing sector was characterized by the following [6]:

a) Inadequate improvements in the technology of the production process;
b) Lack of continuous development of new products and improvement on the old ones;
c) Lack of improvement in the packaging quality of products;
d) Lack of growth in the quantum of engineering and technical skills;

e) Inadequate conformity to standards (quality and environmental);
f) Inability to develop on a continuous basis new marketing techniques;
g) Non responsive organizational modes necessary for acquisition of new capabilities; and
h) Lack of flexibility in the pricing of goods.

A follow-up survey between 2011 and 2012 revealed that Zambia still remained fundamentally a low income country by its structure, and that the manufacturing section was still dominated by low-technology industries, particularly by the food and beverages and fabricated metal products [5]. The study further revealed that out of the product list of goods manufactured in Zambia, high-technology products were largely missing; these included watches, motor cycles, railway locomotives, fibre optic cables, machinery for mining and quarrying, air and space craft, medical and dental instruments, among others. With respect to product quality, the study revealed that 86% of the products exported did not meet the importers quality demands. This probably could be explained by inadequate skilled labour, as revealed by the same study which showed that 41% of the enterprises across the country faced this challenge.

b) Absorption Capacity of the Industries: Is it Critical?

The revelation by the 2011-2012 manufacturing sector survey in Zambia with respect to challenges of skilled labour and low quality products [5] implies that there is a challenge of "absorption capacity" of the scientific knowledge in the sector. In order to benefit from science, firms need to able to identify, assimilate and exploit the relevant knowledge [7]. Thus the firms must employ effort in order to absorb scientific knowledge. This fact was echoed in a number of studies where it was noted that a certain degree of "absorptive capacity" was crucial for the transformation of scientific knowledge into innovations [8] as well as higher firm performance [9], [10]. Since research-related knowledge often resides with the researcher, it is often not easy to be transferred. Thus, industries need a certain level of in-house scientific competence in order to be able to successfully adapt scientific know-how [10].

Clearly, from the studies conducted in the Zambian manufacturing sector, it may be deduced that industries do lack the absorptive capacity that is necessary for the identification and exploitation of scientific knowledge. The inadequate improvements in the technology of the production process, the lack of growth in the quantum of

engineering and technical skills and other characteristics of the manufacturing industry are all indicative of the inadequate capacity to absorb the scientific knowledge necessary for high technologies and high performance.

c) Science, Technology, Innovation and Industry

The stone-age ended not because the world ran out of stones but rather because humans discovered bronze which has more desirable properties and greater functionality than stone [11]. To elaborate on this, science can be looked at as the concerted human effort to understand better how the natural world works, with observable physical evidence as the basis of that understanding. Scientists perform experiments or use other means to test new ideas; they discover new things that change the way society thinks about nature.

Thus scientists generate new knowledge that is used by industry corporations to improve their products and services. Corporations are able to come up with technologies (e.g. machines, electronic devices, food products, packaging, etc.) by using scientific knowledge generated by scientists. Further, innovation (something that is more effective) comes about, often via some engineering process. Clearly, industry cannot advance without science, technology and innovation. Science, technology and innovation is a key tool for moving the world onto a sustainable path [12]. Moving the world development onto a sustainable path depends not only on scaling up of existing technologies, but also radical innovations (including social ones) and changes in mindsets and behaviors.

As indicated earlier, technology is a product of science. Science contributes to technology in at least six ways [13]:

1) New knowledge which serves as a direct source of ideas for new technological possibilities;
2) Source of tools and techniques for more efficient engineering design and a knowledge base for evaluation of feasibility of designs;
3) Research instrumentation, laboratory techniques and analytical methods used in research that eventually find their way into design or industrial practices, often through intermediate disciplines.
4) Practice of research as a source for development and assimilation of new human skills and capabilities eventually useful for technology;
5) Creation of a knowledge base that becomes increasingly important in the assessment of technology in terms of its wider social and environmental impacts; and

6) Knowledge base that enables more efficient strategies of applied research, development and refinement of new technologies;

It is, however, important to note that technological progress is more than a series of supernovae or spectacular discoveries of completely novel materials and processes [11]. Rather, it is often based on sustained efforts of testing new concepts, identifying roadblocks, and pursuing scientific and technical solutions. It relies on a foundation of scientific knowledge, thereby enabling a technology to steadily advance to a point where it can reach a commercial tipping point and make a truly transformative impact on society. On innovation, it is noted that this aspect relies on contributions from basic research to bridge major gaps in the understanding of the phenomena that limit efficiency, performance, or lifetime of the materials or chemistries of technologies [11]. Thus, efforts aimed at understanding the scientific issues behind performance limitations can have a real and immediate impact on cost, reliability and performance of technology, and ultimately a transformative impact on an economy.

d) Academic Research Vs. Industry Research: Do Universities Contribute to the Productive Capacity of Industry?

Both universities and industry conduct research. However, the nature of inventions produced in academia differs significantly from corporate inventions [7]. It has also been observed that while industry R&D is directed at commercial success, university research is focused on solving fundamental science questions [14]. University research can therefore be described as scientific research which aims at developing and testing theories in order to understand why certain phenomena occur. Further it relies on a vivid discussion of earlier research results including a careful documentation of trial and error of the experiments carried out. On the other hand, industry research is mainly focused on exploitation of existing technologies in order to increase profits, for example by altering one component of an existing invention [15].

It has been demonstrated that acquisition of scientific research by firms is beneficial for them as becomes, for example, visible in increased R&D productivity [16] and enhanced patent quality [17] including reduced labour cost. Explanations for these beneficial effects of science in industry include the fact that science provides substantial guidance for industrial research by pointing out promising avenues for future technology development leading to efficiency enhancement and avoidance of wasteful R&D investments and experimentations [15], [18]. Thus

university research has a higher importance for future technological development [16]. Through their activities in describing, using and diffusing knowledge, universities play a crucial role in spurring research and innovation [7]. As part of a national and international infrastructure, universities help advance education and training, assist with technology transfer and can achieve targeted policy objectives. Their activities often generate spillovers for the wider economy by helping firms to expand their capabilities.

In a nutshell, university research is critically important for the advancement of industry. However, university researchers must work in close collaboration with industry researchers. In an historical analysis of the Philips R&D department's management, it was found that a mixture of scientific and industrial skills, knowledge and expertise, together shaped an industrial research culture [19]. Thus university scientists and businesses have a responsibility to work together for the benefit of the public. Thus, increased dialogue between science and industry would be to everyone's advantage [20].

<center>e) Collaboration Between Universities and Industry: The Case for Zambia</center>

There are currently six public universities and more than 60 private universities in Zambia. Yet Zambia still remains a poor country with high incidence of poverty and hunger, particularly in the rural areas. The surveys conducted in 2001-2002 [6] and 2011-2012 [5] showed that Zambia's technological development was still very low. The results from these surveys were supported by another study [3] where it was reported that while Zambia's economy was growing, it was not accompanied with adequate job creation, essentially due to the fact that there was no structural transformation to grow the manufacturing sector. The current manufacturing sector mainly consists of low technology industries. The high technology industries are virtually absent. Majority of the manufactured products are of low quality and do not conform to international quality and environmental standards as clearly shown from the 2011-2012 survey results [5] where 86% of the exported products did not meet the importers' quality demands.

The question is "What is the role of all these universities in Zambia?" Secondly, is there any collaboration between the universities and industry in Zambia? The works which have already been cited [3], [5], [6] do not provide any evidence that collaboration exists between the two sides. In fact there is no mention anywhere throughout the reports about scientific research feeding into industrial technological

development to improve on the quality of the available technologies. What is clear, though, is that the absorptive capacity of the Zambian industries is low and this is confirmed by the 2011-2012 survey [5] where 41% of the enterprises across the country reported the availability of skilled labour being a challenge.

Further, none of the two reports gives any evidence that the Zambian government encourages any collaboration between universities and industry. This is unlike in Europe where the Organization for Economic Cooperation and Development (OECD) offers comprehensive assessments of a country's innovative system, focusing on the role of government to ensure efficient linkages between science and industry. The OECD also helps governments to ensure that investments in science-based education yield net benefits for the economy by identifying good training practices and highlighting future directions to support career development and improved research. In Europe, therefore, policy makers have a responsibility to ensure that policies contribute to improving the quality of life across all segments of society.

<center>IV. CONCLUSIONS</center>

It is acknowledged that scientific research conducted by universities adds value to industrial technological development, not only for the advancement of industry but for improvement of quality of life across society. Thus access to new and appropriate technologies promote steady improvements in living conditions, which can be lifesaving for the most vulnerable populations, and drive productivity gains which ensure rising incomes [21]. In this process, the ability of local firms and enterprises to access technological knowledge-how is fundamental to shaping their ability to provide products and services, both of the kind that are essential to improve living standards, and that could also promote growth and competitiveness. Research and Development done by universities contributes to the knowledge accumulation by industry to achieve the desired technological advancement. Thus for industrial technological development, scientific research is a necessity rather than a choice.

Unfortunately, the Zambian picture does not provide any evidence that there is strong formal collaboration between universities and industry, particularly pertaining to scientific research and technological development. The low technological development in the Zambian industry and low job creation are indicative of the absence of this collaboration. Currently, collaboration between universities and industry is mainly at superficial level

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where industries, through their Corporate Social Responsibility (CSR), "give back to communities" by sponsoring prizes or scholarships for undergraduate students. Finally there is no evidence that the Zambian government has created any platform to foster collaboration between universities and industry. The consequences are grave as evidenced from the various studies.

V. RECOMMENDATIONS

In order to bridge the gap between industry and universities, the following are recommended:

1) In an effort to bridge the gap between university research and industry, government will be the biggest trigger for the two sides to begin collaborating effectively. By integrating science and technology into public policy goals and creating a platform through which scientists from universities and industry (including other stakeholders) can meet and share knowledge, government will effectively close the gap which should lead to R&D taking its position in economic development.

2) Notwithstanding the above, universities and industry should foster stronger communication and more direct technical collaborations between their research communities. This engagement is essential for focusing research attention on key scientific issues that block development of high technologies and for facilitating knowledge transfer to industry.

3) While ordinarily, industry is expected to significantly invest financial resources into scientific research being conducted by universities, the Zambian government must embrace R&D and look at it as public goods, largely to be paid for from the public account. This is because scientific research does not benefit industry alone but the entire country.

4) Media is critically important in disseminating messages about the happenings in the scientific community and technological development. It is therefore essential that some media personnel are specifically trained in reporting on R&D and other scientific issues to help reshape the society's thinking on the value of science, technology and innovation.

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Zambia Business and Economic Model for Social-Conomic Development

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Abstract **- In order to accelerate the economic and social development of the country, the Zambia should design a new innovative business and economic model (BEMo). Unlike the current BEMo, designed in the 1970's and its associated path dependent changes/innovations, the proposed BEMo is not path dependent but rather revolutionary and departs from the tradition.**

Zambia was classified as a middle income country in 1969 but the BEMo that was designed during the second republic (1970) and the current third republic not only pushed Zambia to low-income country but also struggling to attain vision 2030 "*Prosperous Middle Income Country…*" Hence, Zambia needs a new BEMo. for creating, delivering and capturing economic and social values at national level.

The necessary constituent elements of a BEMo are: the right prevailing political ideology with the democratic (efficient, honest and flexible) political institutions, the economic institutions (with ability to innovative, invest, take risk), the supportive economic and social policies, and the competitive business environment.

The new BEMo proposes higher learning institutions as "anchor" institutions for the *State Investment building block* – the value creating building block. In this model, the state investments would utilize the capacities and facilities (expertise, skill, innovations, inno-infrastructure) that "anchor" institutions have. This model also enables development of a *natural triple helix* which is vital for spurring innovation and economic development. The current BEMo has its economic institutions anchored by either political institutions or quasi institutions governed and controlled directly by polity. These institutions (polity) are not vital centres of competence. There is a very weak synergy between higher learning institutions and state investment institutions as well as private institutions. The institutions in the proposed BEMo provides avenue to own property rights, autonomy to operate effectively, strive for excellence, incentive to take up risk, invest and take part in economic activities, while the current BEMo inhibits such.

Just like any enterprise has a business model, every nation has implicitly or explicitly its business model for economic and social development. The proposed BEMo is an economic and social development framework ct and a set of index terms. The Abstract and Index Terms text must be 10 point Times New Roman, fully justified and contained within one paragraph. Begin the Abstract with the word Abstract - in Times New Roman italic. The entire Abstract should be in bold. Do not indent. Use a standard dash after the word "Abstract." Do not cite references or use abbreviations in the abstract. It should be approximately 125 - 175 words. A copy of this abstract will be copied and included in the conference program book so please follow these guidelines to ensure every presentation will have an abstract in the program book.

Keywords - Business and economic model, political ideology, political institutions, economic institutions, business environment competitiveness, anchor institutions, industrial policies, economic actors, Africa development crisis, triple helix

I. Introduction

In order to achieve the 2030 vision, Zambia requires new innovative and responsive business and economic model (BEMo) for the socioeconomic development of the country. The current levels of Zambia's economic and social development can be attributed to the BEMo adopted in the 1970's as a result of the Mulungushi Economic Reforms of April 1969 and its associated modifications thereof to date. In 1969, Zambia was classified a middle-income country, with one of the highest per capita GDPs in Africa; three times that of Kenya, twice that of Egypt and higher than Brazil, Malaysia, Turkey, and South Korea, (Fraser and Larmer, 2010). The business and economic model inherited from the colonial era and the Neolibelism economic policies were responsible for those levels of socioeconomic development.

The social, economic, political, institutional and administrative reforms that occurred in 1970's (era of second republic) as well as those of the third republic (starting 1991 to date) have taken longer to take Zambia

back to the middle-income country. The country requires a new innovative BEMo, that brings about constructive destruction, to become a "Prosperous Middle Income Country…", or indeed to become an "upper-middle-income country ($3,958 to 12, 235 GNI)" and eventually the *higher-income country* ($12,236 and more GNI). Zambia was once a prosperous middle income country; therefore, 2030 vision is a mundane target. The country needs similar business and economic model that propelled countries like Malaysia, Singapore and South Korea, where they are within a span of half a century (see appendix 2 World Bank Group's Classification).

Companies design agile business models to create, deliver and capture economic value through four building blocks, namely, value creation, resource, investment and return elements, in order to survive and outperform competitors in the market place (Fielt, 2014). Similarly, for a nation to deliver its mandate [economic & social impact] to the people, it must design an innovative BEMo that is able to create, deliver and capture the value using five building blocks (figure 2). The business model elements in Fielt (2014) are applicable to BEMo as follows:

- The value creation element – how Zambia seeks to create value for citizens
- The resource element – what resources Zambia needs to access to create value and achieve its teleology
- The investment element – philosophy and methodology for building and financing economic institutions
- The return element – how the government. proposes to capture part of economic value

Thus, just like any enterprise has a business model, every nation too has a business model for economic and social development.

Explicitly or implicitly, every country has a business and economic model it uses to achieve its national economic and impact goals. Nations that have an explicit innovative BEMo register sustained economic and social development and this is true for Asian countries with a strong Mandarin culture – Malaysia, Singapore and Taiwan, which were almost at the same level of development like Zambia half a century but are highly developed than Zambia, (Fraser and Larmer, 2010). Zambia BEMo for socioeconomic development has been implicit rather than explicit. No wander there is anecdotal studies to date that look into or examine the effectiveness of Zambia's BEMo. This paper presents a tentative explicit business and economic model for Zambia. Specifically, the paper presents the concepts and conceptual BEMo. Central to BEMo, are anchor institutions for higher learning (universities) and the synergy between government, industry and universities – triple helix.

II. Background

It is now widely accepted that those countries that managed to catch up with the old industrialized, high-income countries are the ones whose governments proactively promoted structural change, encouraged the search for new business and economic models and markets for channeling resources into promising and socially desirable new activities. None of the countries that strictly followed the Washington Consensus have achieved comparable success in terms of technological upgrading, economic growth, and poverty reduction (Altenburg, 2011, p.1).

Zambia has gone through three paradigms of political and economic dispensation (Nicholas 2013). The first phase was First Republic, 1964-1972 – with neolibelism economic policies adopted at independence; the second phase ushered the Second Republic 1973-1990 where state-led development policies. The ideology of African Socialism with central planning and nationalization economic policies were espoused and followed. This led to a massive nationalization of private businesses to form state owned enterprises (SOEs). The third epoch came with the Third Republic in 1991 to date. The third paradigm can be divided into the Movement for Multi-party Democracy – Chiluba Era 1991-2001, who brought about economic liberalization, free market principles and political freedom – in short, neoliblalism policies or "Washington consensus" was embraced. The Mwanawasa New Deal Administration 2001-2008, he continued with neoliblalism policies, but with moderations in form of state intervention, especially in agriculture industry that was on its knees. After the death of president Mwanawasa, Rupiah Bwezani Banda (2008 – 2011) continued with Mwanawasa policies. The Patriotic Front (PF) era started in 2011 to date, firstly led by the Late President Sata and currently by President Edgar Chagwa Lungu. During the PF, the SOEs to operate side-by-side with investor owned firms (IOFs) were again embraced.

Both state-led and market-led approaches to economic development failed in Zambia as articulated in Bigsten and Kayizzi-Mugerwa (2000, p. 2). A fully recorded history of economics and politics of the past two paradigms were characterized by state and market failures.

While the political paradigms occurred, as illustrated in the previous paragraphs, the institutions generating wealth remained unchanged, or if any, changes have largely been *path dependent*. In fact, the institutions that were mandated to generate wealth during the first Republic have largely remained the same by the subsequent Regimes. Thus, the economic and social development in the nation has brought for the past half a century is as a result of the changing political paradigms but with the same institutions for wealth creation.

In order to attain *Vision 2030 of Zambia Becoming a Prosperous Middle Income Country…",* the nation cannot continue using the same institutions for wealth creation or else the vision to become a prosperous middle income country will not be realized in 2030. To avoid undue delays in attaining Zambia's Vision, an innovative BEMo to industrialization supported by appropriate policies enshrined

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in an appropriate political ideology is required (Kyambalesa, 2015; Saasas, 1987). The challenge for the past implicit BEMo has been to strike a balance between economic institutions that generate (create) wealth and political institutions that regulate and distribute it and the relevant economic and social policies Ferguson (2012).

The questions that require further study of political, economic and business scientists in guiding Zambia as we move forward are: what business and economic model are we using? Are we following the right political ideology? Learning from the past history of political and economic dispensation, are we getting better? Are we using effective and efficient institutions for wealth creation?

III. Research methodology

The paper adopted an online desk research by reviewing what other people have done in the field of economic and institutional models (Crouch and Housden, 2003). The author then synthesized the secondary data in order to model a prototype BEMo for further testing with other research methodologies.

IV. Conceptual business and economic model of industrialization

What is a business and economic model to industrialization? Conceptually, the business and economic model of industrialization is shown in figure 1. From modelist point of view, the business and economic model to industrialization can be described as a framework of political institutions that allocate, regulate, distribute and capture wealth – through national budget – to framework of economic actors and institutions that generate (create) wealth. With the right political ideology and economic policies, the particular nation, sector of economy or region will experience high level of economic and social development (industrialization) if business environment competitiveness is present or promoted.

Figure 1: Conceptual BEMo
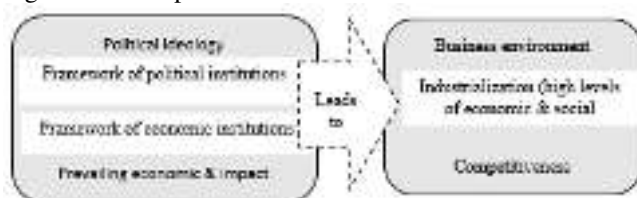
Source: Modified from Alternburg (2011, p6)

A high level of wealth creation requires business environment competitiveness. This takes place in a business friendly environment and where pro-business political ideology and economic policy framework exist. The process of constructing a business and economic model of industrialization depicts government strategy to industrialization.

Essentially, the BEMo to industrialization (economic and social development) is where government strikes the right balance between the economic institutions that generate wealth and the political institutions that regulate and distribute wealth.

Thus, a successful business and economic model of industrialization requires:

a) The political ideology that minimizes political risks (macro and micro risks) (Alon et al., 2006, p. 623-642; Facchine and Melki, 2013);

b) Appropriate economic policies that are not in conflict with political ideology (Altenburg, 2011);

c) The anchor-political institutions to capture, allocate, regulate and distribute wealth; and

d) Anchor economic institutions to create wealth through industrialization that leads into the economic and social development

e) Business environment, competitiveness (ease of doing business, presence of innovative infrastructure, good infrastructure development, independent and impartial legal institutions, etc.)

I.1 Political ideology and economic theory

The political ideology of government in power often affects the choice of economic policies of the country. The choice of political ideology affects economic progress and an enlightened political ideology is envisioned in the context of economics, political science and history. Smith argued that one cannot separate economics, political science and history. Politics is the control of the economy. History is the story fully recorded of economics and politics. They are interconnected (Smith, 1994 p. 22; Facchine and Melki, 2013). Zambia can learn from the past political and economic paradigms in order to develop an appropriate business friendly political ideology and economic theory.

Concerning political ideology, Ferguson said that "We are all state capitalists now! He warned against an unhelpful over simplification to divide the world into market capitalism and state capitalist camps. The reality is that most countries are arranged along a spectrum where both the intent and the extent of state intervention in the economy vary (Ferguson, 2012). The real contest of our time is not between a state capitalist (China or Russia) and a market capitalist (America) with Europe somewhere in the middle. It is a contest that goes on within all three regions as we all struggle to strike the right balance between the economic institutions that generate wealth and the political institutions that capture, allocate, regulate and distribute it.

It is now widely accepted that those countries that managed to catch up with the old industrialized, high-income countries are the ones whose governments proactively promoted structural change, encouraging the search for new innovative business and economic models and markets and channeling resources into promising and socially desirable and sustainable new activities. None of the countries that strictly followed the Washington Consensus, in contrast, have achieved comparable success in terms of

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technological upgrading, economic growth, and poverty reduction (Altenburg, 2011, p.1).

I.2 The framework of political institutions

The frameworks of political and economic institutions are shown in figure 2. The framework of political institutions consists of those that have political power to capture, allocate, regulate/stabilize and distribute financial and non-financial resources through the national budget. The distribution of political power in society is determined by political institutions and the distribution of resources. Political institutions allocate de jure political power, while groups with greater economic might typically possess greater de facto political power. As such, political institutions and the distribution of resources are dynamic state variables. These variables themselves change over time because prevailing economic institutions affect the distribution of resources, and because groups with de facto political power today strives to change political institutions in order to increase their de jure political power in the future.

Figure 2: The model for political and economic institutions

Resource allocation/ holding block	Resource allocation/ holding block	Stabilization & Regulation Block	Core investment and distribution block		Core revenue Collection Block	

Source: Abstracted from Alterman, (2011) and Acemoglu, Johnson and Robinson, (2004)

In driving the economy, Zambia has been using the model of political institutions shown in figure 2 since 1964. The political institutions depicted in the resource allocation and resource distribution blocks have the economic power to direct economic performance and distribution of resources to the rest of the blocks shown in figure 2. This model of political institution has economic institutions that capture revenue for the government, SOEs and institutions that generate impact (education, health etc.). The public sector consists of the political institutions and businesses in figure 2. In a developing country, like Zambia, the efficiency and effectiveness of the public sector enables the private sector (market economy) to thrive and together leads to robust, sustainable economic and social development. Consequently, if the public sector institutions depicted in figure 2 isn't sufficiently innovative, effective and efficient, low level of the economic performance ensures and this explains why it has taken the country half a century to attain the present level of economic development (Lower-middle-income country with $1,006 to $3, 955 GNI).

I.2.1 Origins of Africa's development crisis

The institutions obtaining in state enterprise that are involved in wealth creation affect the performance of the public and the whole nation. The role of institutions is explained in item 5.0. Observing other scholars and activist cases, Humphreys and Bates (2005) and Van de Walle (2001), stressed the inability, or unwillingness, of states implement policies that provide benefits to the broader public rather than to the governments itself, even in the face of the pressures orchestrated by the international financial community. For Englebert (2000), the economic decline of some Africa's states can be traced on political choices of state structures whereby the structures chosen happen to fail to deliver desired results to majority but except a few privileged elite. According to World Bank (1989, 1994), Africa's economic crisis – systematic and internal forces that lowered the rate of return on investments and economic growth rate - emanated from poor public policies and lack of political will to correct them.

In some democracies where political accountability renders the government an agent and the citizens its principal, the interests of the two may not fully be aligned. The government may possess private interests of its own and is therefore a less than perfect servant of the citizenry resulting into properties of game relationship between government and the citizens. The citizens play the game first by choosing a minimum level of acceptable performance by their government. Government's knowledge of what the people want then chooses public policies, seeking to gain the maximum private benefits from offices that are consistent with re-selection. After its term has been completed, the citizens evaluate the government's performance. If some decisive group of citizens approves of, it may choose to renew the government's contract. The game between the citizens and their government is played over an infinite number of periods of fixed length; each player's valuation of utility is given by the sum of welfare in each period, discounted for time. This, of course, is at the expense of sustainable public economic policies.

I.3 Business environment competitiveness

This can be achieved through creating institutions that regulate and intervene in the market to provide a level playing field and existence of colleges and universities that equip the youth with appropriate skills in all fields – agriculture, business, technology, and job creation entrepreneurship. For business environment competitiveness, the World Bank advocates market-friendly approach, but recognizes that there are many imperfections in the markets of many developing nations and thus argues that some government intervention is an effective means of fixing such imperfections.

Business environment competitiveness is important to enterprise, innovation, productivity, efficiency, economic growth, job creation, and improving standard of living and wages. This is achieved by creating an appropriate economic institution such as clusters industrial zones, research facilities, triple helix, and appropriate skills development in colleges and universities and triple helix which has been a key factor in the rise of the United States as a technological

power. The triple helix has been a long tradition of close ties and frequent collaboration between companies and a network of first-rate universities (The Science Business Authors, 2012).

In addition to the traditional function of universities in expanding human capital through education and training and research, universities and colleges world-over play a center role in spurring economic development by developing technology with and transferring technology to local industry and stimulating the creation of new businesses in university-centered incubators and science parks. Technology-intensive companies commonly locate their operations near the best universities in particular fields of science and engineering in order to enable their internal research departments to work with "star" scientists and to recruit promising students (Edmondson et al., 2012, p. 3-4; Paytas et al., 2004 p. 2; Kent, 2006, p.4). Similarly, colleges are an important resource base for creating the high-skills workforce needed to sustain an innovation-based economy. Thus, colleges play a greater role in enhancing workforce skills, relevant to work opportunities, such as manufacturing, computer, and scientific skills, fostering innovation, and enhancing production/manufacturing competitiveness.

For example, the underlying the success of innovation clusters such as Silicon Valley, Route 128, and the Research Triangle of North Carolina are local universities with a longstanding mission of spurring economic development by developing technology with and transferring technology to local industry and stimulating the creation of new businesses in university-centered incubators and science parks. Technology-intensive companies commonly locate their operations near the best universities in particular fields of science and engineering in order to enable their internal research departments to work with "star" scientists and to recruit promising students.[1] For Altenburg (2011), systematic competitiveness encompasses the following matters depicted in figure 3.

Figure 3: determinants of systematic competitiveness
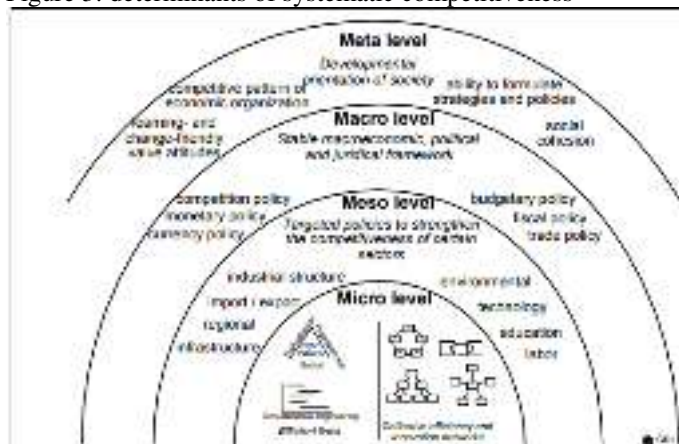
Source: Altenburg (2011, p12)

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[1] http://foreignpolicy.com/2012/02/09/were-all-state-capitalistss-now

I.4 Appropriate industrial policies

A sustainable economic and social development requires a host of policy framework such as human development policy, Science, technology and innovation policy, national investment policy, national agricultural policy, national education policy, land ownership policy, energy policy, transportation and communication policy etc.

Siting an example of a specific policy, the agricultural development policies in Africa have not generally worked – neither the state-led policies of the post-independence period nor the market-liberalization policies that followed. Many policies have not been implemented or have been implemented only in part or very poorly; those that have been implemented well have often not delivered sustainable benefits (Kirsten et al., 2009, p. 7). This is true in case of agricultural and co-operative policy of Zambia and the associated poor performance of co-operative enterprises. Successful countries, according to Altenburg (2011), have followed state capitalism – mixed economic policies.

Industrial policy of centrally planned economies failed miserably, while more moderate strategies of import-substituting industrialization – popular in 1960 and 70s – had limited success in making industries competitive. At the level of specific technologies, billions of subsidies had also been wasted on failed projects, both in developed and developing countries. Hence, even when market failure justifies public intervention in principle, inappropriate policies may have outcomes that are even worse – either due to erroneous assumptions or because public policies are captured by interest groups.

Good policies in a competitive industry promote entrepreneurial responsibility, freedom of contract between economic partners, competition, and a properly working price system form the foundations of a market economy. State intervention must not override these factors. The main task of industrial policy is therefore to set rules that protect industry's competitiveness and increase its potential for growth, job creation, and innovation. Simultaneously, there are situations in which additional state activities are necessary and beneficial, especially those policies that stimulate specific economic activities and promote structural change. As such, industrial policy is not about industry only but also policies targeted at non-industrial sector (services) qualify (Rodrik 2007, p. 3 f.).

A case study of industrial policies of seven African countries found that few countries had policy think tanks that are regularly invited to review policy experiments and inform policymaking. Industrial policies were generally not well coordinated with other related policies, such as Small and Medium Enterprises (SME) policies, investment promotion, trade policies, or science and technology policies. Tunisia and Ethiopia were found to be highly committed to an agenda of industrial development and upgrading, which is reflected in strong investments in industrial capacity building and targeted competitiveness initiatives, including the establishment of a range of sector-

5

specific meso-institutions shown in figure 3. The case study recommended that policy formulation, financing, implementation, evaluation, etc. – should be unbundled. Independent policy think tanks may further ensure that policy decisions are evidence-based and that rent-seeking behaviour is avoided. The whole policy procedure should be designed as a collaborative process of experimental learning (Altenburg, 2011).

V. The economic institutions and actors

Many scholars, including John Locke, Adam Smith, John Stuart Mill, Douglass North and Robert Thomas have emphasized the importance of economic institutions. Economic institutions matter for economic growth because they shape the incentives of key economic actors in society; in particular, they influence investments in physical and human capital and technology, and the organization of production. And according to Acemoglu et al., (2005), differences in economic institutions are the fundamental cause of differences in economic development.

What are institutions exactly? North (1990, p. 3) offers the following definition: "Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction". He goes on to emphasize the key implications of institutions since, "In consequence, they structure incentives in human exchange, whether political, social, or economic".

Economic institutions determine the incentives of and the constraints on economic actors, and shape economic outcomes. As such, they are social decisions, chosen for their consequences. Because different groups and individuals typically benefit from different economic institutions, there is generally a conflict over these social choices, ultimately resolved in favor of groups with greater political power. The distribution of political power in society is in turn determined by political institutions and the distribution of resources. Political institutions allocate de jure political power, while groups with greater economic might typically possess greater de facto political power.

Economic institutions encouraging economic growth emerge when political institutions allocate power to groups with interests in broad-based property rights enforcement, when they create effective constraints on power-holders, and when there are relatively few rents to be captured by power-holders.

Societies are economically successful when they have 'good' economic institutions and it is these institutions that are the cause of prosperity. We can think of these good economic institutions as consisting of an interrelated cluster of things. There must be enforcement of property rights for a broad cross-section of society so that all individuals have an incentive to invest, innovate and take part in economic activity.

Arising from the fact that differences in economic institutions are the fundamental cause of differences in economic development (Altenburg, 2011), the level of

economic and social development in Zambia is behind, for example, that of Malaysia because of the prevailing institutions and the model of political institutions presented in figure 2. The political institutions (allocation and distribution blocks) shown in figure 2 not only create the institutions in other blocks (investment creation, capture and regulators/stabilizer), but also determine the incentives of and the constraints on economic actors therein. In most cases, the economic actors in investment creation, capture and regulators/stabilizer blocks lack incentives to innovate, don't have property rights and final authority to invest but rather behave in line with the wishes of those who hold political power and (allocate) economic power.

In order to accelerate economic and social development, better institutional environment and institutional arrangement or governance structures have been proposed in the prototype BEMo, shown in figure 4. In this model (figure 4), as opposed to that of figure 2, the economic actors are permitted to own property rights, they are incentivized to invest, innovate and take part in economic activities.

Figure 4: Prototype Business and economic model for Zambia
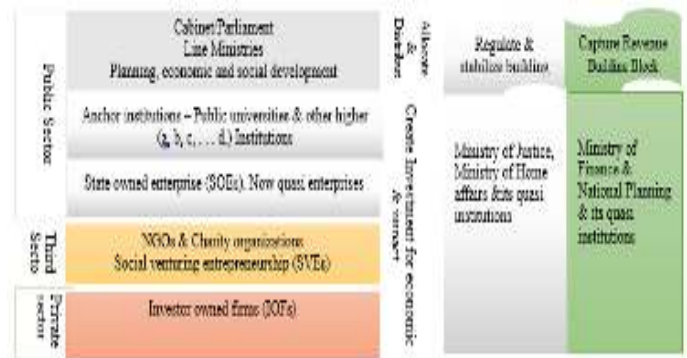
Similarly, the institutional arrangement in BEMo provides economic actors freedom to make economic a nd social decisions to invest in new venture, joint venture, franchise, etc. (see Siame, 2016, p174 business model symbiosis for alternative innovations). It also mitigates rent-seeking behaviours that are common in figure 2.

In prototype BEMo, anchor-institutions for economic and social development (universities in this case) are created. For example, the unbundling the current public universities into specialization such as, university of agriculture and natural resources, university of engineering, technology and communication, university of medicine and natural sciences, university of business and public administration, and university of built environment and mining, as denoted using a, b, c,... in figure 4. These anchor institutions would be given the mandate to superintend on the specific SOEs and institutions, denoted by a, b, c... in figure 4 (see also appendix 1).

Creating the anchor institutions is a political choice the polity has to make in order to allocate resources for economic and social development. The anchor institutions in turn shall assume de facto political and economic power to deliver social-economic development. The behaviour

and activities of anchor institutions bring maximum benefit to the local economy and creates wealth for the local community (Jackson and Mclnroy, 2015; Paytas et al., 2004). Universities and other higher learning institutions play the role of economic actors or anchor institutions in several countries (Nyangau, 2014; Jackson and Mclnroy, 2015; the science business authors, 2012). Therefore the choice for anchor institutions should be measured by available institutions that promote social-economic development, such as ability and motivation to innovate, invest and take risks and centre of competence, excellence and autonomy to operate effectively.

VI.   Creating business environment competitiveness

The conceptual BEMo, figure 1, proposes business environment competitiveness as a key requirement for supporting high levels of economic and social development. Once the anchor institutions have been created, they will be required to design subsequent models to deliver the required variables that   contribute to business environment competitiveness as shown in figure 5 (Edmondson et al., 2012, p. 3-4; Paytas et al., 2004 p. 2; Kent, 2006, p.4; and Altenburg, 2011).

Figure 5: BEMo desired outcome
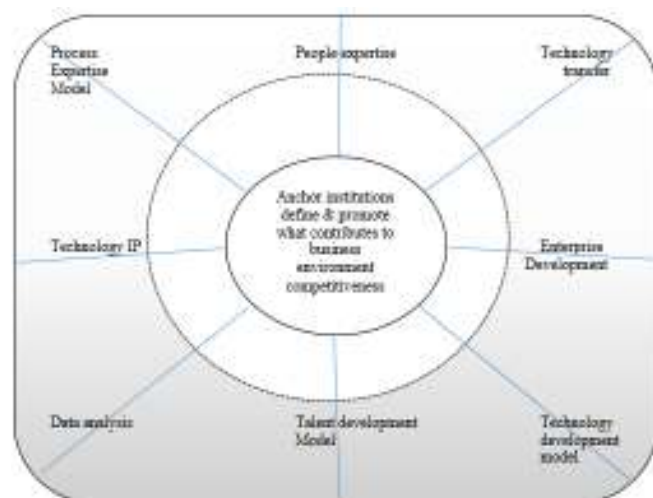
VII.   The Prototype VS the actual BEMo

How does the prototype BEMo differ from the present BEMo? The prototype BEMo has advantages over the current BEMo due to the presence of the indicated institutional variables as explained in Table 1.

Table 1: The BEMO institutions

Institutional variables	Proposed BEMo	Current BEMo
Autonomy	Promotes economic actors autonomy	Inhibits economic actors autonomy
Innovation	Encourages economic actors to	Encourages economic actors to abide by norms

	innovate	
Risk taking	Incentive to take up risk & invest by economic actors	The preserve of polity only @ the expense of others
Property rights	Enables economic actors to own property rights	Suffers from the tragedy of the commons
Triple helix	Natural formation of triple helix model	Dysfunctional - triple helix model is inhibited by self-interest
University start-ups	The model allows universities to create startups by students	The model doesn't allow universities to create enterprise using students

Abbreviations:

CEEC: - Citizens Economic Empowerment Commission
ZDA: - Zambia Development Agency
IDC: - Industrial Development Corporation
ZRA: - Zambia Revenue Authority
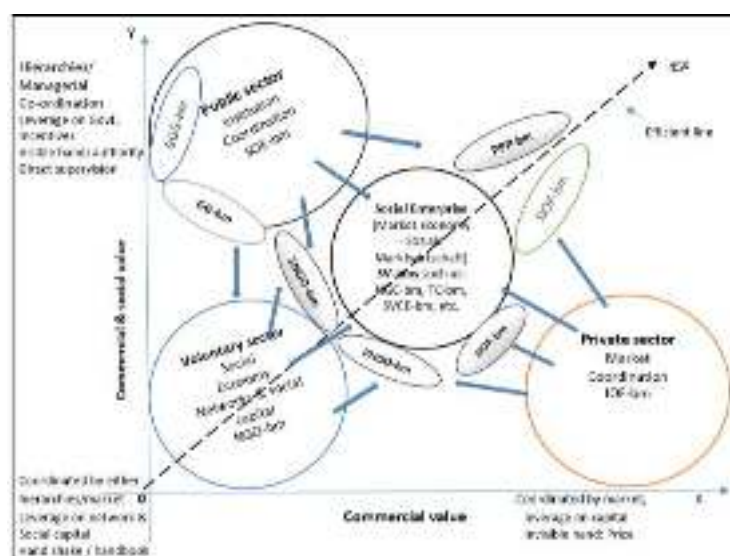GIN: - Gross National Income
NAPSA: - National Pension Savings Authority

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Appendices 1

Example of SOE, IOF, SVE and NGOs Enterprises

Appendix 2

The World Bank Group's classification to define low-income status based on gross national income (GNI) per capita in 2014

Low-income countries (GNI per	Afghanistan, Gambia, Niger, Benin, Guinea, Rwanda, Burkina Faso, Guniea-Bisau, Sierra Leone, Burundi, Haiti,

capital of $1,045 or less)	Somalia, Cambodia, North Korea, South Sudan, Central African Republic, Liberia, Tanzania, Chad, Madagascar, Togo, Comoros, Malawi, Uganda, Congo DR, Mali, Zimbabwe, Eritrea, Mozambique Ethiopia, Nepal
Lower-middle-income countries (GNI per capital of $1,046 to $4,125)	Armenia, Indonesia, Samoa, Bangladesh, Kenya, São Tomé & Principe, Bhutan, Kiribati, Senegal, Bolivia, Kosovo, Solomon Islands, Cabo Verde, Kyrgyz Republic, Sri Lanka, Cameroon, Lao PDR, Sudan, Congo, Rep, Lesotho, Swaziland, Côte d'Ivoire, Mauritania, Syrian, Djibouti, Micronesia Fed. Sts., Tajikistan, Egypt, Moldova, Timor-Leste, El Salvador, Morocco, Ukraine, Georgia, Myanmar, Uzbekistan, Ghana, Nicaragua, Vanuatu, Guatemala, Nigeria, Vietnam, Guyana, Pakistan, West Bank and Gaza, Honduras, Papua New Guinea, Yemen, India, Philippines, Zambia
Upper-middle-income countries (GNI per capital of $4,126 to $12,735)	Albania, Fiji, Namibia, Algeria, Gabon, Palau, American Samoa, Grenada, Panama, Angola, Iran, Paraguay, Azerbaijan, Iraq, Peru, Belarus, Jamaica, Romania, Belize, Jordan, Serbia, Bosnia and Herzegovina, Kazakhstan, South Africa, Botswana, Lebanon, St. Lucia, Brazil, Libya, St. Vincent & Grenadines, Bulgaria, Macedonia, FYR Suriname, China, Malaysia, Thailand, Colombia, Maldives, Tonga Costa Rica, Marshall Islands, Tunisia, Cuba, Mauritius, Turkey, Dominica, Mexico, Turkmenistan, Dominican Republic, Mongolia, Tuvalu, Ecuador, Montenegro

The Use of Open Source Tools in Research

A Case Study of the Mutation of African Cassava Mosaic Virus

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Research continues to be a key to the successful systematic development of new knowledge and a fundamental aspect to the usefulness of all higher education. Particularly, higher education also aims to advance, create and disseminate knowledge through research. However, in many African countries, research is faced with numerous challenges. One of these challenges is the availability of affordable software tools. In this research we use the study of the rate of mutation of the African Cassava Mosaic Virus (ACMV) as a case study of how open source tools can be used in place of expensive proprietary tools. The study of ACMV mutation is hampered by fragmented and non-user-friendly tools currently available. A number of the tools used also depend on network connection, especially the Internet, to access and analyze data. To help alleviate this problem this research proposes the use of open source libraries to generate cost efficient and user-friendly solutions. We further propose the use of an open standard using XML as a standard protocol to share data between applications used to analyze ACMV. Initial results show that it's possible to use free tools to analyze data in the life sciences and consequently reduce the time and cost required to analyze ACMV. Based on this case study we propose the adoption of such open source libraries in order to make research much more affordable for scientists in the life sciences for researches that operate within a constrained budget.

Keywords—Bioinformatics; Open Source Tools; Metagenomics; Software

I. INTRODUCTION

Cassava Mosaic Virus (*Begomovirus*) is one of the major causes of the farmers' loss of cassava yield in Central and East Africa. Cassava is generally cultivated in Latin America, Africa and India. However, species of cassava-infecting geminiviruses have only been recorded in Africa (East African Cassava Mosaic virus and South African Cassava Mosaic virus) and India and its neighboring islands (Indian Cassava Mosaic virus, ICMV). Attacks from the African Cassava Mosaic Virus (ACMV) often lead to a decline in cassava yield.

Finding a solution to the declining yield in cassava caused by the ACMV has been, to a large extent, hindered by the ACMV's quick and unpredictable mutation. Currently, the tools used to predict mutation of the ACMV are fragmented and non-user friendly. Such tools are usually also expensive. Furthermore, a number of the tools used depend on network connection, especially Internet, to access and analyze data. As such, the process of accessing genome databases and that of analyzing the downloaded data on data files is somewhat long. This often hinders the scientists' and researchers' ability to intervene. It is also important to note that most of the analysis is done using several software tools because one tool alone does not give all the desirable output. Therefore, researchers have to manually move data from one tool to the next and sometimes some output from some tools may not be compatible with the file format required as input in the next tool. Life science researchers will often have to use some intermediate tool to convert the output into a format the next tool will accept as input. This often requires more expertise and knowledge than the life science research is equipped with.

Consequently, even though agricultural and biological science researchers, in Zambia, have been working to come up with ways to eliminate or reduce the virus and its effect, the rapid mutation has always out done them. This is due to the major challenges the researchers face, which are related to fragmentation, non-user-friendliness and cost of software tools used. This makes the researchers fail to meet the output rate required to help come up with solutions quick enough to beat the virus' rate of mutation.

In order to overcome the challenge of software tools, this research aims at developing a computational framework, which can be used to determine the rate of mutation of the African Cassava Mosaic Virus (ACMV) in order to provide a tool for

the life scientists who seek solutions to the mutation problem. We further propose the use of open source libraries, which can also be used to develop other tools that can be used to solve other similar problems in the life sciences. For sharing of data and information we propose the use of XML based protocols. The rest of our paper is outlined as follows; in section II we discuss the African Cassava Mosaic Virus, in section III we present various tools which are currently used in the analysis of the mutation rate of ACMV, then in section IV we discuss XML technology, in section V we discuss our proposed solution, in section VI we bring out preliminary results and finally make a conclusion in section VII.

II. AFRICAN CASSAVA MOSAIC VIRUS

A. Yield Dwarfing Cassava Viruses

One of the major yield dwarfing factors of the African cassava is the ACMV. Its prime vector is the African Cassava Whitefly, *Bemisia tabaci* [1] [2]. Studies done between the year 2000 and 2016 indicate that the rate and pattern of mutation in ACMV are unpredictable, thereby always outdoing the farmers and researchers. Since the year 2000 there has been a lot of research on ACMV. Nonetheless, ACMV was first reported in East Africa in 1894 [3]. Vincent N. Fondong and Kegui Chen in [4] said that Cassava geminiviruses occur in all cassava growing areas of Africa and are considered to be the most damaging vector-borne plant pathogens. J. P. Legg et. al. also said the rapid geographical expansion of the cassava mosaic disease (CMD) pandemic, caused by cassava mosaic geminiviruses, has devastated cassava crops in 12 countries of East and Central Africa since the late 1980s [5] and that there is definitely need to find a solution to the ACMV problem. Basavaprabhu L. Patil et. al. suggested that the use of RNA interference (RNAi) is an important strategy for the control of ACMV [6]. The challenge farmers and researchers face with the ACMV is its rate of mutation that has been unpredictable so far. This makes it difficult to find reliable ways to eliminate it. R. C. Aloyce et. al. developed a single tube duplex and a multiplex PCR for the simultaneous detection of African cassava mosaic virus (ACMV), East African cassava mosaic Cameroon virus (EACMCV), East African cassava mosaic Malawi virus (EACMMV) and East African cassava mosaic Zanzibar virus (EACMZV), four cassava mosaic begomoviruses (CMBs) affecting cassava in sub-Saharan Africa [7]. The unprecedented rate of mutation and transmission of the ACMV has been aided by the super-abundant population of the whitefly vector [8].

B. Metagenomics of ACMV

Metagenomics, which is the study of genomic sequences in order to understand relatedness of organisms, has gained ground in the past several years. Metagenomics allows scientists to study microbial diversity and dynamics without having to perform any wet tests in the artificial media [9] [12] and is often used to study mutation of viruses. Often researchers that study this mutation are not specialists in information technology and as such relevant tools used in metagenomics must be efficient and user-friendly.

Most tools used by researchers in Zambia to study plant crop viruses are Internet based. Tools such as NCBI will depend on factors such as bandwidth and connectivity for output. Alicai et. al. in [10] reported the use of a package called Phylogenetic Analysis by Maximum Likelihood (PAML) which Ziheng Yang in [11] said was not the best for phylogenetic tree making because you have to manually modify tree files. With the foregoing, it implies that researchers have to move data from software to software in order to get all components of their desired results.

III. RELATED WORKS

From the information given by interaction with scientists from Mt. Makulu Research Station, in Zambia and our own study of the currently used tools, we outline commonly used tools and what they are generally used for in this section and later on in section V scenario of their uses.

A. Bioedit

Bioedit is an old software tool that is mostly used by scientists for percentage identity analysis and the study of phylogenetic relatedness of different DNA sequences. Virus DNA sequences are compared against other sequences in e-libraries. If the percentage is less than 80 percent the virus being analysed is considered not to be related to the other similar viruses in the database. When used in the study of ACMV Bioedit is often used before using the Sequence Demarcation Tool to prepare the data for export into the other software tools used later on in the analysis. Bioedit can import data from a clipboard as long as the data is in a well-defined format such as fasta files. Apart from clipboard imports, Bioedit can also read a number of formats including ".txt", ".fas", ".fasta", ".fst", ".xml", ".meg" (from Mega) as long as they are fasta file formats. Bioedit also has a NCBI web service capability and it allows for sequences to be viewed in many forms including colour shades on alignments.

B. Mega6 /7

Mega6 is a sequence alignment tool. It aligns gene sequences for comparison of related positions. It is also used for making of phylogenetic trees. Mega7 can read from many file formats but ".txt", ".xml", ".cvs" formats are not supported. Though Mega7 has many things it can do, it does not communicate directly with NCBI. Therefore, data must first be exported to a file before it is imported into Mega7. Furthermore, to achieve basic alignment using Mega tools requires the use of a basic specific plugin.

C. Sequence Demarcation Tool (SDT)

SDT has all the features contained in Bioedit and Mega 6 but is visually more pleasant. SDT is also used mostly for virus percentage identity comparisons. Any percentage above 80 percent may be interpreted as a prediction of relatedness of one or more viruses being compared with a given virus. Such a percentage may also mean the viruses being compared are the same species and strain. A percentage less than 40 will mean a lack of relatedness of the viruses under comparison by DNA or RNA. Apart from being able to align the sequences, SDT also presents pairwise comparison using colour codes. This makes it easy for laymen to understand the identity comparisons. However, the matrix presentation of SDT is not that easy to understand for laymen. SDT can read from many file formats including ".txt", ".meg", ".fas" but does not have a NCBI web

service capability and so data has to first be exported to text files before importing into SDT.

D. Geneious

Geneious is a commercial genome analysis software tool. It has web service support for genome data. It has support for multi file formats for output such as ".txt", ".geneious" and ".csv". It can do all what the previously discussed tools can do from alignments to phylogenetic trees. It however lacks in the look and feel of outputs when compared to the other tools such as that of Mega. For example, the presentation of the alignment output does not have a pleasant look and feel but the phylogenetic tree does. Geneious also has a NCBI web service capability and can also create a local library for offline use.

E. National Center for Biotechnology Information

The National Center for Biotechnology Information (NCBI) advances science and health by providing access to biomedical and genomic information. In the study of the mutation of ACMV, NCBI is used just for percentage identity of microorganisms by comparison with existing organisms already fed into the NCBI genome library. NCBI gives a sequence-by-sequence relatedness of microorganisms like virus strains. Data from NCBI can also be used for DNA/RNA sequence alignment. Data from NCBI can be exported to many file formats including ".txt", ".fas", ".cvs", ".asn", ".json", and ".xml". NCBI provides both data for molecular biology as well as tools to analyse and study this data.

IV. eXtensible Markup Language.

eXtensible Markup Language (XML) is essentially a markup language that defines and outlines a set of rules for encoding data files in a format that is both human and machine-readable. XML was designed to be both human- and machine-readable. For this reason, XML is increasingly becoming important norm and standard for the exchange of a wide variety of data on the Web and distributed applications [13] [14]. Using XML, disparate systems can communicate with each other by exchanging XML messages. Furthermore, XML can also be used to store the data persistently. XML protocols have been developed which can be used to develop solutions that allow two or more applications to communicate in a distributed environment, using XML as the language of encapsulation, storage and transportation. Thus, XML can be used for both storage and transportation of such data.

V. MATERIALS AND METHODS

The main aim of this research is to develop a computational framework, which can be used to determine the rate of mutation of the African Cassava Mosaic Virus (ACMV) in order to provide a tool for the life scientists who seek solutions to the mutation problem. To achieve this, we first begun by conducting a study of online and standalone software tools used by Zambian agricultural and biological researchers to analyze the ACMV genome. Based on this study we then propose a computational framework for the prediction of the mutation of the ACMV and use the framework and open source libraries to start the development of a comprehensive user-friendly tool.

To better understand the usage scenarios, we had audience with researchers from Mount Makulu Research Station in Zambia to find out the procedure used when analyzing genome data for the prediction of the ACMV mutation rate. We will briefly describe the procedure used.

A. CASE OF MT. MAKULU RESEARCH STATION

The researchers from Mount Makulu Research Station took the following steps in analyzing ACMV genome data:

1. Percentage Identity Analysis

Percentage identity is the quantitative similarity between at least two DNA, amino acids and other genetic sequences. The Mount Makulu researchers were always interested in first knowing whether the organism they were studying had already been recorded somewhere or it was a newly discovered organism altogether. In order to do this, they fed their genetic sequence in the *ncbi* library for percentage identity. *Bioedit* is another software tool (standalone), which they could use for percentage identity of multiple sequences, which have been downloaded from *ncbi*. However, they only used *Bioedit* to export the sequences to a fasta format file, which was then imported into *SDT* for percentage identity analysis. The researchers leveraged on *ncbi* only for downloads of similar sequences and not for identity analysis. Using *SDT*, if their sequence got at least 80 percent identity they deduced that the organism under study was either related to those in the library, which had at least 80 percent hit or it was exactly the same as one of the existing organisms. If the relatedness was less than 40 percent, they supposed that their organism could be a new discovery. The multiple sequences of interest identified from the *ncbi* were saved on a file in fasta format for input in Mega 6/7 or Geneious, for sequence alignment. *Although* these researchers used only *ncbi*, it is not the only genome data library; others like *Swis-Prot* and *ExPASy* exist [15].

2. Sequence Alignment

After the identity analysis, the Mount Makulu researchers proceeded to have their multiple genetic sequences aligned in a manner that would allow them to identify pattern consistency or inconsistency which would lead to conclusions on whether mutation occurred or not. The software tools they generally used for sequence alignment are Mega 6 and Geneious.

3. Pairwise Analysis

Following the sequence alignment is the analysis of sequences in pairs for relatedness. SDT is used for this purpose because it displays the results of pairwise analysis in nice colour density grids, which the Mount Makulu researchers find easy to interpret because they are laymen in computer programming. The other reason for their love of SDT is its visual results, which are easy to display for explanation to other laymen.

4. Evolutionary Relationship Analysis

Once the genetic relatedness of sequences has been established and the multiple sequences have been aligned for consistency check and pairwise analysis, the final stage by the Mount Makulu researchers was to show evolutionary

relationship of the many strains represented by the individual sequences. This was achieved by creating a phylogenetic tree using Geneious.

The four stages of genome data analysis have been summarised using the flowchart in figure 1. Each process shape contains a stage of the genome data analysis and the software tools used by Mount Makulu Research Station researchers to achieve their desired output. Some of software tools can do more than what the researchers use them for.
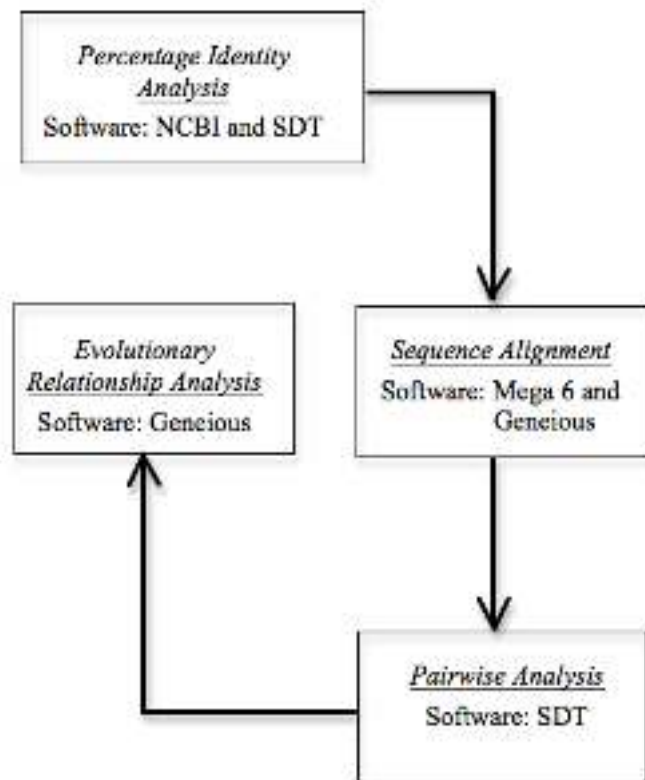

Figure 1: Stages of Genome data analysis carried out by Mt. Makulu Research Station researchers. Research software tools included

B. Proposed solution: OPEN SOURCE SOFTWARE (Bio-pyhon libraries based tool)

We observed that some of the challenges in arriving at a timely solution to the ACMV are the rate at which the virus mutates against the software tools that give output slowly and the availability of affordable fast output software tools. In striving to provide a solution to the challenges, we delved into the study of Bio-python libraries to find cheaper and quicker ways of carrying out the same analyses described in sub-section A of section V. We discovered that the analyses could be done using some Bio-python modules, methods, functions and few other integrated open source tools as described in sub-sections 1 to 4 that follow.

1. Percentage Identity Analysis

Bio-python has a function *qblast( )* that calls the NCBI Internet blast module *Bio.Blast.NCBIWW*. This function can successfully be used to create a web service to be used for searching the NCBI library for related sequences of any microbe being studied. The NCBI genome library can be downloaded onto a local storage using Bio-python. Once this is done, a *blastx* Bio-python wrapper *Bio.Blast.Applications* module can be used to create command-line strings for blast purposes (identity searches from the local genome library). Blast is faster if the genome data sits on a local storage. The blast output using Bio-python libraries include XML. This makes it possible to come up with a framework that helps various software tools to communicate, knowing that XML is universal standard. The blast output can successfully be parsed using Bio-python XML parsers when carrying out analyses.

2. Sequence Alignment

Using Bio-python, sequence alignment (from few sequences to many) can be achieved by utilising *Bio.AlignIO.read( )* function (for very few sequences) and *Bio.AlignIO.parse( )* function (for multiple sequences). The output can be written to a file of any fasta format including XML using *Bio.Align.Write( )* or *Bio.Align.convert( )* functions. *Bio.Entrez* is a parser for parsing the XML alignment files. Bio-python has command-line tools for multiple sequence alignment; *Clustalw* and Clustalx are the most popular. They must be installed on a local pc first before an alignment is done. Bio.Align.Applications module in Bio-python has a wrapper for the tools. When we tested alignment using Mega 6 and Geneious, it took over an hour to have the sequences aligned. Using Clustalx command-line tools took only slightly over 30 minutes, during our comparison test.

3. Pairwise Analysis

In order to carry out pairwise analysis using Bio-python, the *Bio.pairwise2* module does the work. The input is mostly a fasta file but the module allows programmers to create their own functions. This is a plus in that during the creation of our own functions we could use XML files which is our proposed file share standard. Pairwise analysis is just an alternative to the sequence alignment described in sub-section 2 of section V (B).

4. Evolutionary Relationship Analysis

Evolutionary relationships are easily presented using phylogenetic trees. Bio-python has *Bio.Phylo* module for phylogenetic tree creation. PhyloXML feature of the same module helps to create XML phylogenetic trees. Phylo module can read from .dnd and .xml files. Having implemented this step of genome data analysis, figure 2 shows a portion of an ascii phylogenetic tree while figure 3 shows a portion of a PhyloXML tree, both created using bio-python libraries during our testing the Bio.Phylo module of bio-python.

Figure 2: Screenshot of a portion of Bio-python ascii phylogenetic tree output and creation code

Figure 3: Screenshot of a portion of Bio-python PhyXML phylogenetic tree output and code (in insert)

Generally, we observed that it is possible for us to use the XML standard for data transfer between modules and functions of Bio-python. This would make data sharing universal because XML is universal. Figure 4 presents a summary of the proposed solution and computational framework that uses Bio-python libraries; modules and functions. File sharing will be done through XML files. One XML output of one module or function will serve as input into the next module or function and this will go on until the final desired output or visual representation. The final product will be a software tool with graphical user interfaces for easy use by lay people in the underlying computer science.


Figure 4: Proposed solution and computational framework of open source tools using Bio-python libraries

VI. PRELIMINARY RESULTS

We tested the five existing software tools that are used by local researchers, in Zambia, to study genome data of the ACMV and found that the total time taken to go through all the desired steps was at least nine (9) hours; one process ran infinitely. When we used libraries from the proposed bio-python we ran through all the steps within three (3) hours, which is at most one-third the time it took while using the preexisting software tools. Our implementation of the Evolutionary Relationship analysis appears as screenshots in figures 2 and 3.

VII. CONCLUSION

In this research we propose a computational framework that uses preexisting tools to offer a comprehensive user-friendly tool that will be used to determine the rate of mutation of the African Cassava Mosaic Virus. After analysis of the steps and procedures involved in the analysis of the mutation of ACMV we further propose the use of Bio-python, which has libraries that have many capabilities from sequence alignment to

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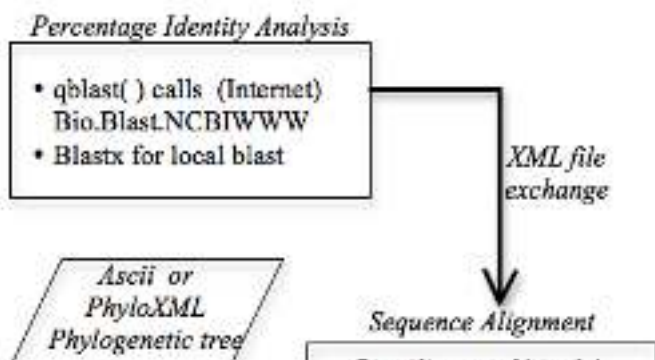
pairwise analysis of genome data and phylogenetic tree production. We observed that downloading the genome libraries to local servers would make genome analysis faster. We also observed that the use of XML files would help with the various components of the software tools communicating with each other in form of output to input relationship. Fortunately, Bio-python has methods for downloading genome data and can read from XML file as initial input and at any level of analysis. This is a score to meet our aim of developing a computational framework that uses preexisting tools to offer a comprehensive user-friendly tool. This tool will be used to determine the rate of mutation of the African Cassava Mosaic Virus.

Biological science and agricultural science researchers in Zambia at the time of this research used manual feeding of data into each software tool used to analyse the genome data of the ACMV for its mutation. Developing a comprehensive user-friendly tool that will be used in the study of the mutation of ACMV should improve the rate at which solutions against the virus are provided. This will help in enhancing resistance to the virus, in the cassava, and thus improve cassava yields.

For future work we plan to implement data sharing using an XML based protocol for sharing information between the different stages of the analysis stages. Using this protocol, we can implement a distributed solution that takes advantage of high performance architectures and hence enhance performance of the integrated tool. We also plan to do a survey to get feedback from the life science researchers on how to better the comprehensive customized tool.

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Social Enterprises Skills Development in Kenya

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Abstract—**Social enterprises are created to further a social purpose in a financially sustainable way by providing income generating opportunities that meet the basic needs of people who live in poverty. Universities can contribute to social change by shifting their focus in training to influence social change through, among other things, incorporating social enterprises training and practices. This paper reports results of a study that was carried out in universities in Kenya to establish the extent to which they were implementing social entrepreneurship training. Specifically the study sought to the find out; i) if and how universities in Kenya were providing students exposure to social enterprises, ii) The nature of entrepreneurship training in Kenyan universities, and iii) the kind of innovations that were being generated from Kenyan universities and to what extent the innovations related to social enterprise development. The study utilized a mixed-methods approach utilizing desk research, and stakeholder interviews with university leaders, implementers and policy makers in Kenya. The study reveals that entrepreneurship courses are popular in all the universities that participated in this study. These courses are offered at undergraduate and post graduate levels as either full programs or course units in different combinations. The entrepreneurship courses offered in the universities are however more focused on developing business entrepreneurs and are weak on social entrepreneurship skills both in content and delivery methods.**

Key Words: *Social Entrepreneurship, Skills training, Business incubation*

I. INTRODUCTION

Universities around the world play a leading role in their countries' economic development efforts as they pass knowledge on to the next generation and create new knowledge through research. Over the years, development models have evolved from focus on just economic development to include social well-being and lately also environmental sustainability. Universities can fit in the new responsibility of enhancing societal well-being by investing in training for development of social enterprises. Social enterprises provide a means to achieving triple benefits of improved social wellbeing, environmental sustainability, and better economic performance. They are purpose-driven organisations that trade to deliver social and environmental impact by combining financial sustainability with social and environmental leading to human development.

Universities can offer students more exposure to social enterprise training that provides students and graduates with the opportunity to develop enterprise skills, which are applicable in sustainable business ventures. Studies have shown that higher levels of education can produce better entrepreneurs by equipping them with skills to better evaluate the opportunities as they arise [1]. The idea is that graduates with entrepreneurial skills may have more chance of creating work and livelihoods for themselves. More universities around the world are paying attention to entrepreneurship education. Some of universities combine this training with their community engagement projects. In this way, students learn to be social entrepreneurs: people who can set up and run community projects while a few institutions nurture social entrepreneurship by setting up incubation centres dedicated to this work.

This study sought to establish whether Kenyan universities were taking this or similar approaches to social entrepreneurship training. The study involved eight public universities in Kenya (University of Eldoret, Jomo Kenyatta University of Agriculture and Technology, Kenyatta University, Karatina University, Egerton University, Maseno University, University of Nairobi, and Masoned Mulino University of Agriculture and Technology) and three government institutions, the Commission for University Education, Kenya Vision 2030 Secretariat and the National Commission for Science, Technology and Innovation.

II. METHODOLOGY

The study used a mixed-methods approach utilizing desk research, and stakeholder interviews with university leaders, implementers and policy makers in Kenya (Figure 1). The findings from these sources have been triangulated to provide a comprehensive picture of the state of ongoing efforts and emerging opportunities in social enterprise development training, and entrepreneurship innovations coming out of public universities in Kenya. In particular, the study examined policy frameworks, priorities, agendas, and strategies that shape the development and strengthening of quality social enterprise skills development in Kenya.

Fig. 1. Study Methodology

III. RESULTS

A. *Entrepreneurship programs in Kenyan universities*

Entrepreneurship programs in higher institutions of learning play a crucial role in acquisition of entrepreneurial knowledge, skills and values [2]. The level at which entrepreneurship training is offered and its content coverage

influences students' entrepreneurial orientation [3]. This study established the all eight universities which participated in the study offer at least one course unit on entrepreneurship. Entrepreneurship courses in Kenyan Universities are offered at undergraduate and post graduate levels as either full programs or course units.

Six out of the eight Universities have full programs in entrepreneurship. However, only one has established full programs on entrepreneurship from undergraduate to PhD level. Two out of the six have established a full program at bachelors and masters levels. Three universities offer the entrepreneurship course as a university common unit. In some universities this course unit is offered as core course only in business schools but optional for other schools.

This indicates that universities in Kenya are increasingly adopting entrepreneurship courses and programs to equip their graduates with relevant skills and knowledge. The intention is to influence students' attitudes towards self-employment and build their capacity to be entrepreneurs. Universities are however investing in business entrepreneurship as opposed to social entrepreneurship as evidenced by their content and delivery methods.

Social entrepreneurship focus is largely lacking as the courses we examined tend to focus more on developing entrepreneurs who can handle self-employment and create their own work. The course content had little or no focus on social entrepreneurship. This makes sense when considering the country's broader policies on job creation and entrepreneurship. For instance, Kenya's Vision 2030, the country's economic blueprint outlines the government's commitment to creating an environment in which all citizens embrace entrepreneurship and innovation through training [4]. The intention is to equip learners with knowledge, skills and competencies so they can work and earn a living but social entrepreneurship is not emphasized in the document.

Though universities are taking their cue from government policies, there recently have been calls from Kenyan researchers to shift universities' entrepreneurship training from purely focusing on economic development to also include social responsiveness [2]. This is because social enterprises have the ability to bring change for the better by tackling social problems and improving the lives of individuals and their communities. They achieve this by facilitating the flow of resources to where they have the largest economic and social benefit [5] (world Bank, 2014). This makes social enterprises especially suitable for Kenya and other developing countries.

B. *Prioritizing Social Entrepreneurship*

Delivery Methods

There are problems even where universities do offer social entrepreneurship training. The teaching methods used are not necessarily fit for purpose. Most of the entrepreneurship courses use lecture method with very limited practical training. [6] notes that higher-learning institutions should make their degrees more engaging and hands-on by blending the traditional economic and business dogmas with real-world, practical experiences and operational challenges. Educational methods suggested by researchers to make social entrepreneurial learning truly

valuable include case studies, role plays, project based methods, guest lectures from business practitioners, peer assessment and reflective accounts [7] [8] [9][10].

Peer assessment and reflective accounts are also useful tools, but are largely lacking at the eight universities. These approaches are important because social entrepreneurship training should blend traditional economic and business lessons with real-world practical experiences and challenges.

Business incubation in universities in Kenya

Business incubators do not just offer entrepreneurship training to business students. Instead, they work with undergraduate students across diverse faculties [11]. They provide a platform where ideas are nurtured into viable business through expert mentoring; some help students access initial funding for their ideas. Some universities in Africa and around the world are deliberately adapting their curriculum to nurture social entrepreneurs at various levels undergraduate and graduate. Currently, there are about 7 000 such centers worldwide (https://inbia.org). Apart from countries like Nigeria and South Africa, these centers are not particularly widespread in sub Saharan Africa. University business incubators are only just becoming more common in Kenya and not much information is available on their achievements and performance.

Most Kenyan universities however have some kind of systems in place at different levels departmental, faculty or institutional to support business innovation ideas. These focus on intellectual property units, innovation databases and the allocation of budgets for innovation. The incubation facilities provide space within which students and staff are trained, mentored and facilitated to develop financial and socially viable ideas and products. This is done mostly on individual basis where students approach their lecturers with ideas for advice. In this case where faculties have established some form of incubation system they act as a link between the staff and students. The innovations incubated through these systems over the past decade have addressed a range of themes among them Agriculture and Information Communication Technology. Around 50% of these interventions can be categorized as social enterprises.

Business Innovations in universities in Kenya

This study also looked at entrepreneurship innovations developed in Kenyan universities with and without incubation, with intention to categorize those that would lead to development of social enterprises. Within the last ten years, seven (7) of the eight (8) participating universities have had different forms of innovations some of which could be categorized as social entrepreneurship innovations. Table 1 presents innovations both registered and unregistered under various thematic areas.

TABLE I. INNOVATIONS IN KENYAN UNIVERSITIES WITHIN THE LAST 10 YEARS

TABLE I. INNOVATIONS IN KENYAN UNIVERSITIES WITHIN THE LAST 10 YEARS

Registered either by university's intellectual property rights, Kenya Institute of Property

** Information not available at the time of publication*

● *More than half of total university innovations*

The innovations undertaken by the eight participating universities address a wide range of thematic areas: agriculture, health, energy, business, environment and infrastructure and services such as water and sanitation. From the study findings agriculture has been attracting the most significant number of innovations among all the other themes. This demonstrates that innovations in universities are responsive to relevant socio economic issues such as climate change and food insecurity. Information and Communication Technology (ICT) is also a common theme across all the 7 universities and is a key enabler of innovations in institutions of higher learning.

IV. CONCLUSION

This study revealed that entrepreneurship courses are popular in all the eight universities that participated in this study. The courses are offered at undergraduate and post graduate levels as either full programs or course units in different combinations. The entrepreneurship courses offered in participating universities are however more focused on developing business entrepreneurs and are weak on social entrepreneurship skills. The courses do not adequately reflect social enterprise training. These courses rely on lecture methods and the other forms of pedagogy which are crucial to providing social entrepreneurial skills like, internships, case studies, role plays, project based methods, and guest lecturers from business practitioners, are lacking to a great extent.

Innovations are an important pathway through which social enterprises can be developed as it facilitates the linkage between social entrepreneurship training and practice. Universities in Kenya are only recently putting in efforts especially after the establishment of the NACOSTI which is encouraging innovations beyond basic research.

This study established that universities in Kenya are encouraging innovations by providing innovations resources to staff and students, and rewarding staff through promotions. Many universities are also incubating business ideas to lead to innovations. These incubation facilities are established either at the faculty or/and university level.

Innovations are an important pathway through which social enterprises can be developed as it facilitates the linkage between social entrepreneurship training and practice. Universities in Kenya are only recently putting in efforts especially after the establishment of the NACOSTI which is encouraging innovations beyond basic research. This study established that universities in Kenya are encouraging innovations by providing innovations resources to staff and students, and rewarding staff through promotions. Many universities are also incubating business ideas to lead to innovations. These incubation facilities are established either at the faculty or/and university level.

This study did not find evidence of deliberate efforts to emphasize social entrepreneurship though about half of the innovations in the study universities over the last 10 years actually fall in the category of social entrepreneurship. To achieve desired results, universities in Kenya should intentionally prioritize social entrepreneurship training and innovations by engaging in appropriate pedagogy, encouraging social enterprises innovations, and setting up dedicated business incubation centers.

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Redefining Development Model For African Nations From An Outside In To Inside Out Approach

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Abstract— Africa needs a development model that is not only effective but consistent with its inner convictions for sustainability. Inner convictions drive the direction and destiny of its masters. Imposing direction and conduct on people with variant convictions has not only proven ineffective but a major drain of limited resources. This paper discusses fundamental issues upon which effective paradigms that can drive sustainable development for Africans are founded. The paper looks at fundamental principles of existence that not only guide nature but decide the natural fate of human actions. The principles discussed in this paper are fundamental to development of ethics and a productive culture at all levels of society including individual, institutional and national levels. The paper exposes among other things forces responsible for; i. Keeping African Nations in development circus. ii. Keeping African Nations as development consumers and not initiators and iii. Poor governance. Finally although the paper is written in simple to comprehend manner it is founded on proven scientific principles.

Keywords— Development model; inner convictionsn; Fundamental Issues; Sustainable Development

I. INTRODUCTION

This paper is an explanatory research aimed at identifying root problems responsible for Africa's underdevelopment. The author combines a philosophical approach and modern scientific guidance to come up with natural principles are fundamental to the development process. The author introduces some new terminologies to define new concepts and redefines some terms to express their conceptual meaning. The new definitions do not alter conceptual meaning of the affected words. They rather introduce a perspective with broader application for the affected words without altering their traditional meaning. New terminologies that have been introduced are meant to convey concepts that are vital in re-orienting the mindset of Africans for positive actions and behaviour.

The researcher identifies the outside in development approach as a root cause to the development challenges associated with most African Nations. He argues that the outside in approach to development pursued by most African Nations is in essence not development at all when development is viewed from its conceptual sense. The outside in development approach associated with most African Nations is more of an imitation rather than development. The researcher advises a change in the mode of development from an outside in approach to an inside out approach by refocusing the mind from development imitation to development based on ideal mental frameworks. The inside out approach to development focuses and thrives on compliance with laws that govern nature and determine the fate of entities in existence.

The researcher unveils what he terms the principle law of existence which acts as an ideal or standard for understanding and assessing human behaviour. The research lists some conditions that define the ideal or standard framework that complies with the principle law of existence.

Statement of the problem

Most African countries are endowed with abundant natural resources but still remain amongst the poorest nations of the world. Zambia, for instance, is the 48th poorest nation in the world out of 189 countries captured according to the Global Financing Magazine of 13th February 2017. The Democratic Republic of Congo, rich in mineral resources, is the second poorest nation in the world. A lot of questions can be posed to find out where things are going wrong including questioning the calibre of manpower being trained to uplift the socio-economic status of respective nations and the type of research needed to provide lasting solutions… [13]

A. Specific objectives

The study was anchored on the following specific objectives; i) to identify root cause of recurring development problems associated with most African Nations, ii) provide a lasting solution to Africa's development problems.

Sociology is the scientific study of social behaviour and human groups. It focuses primarily on the influence of social relationships on people's attitudes and behaviour and on how societies are established and changed. [8]

Sociology emerged in Western Europe in the late eighteenth century during the Enlightenment (also known as the Age of Reason). Spurred by dramatic social changes such as the Industrial Revolution, the French Revolution, urbanization, and Capitalism, intellectuals during this period promoted the ideals of progress, democracy, freedom, individualism, and scientific method. These ideas replaced those of the old medieval order where religious dogma and unquestioned obedience to royal authorities dominated. They also believed that society itself could be analyzed rationally. Out of this intellectual mix, several key theorists laid the foundation for contemporary sociology thought. [4]

Our capacity as cultural animals distinguishes us from all other species. Many species, such as starlings and dolphins have complex communication systems. Many species such as honey bees and meerkat, have elaborate social systems. Many species such as elephants and octopi exhibit social learning and tool use. However, no other species that we are aware of innovates, accumulates, and transmits ideas, information and practices on the scale or at the rate that we do. [7]

An attitude is a set of beliefs that we hold in relation to an attitude object, where an attitude object is a person, thing, event or issue. [6]

In reality, the term science does not refer to a special group of highly advanced fields. Rather, it refers to two things: (1) a set of values and (2) several methods that can be used to study a wide range of topics. In deciding whether a given field is or is not scientific, therefore the critical question is, Does it adopt these values and methods? To the extent it does it is scientific in nature. To the extent it does not, it falls outside the realm of science. [5]

[5] States four of most important scientific values as:

Accuracy: A commitment to gathering and evaluating information about the world (including social behaviour and thought) in a careful, precise, and error free a manner as possible.

Objectivity: A commitment to obtaining and evaluating such information in a manner that is as free from bias as humanly possible.

Skepticism: A commitment to accepting findings as accurate only to the extent they have been verified over and over again.

Open-mindedness: A commitment to changing one's views-even views that are strongly held-if existing evidence suggest that these views are incorrect.

An argument is a set of statements, one of which is called the conclusion, is affirmed on the basis of the others, which are called the premises. The premises of an argument are offered as support (or evidence) for the conclusion, and that support (or evidence) may be adequate or inadequate in a given case.

But the set of statements counts as an argument as long as one statement is affirmed on the basis of the others. [2]

A valid argument is one which the premises support the conclusion completely. More formally a valid argument has this essential feature: It is necessary that if the premises are true, then the conclusion is true. Two key aspects of this definition should be noted immediately. First note, the important word "necessary". In a valid argument there is a necessary connection between the premises and the conclusion. The conclusion doesn't just happen to be true given the premises; rather, the truth of the premises. We could put this negatively by saying that a valid argument has this characteristic: It is impossible for the conclusion to be false assuming that the premises are true. Second note that the conditional (if-then) aspect of the definition. It does not say that the premises and conclusions of a valid argument are in fact true. Rather, the definition says that, necessarily, if an argument is valid, then on the assumption that its premises are true, its conclusion must be true also. [2]

A valid argument has this essential feature; It is necessary that if the premise are true, then the conclusion is true. [2]

A sound argument has two essential features; It is valid, and all its premises are true. [2]

Methodology

A. Research Design

A scholarly definition is given by [9] that, "…a research design is a plan on how a study will be conducted or a detailed outline on how an investigation will take place."

This research focuses on the question why is it going on and not what is going on. What is going on in development with regard to African Nations and Zambia in particular is properly defined in the concerns of the conference as given by [13]; Most African countries are endowed with abundant natural resources but still remain amongst the poorest nations of the world.

The question this research is trying to answer is why African countries are poor when they have abundant natural resources.

This research is an explanatory research. As an explanatory research, the research focuses on why questions. An example given by [4] is; it is one thing to describe the crime rate in a country, to examine trends over time or to compare the rates in different countries. It is quite a different thing to develop explanations about why the crime rate is as high as it is, why some types of crime are increasing or why the rate is higher in some countries than in others.

The researcher adopted root cause problem solving strategy outlined below by [10];

The Research Procedure

The objective in root cause procedure is to discover the points of leverage where patterns of behavior originate and can be

changed. The challenge lies in being able to distinguish between problem symptoms and problem causes.

Problem symptoms

What people traditionally call problems are frequently only symptoms of problems. For example, the problem of decreased sales is really a symptom of whatever is causing sales to drop, which is the real problem. Defining a problem in terms of its symptoms obscures the real cause and leads to symptomatic solutions that fail to correct the basic condition.

Problem causes

Problems are undesired results caused by structural relationships among system components. When these relationships are complex and hidden, traditional problem solving is not effective and another technique is needed.

Root cause problem solving consists of discovering and correcting these structural relationships. This process is called leverage and requires a systems approach to identify the system dynamics creating these outcomes.

Differentiating between problem symptoms and problem causes

Problem symptoms and problem causes can look very much alike. For example the cause of a defective product could be identified as a final inspection problem, a process control problem, or a material procurement problem, yet all of these could be symptoms of a management problem. The following process will help identify fundamental problem causes.

1. Identify the undesirable condition that needs to be corrected or the events associated with this condition.

2. Use the "multiple why" process to identify the causes underlying this undesirable condition.

This process is an adaptation of a Japanese quality technique. It consists of continually asking "why is this occurring?" to each explanation and subsequent explanations until a common cause is identified.

3. Continue this "multiple why" process until a fundamental or root cause is apparent.

Structural relationships are identified when the explanation changes from one system component to another.

Example, the explanation for homelessness moves from society (unemployment) to the individual (addiction) or when the explanation for a quality problem moves from manufacturing (defective product) to procurement (improper material).

A simplified root cause problem solving process

1. Select the most significant problem symptom and ask, "Why is this occurring?"

Describe the symptoms using all the specific facts and data available. This will enable a more focused examination of the conditions needing correction and a more precise definition of the problem.

Example, "Why are we unable to sustain operating profits higher than our cost of capital?" is more informative than "Why are our profits down?"

Record all of the explanations.

2. Repeat this questioning for each explanation.

Record and compile all additional explanations.

Identify any emerging patterns.

3. Continue this process until these explanations converge into some fundamental causes.

Avoid fixation on events or on blaming individuals.

Focus on systemic explanations.

4. Define the problem or problems by describing the root causes creating them.

Accurate problem definition is critical for the development of meaningful solutions.

Identify the system structural relationships that are creating the conditions that need correcting.

5. Determine the action or actions needed to change the system relationships creating the problem or problems.

III.   FINDINGS AND DISCUSSIONS

The Relationship between Nature and the Human Mind

Nature refers to the reality that exist independent of human thinking, action or behaviour. Man himself is part of nature. The mind is central to man's thinking, actions and behavior. The relationship that exist between nature and man through the mind is a very important relationship in understanding the wellbeing of mankind on planet earth. Man's rational actions and behaviors come from the mind and depends on how man interprets his environment. Man's environment is made up of the natural and artificial environments. The natural environment is the dominant environment because it governs the artificial environment. Both man and his artificial environment are subject to natural laws that govern nature. For example the law of gravity is not limited to natural entities such as animals and plants, it applies equally to artificial products such as buildings, cars, planes etc. There is nothing that man has created that is above natural laws.

Natural laws function in the same manner as civic laws. The purpose of all laws whether natural or manmade, is to ensure order and sustainability. Laws are forces that are responsible for or aimed at creating and sustaining order and intended function in their domain or area of jurisdiction. Natural laws are forces responsible for creating and sustaining order and function of all entities in the universe. The domain or jurisdiction of natural laws is universal. Manmade laws are

forces aimed at creating and sustaining order and function in their particular domain or territory. Human laws that apply in a particular state, country or region do not apply in other states, countries or regions. They have limited jurisdiction of enforcement. On the other hand, natural laws are universal. The laws of nature do not apply only to earth or some sections of the earth. Our entire universe follows the same laws. And these laws never change they are in force everywhere in the physical universe.

What governs the impressions we encounter in nature are laws of nature. The laws of nature are empirical statements which cannot be proved, but are nevertheless valid. Nature does not express its laws, they need to be discovered. What we see or experience in nature are impressions of nature resulting from the effects of its laws. The laws of nature are only identified and formulated through observation. All of modern science rests in the belief that rational laws, exist in the universe. Coffee left on a counter will always become cool. Heat always move naturally from a hot medium to a cold medium and not the other way. Gravity remains steady, never random. The speed of light remains constant. The earth rotates in 24 hours.

Understanding nature and how it relates with man is important in understanding how man should relate with and behave in nature. We can change how man relates with and behaves in nature and not how nature relates with man's actions and behavior.

The big question arising from the above statement is; do laws of nature apply to human behaviour?

Figure 1 which illustrates the fundamental relationship between nature and man suggest that man's rational actions and behavior are based on man's interpretation of nature.
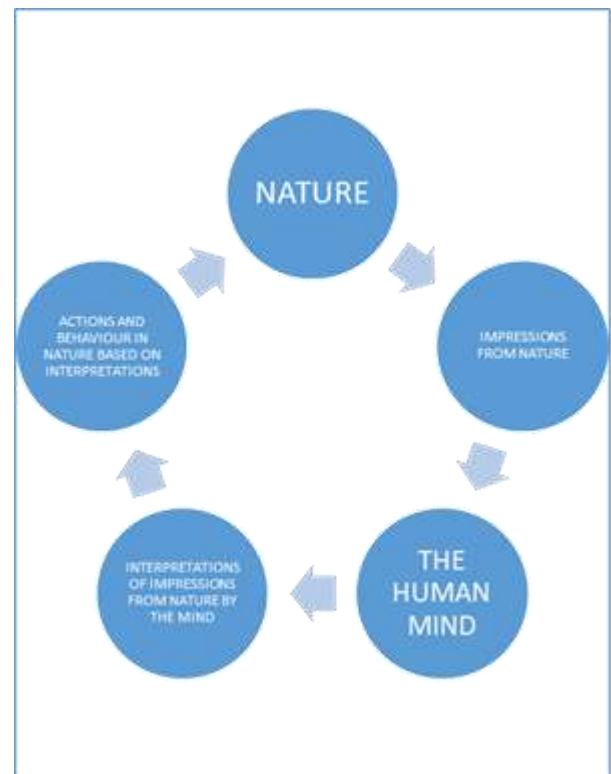

Figure 1. Illustration of the fundamental relationship between man and nature

The figure above demonstrates the fact that the human mind receives impressions from its environment which include nature and manmade environment. Considering the fact that things that are constitute the manmade environment are subject to laws that govern the natural environment, the manmade environment is not included in the illustration above.

The manmade environment comprise outputs that are products of man's mind and nature A society's interpretations of its environment together with the associated manmade objects, institutions, etc. define the culture of that particular society. The success of a particular society is dependent on how its culture relates with nature. Nature's determinant factors are its laws. Societies flourish or struggle in nature depending on whether their interpretations of nature, actions and behaviors are in compliance with the laws of nature or not.

The laws of nature are very important factors in determining success of people on planet earth. Without the laws of nature we would have had a very limited knowledge of the physical, chemical, astronomical, and biological processes occurring in the world around us. Science mostly relies on the fact that fundamental principles are identified and classified, even when different effects are studied. The laws of nature enable

us to make predictions and make technological development possible. All engineering constructions and all technical manufacturing processes are based on the laws of nature. The reason why the construction of a bridge, a car, or an aircraft can be planned in advance, is that the relevant laws of nature are known. Without knowledge of the laws of nature, there could have been neither chemical nor pharmaceutical industries.

Discovery of the principle law of existence

By consistently asking the questions why to a number of socio economic and national development problems associated with African Nations over a long period of time, about 20 years, the researcher stumbled at a natural law that seem to govern all entities in the universe and determines fate of their actions and behaviors. The laws governs all entities in the universe including mankind.

The principle law of existence states; **an entity in the universe shall exist as a unity-in-diversity entity that operates as an interdependent system in a higher interdependent system and unity-in-diversity entity.**

Entities that comply with the principle law of existence flourish in the universe whilst entities that ignore the principle law of existence struggle or perish in the universe.

Understanding the principle law of existence

All entities in the universe such as planets, moons, minor planets, stars, galaxies, the contents of intergalactic space, and all matter are frameworks of functionally different sub entities that are individually vulnerable but corporately invulnerable under a common framework. The principle natural law of existence supports existence of unity-in-diversity entities that are functionally different but united in common purpose to flourish in the universe.

Interdependent systems (ecosystems)

The researcher divided interdependent systems in the universe into four broader categories; non-living interdependent systems, biological interdependent systems, social interdependent systems and integrated interdependent systems.

Non-living interdependent systems (Non-living-ecosystems)

Non-living interdependent systems refer to interdependent systems of non-living things. Non-living interdependent systems include all non-living bodies in space from the smallest building blocks of matter, the atoms to larger bodies in the cosmos and artificial entities. Examples of non-living interdependent systems include atoms, molecules, elements and substances, bodies in the cosmos, the solar system, and other galaxies.

From an atom to the cosmos, all entities have a structure in form of a universe as redefined and an operating system in form of the interdependent or ecosystem as redefined.

An atom is a unifying framework of its functionally different sub entities, the electrons, protons, and neutrons. The electrons, protons and neutrons are mutually dependent on each other in fulfilling their common roles that define the role of the atom. Therefore an atom and all matter built from it has a structure in form of a universe as redefined and operates as an interdependent system.

An atom and all other non-living matter built from it are therefore unity-in diversity entities. They all have sub entities that play different roles but united in purpose and habitation. Artificial nonliving interdependent systems include such things as machines, computers, factories etc. Artificial nonliving unity-in-diversity entities include artificial entities such as buildings, bridges, roads etc. All unity-in-diversity entities have a structure.

From the principle law of existence we can say that all things in existence have a structure.

By viewing all nonliving entities as interdependent systems and as unity-in-diversity entities or in other words as systems and structures a number of important relationships have been discovered in physics and chemistry.

Some outstanding relationships regarding a system include laws of thermal dynamics and laws of motion.

The laws of thermal dynamics and laws of motion have been and still remain instrumental in understanding and solving problems in chemistry and physics.

Biological Interdependent Systems (Biological-ecosystem)

A biological interdependent system is a network of biological entities. Examples of biological interdependent systems are organisms, or on the organ and tissue scale in mammals and other animals, the circulatory system, the respiratory system, the nervous system, etc.
On the micro scale, examples of biological systems are cells and organelles.

Knowledge of biological systems and structures is instrumental in understanding and solving problems in biological entities including human beings.

Social Interdependent Systems (Socio-ecosystems)

Social interdependent systems describe those interdependent systems that have two or more rational entities interacting or associating. This paper is focusing on associations of human beings as interdependent social entities. The simplest social interdependent system is one that involves two people. Other social interdependent systems include family, community, and

other institutions that include political, social, economic and religious or faith institutions.

Integrated Interdependent Systems (Integrated-ecosystems)

Integrated interdependent systems are an aggregation and interaction of the non-living interdependent systems, biological interdependent systems and Social interdependent systems.

The integrated interdependent system is a universal system.

The researcher focused on social interdependent systems in line with the objectives of the paper to solve socio-economic challenges that are prevalent in Africa and Zambia in particular.

Conditions defining an ideal social system that complies with the principle law of existence.

For any social system or entity to operate in an orderly and sustainable manner it must meet the following ideal conditions;

1. Presence of functionally different entities that are individually vulnerable but are complementally to each other.
2. A unifying objective
3. A unifying structure and system
4. A governing law or legal framework and a unifying
5. A government
6. Presence of a conducive environment that is also a unity-in diversity entity and interdependent system.

The society that meets the ideal conditions described above, forms the ideal object that human societies are trying to achieve to comply with the principle law of existence.

The research identifies the above ideal social institution as the standard against which all human institutions and actions or behaviors can be judged as right or wrong, healthy or unhealthy, rich or poor, productive or unproductive, effective or defective.

This means that we now have a model or standard against which we can judge our actions and behavior as opposed to a situation where we don't know why an action or behaviour is right or wrong, good or bad.

The realization of an ideal social institution is a major breakthrough in solving human problems. For this new paradigm and approach of problem solving to be effective there is need to formalize the discipline that stands on this paradigm.

The researcher proposes the construction of a new discipline called Social Engineering.

Social Engineering

Social Engineering is inspired by the principle natural law of existence and the ideal social institution. The concept of social engineering differs from other existing fields in humanities and social sciences on the basis of how problems associated with humanity and society are viewed.

A social engineer will be trained to look at social related problems from a structural and system perspective in light of the ideal social institution. Some of the roles that will be carried out by social engineers among other things include the following:

1. Education of the masses on the existence of the principle law of existence and the importance of complying with the principle and the implications of ignoring the principle.

2. Design of institutions that comply with the principle law of existence and

4. Identify and fix institutional root problems in light of the ideal social institution thereby effectively solving symptom problems.

What other people may consider to be complex and confusing humanitarian or social problems, to a social engineer is a matter of system or structural problems in relation to guiding laws of nature.

Examples of structural and system problems that appear complex.

An example of structural and system problems that appear complex is that of low productivity, lack of well-structured commerce and unemployment in Zambia.

From a social engineering perspective the ideal situation in Zambia should be that of the ideal social institution.

The ideal social institution meets the following conditions which entities in Zambia should comply with in order to flourish.

1. Presence of functionally different entities that are individually vulnerable but complementally to each other.
2. A unifying objective
3. A unifying structure and system
4. A unifying law or legal framework and a unifying government
6. Presence of an environment that is also a unity-in diversity entity and interdependent system.

Where the above conditions are not met, the following problems will surface;

1. Problems associated with the absence of functionally different entities that are individually vulnerable but complementary to each other.

Specialization is a prerequisite to industry and commerce. Where there is no specialization there can be no industry or

commerce. This problem is typical in rural settings where people are not trained in specific fields.

The absence of industry and commerce leads to low productivity and low trade. Therefore the root cause of low productivity and low trade in rural parts of Zambia hinges on the absence of functionally different entities that are individually vulnerable but complementary to each other or in other words the absence of specialisation.

2. Problems associated with absence of a unifying objective.

Let us assume the first condition is met as is the case in urban settings where there are number of graduates trained in different fields and are individually vulnerable but complementally to each other.

This condition or problem of have graduates that are trained in different fields showing signs of vulnerability is what surfaces is or manifest as unemployment.

In an ideal situation this condition of unemployment fulfils the first condition but not the other conditions necessary for a functional entity.

The first problem that is identified is that of lack of a unifying objective by the specialized graduates.

In an ideal situation graduates in different fields are supposed to unite under a unifying object to marshal their different inputs. The unifying object should specify what unified entity will take the market.

After coming together, they need to establish a structure and put in a system that will allow them operate and meet their common objective.

For the structure and system to operate effectively and efficiently they need guiding laws and governance.

After sorting out internal requirements they need be in an environment that is has higher entities that are functionally different and need other complementally entities to care for their vulnerability.

The above ideal system illustrates that life is a system of systems. Without the higher the lower systems cannot function and without the lower systems the higher system cannot function. Systems are interdependent.

The absence of a higher system in the system equation.

Imagine in the village set an individual undertakes to specialize in a particular field. The individual will surfer vulnerability and ridicule in the absence of complementally entities and a functional system to employ his specialization.

This is why it looks like madness to undertake a specialisation in a village set up. The conditions in the village do not allow specialisation.

The Outside in vs. Inside out Development Model

The researcher identified the outside in approach to development as a root cause to development challenges facing African Nations and Zambia in particular.

The outside in approach to development is an imitation of development processes and structures of developed Nations.

The fundamental ingredients that are associated with an inside out approach to development are absent in an outside in approach to development making the later weaker and exposed to many challenges.

Successful existing development products comply with the principle natural law of existence.

Examples of existing successful development products of other cultures other than African Nations include; Industrialization and its outputs, education systems anchored on specialisation, economic institutions, political institutions, business institutions etc.

They fulfil conditions defining a healthy social ecosystem entity

As earlier described for any social ecosystem to be complete and operate effectively it must meet the following conditions;

1. Presence of functionally different entities that are individually vulnerable but complementally to each other.
2. A unifying objective
3. A unifying structure and system
4. A unifying law or legal framework and a unifying government
5. Presence of an interdependent environment.

The above criteria is fulfilled by existing western institutions such as government and other corporate institutions as follows:

1. Developed Western Institutions such as governments and corporate organizations meet the first criteria. Western governments are founded on separation of powers which fulfils the first requirement of the presence of functionally different entities that are individually vulnerable but complementary to each other. The three wings of government namely, the legislature, the executive and the judiciary fulfil this requirement.

Were separation of powers is ignored system problems manifest which temper with the effectiveness and success of governance. These system problems arising from ignoring the need for separation of powers constitute a fundamental cause of governance problems in African Nations.

2. Existing Western Institutions have well defined objectives that unite and direct their institutions.

Most African societies associate without defined objectives to direct their corporate objectives. People live together in communities without specific objectives to marshal their corporate energies.

The lack of corporate objectives in rural setups or in associating group constitute a fundamental cause of development inertia.

3. Established Western Institutions have well defined organisation structures and operating systems that are in line with the requirement of a unifying structure and system.

Most African associations have no defined structures and operating systems. An example is a farming community that has the same objective to grow a particular crop. These communities for lack of a unifying objective and unifying structure and system will resort to individual production models such as subsistence farming. Nature has many examples to illustrate that the sum of individual efforts is less than the output of a unified entity or system. The system benefits from synergy which results from integrated efforts.

African Nations embrace the illusion that they can sustain their economies on individual efforts. They finance subsistence at the expense of systems.

4. Established Western Institutions have well defined unifying law or legal framework that governs the actions and behaviors of its constituent entities.

Most African associations lack a unifying law or legal framework.

5. A unifying government: Established Western Institution have well defined governments or managements that rule by the established organisation or institutional law or constitution.

Most African associations lack well defined governments or management structures.

The above mentioned system problems constitute fundamental causing factors to most institutional and social problems in African communities.

Problem analysis using root cause method

Example
Do Africans or Zambians conceive intended mental frameworks or pictures that comply with the principle law of existence?
The principle natural law of existence states; an entity in the universe shall exist as a unity-in-diversity entity that operates as an interdependent system in a higher interdependent system and unity-in-diversity entity.
In other words do Africans or Zambians conceive intended mental frameworks that are unity-in diversity entities that operate as ecosystems?

Possible answer; this activity happens in the mind as such it is difficult to see. We will proceed to the next stage to get guidance on this question.

2. Do Africans commit intended mental frameworks or pictures that comply with the principle law of existence?

Possible Answer. No they don't.

3. Why do Africans and Zambians in particular not commit intended mental frameworks or pictures that comply with the principle law of existence?

Possible answers:
1. Africans and Zambians in particular conceive intended mental frameworks or pictures that comply with the principle law of existence but do not have the skills to put their thoughts to paper.
2. Africans and Zambians in particular have the skills to put their thoughts to paper the challenge they have is to conceive intended mental frameworks or pictures that comply with the principle law of existence.

Of the two scenarios above, the first one is easier to analyze and document than the second one. Basing the judgment on the number of university and college graduates in African communities and Zambia in particular that are literate with the ability to express their thoughts on paper, it is a fair judgment to say the first assumption is not correct.
Since the second assumption is a direct opposite of the first it fair judgment to say the second assumption is representative of the facts on the ground.
Therefore we can identify the challenge to conceive intended mental frameworks or pictures that comply with the principle law of existence as a root cause to innovation.

The ability to conceive intended mental frameworks or pictures that comply with the principle law of existence is a prerequisite to an inside out development model and innovation.

Conclusion

Africans are visually impaired in terms of development hence their reliance on the outside in mode of development which is not congruent with their inner convictions and culture. External development model embraced by Africans is not internalized due to incongruent beliefs that are contrary to beliefs behind the embraced development. Africa has a choice to make out of two options of realigning its beliefs with the embraced external mode of development or pursue development that is in line with its fundamental beliefs in order to get out of its development circus.

Africa's beliefs which are tied to how Africans view the world are defective. Africa's perception of the world is yet to produce development that we can count on. Africa is an underdog or loser in the continental development game.

Africa cannot get out of its development circus without the aid of development spectacles. Africans need development spectacles to up their development game. The lens through which Africa views reality and development is impaired.

Recommendation

Africans need to revisit the way they interact with nature. The casual manner that characterize Africa's interaction with nature cannot continue in the 22nd Century. Africa must change its game plan if it is going to be taken seriously in its development quest. The business as usual attitude exhibited by African countries that hold firm to their traditional crude beliefs and practices whilst anchoring their lifeline on outputs of progressive nations must come to an end.

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The use of Information and Communication Technology to Teaching and Learning in Schools

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Abstract— Policymakers who have invested in the use of ICT in education are often motivated by its promise to realize pedagogical innovations. However, the unrelenting gap between the promise and performance of ICT has continued to prompt further research into how the affordances of technology can be better harnessed in schools. This three-year qualitative case study hopes to shed light into this matter by looking at the: 1) ecological factors of how an ICT-enriched Secondary school in Zambia had been using technology to support the pedagogical reform for student-centered learning; 2) conditions that led to its sustained use of technology for this purpose. Complexity theory was employed as the analytical framework for the study. By examining the inter-connectedness of systemic influences governing the use of ICT in the selected schools, educational leaders and policymakers can gain a holistic perspective of the factors that may promote or impede technology integration effort.

Keywords— Information, Communication, Technology, Computer, organisationInfor Introduction

1.0 INTRODUCTION

Through the use of interviews, lesson and meeting observations as well as document analysis, the trajectory of the school's ICT journey was mapped out. The development history surrounding the use of technology for teaching and learning provided a precursor to investigate how the school organisation as the unit of analysis had created favourable conditions leading to the sustainability of ICT-related innovations. Specifically, five themes had emerged: 1) continuous scanning of environment; 2) multi-pronged capacity building efforts; 3) mitigating systemic tensions amongst stakeholders; 4) shared accountability and 5) systematic pacing. Based on the findings to the study, a complexity-informed model for technology leadership, stakeholders' dynamics and guidelines for policymaking were drawn up. The dissertation concludes with reflections on the use of complexity theory and recommendations for future research. The role Information Communication Technology (ICT) play in the educational and learning environment cannot be over emphasized. The use of ICT in modern learning environment ranges from slice use of computers in practical aspects to an online learning experience which enhances and improves students" intellectual and learning behavior (Smith, 2003). With the introduction of computers, the precursor of our modern-day ICT, and the promising potentials of computer-based instruction and learning,

many researchers and funding agencies were led to invest much of their resources to investigate the possibility of computers replacing teachers in key instructional roles.

Moreover, many people believe that computers should be brought into the education arena simply because "they are there" and the resultant perpetuation of the myth those students would benefit quantitatively from computers by simply providing them with the software and hardware for an effective learning process (Wheeler, 2010). We are living in a constantly evolving digital world. ICT has an impact on nearly every aspect of our lives – from working to socializing, learning to playing. The digital age has transformed the way young people communicate, network, seek help, access information and learn. We must recognize that young people are now an online population and Internet access is through variety of means, such as computers, TV and mobile phones (Tapscott, 2005). As technology becomes more and more embedded in our culture, we must provide our learners with relevant and contemporary experiences that allow them to successfully engage with technology and prepare them for life after school. It is widely recognized that learners are motivated and purposefully engaged in the learning process when concepts and skills are underpinned with technology and sound pedagogy. Learning and teaching aim to provide resources for practitioners, parents and pupils to engage with these technologies in order to inform and enhance the learning experience (Wesley, Krockover & Hicks, 2008).

The use of ICT has a positive influence on students" achievement, motivation and learning process. Although classrooms are considered a face-to-face learning environment, yet the installation of ICT equipment such as web-based tools and other technologies positively influence students" blended learning situation. "Classrooms with ICT learning equipment whether completely online or blended, on average produce stronger learning outcomes and motivation than learning face-to-face alone" (U.S. Dept. of Education, 2009). In addition, ICT motivate both teachers and students. There appears to be some consensus that both teachers and students feel that ICT use in the class greatly contributes to students" motivation for and engagement in learning. "A very high 86% of teachers worldwide agree that students are more motivated and attentive when computers and the Internet are used in class... ICT has strong motivational and positive effects on students' learning behavior, communication and process skills." (Balanskat, 2006). To this end, ICT can promote lifelong independent learning skills. Evidence exist that use of ICT in schools increase learner's autonomy and self –regulated learning. Students assume greater responsibility for their own learning when they use ICT, working more independently and

effectively. This has great and positive influence on students'' learning behavior and education system in general.

Information and communication technology (ICT) have become commonplace entities in all aspects of life. Across the past twenty years, the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavor within business and governance. Education is a very socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees of personal contact with learners. The use of ICT in education lends itself to more student-oriented learning settings. However, with the world moving rapidly into digital media and information, the influence of ICT on both education and students' learning behavior is becoming more and more important and this importance will continue to grow in the 21st century.

There is widespread research interest in information and communication technologies (ICTs). According to Crede & Mansell (1998), ICTs are crucially important for sustainable development in developing countries. Thioune (2003) notes that for the past two decades most developed countries have witnessed significant changes that can be traced to ICTs. These multi-dimensional changes have been observed in almost all aspects of life: economics, education, communication, and travel. In a technology-driven society, getting information quickly is important for both sender and receiver. ICTs have made it possible to quickly find and distribute information. Thioune (2003) indicates that many initiatives have taken at the international level to support Africa's efforts to develop a communication infrastructure and. These efforts are designed to enable African countries, including Nigeria, to find faster ways to achieve durable and sustainable development.

Helmut (1998), cited by Akpore (1999), states that of the technological changes that have influenced our lives in recent years, information technology (IT) has had the greatest impact. This will continue at least until the end of the first half of the century, when other major technological breakthroughs in the area of new materials, biotechnology, or energy, may provide entirely new ways of living.

An information society is one that makes the best possible use of ICTs. Martin (1995) supports this view by describing it as a society in which the quality of life, as well as prospects for social change and economic development, depend increasingly upon information and its exploitation. In such a society, advances in information and knowledge influence all living standards, patterns of work and leisure, the education system, and marketplace. This is evidenced by an increasing array of information-intensive products and services (Martin, 1988).

Annan (2002) notes that the information society is a way for human capacity to be expanded, built up, nourished, and liberated by giving people access to tools and technologies, with the education and training to use them effectively. There is a unique opportunity to connect and assist those living in the poorest and most isolated regions of the world. Informatization of society is a major hurdle that most nations, especially developing countries, are encountering. The information society or information age is a phenomenon that began after 1950, which brings challenges as we seek to integrate and expand the universe of print and multimedia sources. The two terms are often used to describe a cybernetic society in which there is a great dependence on the use of computers and data transmission linkages to generate and transmit information (Bruce, 1995).

1.2 STATEMENTS OF THE PROBLEM

In a Zambian context, there has been a rapid change in the role of the teacher in recent years. There are many new changes and challenges that teachers face, and are required to adapt to. Included in this are a more modern and westernised approach from schools; new methods of teaching and learning, an increase in student numbers, and (most importantly) an explosion in the development of teaching with ICT. All of this means teachers need to update their knowledge and skills to develop the educational process in the classroom.

With the advent of a new philosophy towards ICT and its role in education, a wide body of research has developed investigating the role of ICT and its effect in developing an interactive education environment. Many of these studies have provided evidence of the significant contribution that ICT makes to improving methods of teaching and positively influencing the learner (Kennewell and Beauchamp, 2007).

A. However, many of these studies have been limited to investigating the impact of ICT on learners. There is substantially less research, which focuses on the role, which ICT plays in creating and promoting a more interactive educational environment, as part of teaching and learning. The presence of ICT in the interactive educational environment can help to develop thinking skills and make classrooms an environment for educational growth. ICT also helps students to develop new thinking skills, which may transfer to different situations, which may require analysis and comprehension skills, and consequently critical skill development (Al Hudhaifi and Al Dughaim, 2005). This again was a motivation for the study; to investigate the role of ICT in promoting an interactive learning environment.

Objectives of the project

1. TO INVESTIGATE THE DIFFERENCE THAT ICT MAKES TO TEACHING AND LEARNING.

2. To explore how ICT affects teachers' confidence in the classroom.

3. To examine the teaching and ICT contributions to improving attainment –notably students" perception of their attainment.

4. To investigate the advantages and disadvantages of using ICT in the classroom for teachers and students in selected subjects in the curriculum.

2.0 Literature Review

This chapter will review the literature related to the use and impact of ICT on learning at Rhodes Park, Olympia Park and Kabulonga Girls' Secondary Schools. Due to the central role of learning in this thesis, the chapter will begin with a discussion of the most prominent theories of learning from the last two centuries. In a study that addressed the effects of providing „procedural" opportunities for learning, Cooper & McIntyre (1994) discussed a model involving a continuum, starting from a discourse and extending through interactivity and interactive reaction, to a self-centered learning. According to them "interactive" teaching exists where teachers integrate with their plans as well as with knowing their students, provided that "teachers believe that the correct use of students" inputs will take place only within a framework of specific criteria based on the plans that precede the lesson they intend to provide" (Cooper & McIntyre, 1994: 639).

The UK National Literacy Strategy (NLS), in parallel with number strategy in the UK (DFE, 1998a, 1999), called for a greater emphasis on interactive learning, having been considered one of the factors that lead to success -in conjunction with greater discussion, trust, ambition and learning tempo. It has also pointed out that learning becomes interactive when students" participations are encouraged, expected and enlarged (DFEE, 1998a: 8). Hargreaves et al. (2010, p. 224) defined nine different features of interactive learning based on teachers" own interpretations of how to promote interactive learning:

• Students' practice.

• Students' practical and effective participation.

• Students' expanded participation.

• Cooperative activity.

• The transfer of knowledge and „deep" work patterns.

Burns and Myhill (2004) have suggested some important features that interactive lessons offer; Mutual opportunities for discussion, which help children to develop independent voices during discussion; appropriate direction and 'patternisation' when the teacher organizes language and skills to think collectively; Environments that stimulate students" participation, and; raising students" level of independence.

Many studies in interactive learning emphasizes the shift from high levels of teachers" control to greater self-centered learning on the students" part. It may be useful for future researchers to imagine interaction in teaching regarding interaction and scaffolding nature through dialogue. Kennewell, Tanner, and Beauchamp (2007) for example, expect interactive teaching to include several levels of interaction in order to cope with teaching objectives.

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3.0 METHODOLOGY/RESEARCH DESIGN

This thesis will assess and evaluate the level and nature of ICT use in secondary school classrooms of Rhodes Park, Olympia Park and Kabulonga Girls' Secondary Schools

The presence of ICT in the interactive educational environment helps develop thinking skills and can make classrooms an environment for educational growth. This statement was the catalyst for this study, the purpose of which is to examine the scale and nature of ICT use in secondary classrooms in some selected schools in Lusaka. This study will be useful for all researchers interested in the use of ICT in classrooms, teachers who are in the process of developing ICT use in schools, and strategists and policy makers within the Ministry of Education in Zambia.

This study will support educational administrators and policy makers in choosing appropriate methods of managing ICT change in the educational system in Zambia. It is the first study in Zambia that takes into consideration different aspects of the application of ICT in the educational system. This study will consider five main research questions:

• *1. How confident are teachers in using ICT in the teaching and learning process?*

• *2. Does this confidence and application vary between subjects?*

• *3. How do students use ICT in the classroom and at home?*

• *5. Are there any differences between male and female students' teaching and learning in terms of their use of ICT in the classroom?*

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1. How confident are teachers in using ICT in the teaching and learning process?

2. Does this confidence and application vary between subjects?

3. How do students use ICT in the classroom and at home?

4. Are there any differences between students' teaching and learning in public schools and private schools in terms of their use of ICT in the classroom?

5. Are there any differences between male and female students' teaching and learning in terms of their use of ICT in the classroom?

3.1 Sampling procedure

People who use statistics use different methods to choose the sample from the population. The purpose of sampling is to enable one to select samples, which represent the population where they come from, and to ensure that all samples have a chance of being selected (Chama 2007, p. 19). In random sampling, the researcher has used the rotary method. People who use statistics use different methods to choose the sample from the population. The purpose of sampling is to enable one to select samples, which represent the population where they come from, and to ensure that all samples have a chance of being selected (Chama 2007, p. 19). In random sampling, the researcher has used the People who use statistics use different methods to choose the sample from the population. The purpose of sampling is to enable one to select samples, which represent the population where they come from, and to ensure that all samples have a chance of being selected (Chama 2007, p. 19). In random sampling the researcher has used the lottery methods to select the ICT teachers and learners from different schools where the res

3.2 Target populations and Sample size

Target population or institutions and reasons for targeting them must be stated, applied consistently with the project design and sampling technique and the sample size to be considered in the project. The three schools targeted were chosen because they were the pioneers in building modern computer labs. We sampled 45 students per school and 5 teachers per school giving a total of 150-sample size.

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3.3 INSTRUMENTS OF DATA COLLECTION

Data was collected from both the primary and secondary sources. Crucial data was sourced from structured questionnaires and secondary data came from available literature. Some literature came from books, periodicals and other government records. The researcher also ensured confidentiality and anonymity of the participants under study. Furthermore, consent was sought before engaging in any interview.

3.3 Data analysis techniques

The researcher used both the qualitative and the quantitative methods in data analysis. Data was sorted out according to the numbers collected from the field. Crosschecking was done to ensure information completeness and consistency for good interpretation and facilitation process. The researcher used the manual method and the computer, especially the statistical package of social sciences (SPSS) in data processing. Later data was coded according to essential variables and coded according to responses. The data obtained was analyzed and interpreted using frequency tables and bar charts.

4.0 FINDINGS AND DISCUSSION

In this chapter, the researcher has analysed the data, which was collected from the field of research. The researcher has interpreted data by using the known methods already used in the research and has done it by comparing the results from the data collected. What is presented is information that was gathered from the field.

The information that was gathered carried a theme on the use of Information and Communication Technology to Teaching and Learning in Schools

a) . It is important to have a fair representation of sexes in any research in order to avoid biases in data collection. The participation of male and female brings a variety in data collection. Thus from the data that was collected, the indication is that there was fair gender representation. During the general audience survey, female representation was 47.6% and male representation was 52.6%. In the survey for MoGE staff, female representation was 45% and male representation was 55%. The focus group discussion α and β in-depth interviews had 65% female representation and male representation was 35%. 1. To

investigate the difference that ICT makes to teaching and learning.

The findings for this objective was that 70% of the respondents accepted that ICTS play a major role in teaching and learning while 20% argued that its not good to use these ICTs and 10% indicated that they were not sure. This means that ICTs have a Positive impact in Education.

2. To explore how ICT affects teachers' confidence in the classroom.

The finding for this objective were that 80% of the respondents accepted that ICTS Improves the confidence of the teacher if they have an idea of ICTs while 20% did not agree to this fact.

3. To examine the teaching and ICT contributions to improving attainment –notably students" perception of their attainment.

Most respondents agreed to the fact that ICTs improves learners ability to do well in academic work as compared to those who do not have the exposure to ICTs especially in Education

ICTs plays a pivotal role in improving the results of learners in Education.

The results from the students' perspective, in terms of answering the third research question, offer a number of incites. These include:

1. Students are very critical of their use of ICT, reflective of the teachers' application of ICT, notably in features the research would hope to be utilized more, such as spreadsheets or use of the internet to look up information.

2. Considerably more use of ICT, even in a learning context, is actively undertaken in the home, which still points to the prevailing gap between home use and application in the classroom.

3. Students are positive, to an extent, about the application of ICT in the classroom and its impact on their learning. However, there are still considerable reservations about the use of ICT and a belief amongst students that it can negatively affect their learning.

4. Students are extremely confident about their ICT use, similar again, to teachers, which highlights the potentially wasted opportunity that the lack of ICT provision highlights.

These findings take us some way to answering the question "How do students use ICT in the classroom and at home?' notably that there is conceivable evidence to suggest there is certainly capacity from students (in addition to that from teachers highlighted in the last section) to utilize the full scope that ICT can offer. This has to be married with the existence of criticisms relating to the impact of ICT, which we will further discuss in the next chapter.

5.0 CONCLUSIONS

This chapter summarizes the research and thereafter attempts to make recommendations associated with those findings. This follows the two preceding chapters, the analysis and the discussion, in considering each of the key questions in turn. Similarly, the recommendations will be based on the findings associated with each research question. Additionally, the chapter investigates the limitations associated with this piece of research and proposes areas of further study for the researcher, or indeed other researchers in this field.

The main question of this research was "A Study on the Scale and Nature of ICT use in Secondary Classrooms". The researcher then derived five sub-questions, all of which were addressed through the questionnaire (and quantitative) analysis, and the first two of which were supplemented by the use of interview (and qualitative) analysis. The main question of this research was "A Study on the Scale and Nature of ICT use in Secondary Classrooms". The researcher then derived five sub-questions, all of which were addressed through the questionnaire (and quantitative) analysis, and the first two of which were supplemented by the use of interview (and qualitative) analysis.

ICTs have come and let us embrace them in all areas of our lives. Integrating ICTs in Education trickles down to all sectors of society. It starts with the school then goes to the industry.

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Using Artificial Neural Networks for Seasonal Rainfall Forecasting in Zambia for Educational Purposes

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Weather forecasting applies science and technology in order to predict weather conditions. Rainfall is one of the weather parameters whose accurate forecasting has significant implications for agriculture and water resource management. It is mainly done by experts who have gained sufficient experience in the use of appropriate forecasting techniques like modelling. Making models that capture this knowledge is often difficult. In this research, artificial neural networks are suggested as a model that can be 'trained' to mimic the knowledge of rainfall forecasting experts. This makes it possible for researchers to adapt different techniques for different stages in the forecasting process. We begin by noting the five key stages in the seasonal rainfall forecasting process. We then apply artificial neural networks at each step. Initial results show that the artificial neural networks can successfully replace the currently used processes together with the expert knowledge. We further propose the use of these neural networks for teaching such forecasting processes, as they make documentation of the forecasting process easier and hence making the educational process of teaching to forecast seasonal rainfall easier as well.

Keywords—Artificial neural networks; seasonal rainfall forecasting, expert knowledge, machine learning;

I. INTRODUCTION

Rainfall is a natural phenomenon resulting from atmospheric, oceanic circulation systems and complex physical processes that cause an amount of rain to fall at a place during a particular period. Rainfall is one of the weather parameters whose accurate forecasting has significant implications for agriculture and water resource management [1]. Amongst all weather parameters, rainfall is the one that mostly affects human life and livelihood in developing countries and least developed countries like Zambia where the majority of the population depends on rain fed agriculture [2][3][4]. Rainfall also affects many sectors including but not limited to water resources management, energy, tourism, health, disaster risk reduction (DRR) and infrastructure development. Thus, accurate seasonal rainfall forecasting is essential for planning and management of many sectors [5] [6].

Seasonal rainfall forecasting, which is the prediction of the expected rainfall performance for a given rainy season, is usually generated in August and issued in September in the Southern African Development Community (SADC) region. Current seasonal rainfall forecasting methods used in Zambia have been proved to be less accurate [7]. These techniques do not take into account all factors that may influence rainfall and are statistical models based on regression analysis and eyeball inspection. This research proposes to use Artificial Neural Networks (ANNs) as an objective alternative for forecasting seasonal rainfall in Zambia, since statistical models have some inherent limitations over long range rainfall forecasts and are subjective [8] [9].

The current seasonal rainfall forecasting method assumes a direct correlation between the Pacific Sea Surface Temperatures (SSTs) and station rainfall observations. Atmospheric systems are not governed by only these two factors, but this assumption ignores the availability of other factors in influencing rainfall [10]. Other parameters that may influence rainfall include temperature, relative humidity and wind speed.

A limitation of high spatial variability of station point rainfall observations increases the inaccuracy and uncertainty that reduce the skill (accuracy) of the forecasts. Moreover, changing climate has introduced further uncertainties that need to be considered in this assumption of a direct linear correlation between observed rainfall data and SSTs [11] [12]. Seasonal rainfall forecasts in Zambia are therefore, currently not of high efficacy [13].

Furthermore, some of the stages in the seasonal rainfall forecasting process require expert knowledge through eyeball inspection which is not easy to pass on through an educational process.

This research targets to take advantage of modern computing techniques to overcome the inadequacies related to the passing on of expert knowledge (eyeball inspection) and depend less on user experience in the seasonal rainfall

forecasting process in Zambia and also improve the forecast accuracy. Seasonal rainfall forecast provides information that help the government and stakeholders to prepare for and reduce the potential negative impacts of climate change, hence objective seasonal rainfall forecasting methods will play an integral part in the preparedness.

This study aims to forecast seasonal rainfall in Zambia through the use of ANNs that is highly objective and easy to replicate which consequently improves the forecast accuracy because it does not depend on expert experience. We discuss the work done thus far in this paper. In the rest of this paper we outline how we plan to achieve this aim; in section II we discuss artificial neural networks (ANNs). In section III we set out by further analyzing ANNs with regards to rainfall forecasting methods and outline its suitability for generating seasonal rainfall forecasts. In section IV we proceed to discuss a proposed proof of concept model for forecasting seasonal rainfall based on the ANNs discussed in section III. Finally, in section IV, we discuss the currently used procedure and also propose our new approach and how we will evaluate the proposed proof of concept model using the currently used forecasting method and real data in Zambia.

II. ARTIFICIAL NEURAL NETWORKS

Artificial neural networks are a beautiful biologically-inspired technique that draws inspiration from the way the brain works into a programming paradigm which enables a computer to learn from observational data. Using these neural networks, it is possible train software tools that can maintain expertise on tasks using observational data. Neural networks are currently used as a machine-learning technique for solving a variety of tasks, including language translation, image classification, and image generation.

Recently, deep learning, a powerful set of techniques for learning in neural networks has also drawn the attention of researches. Deep learning neural networks are capable of learning techniques sequentially unlike ordinary neural networks and hence capable of overcoming catastrophic forgetting. This gives deep learning neural networks the capability of maintaining expertise even in tasks which they have not encountered for a long time. Such capability is important especially when it comes to weather forecasting where certain phenomenon can go unobserved for long periods of time.

The neural networks can be used to replace human expertise in situations like image analysis where eyeball inspection is the norm. They are also useful in situation where models are complex and not easy to derive.

III. RELATED TECHNOLOGIES

Soft computing techniques like ANNs have been used in many different applications of weather forecasting and have proved to be powerful methods which excel at function approximation and pattern recognition [14]. Such developments in Artificial Intelligence (AI) techniques, in particular ANNs provide superior rainfall forecasting methods. For example, the performance of the rainfall forecasts

produced using ANNs in India [5], Thailand [15] and west mountainous region of Iran [16] have been said to be very accurate. ANN rainfall forecasting methods provide aggressive models over the existing rainfall forecast methods used in Zambia because ANN has the ability to be trained and to adapt [7]. A. Chaturvedi, applied ANN methods using back propagation for rainfall prediction with minimal Mean Square Error (MSE) in Delhi – India, a region that highly depends on monsoon and seasonal rainfall for agriculture activities [5]. Results for forecasting rainfall using ANNs in Bangkok, Thailand show superiority over the results obtained by statistical linear regression methods [15]. G. Shrivastava et al argues that pattern recognition and prediction in a deterministic approach through ANN techniques based on back-propagation algorithm has been proved to be the most efficient way for long term rainfall prediction [11]. A survey conducted in 2013 show that ANN techniques are more suitable than traditional statistical and numerical methods in forecasting rainfall [9].

Luk et al. implemented and compared three types of ANNs suitable for rainfall prediction i.e. multilayer feed forward neural network, Elman partial recurrent neural network and time delay neural network [17]. ANN is an aggressive method of forecasting rainfall over the linear regression method because of its ability to be trained and adapt [15]. Using ANN algorithms in forecasting rainfall becomes an attractive approach because of its flexibility, nonlinearity and ability in data driven learning in building models without any prior knowledge [9]. ANNs has been used as a suitable technique for the long-term climate variability like seasonal rainfall forecast due to the fact that learning is accomplished through training [18]. ANN forecasting models are based on prediction by smartly analysing the trends from an already existing voluminous historical set of data. Mathematical or statistical weather models have been found to be very accurate in calculation, but not in prediction as they cannot adapt to the irregularly varying patterns of atmospheric data which can neither be written in form of a function nor deduced from a formula [2].

F. Mekanik, et al argue that ANN has the ability to forecast long range rainfall that is one year in advance in their study in the west mountainous region of Iran [16]. Using ANN to forecast rainfall give more details in terms of forecasting for specific location [7]. The ability of ANNs to cope with nonlinearities, speed of computation, learning capacity and prediction accuracy makes it a superior model of forecasting rainfall [19]. ANNs multilayer perceptron has the ability to be trained with error correction learning and most applications in rainfall forecasting utilize a feed-forward neural network that incorporates the standard static multilayer perceptron (MLP) trained with back-propagation algorithm [1].

IV. METHODOLOGY

In this section we discuss our proposed approach. We begin by describing the currently used process and then discuss our new proposed approach which is based on the currently used approach.

A. Currently used approach

We base our study and method for forecasting on the currently used procedure for forecasting seasonal rainfall. The main focus of the initial stages of our study is to replace the parts where human expertise especially through eyeball inspection is the norm for doing analysis with artificial neural networks. The currently used procedure is illustrated in Fig. 1. The first step is the identification of homogeneous rainfall zones. After this, SST data is downloaded and July SST data is used to identify correlation with rainfall regions for specified months i.e. January February March (JFM). This correlation is then used to identify basins that have influence on the rainfall patterns for the respective region. The next stage is a regression based analysis which is used to find the relationship between rainfall amounts and the correlated basins. Empirical statistical forecasting model is developed using Simple Linear Regression model (SLRM) to describe a linear relationship between two variables X as independent(s) (SST basins) and Y as dependent (rainfall).

This data is then used to forecast using eyeball inspection by checking what amount of rainfall was experienced when similar values learnt from the regression analysis were observed. For more detail please check Fig. 1.

B. Proposed approach

We base our procedure on the currently used approach. However, we incorporate artificial neural networks to replace the steps that involve eyeball inspection by human experts.

1) Identification of Homogeneous Rainfall Zones

The first step in the seasonal rainfall forecasting process is demarcating the country into homogenous rainfall zones. These zones exhibit coherency in rainfall variations. Zambia is demarcated into three homogeneous zones. We also use the already identified zones which are used in the current process. Fig. 2 shows how Zambia is demarcated into homogenous rainfall zones.

Fig. 2: Agro-ecological zones of Zambia and meteorological stations for each region

2) Downloading Sea surface temperatures (SSTs)

After identification of the homogeneous rainfall zones, the second stage is downloading of SSTs. We downloaded these

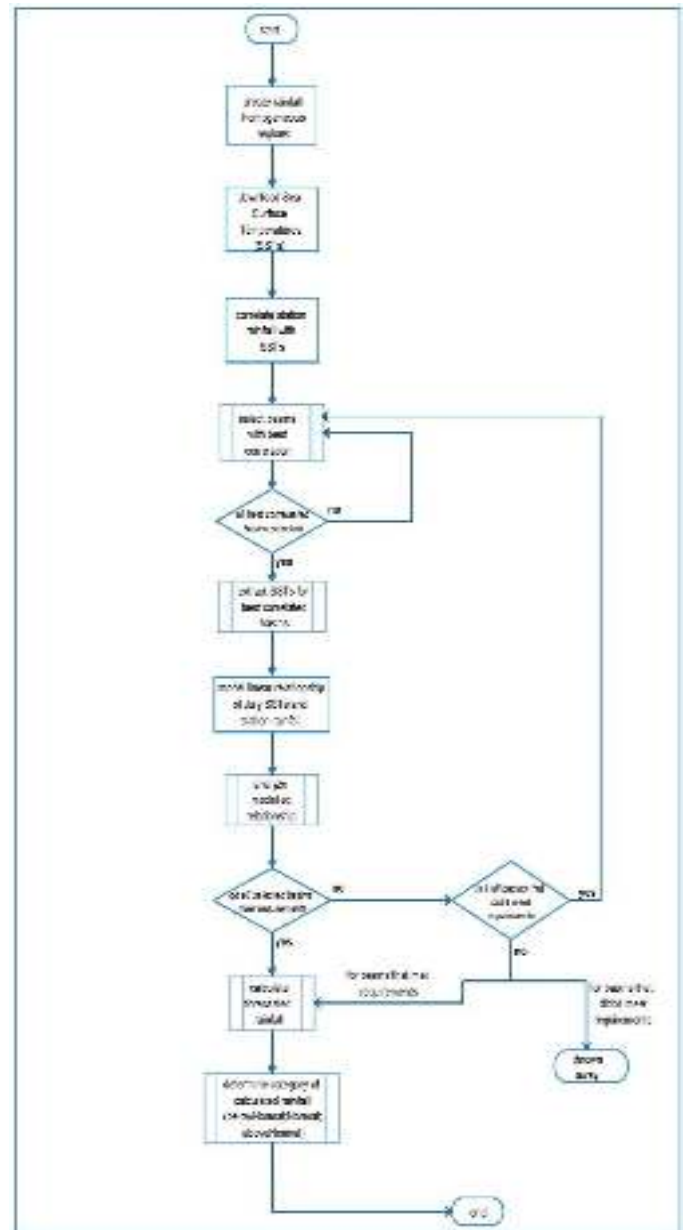from the International Research Institute for Climate and Society (IRI) website.

Fig. 1. Currently used approach for seasonal rainfall forecasting

3) Correlation of rainfall with SSTs

After downloading of SSTs, we proceed by finding a correlation between station rainfall for a region and the SSTs for given i.e. JFM. Fig. 3 is a map showing correlation between rainfall for JFM region 3 and SST. From the correlation map, basins with a more than ±0.3 correlation are selected using an ANN for pattern recognition to estimate the coordinates for the basin areas. In the old process this was done using eye ball inspection and then zooming to each

basin, one at a time to determine best area with a more than ±0.3 correlation as shown in Fig. 4. After this we take note of the selected area coordinates and give the basins an identity. After this, all best correlated basins coordinates are noted and recorded.
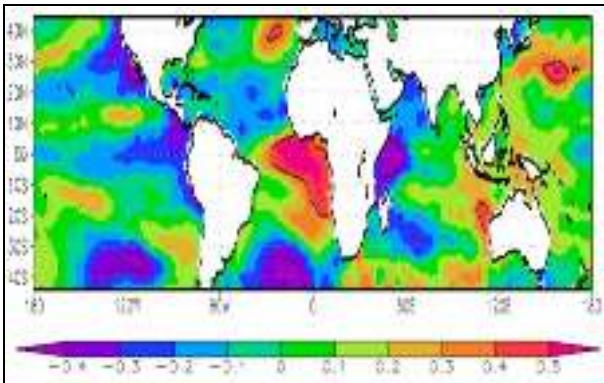

Fig. 3. Correlation between Zambia Rainfall JFM R3 and gridpoint SST

The selected area coordinates for figure 4 are estimated using eyeball as lat1 = -01.2, lat2 = 01.3, long1= -13.8 and long2= -10.2, given name as CWPAC
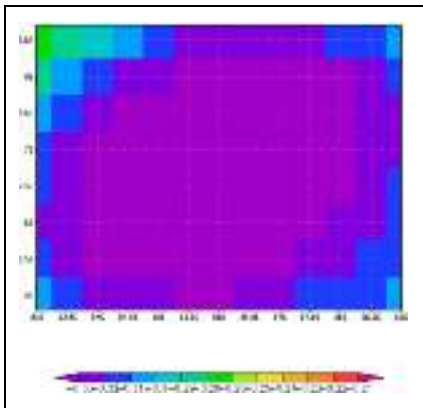

Fig. 4. Correlation between Zambia Rainfall JFM R3 and gridpoint SST

4) Regression analysis

For all selected basins, July SSTs for the zones is collected together with rainfall seasonal averages for the same zone. We then apply an ANN to learn the expected rainfall variable Y. In the currently used approach, an empirical statistical forecasting model is developed using Simple Linear Regression model (SLRM) to describe a linear relationship between two variables X as independent(s) (SST basins) and Y as dependent (rainfall). Standardized data for selected basins and rainfall is used.

To find the forecasted rainfall for any zone, for the given three months i.e. JFM the following formula is used.

$Y = mx + c$ where,

Y is expected rainfall,

M is coefficient for the chosen basin,

X is the SST for month of July and

C is the constant.

5) Forecasting

We then use an ANN to predict the expected amount of rainfall. We do this by first sorting the rainfall by amount and then classifying into 3 groups as either below normal, normal or above normal. We then use this data to train our ANN. For example, we pick rainfall amounts from say 1961 to 2017 and sort them in descending order, divided into 3 groups and pick a group to which a forecasted rainfall figure belongs to using Neural Network. In the current process the rainfall amounts from say 1981 to date are sorted in descending order using excel. The data is then grouped sorted into 3 segments using eyeball inspection. Then the forecasted rainfall figure is compared to the sorted data using eyeball inspection by placing the rainfall figure close to a figure it is close to, thus determining the forecasted rainfall as either below normal, normal or above normal rainfall.

V. INITIAL EXPERIMENTATION AND RESULTS

A. Data set

To do our initial experimentation we downloaded data for SSTs from the IRI site. Then, we get data for rainfall statistics for Zambia from 1961 to 2017 see Table I. Apart from the data for rainfall amounts we also collect data from 1961 to 2017 which classifies each season as either above normal, normal or below normal. This data is based on the rainfall amounts recorded in each year and the demarcation into three groupings for the collected data.

TABLE I. RAINFALL AMOUNTS FOR 1961 TO 2017

Monthly rainfall data		
Location	*From*	*To*
Zambia	June 1961	June 2017

B. Setup

We then applied the procedure outlined earlier on in section IV (B). We however only used neural networks for the forecasting stage instead to replace the eyeball inspection and also in place of the regression analysis. To do the implementation of the neural networks, we use Matlab's neural networking toolkit. All computations were done on a machine running on an i7 processor and windows 10 operating system. We divided the data into sections for training and also for retrospectively testing the predicting ability of our procedure.

C. Results

Our procedure was able to predict whether there will be above normal, normal or below normal rainfall. Thus, we successfully replaced the eyeball inspection done in the forecasting stage of the whole procedure as well the regression model with artificial neural networks.

To train our neural network, we used monthly rainfall data from 1961 to 2010 and tested using data from 2011 to 2017. We were able to pick a group to which a forecasted rainfall figure belongs to using Neural Network the same way it is placed to the group using eyeball inspection in the current process, see Table II.

TABLE II. PICKING GROUP FOR FORECASTED RAINFALL

Year	Current Approach	Proposed Approach (ANN)	Actual
2011	Below Normal	Below Normal	Below Normal
2012	Below Normal	Below Normal	Below Normal
2013	Above Normal	Above Normal	Above Normal
2014	Normal	Normal	Normal
2015	Below Normal	Below Normal	Below Normal
2016	Normal	Normal	Normal
2017	Below Normal	Below Normal	Below Normal

VI. CONCLUSION

The main goal of this research is to enhance processes that are used to generate accurate seasonal rainfall forecasts. The skills required to do seasonal rainfall forecasting are not easy to pass on. In this paper we proposed the use of neural networks to replace the aspect of human skills and thus make the teaching of the forecasting process easier. From the afore going results and discussion, it can be concluded that ANN is a reliable long range rainfall forecasting tool that we can replace human skills which require eyeball inspection with neural networks. It has also shown that this technique can be replicated, without depending on expert experience.

The accuracy level will also be enhanced over the current method as they will be no human errors. It is evident that ANN seasonal rainfall forecasts will improve the planning and decision making of users that user the forecasts. Such forecasts are fundamental as they will have a positive result on agriculture performance and crop yield in particular. This is of great importance because the majority of the population rely on rain fed agriculture in Zambia.

In addition, the seasonal rainfall forecasting provides information that helps the government and stakeholders to prepare for and reduce the potential negative impacts of climate change. This makes accurate forecasting an integral part in the preparedness.

For future works, we plan to replace all the processes that require eyeball inspection with neural networks. We also plan to carry out user testing to evaluate which method is easier to teach that is a comparison between use of neural networks and eyeball inspection.

We further plan to replace the model for selecting the basins with a deep neural network so as to incorporate many other parameters which influence seasonal rainfall forecasting but are not currently incorporated in the currently used model. The deep neural network will also help reduce the risk of forgetting the expertise that is not used over time.

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